# Modicon
# A120 Series I/O Modules
# User Guide

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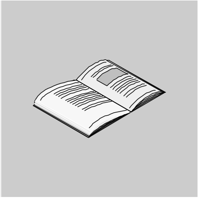

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# Safety Information

## Important Information

**NOTICE**

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

⚡ The addition of this symbol to a Danger or Warning safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

⚠ This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

**⚠ DANGER**

DANGER indicates an imminently hazardous situation, which, if not avoided, **will result** in death or serious injury.

**⚠ WARNING**

WARNING indicates a potentially hazardous situation, which, if not avoided, **can result** in death, serious injury, or equipment damage.

**⚠ CAUTION**

CAUTION indicates a potentially hazardous situation, which, if not avoided, **can result** in injury or equipment damage.

**PLEASE NOTE**

# About the Book

## At a Glance

### Document Scope

This manual describes the functionality of the Modicon A120 Series I/O Modules.

### Validity Note

The data and illustrations found in this book are not binding. We reserve the right to modify our products in line with our policy of continuous product development. The information in this document is subject to change without notice and should not be construed as a commitment by Schneider Electric.

### Related Documents

| Title of Documentation | Reference Number |
|---|---|
| IEEE Std 518--1977, Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources | |
| IEEE Std 142--1982, Recommended Practice for Grounding of Industrial and Commercial Power Systems | |
| Noise Reduction Techniques in Electronic Systems, by Henry W. Ott; published by Wiley--Interscience of New York in 1976 | |

### Product Related Warnings

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# Panel Software Options with A120 I/O Modules

# 1

## Panel Software Option with A120 I/O Modules

**Overview**

This section describes Panel Software options for the A120 series I/O Modules, and related information.

**Panel Software Support**

The Compact Controllers may be configured, I/O Mapped, and programmed using either Concept panel software, full-feature Modsoft panel software or Modsoft Lite depending upon the model.

Either software package may be installed on the Modicon P230, an IBM-AT, or compatible computer.

Programming and configuration editors used for a Compact are similar to those used for other 984s, special I/O Map screens have been designed for A120 I/O modules.

### Concept (E984-258/265/275/285 Only)

Concept may be used with the E984-258/265/275/285 models. Concept contains Function Block Diagram (FBD) and Sequential Function Chart (SFC) programming languages as well as a subset of data types of the international IEC 1131-3 norm. Concept features the following:

- FBD depicts process data flow typically suited for discrete and continuous control applications.
- SFC provides a graphical representation of the process.
- Instruction List is a text-based Boolean language used to build more complex applications.
- EFB is a "C" tool kit that permits you to create custom function blocks.
- Structured Text is ideal to implement complex equations.
- Ladder Diagram (ladder logic) complies with the IEC 1131-3 ladder diagram specification.
- LL984 inside Concept provides the same tools as Modsoft 984 ladder logic.

Concept operates with either: Windows 98, Windows NT, or Windows 2000. The E984-258/265/275/285 models are supported by three different Concept software packages: Concept M (372 SPU 472 01vxx), Concept XL (372 SPU 474 01vxx), and Concept 984 XL (372 SPU 479 0x).

**Note:** You must use Concept 2.1 or higher to operate the E984-258/265/275/285 models. Modsoft does not support these models.

For a detailed description of Concept and its operations, see the Concept User Manual (840 USE 49300).

Refer to *I/O Configuration with Concept, p. 739*, for a list of A120 I/O modules that are compatible with Concept.

**⚠ CAUTION**

**Mode Malfunction Hazard**

The output module Time Out States are only valid in a normal PLC stop state. Therefore, when the PLC powers down or goes into kernel mode, the outputs default to the modules fail safe state. The Time Out States are defined in the I/O Map modules parameter screens.

**Failure to follow this instruction can result in injury or equipment damage.**

## Modsoft Lite (A984-1xx, E984-24x/251/255 Only)

Modsoft Lite (371SPU921000) is provided on 3.5 inch diskettes. Standard panel software packages contain the following editors:

| Editor | Description |
|---|---|
| Configuration | Defines controller and communication parameters, allocates memory, accesses controller operations and specials (e.g., battery coil register, timer register, and time-of-day clock) |
| I/O Map | Links discrete and register reference numbers to modules in the I/O subsystems. Defines I/O data types |
| Programmer | Generates, edits, monitors ladder logic, and accesses controller |
| Transfer | Loads programs from disk to controller, records 984 memory to disk, compares programs on disk and in memory |
| Print | Generates hard copy of user logic program and prints user comments |
| Environment | Defines default configurations for the panel software (e.g. printer setup, file locations) |

For a detailed description of Modsoft lite and its operations, see the Modsoft Lite Programmer User Manual (GM-MSLT-001).

## Modsoft-Full-Feature (A984-1xx, E984-24x/251/255 Only)

Modsoft full-feature (SW-MSxD-9SA) is an integrated software tool for programming, testing, and documenting application logic for 984 controllers. The full-feature Modsoft package includes all the editor functions available with Modsoft Lite along with enhanced features, including sequential function chart (SFC) and macros.

**Sequential Function Charting:** SFC allows you to generate programs arranged in steps rather than a linear ladder logic sequence, this is especially suitable for sequential processes. A sequential function chart can solve multiple networks in a parallel link or one in a choice of several networks in a selective link. Logic is solved within a block until a specified transition event informs the CPU to move to the next step. SFC allows application software to be created in a format that more closely emulates an actual machining procedure or process flow; it can help improve system throughput by solving only those networks specified by transition events rather than moving linearly through each network in the program on every scan.

Modsoft macros simplify the task of generating and updating large numbers of repetitive network structures. They allow you to create the repeating structure once, then specify the node values using macro parameters rather than standard 984 reference numbers. Each macro can contain up to 66 macro parameters-by using (*) wild card characters in your naming scheme, you can create thousands of parameters per macro.

**Note:** If you are using full-feature Modsoft to develop application logic for a Compact system that will be using full Modsoft as its permanent programming software, you must be careful when dealing with SFC and macro ladder logic. You may develop your programs using the /p switch; this switch prevents you from creating SFC logic and does not reserve any registers or coils for SFC use-do not use macros in this case. Alternatively, you may develop programs with SFC and macros, then use the convert-to-file menu in Modsoft to produce an equivalent program in standard ladder logic that will run with other panel software.

For a detailed description of full-feature Modsoft and its operations, see the Modsoft Programmer User Manual (890 USE 115 00).

For a list of A120 I/O modules that are compatible with Modsoft refer to *I/O Configuration of A120 Series I/O Modules with Modsoft, p. 821*

# Overview of the ADU 204/254 Analog Input Module

# 2

## At a Glance

**Purpose**

This chapter begins with an overview of the ADU 204/254 Analog Input Module. The chapter continues with discussions on field wiring, the noise suppression DIP switch, and calibration. Finally, the specifications are given, for the ADU 204/254 Analog Input Module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the ADU 204/254 Analog Input Module?

### Brief Product Description

**Note:** Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/ 211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft.

The ADU 204/254 is a four-channel analog input module without opto-isolation. It performs dual-slope integrating A/D conversions, converting analog values into 12-bit digital values in the recommended range. It may be used in conjunction with either two-wire +/-500 mV sensor field devices or PT100 four-wire resistance temperature detector (RTD) field devices. The ADU 254 functions just like the ADU 204, except that the ADU 254 operates at extended temperature.

**Note:** The ADU 254 model is available with conformal coating. The conformal coating model is ADU 254C, which meets Railway standard EN 50 155.

## ADU 204/254 Analog Input Module Conversion Ranges

### Introduction

The ADU 204/254 is a four-channel analog input module without opto-isolation. It performs dual-slope integrating A/D conversions, converting analog values into 12-bit digital values in the recommended range. It may be used in conjunction with either two-wire +/-500 mV sensor field devices or PT100 four-wire resistance temperature detector (RTD) field devices. The ADU 254 functions just like the ADU 204, except that the ADU 254 operates at extended temperature.

**Note:** The ADU 254 model is available with conformal coating. The conformal coating model is ADU 254C, which meets Railway standard EN 50 155.

### Conversion Ranges

The PLC model determines the ranges. A table is provided below for each of the available ranges:

When the module goes out of range--either over or under range--and then returns to a valid operating range, the module will resume proper operations, unless your out-of-range condition reaches or exceeds the safety range of +/-24 V.

### Conversion table for A984-1xx and E984-24x/251/255

The following table gives the ranges for A984-1xx, E984-24x/251/255 PLC models:

| Input/Voltage | Data Count (Decimal) | Operating Results |
|---|---|---|
| less than or equal to +1 V | 0 | Under range |
| -0.99... -0.501 V | 1... 2048 | |
| -500 mV<br>...<br>0 mV<br>... | 2049<br>...<br>4096<br>... | up arrow<br>...<br>Recommended operating range<br>... |
| +500 mV | 6143 | 0 |
| +0.501... +0.99 V | 6144... 8191 | |
| greater than or equal to +1 V | 8192 | Over range |

## Conversion table for Pt 100 -200 degrees C to 850 degrees C for E984-258/265/275/285

The ranges for Pt 100 -200 degrees C to 850 degrees C for E984-258/265/275/285 PLC models are:

| Temp (degrees C) | 1.0 degrees C | 0.1 degrees C | 1.0 degrees F | 0.1 degrees F | 13-bit | 15-bit + sign | Measuring step/value range |
|---|---|---|---|---|---|---|---|
| less than -205 | -32768 | -32768 | -32768 | -32768 | 0 | -32768 | Under range |
| -200 | -200 | -2000 | -328 | -3280 | 3132 | -7529 | Nominal range |
| 0 | 0 | 0 | +32 | +320 | 4096 | 0 | |
| +850 | +850 | +8500 | +1562 | +15620 | 8191 | 32000 | |
| greater than +870 | +32767 | +32767 | +32767 | +32767 | 8191 | +32767 | Over range |

## Conversion table for Pt 200 -200 degrees C to 250 degrees C for E984-258/265/275/285

The ranges for Pt 200 -200 degrees C to 250 degrees C for E984-258/265/275/285 PLC models are:

| Temp (degrees C) | 1.0 degrees C | 0.1 degrees C | 1.0 degrees F | 0.1 degrees F | 13-bit | 15-bit + sign | Measuring step/value range |
|---|---|---|---|---|---|---|---|
| less than -205 | -32768 | -32768 | -32768 | -32768 | 0 | -32768 | Under range |
| -200 | -200 | -2000 | -328 | -3280 | 819 | -25600 | Nominal range |
| 0 | 0 | 0 | +32 | +320 | 4096 | 0 | |
| +250 | +250 | +2500 | +482 | +4820 | 8191 | 32000 | |
| greater than +256 | +32767 | +32767 | +32767 | +32767 | 8191 | +32767 | Over range |

### Conversion table for Ni 100 -60 degrees C to 250 degrees C for E984-258/265/275/285

The ranges for Ni 100 -60 degrees C to 250 degrees C for E984-258/265/275/285 PLC models are:

| Temp (degrees C) | 1.0 degrees C | 0.1 degrees C | 1.0 degrees F | 0.1 degrees F | 13-bit | 15-bit + sign | Measuring step/value range |
|---|---|---|---|---|---|---|---|
| less than -61 | -32768 | -32768 | -32768 | -32768 | 0 | -32768 | Under range |
| -60 | -60 | -600 | -328 | -3280 | 819 | -25600 | Nominal range |
| 0 | 0 | 0 | +32 | +320 | 4096 | 0 | |
| +250 | +250 | +2500 | +482 | +4820 | 8191 | 32000 | |
| greater than +256 | +32767 | +32767 | +32767 | +32767 | 8191 | +32767 | Over range |

### Conversion table for Ni 200 -60 degrees C to 150 degrees C for E984-258/265/275/285

The ranges for Ni 200 -60 degrees C to 150 degrees C for E984-258/265/275/285 PLC models are:

| Temp (degrees C) | 1.0 degrees C | 0.1 degrees C | 1.0 degrees F | 0.1 degrees F | 13-bit | 15-bit + sign | Measuring step/value range |
|---|---|---|---|---|---|---|---|
| less than -61 | -32768 | -32768 | -32768 | -32768 | 0 | -32768 | Under range |
| -60 | -60 | -600 | -76 | -760 | 2458 | -12800 | Nominal range |
| 0 | 0 | 0 | +32 | +320 | 4096 | 0 | |
| +150 | +150 | +1500 | +302 | +3020 | 8191 | 32000 | |
| greater than +151 | +32767 | +32767 | +32767 | +32767 | 8191 | +32767 | Over range |

## Conversion table for APt100 -200 degrees C to 600 degrees C for E984-258/265/275/285

The ranges for APt100 -200 degrees C to 600 degrees C for E984-258/265/275/285 PLC models are:

| **Temp (degrees C)** | **1.0 degrees C** | **0.1 degrees C** | **1.0 degrees F** | **0.1 degrees F** | **13-bit** | **15-bit + sign** | **Measuring step/value range** |
|---|---|---|---|---|---|---|---|
| less than -205 | -32768 | -32768 | -32768 | -32768 | 0 | -32768 | Under range |
| -200 | -200 | -2000 | -328 | -3280 | 2731 | -10667 | Nominal range |
| 0 | 0 | 0 | +32 | +320 | 4096 | 0 | |
| +600 | +600 | +6000 | +1112 | 11120 | 8191 | 32000 | |
| greater than +614 | +32767 | +32767 | +32767 | +32767 | 8191 | +32767 | Over range |

## Conversion table for APt200 -200 degrees C to 250 degrees C for E984-258/265/275/285

The ranges for APt200 -200 degrees C to 250 degrees C for E984-258/265/275/285 PLC models are:

| **Temp (degrees C)** | **1.0 degrees C** | **0.1 degrees C** | **1.0 degrees F** | **0.1 degrees F** | **13-bit** | **15-bit + sign** | **Measuring step/value range** |
|---|---|---|---|---|---|---|---|
| less than -205 | -32768 | -32768 | -32768 | -32768 | 0 | -32768 | Under range |
| -200 | -200 | -2000 | -328 | -3280 | 819 | -25600 | Nominal range |
| 0 | 0 | 0 | +32 | +320 | 4096 | 0 | |
| +250 | +250 | +2500 | +482 | +4820 | 8191 | 32000 | |
| greater than +256 | +32767 | +32767 | +32767 | +32767 | 8191 | +32767 | Over range |

**Conversion table for R, 0 to 400 ohms for E984-258/265/275/285**

The ranges for R, 0 to 400 ohms for E984-258/265/275/285 PLC models are:

| Resistance in ohms | 13-bit | 15-bit + sign | Value range |
|---|---|---|---|
| 0 | 0 | 0 | Recommended nominal range |
| 100 | 2048 | +8000 | |
| 200 | 4096 | +16000 | |
| 399.902 | 8191 | +32000 | |
| Greater than or equal to 400 | 8191 | +32767 | Over range |

**Note:** In RTD applications, the internal precision source forces a 2.5 mA current through the resistance. For a PT 100 RTD, a range of 18.49... 390.25 ohms would correspond to -200... +850 degrees C; the values 80.31 ohms (-50 degrees C) to 194 ohms (+250 degrees C) are in the recommended range. Consult your RTD data book for the appropriate linearization equations for your field device.

**⚠ WARNING**

**Unit Damage Hazard**

Operation at an extreme out-of-range voltage--at or beyond +/-24 V--will cause permanent damage to the module.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

The ADU 204/254 operates off the 5 V supply voltage provided internally over the I/O bus.

## ADU 204/254 Analog Input Module Field Wiring and LED Displays

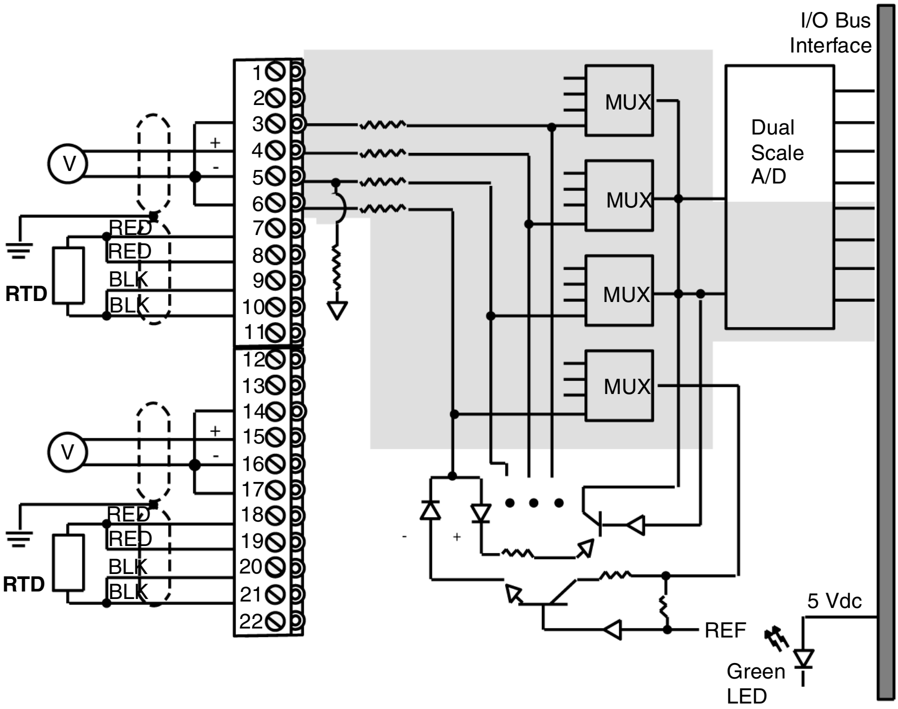
**Introduction**

The ADU 204/254 module may be field wired for any combination of RTD or 500 mV inputs at its four analog channels.

> **Note:** Unused inputs should always be jumpered. Therefore, jumper pins 3 ... 6 for channel 1, pins 7 ... 10 for channel 2, pins 14 ... 17 for channel 3, pins 18 ... 21 for channel 4.

**Wiring Diagram**

The following illustration is a wiring diagram and simplified schematic for the ADU 204/254 analog input module.



**ADU 204/254 Analog Input Module LED**

The ADU 204/254 has one green LED opposite terminal screw 1, used to indicate the presence of the 5 V power supply from the backplane.

## ADU 204/254 Analog Input Module Noise Suppression DIP Switch

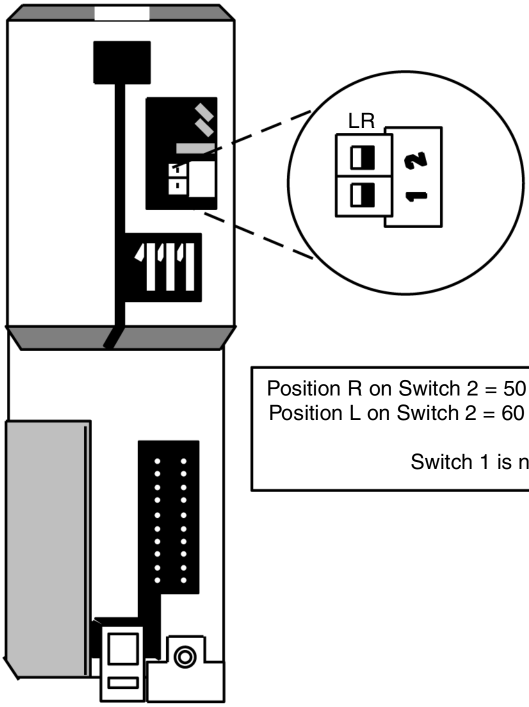
**Introduction**

A two-position DIP switch on the back of the ADU 204/254 can be set to protect the module from external noise interference.

**Changing the Switch Setting**

The factory setting is for 50 Hz voltage interferences. By alternating the switch position, you can set the device for 60 Hz noise suppression.

The following illustration shows the noise suppression switch on the rear of the ADU 204/254.



Position R on Switch 2 = 50 Hz Noise Suppression
Position L on Switch 2 = 60 Hz Noise Suppression

Switch 1 is not used

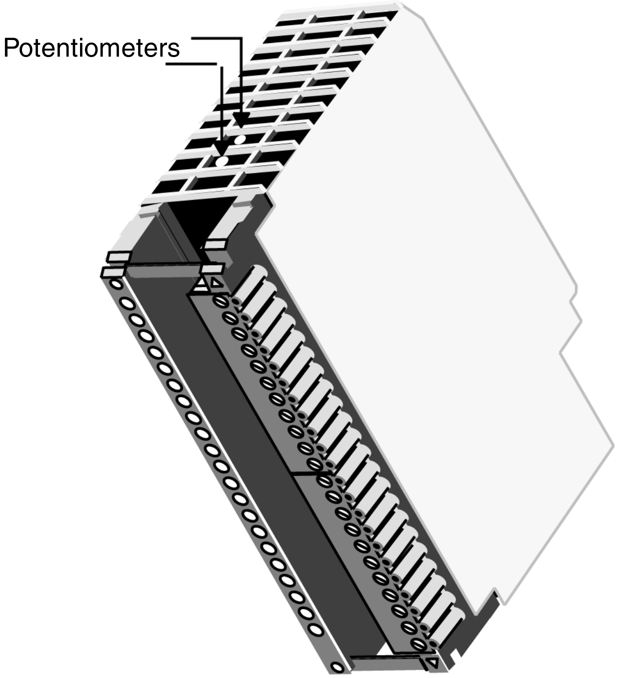
## ADU 204/254 Analog Input Module Calibration

**Introduction**

By adjusting the two potentiometers on the top of the ADU 204/254, you can calibrate the four analog input channels to an accuracy of +/-3 counts over the recommended linear count range of the module (2049... 6143).

**Calibrating the Analog Input Channels**

The following illustration shows the location of the potentiometers on the ADU 204.

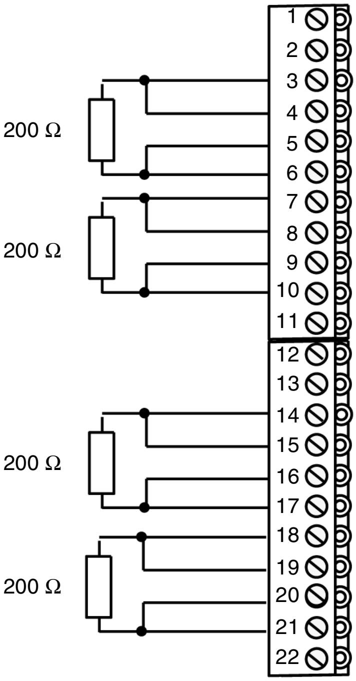


To adjust the potentiometers:

## Adjusting the Potentiometers

The following are the steps to adjust the potentiometers on the 204/254 Input Module:

| Step | Action |
|---|---|
| 1 | Stop your A984-1xx controller. |
| 2 | Using the DIP switch on the back of the module, set it for the desired noise suppression. |
| 3 | To calibrate all analog channels, install a precision 200 ohm (+/-1%) resistor across each input, as instructed below.<br>**Note:** Make sure all jumper wires are the same length and resistor/wire connections are of high quality. |
| 4 | Identify the active input point by taking a precision multimeter and connecting it across each of the 200 ohm resistors. Only one point will display approximately 500 mV; the other three points will equal 0 mV. The identified point is the last point polled by the A/D converter, and is the only point presently outputting the 2.5 mA constant current source. |
| 5 | Having identified the active input point, use the precision Multimeter to adjust potentiometer "A" for a reading of 500 mV (+/-100 mV). This adjustment calibrates the internal 2.5 mA constant current source. |
| 6 | START the 984-1xx controller and enter the Online Reference screen to view the input values associated with the ADU 204:<br>3XXX16143<br>3XXX26143<br>3XXX46143<br>3XXX36143<br>You need one input data register per channel. |
| 7 | Adjust Potentiometer "B" for an input of 6143 (+/-3 counts). This adjustment sets up the overall A/D converter accuracy for all four inputs. |
| 8 | When you are satisfied with the readings on all channels, drop a bead of sealing varnish on each potentiometer to secure its setting. |

| Step | Action |
|---|---|
| 9 | The following illustration shows a 200 ohm resistor across each Input on the ADU 204.<br><br> |

## ADU 204/254 Analog Input Module Specifications

**Table of Specifications**

The following table contains a list of ADU 204/254 specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Channels | 4 | |
| | Isolation | Non-isolated, channel-to-bus or channel-to-channel | |
| | Signal types supported | Two-pole voltage inputs | |
| | | Four-pole RTD inputs | |
| Required Loadable | SW-IODR-001 | | |
| Power Supply | Internally provided source | 5 V, less than 50 mA from I/O bus | |
| DIN Rail Grounding | Less than 0.1 ohms | | |
| Voltage Input Capabilities | Linear Measuring Range | +/-0.5 V nominal | |
| | Channel over range delay | 250 ms at +/-1 V, corresponding to the maximum negative or positive decimal value | |
| | Input Impedance | greater than 10M ohms | |
| | Input Voltage | 24 V maximum | |
| | Wire Size | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| RTD Input Capabilities | PT100 RTD Impedance Range | 18.49 ... 390.26 ohms | |
| | Temperature Measuring Range | -200 ... +850 degrees C | |
| | Resolution | 0.25 degrees C | |

| | | | |
|---|---|---|---|
| A/D Conversion | Conversion Time | @4096 in | 80 ms/input (max) @ 50 Hz suppression |
| | | @2048 in | 66.6 ms/input (max) @ 60 Hz suppression |
| | | | 60 ms/input (max) @ 50 Hz suppression |
| | | | 50 ms/input (max) @ 60 Hz suppression |
| | Resolution | 12 bits recommended range (+1) | |
| | In-range Error Limit | 0.4% of input value @ 0 ... 60 degrees C | |
| | Nonlinearity | +/-2 counts @ 0 ... 60 degrees C | |
| Environmental Characteristic | Operating Temperature | 0 ... 60 degrees C for ADU 204<br>-40 ... +70 degrees C for ADU 254 | |
| I/O Map | Register 3x/4x | 4 in/0 out | |
| Dimensions (WxHxD) | | 40.3 x 145 x 117.5 mm | |
| | | 1.6 x 5.6 x 4.5 in | |
| Weight | | 220 g | |
| | | .5 lb | |
| Agency Approvals | ADU204: VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards. | | |
| | ADU254C: Railway standard EN 50 155; and European Directive EMC 89/336/EEC Standards. UL 508; CSA 22.2 No. 142; FM Class I, Div 2 pending. | | |

# Overview of the ADU 205 Analog Input Module

# 3

## At a Glance

**Purpose**

The purpose of this chapter is to describe the ADU 205 analog input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the ADU 205 Analog Input Module?

**Brief Product Description**

The ADU 205 is a four-channel analog input module without opto-isolation. It performs dual-slope integrating A/D conversions, converting analog values into 12-bit digital values plus sign. It can handle either voltage inputs in the range of +/- 20 V or current inputs in the range of +/-40 mA. The linear input data range is from 2049 ... 6143.

## ADU 205 Analog Input Module Conversion Ranges

**Introduction**

The ADU 205 is a four-channel analog input module without isolation. It performs dual-slope integrating A/D conversions, converting analog values into 12-bit digital values plus sign. It can handle either voltage inputs in the range of +/- 20 V or current inputs in the range of +/-40 mA. The linear input data range is from 2049 ... 6143.

The PLC model determines the available ranges. Refer to the tables below.

**A984-1xx, E984-24x/251/255 PLC Models**

A984-1xx, E984-24x/251/255 PLC Models

| Input Signals | | | |
|---|---|---|---|
| **Voltage** | **Current** | **Data Count (Decimal)** | **Operating Results** |
| <= -20 V | <= -40 mA | 0 | Under Range |
| -19.99 ... -10.001 V | -39.99 ... -20.1 mA | 1 ... 2048 | |
| -10 V<br>...<br>0 V<br>...<br>+10 V | -20 mA<br>...<br>0 mA<br>...<br>+20 mA | 2049<br>...<br>4096<br>...<br>6143 | ↑<br>...<br>Recommended operating range<br>...<br>↓ |
| 10.001 ... 19.99 V | 20.1 ... 39.99 mA | 6144 ... 8191 | |
| >= +20 V | >= 40 mA | 8192 | Over range |

**+/-20 mA, +/-40 mA for E984-258/265/275/285 PLC Models**

+/-20 mA, +/-40 mA for E984-258/265/275/285 PLC Models

| Input current (mA) | 12-bits | 13-bits | 16-bits | 12-bits + sign | 15-bits + sign | Range |
|---|---|---|---|---|---|---|
| <-20/-40 | 0 | 0 | 0 | -4095 | -32768 | Under-range |
| -20/-40 | 0 | 0 | 0 | -4095 | -32000 | Nominal range |
| 0 | 2048 | 4096 | 32768 | 0 | 0 | |
| +20/+40 | 4095 | 8191 | 65520 | +4095 | +32000 | |
| >+20/+40 | 4095 | 8191 | 65520 | +4095 | +32767 | Overrange |

**+/- 10 VDC, +/- 20 VDC for E984-258/265/275/285 PLC Models**

+/- 10 VDC, +/- 20 VDC for E984-258/265/275/285 PLC Models

| Input current VDC | 12-bits | 13-bits | 16-bits | 12-bits + sign | 15-bits + sign | Range |
|---|---|---|---|---|---|---|
| <-20/-40 | 0 | 0 | 0 | -4095 | -32768 | Under-range |
| -10/-20 | 0 | 0 | 0 | -4095 | -32000 | Nominal range |
| 0 | 2048 | 4096 | 32768 | 0 | 0 | |
| +10/+20 | 4095 | 8191 | 65520 | +4095 | +32000 | |
| >+10/+20 | 4095 | 8191 | 65520 | +4095 | +32767 | Overrange |

**0 ... 10 VDC, 0 ... 20 VDC for E984-258/265/275/285 PLC Models**

0 ... 10 VDC, 0 ... 20 VDC for E984-258/265/275/285 PLC Models

| Input current VDC | 12-bits | 13-bits | 16-bits | 12-bits + sign | 15-bits + sign | Range |
|---|---|---|---|---|---|---|
| < 0 | 0 | 0 | 0 | -4095 | -32768 | Under-range |
| 0 | 0 | 0 | 0 | 0 | 0 | Nominal range |
| 10/20 | 4095 | 8191 | 65520 | +4095 | +32000 | |
| >10/20 | 4095 | 8191 | 65520 | +4095 | +32767 | Overrange |

**0 ... 20 mA for E984-258/265/275/285 PLC Models**

0 ... 20 mA for E984-258/265/275/285 PLC Models

| Input current mA | 12-bits | 13-bits | 16-bits | 12-bits + sign | 15-bits + sign | Range |
|---|---|---|---|---|---|---|
| < 0 | 0 | 0 | 0 | -4095 | -32768 | Under-range |
| 0 | 0 | 0 | 0 | 0 | 0 | Nominal range |
| 20 | 4095 | 8191 | 65520 | +4095 | +32000 | |
| >20 | 4095 | 8191 | 65520 | +4095 | +32767 | Overrange |

## 4 ... 20 mA for E984-258/265/275/285 PLC Models

4 ... 20 mA for E984-258/265/275/285 PLC Models

| **Input current mA** | **12-bits** | **13-bits** | **16-bits** | **12-bits + sign** | **15-bits + sign** | **Range** |
|---|---|---|---|---|---|---|
| < 0 ... 2 | 0 | 0 | 0 | 0 | 0 | Wire breakage |
| 2.1 ... 3.61 | 0 | 0 | 0 | 0 | -32768 | Under-range |
| 3.62 ... 3.99 | 0 | 0 | 0 | 0 |  | Tolerable |
| 4 | 0 | 0 | 0 | 0 | 0 | Nominal range |
| 20 | 4095 | 8191 | 65520 | +4095 | +32000 |  |
| > 20 | 4095 | 8191 | 65520 | +4095 | +32767 | Overrange |

## ADU 205 Operation

The ADU 205 operates off the 5 V supply voltage provided internally over the I/O bus.

When the module goes out of range—either over or under range—and then returns to a valid operating range, the module will resume proper operations unless your out-of-range condition reaches or exceeds the safety range of +/-30 Vdc.

**⚠ CAUTION**

**Do not operate at extreme ranges.**

Operating at an extreme out-of-range voltage—at or beyond +/-30 Vdc—will cause permanent damage to the module.

**Failure to follow this instruction can result in injury or equipment damage.**

## LED

The ADU 205 has one green LED opposite terminal screw 1. This LED is used to indicate the presence of the 5 V power supply from the backplane.

## ADU 205 Analog Input Module Switch Settings

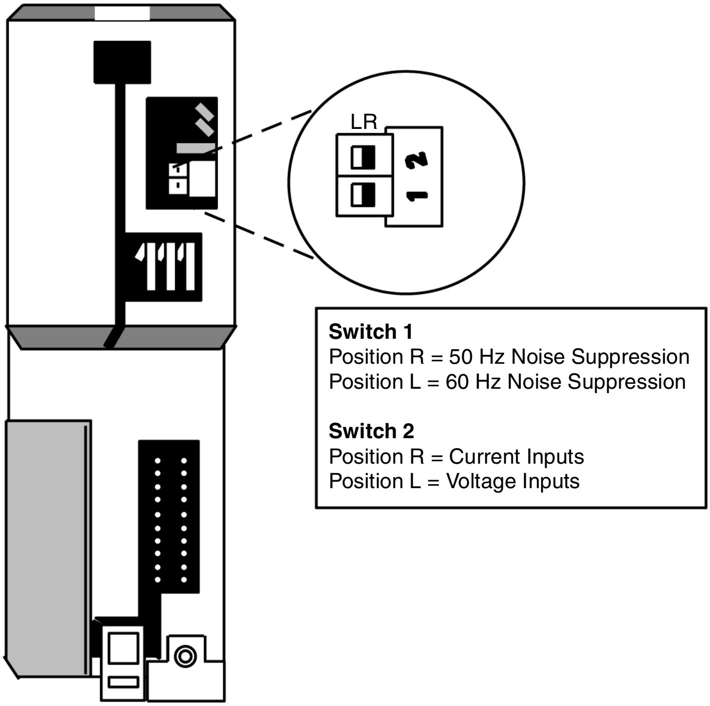
**Introduction**

Two two-position DIP switches are located on the back of the ADU 205.

**Changing the Switch Settings**

Switch 2 is used to specify whether the inputs are voltage or current inputs; switch 1 is used to set external noise interference protection for the module.

The following illustration shows the switches on the rear of the ADU 205.



**Switch 1**
Position R = 50 Hz Noise Suppression
Position L = 60 Hz Noise Suppression

**Switch 2**
Position R = Current Inputs
Position L = Voltage Inputs

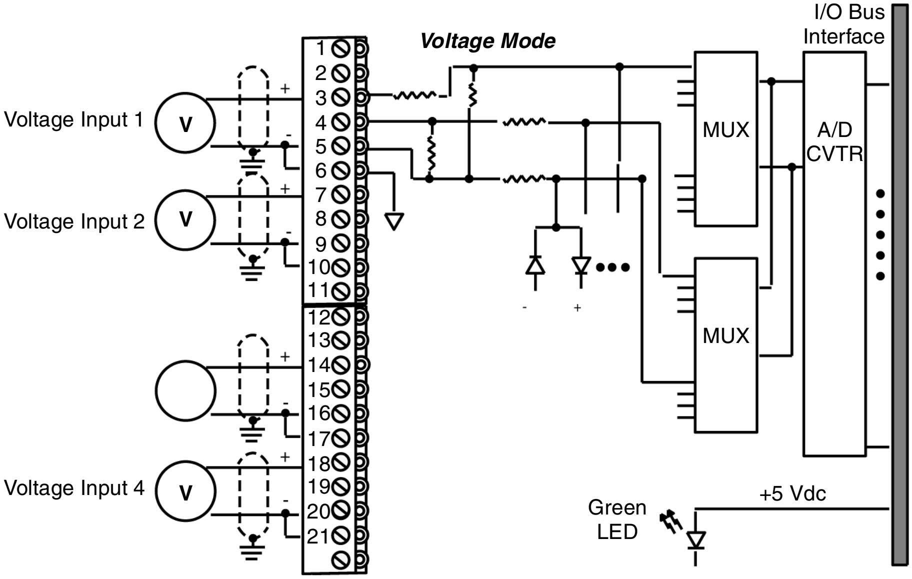
## ADU 205 Analog Input Module Field Wiring

**Introduction**

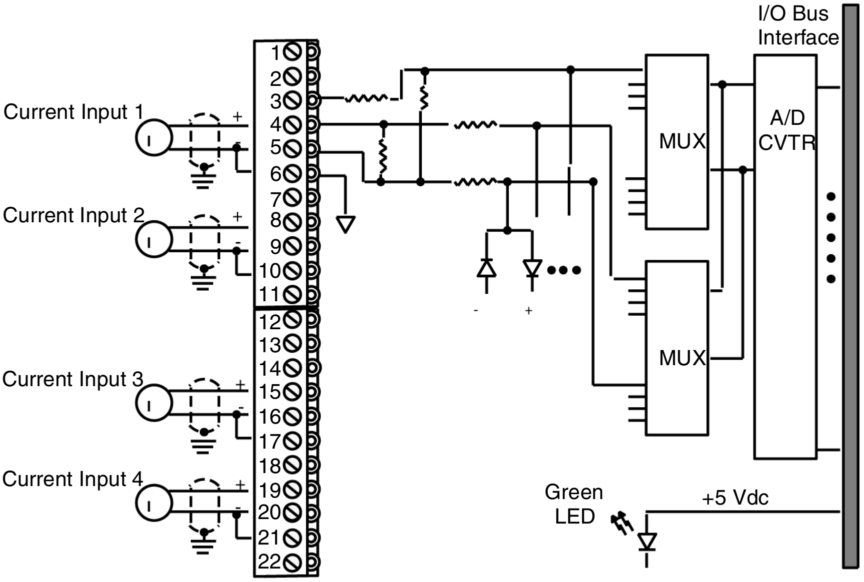
The module will be field wired differently, depending on whether the field device provides voltage or current inputs.

**Wiring Diagram**

The following illustration is a wiring diagram and simplified schematic for the ADU 205 analog input module (voltage mode).



The following illustration is a wiring diagram and simplified schematic for the ADU 205 analog input module (current mode).



**Note:** The jumpers at terminals 5-6, 9-10, 16-17, and 20-21 are factory set to reference the input source(s) to ground. If the source(s) that you use are already grounded, remove the associated jumper(s) to omit ground looping problems and possible module failure.

## ⚠ CAUTION

**Operation Failure Hazard**

When the installed jumpers reference a ground on the negative input and using a grounded power supply, the full loop supply voltage causes the module to fail. We recommend that you wire the loop supply to the negative input side of your module.

**Failure to follow this instruction can result in injury or equipment damage.**

### ADU 205 Analog Input Module LED

The ADU 205 has one green LED opposite terminal screw 1, used to indicate the presence of the 5 V power supply from the backplane.

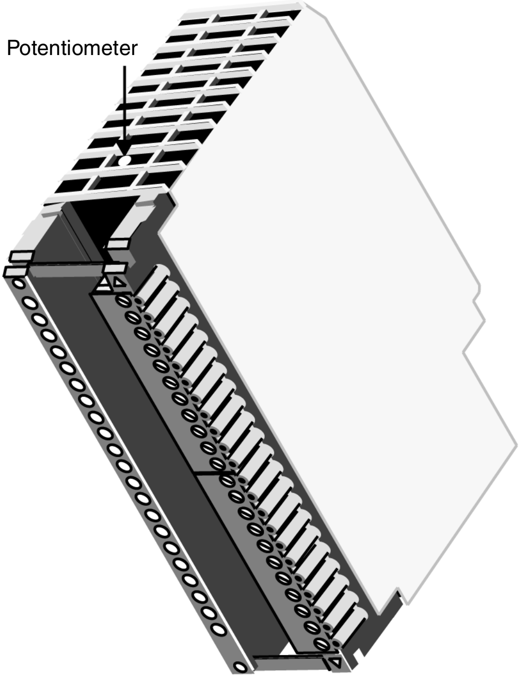
## ADU 205 Analog Input Module Calibration

**Introduction**

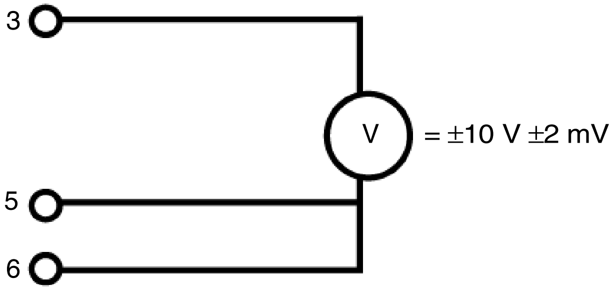
By adjusting a single potentiometer on the top of the ADU 205, you can calibrate the four analog input channels to an accuracy of +/-3 counts over the recommended linear count range of the module (2049 ... 6143).

**Calibrating the Analog Input Channels**

The following illustration shows the location of the potentiometer on the ADU 205.



The following procedure is for voltage inputs. The process is nearly identical for current inputs, except that the input signals applied to each channel must be -20 mA, 0 mA, and +20 mA. To adjust the potentiometers:

| Step | Action |
|---|---|
| 1 | Using the DIP switch on the back of the module, set it for the desired noise suppression. |
| 2 | Calibrate analog channel 1 by wiring terminal 3 to the positive side, and terminals 5 and 6 to the negative side, of a voltage standard - as shown in the following figure.<br><br> |
| 3 | Connect terminals 7, 9, 10, 14, 16, 17, 18, 20, and 21 to each other. |
| 4 | Set the voltage standard to +10 V and adjust the potentiometer until you get a reading of 6143 counts. |
| 5 | Set the voltage standard to -10 V, and adjust the potentiometer until you get a reading of 2049 +/-1 count. |
| 6 | Check the accuracy of your midrange setting by setting the voltage standard to 0 V; the reading should be at or within a count of 4096 counts. Then recheck your high range count by setting the voltage standard to +10 V; the reading should be within 3 counts of 6143. |
| 7 | Verify the calibration adjustment on the other three analog channels: for channel 2, wire terminals 7, 9, and 10 to the voltage standard; for channel 3, use terminals 14, 16, and 17; and for channel 4, use terminals 18, 20, and 21. If you make any fine tuning adjustments on any of these channels, verify their effects on channel 1. |
| 8 | When you are satisfied with the readings on all four channels, drop a bead of sealing varnish on the potentiometer to secure its setting. |

## ADU 205 Analog Input Module Specifications

**Table of Specifications**

The following table contains a list of system-specific specifications for the ADU 205 Analog Input Module.

| | | | |
|---|---|---|---|
| Module Topology | Number of Channels | 4 | |
| | Isolation | Non-isolated, channel-to-bus or channel-to-channel | |
| | Signal types supported | Two-pole voltage inputs | |
| Power Supply | Internally provided source | 5 V, less than 50 mA from I/O bus | |
| Voltage Input Capabilities | Linear Measuring Range | Nominal | +/-10 V |
| | | Maximum | +/-19.99 V |
| | Input Impedance | 50 ohms | |
| | Absolute Maximum Input Voltage | +/-30 V | |
| | Wire Size | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| A/D Conversion | Conversion Time | Each input @ 4096 in | 80 ms (max) @ 50 Hz |
| | | | 66.6 ms (max) @60 Hz |
| | | Each input @ 2048 in | 60 ms (max) @ 50 Hz |
| | | | 50 ms (max) @ 60 Hz |
| | Resolution | 12 bits recommended range (+1) | |
| | In-range Error Limit | 0.5% of input value @ 0... 60 degrees C | |
| | Nonlinearity | +/-2 counts @ 0... 60 degrees C | |
| Noise Suppression | Normal Mode Rejection | 40 dB minimum | |
| | Common Mode Rejection | 86 dB minimum | |
| I/O Map | Register 3x/4x | 4 in/0 out | |

The following table gives general specifications for the ADU 205 Analog Input Module.

| | |
|---|---|
| Dimensions (WxHxD) | 40.3 x 145 x 117.5 mm |
| | 1.6 x 5.6 x 4.5 in |
| Weight | 220 g |
| | .5 lb. |
| Agency Approvals | ADU204: VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards. |
| | VDE 0160; UL 508; CSA 22.2  No.142; and FM Class I, Div 2 Standards. |

# Overview of the ADU 206/256 Analog Input Module

# 4

## At a Glance

**Purpose**

The purpose of this chapter is to describe the ADU 206/256 analog input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the ADU 206/256 Analog Input Module?

**Brief Product Description**

The ADU 206/256 is a four-channel analog input module with opto-isolation. It performs dual-slope integrating A/D conversions, converting analog input signals into digital values based on the principle of successive approximation. The ADU 256 functions just like the ADU 206, except that the ADU 256 operates at extended temperature.

**Note:** The ADU 256 model is available with conformal coating. The conformal coating model is ADU 256C, which meets Railway standard EN 50 155.

### ⚠ WARNING

The ADU 206/256 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

## ADU 206/256 Analog Input Module Conversion Ranges

**Introduction**

The ADU 206/256 is a four-channel analog input module with opto-isolation. It performs dual-slope integrating A/D conversions, converting analog input signals into digital values based on the principle of successive approximation. The ADU 256 functions just like the ADU 206, except that the ADU 256 operates at extended temperature.

**Note:** The ADU 256 model is available with conformal coating. The conformal coating model is ADU 256C, which meets Railway standard EN 50 155.

**⚠ WARNING**

**Faulty operation.**

The ADU 206/256 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

## Conversion Ranges

The ADU 206/256 module has the following characteristics:

- Voltage/current input selection is made using jumpers; range values are set in the software.
- Operates off the 5 V supply voltage provided internally over the I/O bus, along with a user-supplied 24 VDC external power source.
- Resolution is 11 Bit + sign or 12 Bit, depending on the input range selected.
- Out-of-range status indication is software selectable.

The PLC model determines the ranges. A table is provided below for each of the following:

- 0... 10 VDC/2... 10 VDC, 0... 20 mA/4... 20 mA for E984-258/265/275/285
- +/-10 VDC/ +/-20 mA for E984-258/265/275/285

**Note:** See the Specifications section for the ranges for the A984-1xx, E984-24x/ 251/255 PLC models

The following table lists the input ranges for voltage/current input selection.

| **Voltage** | **Current** |
|---|---|
| +/-1 V | +/-20 mA |
| +/-10 V | 4... 20 mA |
| 0... 1 V | 0... 20 mA |
| 0... 10 V | |
| 0.2... 1 V | |
| 2... 10 V | |

The ranges for 0... 10 VDC/2... 10 VDC, 0... 20 mA/4... 20 mA for E984-258/265/275/285 PLC models are:

| **Input voltage (VDC)** | **Current (mA)** | **12-bits** | **16-bits** | **11-bits + sign** | **15-bits + sign** | **Measuring step/value range** |
|---|---|---|---|---|---|---|
| | | 0 | 0 | 0 | 0 | Under range |
| | | 0 | 0 | 0 | 0 | Neg. tolerance range |
| 0/2 | 0/4 | 0 | 0 | 0 | 0 | Nominal range |
| 10 | 20 | 4000 | 64000 | +2000 | +32000 | |
| 10.01... | 20.02... | 4001 | 64016 | +2001 | +32016 | Pos. tolerance range |
| greater than/equal to 10.24/10.19 | greater than/equal to 20.48/ 20.39 | 4095 | 65520 | +2047 | +32760 | Over range |

The ranges for +/-10 VDC/ +/-20 mA for E984-258/265/275/285 PLC models are:

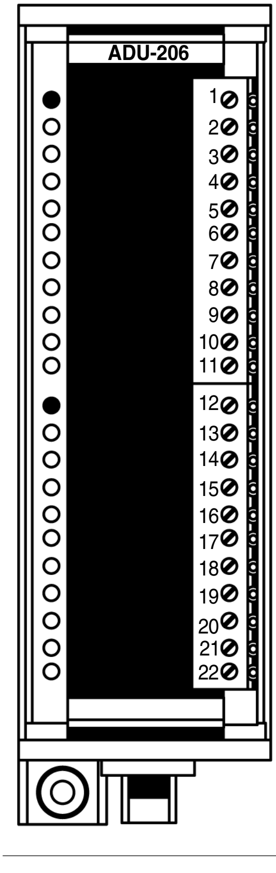
| **Input voltage (VDC)** | **Current (mA)** | **12-bits** | **16-bits** | **11-bits + sign** | **15-bits + sign** | **Measuring step/value range** |
|---|---|---|---|---|---|---|
| less than or equal to -10.24 | less than or equal to -20.48 | 0 | 0 | -2048 | -32768 | Under range |
| -10.01 | -20.02 | 47 | | -2001 | -32016 | Neg. tolerance range |
| -10.00<br>0<br>+10.00 | -20<br>0<br>+20 | 48<br>2048<br>4048 | 768<br>32768<br>64768 | -2000<br>0<br>+2000 | -32000<br>0<br>+32000 | Nominal range |
| +10.01 | +20.02... | | | | | |
| 10.01... | 20.02... | 4049 | | +2001 | +32016 | Pos. tolerance range |
| greater than or equal to 10.24 | greater than or equal to 20.48 | 4095 | 65520 | +2047 | +32752 | Over range |

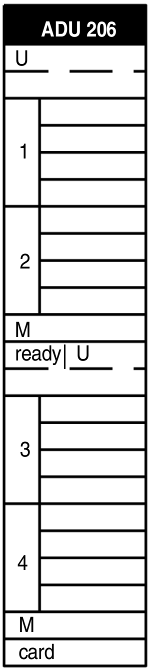
## ADU 206/256 Analog Input Module Physical Characteristics

**Illustration**

The ADU 206/256 can be installed in any slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and peripheral connections on the front. The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided.

A front view with ADU 206 label is provided below.





**LEDs**

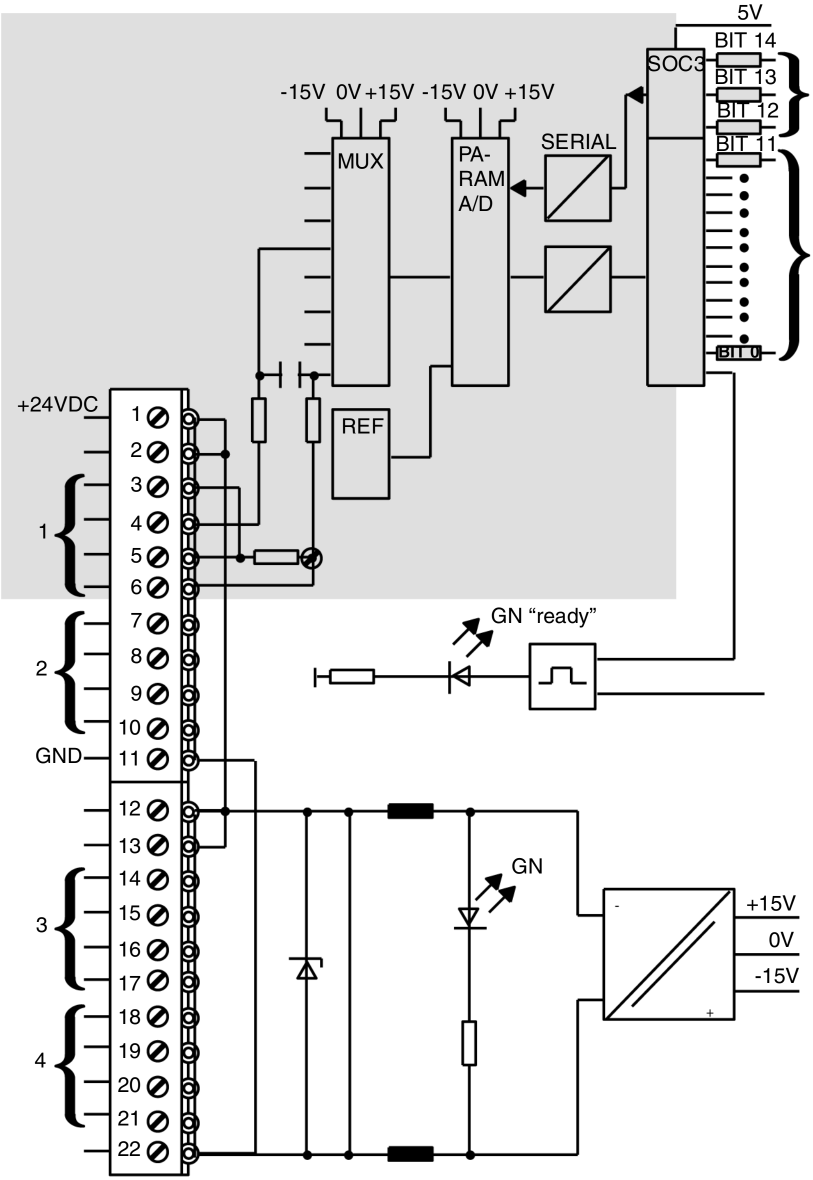
The ADU 206/256 has two green LEDs:

- The LED opposite field wiring terminal #1 indicates the presence of 24 Vdc power from the external source (ON = power supplied; OFF = power off.
- The LED opposite field wiring terminal #12 indicates the condition of the processor/module (ON = fault-free operation; OFF = fault condition).

**Note:** The controller must be running for the READY LED to illuminate.

## Simplified Schematic

A simplified schematic for the ADU 206/256 is provided below.



## ADU 206/256 Analog Input Module Configuration

### Introduction

The following items must be addressed when configuring the ADU 206/256:

- The module must be I/O mapped as five 3x input registers and one 4x output register. Binary must be set for data type.
- Make connections and assignments of input addresses.
- Identify overall mode of operation, type of input, and error indication.
- Cabling guidelines.

### Cabling

- Shielded, twisted pair cable (2 or 4 x 0.5mm per channel) should be used. All channels can be connected with a common shielded cable.
- Connect shield to ground (GND) on one side with a short cable (less than 8 in).
- Observe a minimum distance of 20 in. between the module and power lines or other sources of electrical disturbance.

### Connection and Assignment of Input Addresses

**Note:** Detailed Compact 984 cabling and installation instructions are found in the User Guide.

### Connection and Assignment for Current Inputs

For current inputs:

- Jumper 3-4 for input 1
- Jumper 7-8 for input 2
- Jumper 14-15 for input 3
- Jumper 18-19 for input 4

### Connection and Assignment for Voltage Inputs

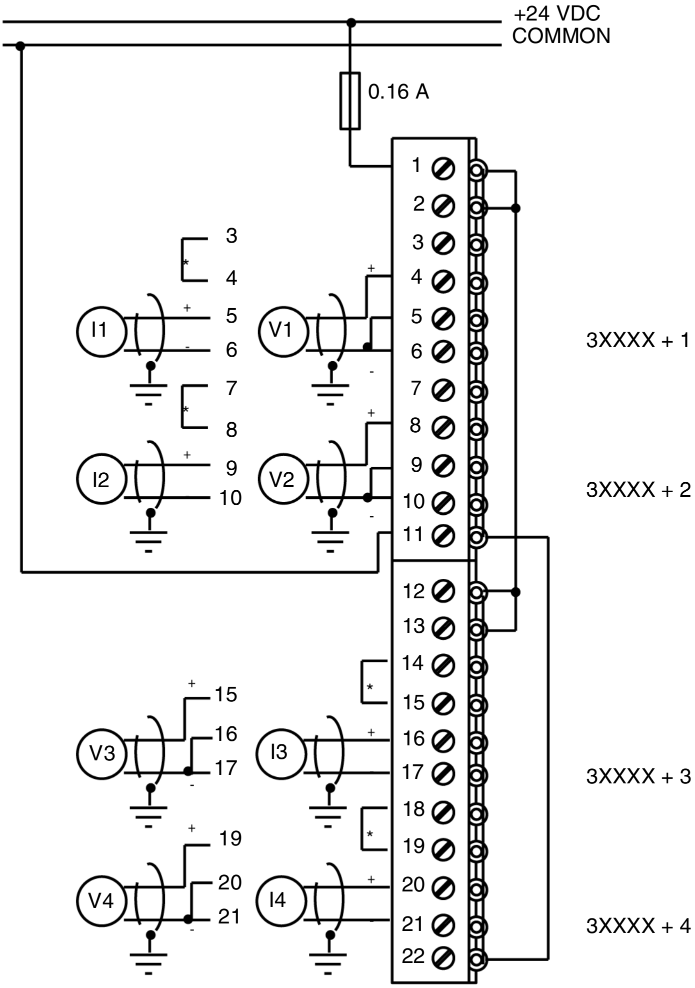
For voltage inputs:

- Jumper 5-6 for input 1
- Jumper 9-10 for input 2
- Jumper 16-17 for input 3
- Jumper 20-21 for input 4

Corresponding input signal names or addresses can be entered on the blank label (supplied).

**Wiring Diagram**

An ADU 206/256 wiring diagram and associated registers for inputs are provided below.



## ADU 206/256 Analog Input Module Programming Modes

### Introduction

The ADU 206/256 is a four-channel analog input module. Its field connector is wired depending on the type of input to be measured, either voltage or current. Any of the four inputs can be either voltage or current, and any combination of the four may be used if levels are within the programmed range for the channel.

The module can operate in one of several modes, and the input channel ranges are individually selectable. The mode and ranges are set by an I/O mapped 4x register.

Five sequential 3x registers must also be I/O mapped. The first register is used to read module operating status, and the remainder contain data representing voltage or current levels at the four channel inputs. Channel input data is updated every 10 ms.

### 4x Control Register

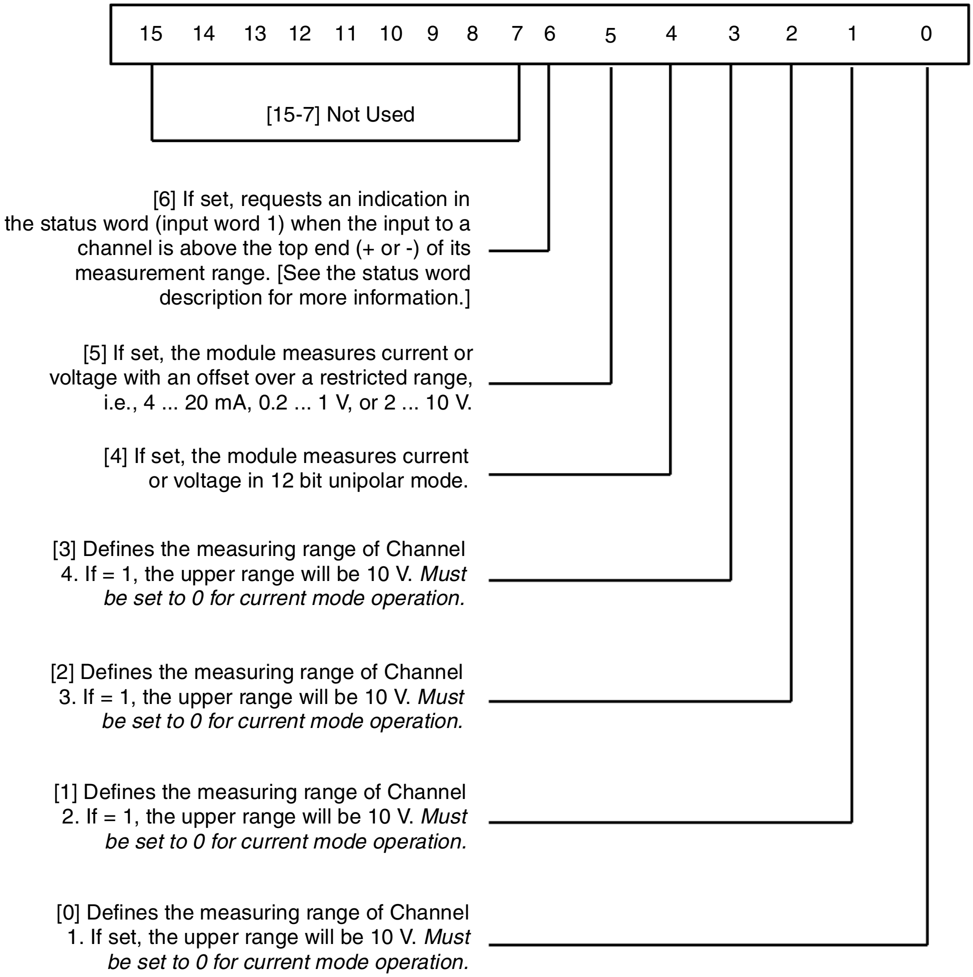
The operating mode of the module and individual channel ranges are set using the lower 7 bits of the 4x register.

Options are:

| Bit | Operating Mode Setting |
|---|---|
| 000X | Bipolar mode without overrange indication |
| 001X | Unipolar mode without overrange indication |
| 002X | Bipolar with offset and extended resolution without overrange indication |
| 003X | Unipolar with offset and extended resolution without overrange indication |
| 004X | Bipolar mode with overrange indication |
| 005X | Unipolar mode with overrange indication |
| 006X | Bipolar with offset and extended resolution with overrange indication |
| 007X | Unipolar with offset and extended resolution with overrange indication |

**Note:** These values are in Hexadecimal.
where the X value determines the individual channel range:
1 = expanded voltage range (10 V)
0 = normal voltage range (1 V)

The following diagram illustrates bits in the ADU 206/256 control word and their meanings.



[6] If set, requests an indication in the status word (input word 1) when the input to a channel is above the top end (+ or -) of its measurement range. [See the status word description for more information.]

[5] If set, the module measures current or voltage with an offset over a restricted range, i.e., 4 ... 20 mA, 0.2 ... 1 V, or 2 ... 10 V.

[4] If set, the module measures current or voltage in 12 bit unipolar mode.

[3] Defines the measuring range of Channel 4. If = 1, the upper range will be 10 V. *Must be set to 0 for current mode operation.*

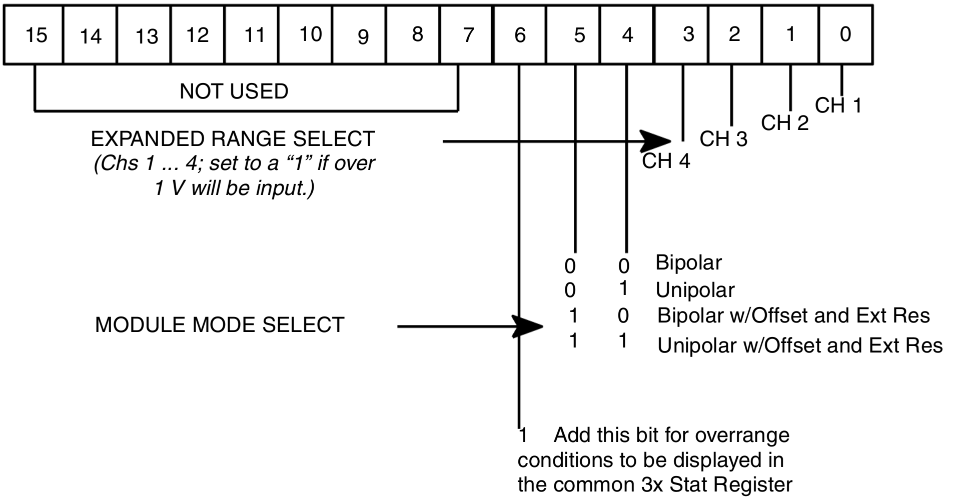
[2] Defines the measuring range of Channel 3. If = 1, the upper range will be 10 V. *Must be set to 0 for current mode operation.*

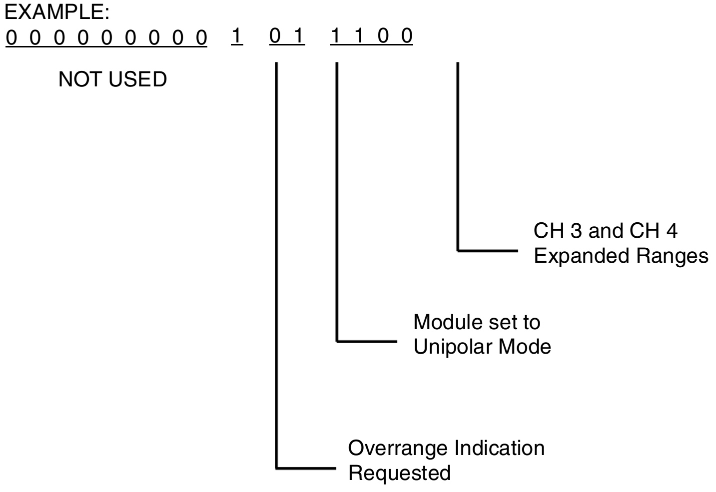
[1] Defines the measuring range of Channel 2. If = 1, the upper range will be 10 V. *Must be set to 0 for current mode operation.*

[0] Defines the measuring range of Channel 1. If set, the upper range will be 10 V. *Must be set to 0 for current mode operation.*

## 4x Control Register Quick Reference

A quick reference diagram of the ADU 206/256 4x Control Register is provided below.





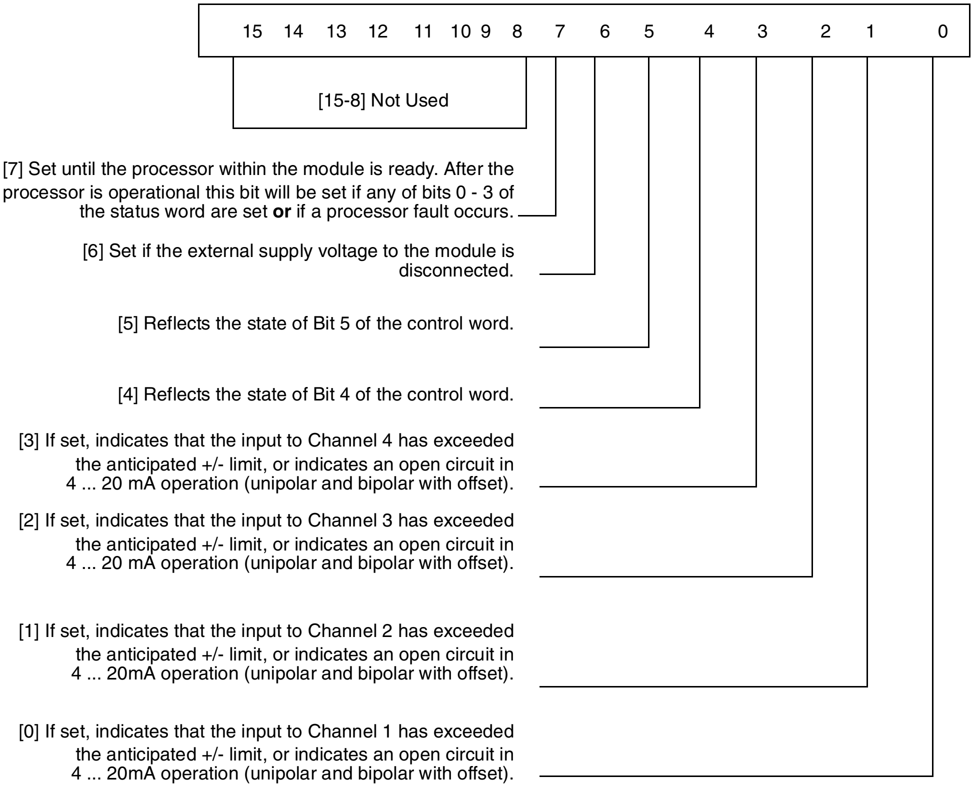
## 3X Status and Data Registers

The bit significance of the first 3x input register, which displays the module status, is displayed in the following illustration.  The next four registers contain data representative of the individual channel input values.  Refer to the rest of the information in this map for more detail about the values that may be expected.

Data values are the result of the type of input selected, the field connector wiring, the module operating mode selected, and the range selected for the channel (normal or expanded).

| I/O Map Registers | Data |
|---|---|
| 3x | Module status information |
| 3x + 1 | Input #1 data |
| 3x + 2 | Input #2 data |
| 3x + 3 | Input #3 data |
| 3x + 4 | Input #4 data |

The following diagram illustrates bits in the ADU 206/256 status word and their meanings.



[7] Set until the processor within the module is ready. After the processor is operational this bit will be set if any of bits 0 - 3 of the status word are set **or** if a processor fault occurs.

[6] Set if the external supply voltage to the module is disconnected.

[5] Reflects the state of Bit 5 of the control word.

[4] Reflects the state of Bit 4 of the control word.

[3] If set, indicates that the input to Channel 4 has exceeded the anticipated +/- limit, or indicates an open circuit in 4 ... 20 mA operation (unipolar and bipolar with offset).

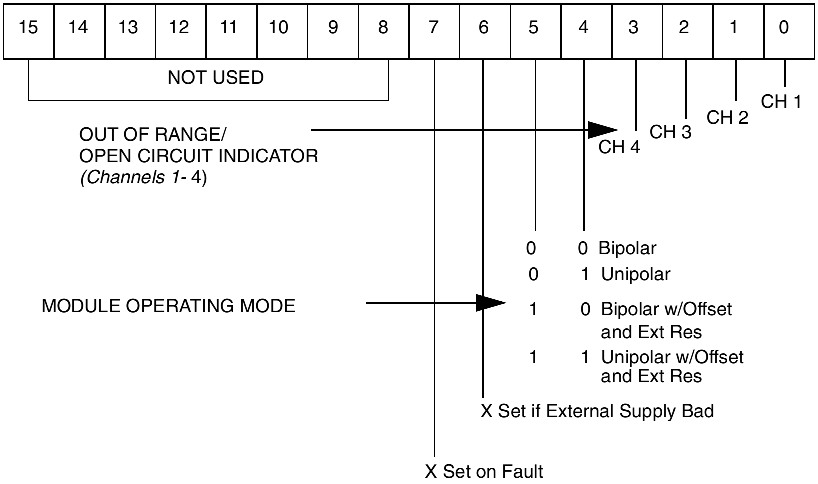
[2] If set, indicates that the input to Channel 3 has exceeded the anticipated +/- limit, or indicates an open circuit in 4 ... 20 mA operation (unipolar and bipolar with offset).

[1] If set, indicates that the input to Channel 2 has exceeded the anticipated +/- limit, or indicates an open circuit in 4 ... 20mA operation (unipolar and bipolar with offset).

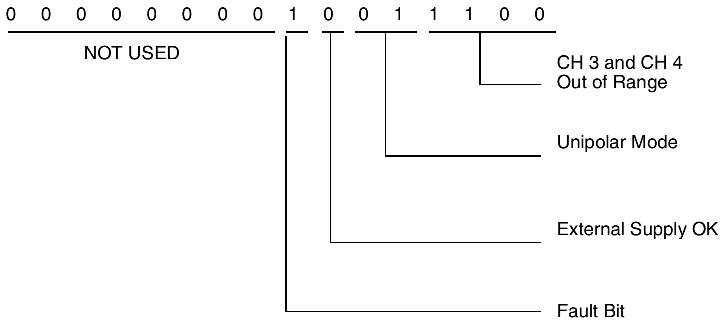
[0] If set, indicates that the input to Channel 1 has exceeded the anticipated +/- limit, or indicates an open circuit in 4 ... 20mA operation (unipolar and bipolar with offset).

## 30xxx Status Register Quick Reference

A quick reference diagram of the ADU 206/256 30xxx Status Register is provided below.



EXAMPLE:



## Types of Modes and Their Functions

When power is first applied to the module, it will be in a state equivalent to all of the control bits being 0. As long as power to the unit is maintained, the operating mode of the module will be unchanged through a stop/start cycle.

When the module goes out of range-either over or under range-and then returns to a valid operating range, the module will resume proper operations unless your out-of-range condition reaches or exceeds the safety range of +/-30 VDC.

**⚠ WARNING**

**Extreme out-of-range voltage.**

Operation at an extreme out-of-range voltage-at or beyond +/-30 VDC-will cause permanent damage to the module.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

### Bipolar (000X, 004X)

Bipolar mode is selected by setting the control word to the value 000X, where X defines the range of any channels used for voltage measurement. In this mode, if out of range indication is requested (control word = 004x), it will turn on at voltages/ currents exceeding the +/- maximum value. Refer to status word description.

The following table describes the current/voltage values in bipolar mode.

| Current | Normal Voltage | Expanded Voltage | Value |
|---|---|---|---|
| -20 mA | -1 V | -10 V | 48 |
| 0 mA | 0 V | 0 V | 2048 |
| +20 mA | +1 V | +10 V | 4048 |

### Unipolar (001X, 005X)

This mode is selected by setting the control word to the value 001X, where X defines the range of any channels used for voltage measurements. In this mode, if overrange indication is requested (i.e., control word = 005X), it will turn on if an input exceeds the maximum range value. Refer to status word description.

The following table describes the current/voltage values in unipolar mode.

| Current | Normal Voltage | Expanded Voltage | Value |
|---|---|---|---|
| 0 mA | 0 V | 0 V | 0 |
| 20 mA | +1 V | +10 V | 4000 |

### Bipolar with Offset and Extended Resolution (002X, 006X)

This mode is selected by setting the control word to the value 002X, where X defines the range of any channels used for voltage measurements.  In this mode, the out of range indication is set whenever the inputs are less than 10% of the range maximum value (i.e., 2 mA, 0.1 V or 1 V).  This serves as a broken wire detector in addition to being a low input indicator.  The out of range indication request bit does not have to be set, and the indication will reset once the input returns to the active range.  In this mode, if overrange indication is requested (control word = 006X), it will turn on if an input exceeds the maximum range value.  Refer to status word description.

The following table describes the current/voltage values in bipolar mode with offset and extended resolution.

| Current | Normal Voltage | Expanded Voltage | Value |
|---|---|---|---|
| 4 mA | 0.2 V | 2 V | 2048 |
| 20 mA | 1 V | 10 V | 4048 |

### Unipolar with Offset and Extended Resolution (003X, 007X)

This mode is selected by setting the control word to the value 003X, where X defines the range of any channels used for voltage measurements.  In this mode, the out of range indication is set whenever the inputs are less than 10% of the range maximum value  (i.e., 2 mA, 0.1 V or 1 V).  This serves as a broken wire detector in addition to being a low input indicator.  The out of range indication request bit does not have to be set, and the indication will reset once the input returns to the active range.  In this mode, if overrange indication is requested (control word = 007X), it will turn on if an input exceeds the maximum range value.  Refer to status word description.

The following table describes the current/voltage values in unipolar mode with offset and extended resolution are.

| Current | Normal Voltage | Expanded Voltage | Value |
|---|---|---|---|
| 4 mA | 0.2 V | 2 V | 0 |
| 20 mA | 1 V | 10 V | 4000 |

## ADU 206/256 Analog Input Module Calibration

**Introduction**

By adjusting the two potentiometers located on the top of the ADU 206/256, you can independently calibrate both the normal and expanded ranges for the four input channels.

**⚠ CAUTION**

**Return units requiring calibration.**

Modicon recommends that units requiring recalibration be returned to the factory, since inaccuracies could be due to faulty components. However, users who wish to perform their own calibration should use the following procedure.

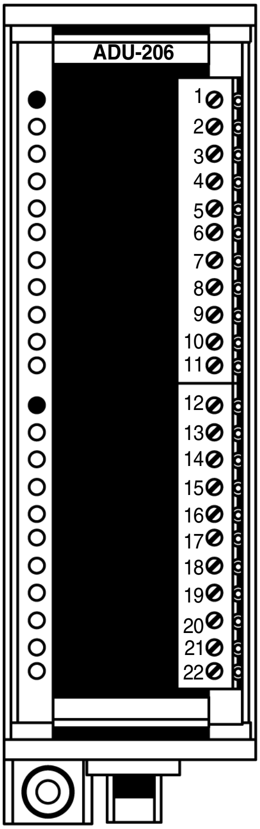
**Failure to follow this instruction can result in injury or equipment damage.**

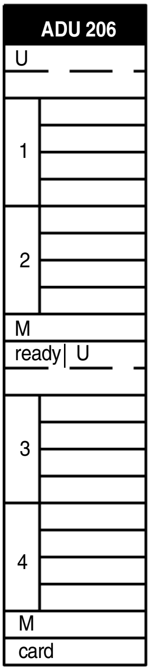
## Calibrating the Analog Input Channels

In the procedure that follows, R65 is used to calibrate the normal ranges, and R64 is used to calibrate the expanded ranges. Items required for calibration are:

- A 1 VDC Power Supply (+/-0.1 mV)
- A 10 VDC Power Supply (+/-1.0 mV)
- A voltmeter with appropriate scales and accuracy of 0.2... 0.5 parts/million

The following illustration shows the location of the potentiometers on the ADU 206/256.





## Adjusting the Potentiometers Procedure

Use the following procedure to adjust the potentiometers.

| Step | Action |
|---|---|
| 1 | Connect a 1 VDC source (+/-0.1 mV), verified with the voltmeter, to the four voltage inputs. Set the module for Unipolar mode and all channels for Normal range. Adjust R65 for a reading of 4000 counts on Channel 1. Channels 2... 4 should read 4000, +/-2 counts. |
| 2 | Set the module to Bipolar mode and check all channels for a reading of 4048 +/-2 counts. |
| 3 | Reverse the 1 VDC supply polarity and check all channels in Bipolar mode. All channels should read 48 +/-2 counts. |
| 4 | Set the module for Unipolar mode and all channels for Expanded range. Connect a 10 VDC source (+/-1.0 mV), verified with the voltmeter, to the four voltage inputs. Adjust R64 for a reading of 4000 counts on Channel 1. Channels 2 to 4 should read 4000, +/-2 counts. |
| 5 | Set the module to Bipolar mode and check all channels for a reading of 4048 +/-2 counts. |
| 6 | Reverse the 10 Vdc supply polarity and check all channels in Bipolar mode. All channels should read 48 +/-2 counts. |
| 7 | When satisfied with the readings on all four channels, drop a bead of sealing varnish on both potentiometers' adjusting screws to secure their settings. |

## ADU 206/256 Analog Input Module Specifications

**Table of Specifications**

The following table contains a list of ADU 206/256 specifications.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Module Topology | | Number of Channels | | 4 | | | |
| | | Data Format | | Two-pole as voltage or current inputs | | | |
| | | Isolation | | Channel-to-bus | | | 500 V |
| | | | | Channel-to-external supply | | | 500 V |
| | | | | Nonisolated channel-to-channel | | | |
| Power Supply | | External | | 24 Vdc | Typical | | 70 mA |
| | | | | | Maximum | | 100 mA |
| | | Internal Source (from I/O bus) | | 5 Vdc | Typical | | 60 mA |
| | | | | Maximum | | | |
| | | Power Dissipation | | | Typical | | 2 Ω |
| | | | | | Maximum | | 3 Ω |
| Voltage Input | | Linear Measuring Range | | | | | |
| A984-1xx, E984-24x/251/255 PLC Models | | | | | | | |
| Analog Value Voltage Inputs (V) | | Current Inputs (mA) | | | Decimal Value | Ext. Resolution | Comments |
| +/-1 V | +/-10 V | 2...10 V | +/-20 mA | 4...20 mA | | | |
| -1.024 ... | -10.24 | | -20.48 ... | | 0 | | Under range in dication in status word |
| -1.015 | -10.15 | | 20.30 | | | | |
| -1.001 | -10.01 ... | | -20.02 | | 47 | | |
| -1.00 | -10.00 | | -20.00 | | 48 | | |
| -0.50 | -5.00 | | -10.00 | | 1048 | | |
| -0.10 | -1.00 | | -2.00 | | 1848 | | |
| -0.050 | -0.50 | | -1.00 | | 1948 | | |
| -0.01 | -0.10 | | -0.20 | | 2028 | | |
| -0.001 | -0.01 | | -0.02 | | 2046 | | Linear Range |
| -0.0005 | -0.005 | | -0.01 | | 2047 | | |
| 0.00 | 0.00 | +2.00 | 0.00 | +4.00 | 2048 | 0 | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| +0.0005 | +0.005 | +2.004 | +0.01 | +4.008 | 2049 | | |
| +0.001 | +0.01 | +2.008 | +0.02 | +4.016 | 2050 | | |
| +0.01 | +0.10 | +2.08 | +0.20 | +4.16 | 2068 | | |
| +0.050 | +0.50 | +2.40 | +1.00 | +4.80 | 2148 | | |
| +0.10 | +1.00 | +2.80 | +2.00 | +5.60 | 2248 | | |
| +0.50 | +5.00 | +6.00 | +10.00 | +12.00 | 3048 | | |
| +1.00 | +10.00 | +10.00 | +20.00 | +20.00 | 4048 | 4000 | |
| +1.015 ... | +10.15 ... | +10.155 ... | +20.30 ... | +20.30 ... | | | Over range Indication in Status Word |
| +1.024 | +10.24 | +10.19 | +20.47 | +20.38 | 4095 | | |

| | | | |
|---|---|---|---|
| | Absolute Max. Input Voltage | | +/-30 V |
| | Input Impedance | | greater than 1 M ohms |
| | Wire Size | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| Current Input Capabilities | Linear Measuring Range | | See the table above |
| | Absolute Maximum Input Current (continuous) | | 40 mA/input |
| | Input Impedance | | 50 ohms |
| | Wire Size | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| A/D Conversion | Conversion Time ( maximum) | | 10 ms for all 4 inputs |
| | Resolution | | 11 bits plus sign |
| | In-range Error Limit | Voltage Maxi mum | 0.4% of input value @ 0 ... 60 degrees C |
| | | Current Maxi mum | 0.56% of input value @ 0 ... 60 degrees C |
| Environmental Characteristics | Operating Temperature | 0 ... 60 degrees C for ADU 206<br>-40 ... +70 degrees C for ADU 256 | |
| I/O Map | Register 3x/4x | 5 in/1 out | |
| Noise Suppression | Common Mode Rejection (minimum) | | 60 dB @ 1 kHz |
| Dimensions (W x H x D) | | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| Weight | | | 330 g |
| | | | 0.725 lb |

| | | |
|---|---|---|
| Agency Approvals | ADU206: VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards. | |
| | ADU256C: Railway standard EN 50 155; European Directive EMC 89/336/EEC Standards. UL 508; CSA 22.2 No.142; and FM Class I, Div 2 pending. | |

# Overview of the ADU 210 Isolated Analog Input Module

# 5

## At a Glance

**Purpose**

The purpose of this chapter is to describe the ADU 210 isolated analog input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the ADU 210 Isolated Analog Input Module?

### Brief Product Description

The ADU 210 is a four-channel analog input module with opto-isolation. It performs analog-to-digital conversions using a delta-sigma conversion method, converting analog input signals into digital values. The ADU 210 module has the following characteristics:

- Voltage/Current input selection is made by appropriate wiring; the range values are set via the panel software.
- Operates off the 5 V supply voltage provided internally over the I/O bus, along with a user-supplied 24 VDC external power source.
- Provides 300 volts maximum channel-to-channel isolation.
- Provides a 15-bit + sign resolution.
- Errors are noted via the Concept I/O Map Status Word.
- Input selection and range can be set independently.

Input ranges are:

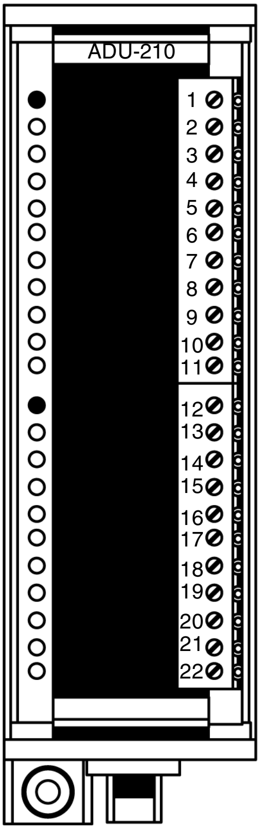
| **Voltage** | **Current** |
|---|---|
| +/-10 V | |
| 0 ... 10 V | |
| 1 ... 5 V | 4 ... 20 mA |
| 0 ... 5 V | 0 ... 20 mA |
| 2 ... 10 V | |
| +/-5 V | +/-20 mA |

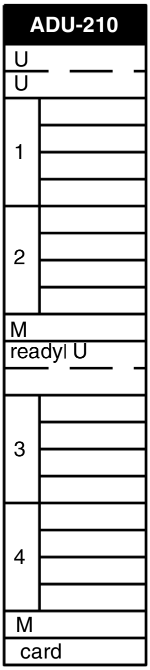
## ADU 210 Isolated Analog Input Module Physical Characteristics

**Illustration**

The ADU 210 can be installed in any slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and peripheral connections on the front. The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided.

A front view with ADU 210 label is provided below.





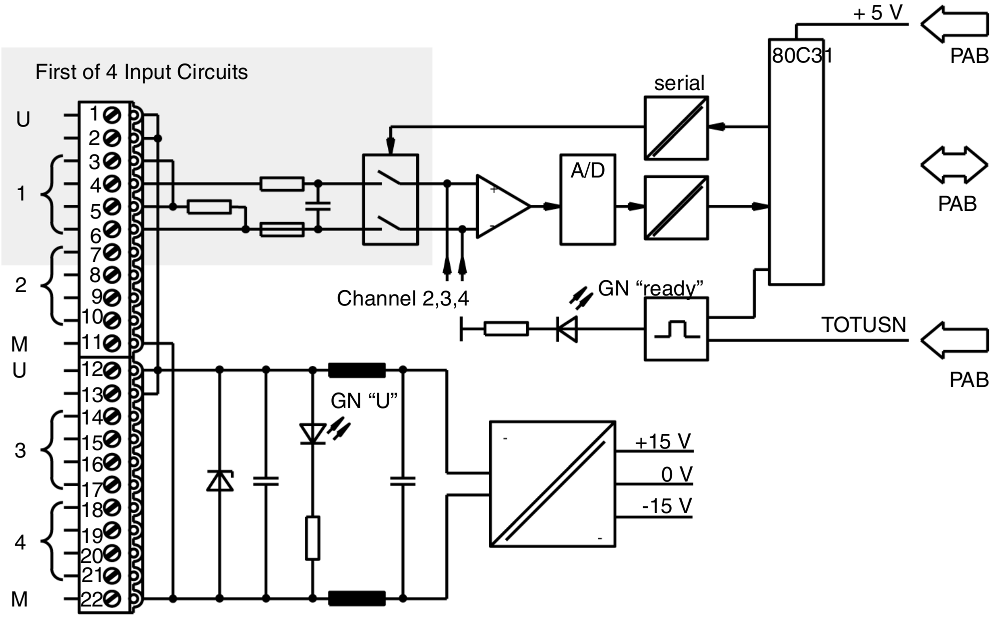
## LEDs

The ADU 210 has two green LEDs.

| LED# | LED Name | Function |
|---|---|---|
| 1 | Power (U) | Pertains to the 24 VDC:<br>ON = Power supply is available<br>OFF = Power supply is NOT available. |
| 12 | Ready | Pertains to the processor operation:<br>ON = Processor operating between the ADU 210 and the PLC without fault<br>OFF = Fault in processor operation |

## Simplified Schematic

A simplified schematic for the ADU 210 is provided below.



## Installing the ADU 210 Isolated Analog Input Module

**Introduction**

The following procedures are necessary when installing the ADU 210:

- Make connections and assign input addresses.
- Map the I/O module as 4-3x input registers.
- Identify the overall mode of operation and type of input.

**Make Connections and Assign Input Addresses**

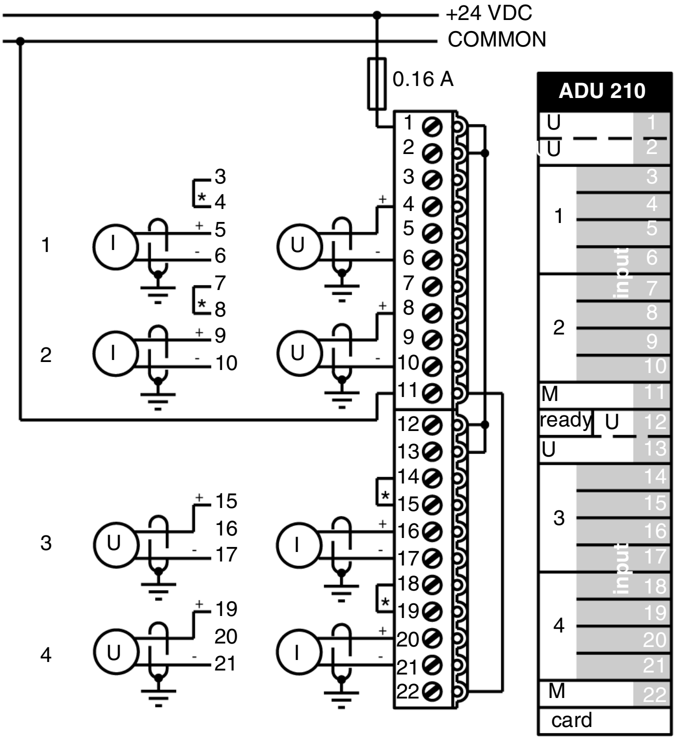
The selection of current (I) or voltage (U) input is determined primarily on the connections and the panel software. However, for the 20mA current range you MUST use the jumpers as noted. Mixed ranges are allowed among the four channels.

The following table outlines jumper placement for a 20 mA current range.

| 20mA Channel Selection | Jumper Placement |
|---|---|
| Input 1 | 3 and 4 |
| Input 2 | 7 and 8 |
| Input 3 | 14 and 15 |
| Input 4 | 18 and 19 |

**Note:** The ADU 210 ships with the four jumpers installed.

**Wiring Diagram** The following illustration is an ADU 210 wiring diagram.



*Apply Jumpers to select 20mA range per channel

## ADU 210 Isolated Analog Input Module Operation

### Introduction

The ADU 210 is a four-channel analog input module. Its field connector is wired depending on the type of input to be measured, either voltage or current. Any of the four inputs can be either voltage or current, and any combination of the four may be used if levels are within the programmed range for the channel.

The module can operate in one of several modes, and the input channel ranges are individually selectable. The mode and ranges are set via the panel software. Channel input data is updated every 270mS. When power is first applied to the module, its inputs are inactive.

### I/O Map

The ADU 210 requires 4-3x input registers. These four registers contain data representative of the individual channel input values.

| I/O Map Registers | Data |
|---|---|
| 3x | Input #1 data |
| 3x + 1 | Input #2 data |
| 3x + 2 | Input #3 data |
| 3x + 3 | Input #4 data |

**Note:** Inputs that are NOT used MUST be set to inactive. This avoids error messages and reduces the conversion time.

## Error Detections and Limits

After system start-up a measured value remains 0, until the ADU 210 is addressed. Next, the ADU 210 displays a parameter error (-32 768) until the value is changed by selecting a valid range. Then the valid range is displayed. Changing the measuring range displays a parameter error (-32 768) in the following cycle, until the valid range is shown after subsequent cycles. It may take up to 300mS maximum.

Input voltages (currents) of up to -1.6% of the rated value in unipolar mode and limiting value 0 result in a digital value (0) without causing an error. When input voltage (currents) fall below this limit an error results and a measured value (-32 767) is displayed.

Negative input voltage (current) in unipolar mode and limiting value -1.6% produce an appropriate digital value (up to -512) without causing an error - up to a input voltage of -1.6% of the rated value. When the measured value falls below this limit an error results and a measured value (-32 767) is displayed.

When measuring ranges with a 20% offset (live-zero) the error limit for value measure underflow is about 10% of the rated value.

When errors occur simultaneously in several inputs the error with the lowest input number is displayed until debugged. Next, the error with the next highest input number is displayed and so on.

When an input error occurs the transferred measured value of that input is set to the defined constants of:

Transferred Measured Values after an Error Detection are listed in the following table.

| **Measured Values** | **Descriptions** |
|---|---|
| -32 768 | Inactive input (invalid measuring range) |
| +32 767 | Measuring range overflow |
| -32 767 | Measuring range underflow |

**Conversions**

The following tables detail the various voltage and current conversions for the ADU 210 module.

**Note:** Brackets denote range with limiting value -1.6%. No brackets denotes range with limiting value 0.

The conversion values of voltage inputs are listed in the following table.

| Analog value 0 ... 5 V | Analog value 0 ... 10V | Analog value 1 ... 5 V | Analog value 2 ... 10 V | Analog value +/-5 V | Analog value +/-10 V | Decimal value | Notes |
|---|---|---|---|---|---|---|---|
| <-0.080 | <-0.16 | <+0.52 | <+1.04 | <-5.12 | <-10.24 | -32 767 | underflow error |
|  |  |  |  | -5.119 ...<br>-5.00 | -10.239...<br>-10.00 | -32 766...<br>-32 001 | overload range |
| -0.08 ...<br>-0.00 | -0.16 ...<br>-0.00 | +0.52 ...<br>+0.936 ...<br>+0.99 | +1.04 ..<br>+1.87 ...<br>+1.99 |  |  | 0 (-3 840)<br>0 (-512)<br>0 (-1) | overload range |
|  |  |  |  | -5.00 | -10.00 | -32 000 | linear |
|  |  |  |  | -2.50 | -5.00 | -16 000 | linear |
|  |  |  |  | -0.50 | -1.00 | -3 200 | linear |
|  |  |  |  | -0.25 | -0.50 | -1 600 | linear |
|  |  |  |  | -0.05 | -0.10 | -320 | linear |
|  |  |  |  | -0.005 | -0.01 | -32 | linear |
|  |  |  |  | -0.0025 | -0.005 | -16 | linear |
| 0 | 0 | 1 | 2 | 0 | 0 | 0 | linear |
| 0.0025 | 0.005 | 1.002 | 2.004 | +0.0025 | +0.005 | +16 | linear |
| 0.005 | 0.01 | 1.004 | 2.008 | +0.005 | +0.01 | +32 | linear |
| 0.05 | 0.10 | 1.04 | 2.08 | +0.05 | +0.10 | +320 | linear |
| 0.25 | 0.50 | 1.20 | 2.40 | +0.25 | +0.50 | +1 600 | linear |
| 0.50 | 1.00 | 1.40 | 2.80 | +0.50 | +1.00 | +3 200 | linear |
| 2.50 | 5.00 | 3.00 | 6.00 | +2.50 | +5.00 | +16 000 | linear |
| 5.00 | 10.00 | 5.00 | 10.00 | +5.00 | +10.00 | +32 000 | rated value |
| 5.000...<br>5.119 | 10.000...<br>10.239 | 5.00...<br>5.09 | 10.00...<br>10.19 | +5.000..<br>+5.119 | +10.00...<br>+10.239 | +32 001...<br>+32 766 | overload range |
| >5.12 | >10.24 | >5.09 | >10.19 | >+5.20 | >+10.24 | >+32  767 | overflow error |

The conversion values of current inputs are listed in the following table.

| **Analog value 0 ... 20 mA** | **Analog value 4 ... 20 mA** | **Analog value +/-20 mA** | **Decimal value** | **Notes** |
|---|---|---|---|---|
| <-0.32 | <+2.08 | <-20.479 | -32 767 | underflow error |
| | | -20.478 ...<br>-20.000 | -32 766 ...<br>-32 001 | overload range |
| -0.32 ...<br>-0.00 | +2.08 ...<br>+3.74 ...<br>+3.99 | | 0 (-3 840)<br>0 (-512)<br>0 (-1) | overload range |
| | | -20.00 | -32 000 | linear |
| | | -10.00 | -16 000 | linear |
| | | -2.00 | -3 200 | linear |
| | | -1.00 | -1 600 | linear |
| | | -0.20 | -320 | linear |
| | | -0.02 | -32 | linear |
| | | -0.01 | -16 | linear |
| 0 | +4 | 0 | 0 | linear |
| +0.01 | +4.008 | +0.01 | +16 | linear |
| +0.02 | +4.016 | +0.02 | +32 | linear |
| +0.20 | +4.16 | +0.20 | +320 | linear |
| +1.00 | +4.80 | +1.00 | +1 600 | linear |
| +2.00 | +5.60 | +2.00 | +3 200 | linear |
| +10.00 | +12.00 | +10.00 | +16 000 | linear |
| +20.00 | +20.00 | +20.00 | +32 000 | rated value |
| +20.000 ...<br>+20.478 | +20.00 ...<br>+20.38 | +20.000 ...<br>+20.478 | +32 001 ...<br>+32 766 | overload range |
| >+20.479 | >+20.38 | >+20.479 | >+32 767 | overflow error |

## ADU 210 Isolated Analog Input Module Specifications

**Table of Specifications**

The following table contains a list of specifications for the ADU 210 module.

| | | |
|---|---|---|
| Module Topology | Number of channels | 4 |
| | Data Format | Unipolar and Bipolar as voltage or current inputs |
| | Isolation channel to channel | 300 Vdc maximum |
| | Isolation channel to bus | 500 Vac maximum |
| Power Supply | Internal Source (from I/O bus) | 5 VIO; 90mA maximum, 40mA typical |
| | External | 24 Vdc; 120 mA maximum, 60 mA typical |
| | Power Dissipation | 3Ω maximum, 2Ω typical |
| I/O Map | Register 3x/4x | 4 in/0 out |
| Voltage Inputs | Linear Measuring Range | Unipolar: 1 ... 5V, 0 ... 5V, 2 ... 10V, 0 ... 10V<br>Bipolar: +/-5V, +/-10V, |
| | Input Impedance | ≥ 1 M ohms |
| | Resolution | *Brief Product Description, p. 76* |
| | Absolute accuracy error @ 25 degrees C | Maximum 0.1% of full scale |
| | Absolute accuracy error @ 60 degrees C | Maximum 0.25% of full scale |
| | Typical accuracy error | ≤0.5 of above maximum error |
| | Maximum overvoltage | +/-30 V static (1 input for each module)<br>+/-50 V dynamic for max. 100 ms |
| | Conversion values | *ADU 210 Isolated Analog Input Module Operation, p. 81* |
| Current Inputs | Linear Measuring Range | +/-20 mA (+/- 5 V),<br>0 ... 20mA (0 ... 5 V),<br>4 ... 20 mA (1 ... 5 V) |
| | Input Impedance | 250 ohms |
| | Resolution | *Brief Product Description, p. 76* |
| | Absolute accuracy error @ 25 degrees C | Maximum 0.1% of full scale |
| | Absolute accuracy error @ 60 degrees C | Maximum 0.25% of full scale |
| | Typical accuracy error | 0.5 of above maximum error |

| | | |
|---|---|---|
| | Critical values | 48 mA, maximum overvoltage from 12 V |
| | Conversion values | *ADU 210 Isolated Analog Input Module Operation, p. 81* |
| Dynamic Characteristics of Inputs | Conversion time for all inputs | 270 mS maximum |
| | Time constant for HF suppression | 0.4 mS typical |
| | Interference voltage suppression (main suppression) for f=nx50 or 60Hz | n=1,2 ... |
| | Common-mode rejection | ≥105 dB |
| Processor/ Memory | Processor Type | Intel 80C31 (8-bit) |
| | Memory | 32 kByte EPROM for firmware |
| Physical Characteristics | Format | 1 slot |
| | Dimensions (W x H x D) | 40.3 x 145 x 117.5 mm<br>1.6 x 5.6 x 4.5 in |
| | Weight | 320 g, 0.710 lb. |
| | Wire Size | 1-14 AWG, 2-20 AWG |
| Environmental Characteristics | Operating Temperature | 0 ... 60 degrees C |
| | Agency Approvals | VDE 0160; UL 508; CSA 22.2 No.142; and European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 857*) Standards |

# Overview of the ADU 211/212 Universal Analog Input Module

# 6

## At a Glance

**Purpose**

The purpose of this chapter is to describe the ADU 211/212 universal analog input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the ADU 211/212 Universal Analog Input Module?

### Brief Product Description

**Note:** Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft. Refer to *Installing the Loadables for A120 Series I/O Modules, p. 869*

The ADU 211/212 Universal Analog Input Module is a highly versatile module that digitizes up to eight analog inputs into a Modicon Compact 984 or Micro PLC (programmable logic controller). The module accepts thermocouple, RTD (resistance temperature device), voltage, and current loop inputs, and (through automatic channel sequencing or ladder logic) provides these inputs to the PLC using only three 30XXX registers. Commands to the module are processed through three 40XXX registers.

**⚠ CAUTION**

**Note difference between ADU 211 and ADU 212.**

The difference between the ADU 211 and the ADU 212 is how they are powered. The ADU 211 requires a external 24 Vdc power supply and draws less than1 mA from the internal +5 Vdc. In contrast, the ADU 212 only draws power from the internal +5 Vdc (450 mA typical, 600 mA maximum) and does not require an external power supply.

**Failure to follow this instruction can result in injury or equipment damage.**

**Note:** For application specific concerns refer to *ADU 211/212 Universal Analog Input Module Application Notes, p. 105*

## ADU 211/212 Universal Analog Input Module "J" Thermocouple Quick Start

### Introduction

This section is provided as a reference **only** for users who are familiar with the ADU 211/212 module. Until you have become completely familiar with the ADU 211/212 module, do **not** try to follow these steps.

**Note:** For application specific concerns, refer to *ADU 211/212 Universal Analog Input Module Application Notes, p. 105*

### Procedure for "J" Thermocouple Quick Start

The following table describes the procedure for "J" Thermocouple Quick Start

| Step | Action |
|---|---|
| 1 | Ensure that DIP switch poles 1, 3, and 9 (both top and bottom DIP switches) are turned ON (closed), while the others are turned OFF (open). This step configures the module for thermocouple inputs. |
| 2 | Attach a "J"-type thermocouple to the field wiring terminal block: connect the thermocouple white wire (+) to Terminal 2 and the red wire (-) to Terminal 3. |
| 3 | Install the ADU 211/212 in the rack. +24 VDC power and common need to be connected on the ADU 211. |
| 4 | I/O map the module slot as 30001-30003 and 40001-40003 BIN. |
| 5 | With the controller in RUN mode, in the panel software reference screen, configure the Control Words as follows:<br>● 40001 = 1660 HEX (degrees F display of "J" Thermocouple)<br>● 40002 = 0F6A HEX (internal cold junction compensation, 100 ms integration time and Floating Point data format) |
| 6 | Display 30001 in Floating Point format and 30003 hex. The Registers should appear as:<br>● 30001 = Room temperature in degrees F<br>● 30003 = 8000 HEX, indicating valid data on Channel 1 |

## ADU 211/212 Universal Analog Input Module Inputs

**Introduction**

Built into the module's firmware are automatic calibration, linearization of thermocouple and RTD inputs, and internal diagnostic tests.

**Channels**

The module provides two groups of four isolated input channels. Each group can be configured independently for:

- 100 ohms Platinum RTDs, 385 or 392 alpha
- Type J, K, T, E, R, S, or B thermocouples (ungrounded type)
- +/-0.050, 0.5, 2, 5, or 10 VDC inputs
- 4-20 or +/-20 mA current loops

**Formats**

The module can provide data to the PLC in these formats:

- 12-bit (0 to 4095)
- signed 15-bit (-32768 to +32767)
- unsigned 16-bit (0 to 65535)
- IEEE 754 floating point

## ADU 211/212 Universal Analog Input Module Installation

**Before You Install the Module**

Before installing the ADU 211/212 module, you should:

- Set the DIP switches to correspond to your application.
- Field wire the module’s terminal block for your application.

**Note:** For application-specific concerns refer to *ADU 211/212 Universal Analog Input Module Application Notes, p. 105*

## ADU 211/212 Universal Analog Input Module Switch Settings

**Introduction**

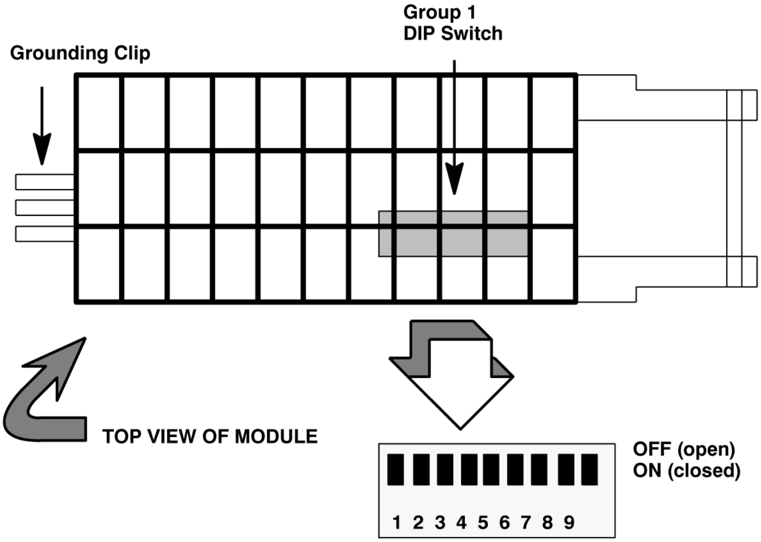
Before installing the ADU 211/212 module, you should:

- Set the DIP switches to correspond to your application.
- Field wire the module's terminal block for your application.

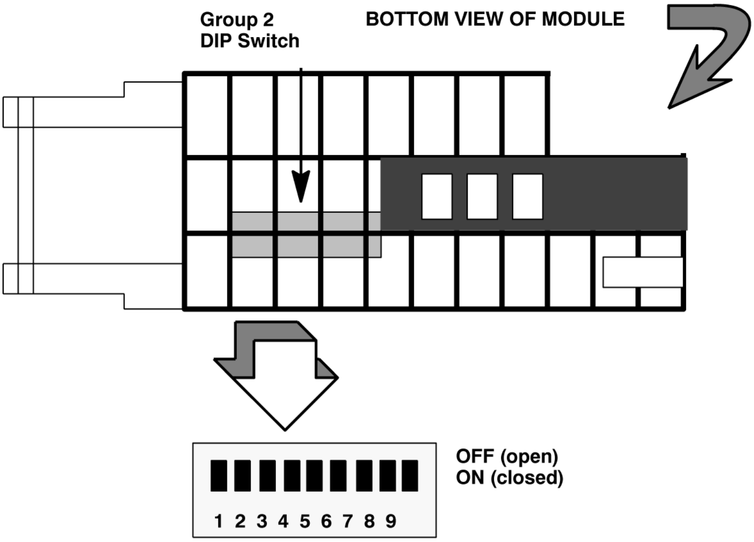
## Setting the DIP Switches

Prepare the ADU 211/212 for operation by setting the DIP switches on the top and bottom of the module. In general, the switches on the top of the module configure Group 1, and the switches on the bottom of the module configure Group 2. See the following illustrations and tables for DIP switch locations and settings.

A top view of the module -- the Group 1 DIP switch location -- is provided below.



A bottom view of the module -- the Group 2 DIP switch location -- is provided below.



## DIP Switch Settings

DIP switch settings for Groups 1 and 2 are listed in the following table.

| For this type of application... | | Turn these DIP switch poles ON (ON = closed) |
|---|---|---|
| Thermocouple | with internal CJC | 1, 3, and 9 only |
| | with external CJC* | 1, 9 and see table below |
| Voltage | +/-0.05, 0.5, 2.0, or 5.0 VDC | 1, 3, and 9 only |
| | +/-10.0 VDC | 1 and 3 only |
| Current | | 1, 3, and 5 through 9** |
| RTD | | 2, 4, and 9 only |
| * You need external CJC (cold junction compensation) only if the ADU 211 will be operating under extreme temperatures.<br>** If you want to use your own current shunts (instead of the internal shunts provided), see the table provided for that purpose later in this section. | | |

DIP switch settings for external CJC* are listed in the following table.

| For external CJC on this Group... | Turn this DIP switch pole ON... ON = closed | And turn these DIP switch poles OFF OFF = open |
|---|---|---|
| Group 1 | 4 on bottom | 3 and 4 on top, and 3 on bottom |
| Group 2 | 4 on top | 3 on top, and 3 and 4 on bottom |
| * If external CJC is needed, these settings for DIP switch poles 3 and 4 (only) take precedence. This is the only time when DIP switch settings for one group affect the other | | |

**Note:** Only one Group may be configured with external Cold Junction Compensation (CJC). If external CJC is needed with both groups (e.g., when thermocouples are used with both groups), configure Group 1 for external CJC. The module will use the external CJC value from Group1 for both groups of thermocouples. See the Field Wiring examples for more information.

Set the DIP switches as follows to disable the internal 250 ohm shunts.

| | To disable the shunt on this channel... | Turn this DIP switch pole OFF. OFF = open |
|---|---|---|
| Group 1 DIP switch: | 1 | 8 |
| | 2 | 7 |
| | 3 | 6 |
| | 4 | 5 |
| Group 2 DIP switch: | 5 | 8 |
| | 6 | 7 |
| | 7 | 6 |
| | 8 | 5 |

**Note:** For current applications, you should enable the internal 250 ohm current shunts, unless you want to connect your own.

## ADU 211/212 Universal Analog Input Module Field Wiring

**Introduction**

Before installing the ADU 211/212 module, you should:

- Set the DIP switches to correspond to your application.
- Field wire the module's terminal block for your application.

**Field Wiring**

**⚠ WARNING**

**Possible Injury Hazard**

When in hazardous location, turn off power before replacing or wiring modules.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

Power, input, and output (I/O) wiring must be in accordance with Class 1, Division 2, wiring methods [Article 501-4 (b) of the National Electrical Code, NFPA 70] and accordance with the authority having jurisdiction.

For field wiring, use shielded, twisted-pair cable (such as Belden 9418 for voltage and current applications), and ground each cable's shield wire at one end only. At the opposite end of each cable, tape the exposed shield wire to insulate it from electrical contact. A good shield wire ground is a rack assembly mounting bolt or stud.

When wiring the terminal block, keep the length of the unshielded hookup wires as short as possible. Use 60/75 copper (Cu) for the power connections and 4.5 in-lb of torque for the set screws. See the table below for the terminal block assignments.

**Note:** The ADU 211 requires power from an external 24 Vdc source to operate. The ADU 212 draws power from the A120 rack's +5 Vdc internal supply. Ensure that 450 mA of rack power is available for the ADU 212.

**Note:** The ADU 212 draws power from the A120 rack's +5 Vdc internal supply. Ensure that 450 mA of rack power is available for the ADU 212.

**Note:** For application specific concerns refer to the *ADU 211/212 Universal Analog Input Module Application Notes, p. 105*

For an unused channel, you should short the unused channel's terminals (that is, run a wire from the channel's + terminal to the channel's - terminal).

## ⚠ CAUTION

**Connection Hazard**

If during installation you hear a high pitched audible sound, ensure that power and ground are properly wired.

**Failure to follow this instruction can result in injury or equipment damage.**

When configured for RTD operation, only one two-wire, three-wire, or four-wire RTD is allowed per group. Connect the sense lines to Channel 1 (for Group 1) or Channel 5 (for Group 2) only. Leave the other channels unconnected.

For a four-wire RTD (the most accurate), the excitation line resistance should never exceed 40 ohms. For a three-wire RTD (the next most accurate), the excitation line resistance should never exceed 20 ohms. For a two-wire RTD (the least accurate), the excitation line resistance should be kept as low as possible.

**Note:** For thermocouple wiring, the U.S. convention is to use red wire for negative, so when connecting thermocouples, always check the manufacturer's color-coding tables.

After wiring the module, route all signal wires as far as possible from potential sources of electrical noise, such as motors, transformers, contactors, etc., (especially ac devices). As a general rule, allow 15.2 cm (6 in) of separation for every 120 V of power. Signal wires must never share the same conduit with ac wiring. Also, when you must route signal wires past ac wiring, do so at right angles.

The following table lists the ADU 211/212 terminal block assignments.

| Group | Terminal | Channel | Function |
|---|---|---|---|
| One* | 1 | | +24 Vdc External Power (required for the ADU 211): No connection (for the ADU 212) |
| | 2 | 1 | TC, Voltage, Cur rent, or RTD Sense + |
| | 3 | | Channel 1 Common or RTD Sense - |
| | 4 | 2 | TC, Voltage, or Current + |
| | 5 | | Channel 2 Common |
| | 6 | 4 | TC, Voltage, or Current + |
| | 7 | | Channel 3 Common |
| | 8 | 4 | TC, Voltage, or Current + |
| | 9 | | Channel 4 Common |
| | 10 | | Open TC circuit detection or RTD 200 micro A Ex citation + |
| | 11 | | External CJC Thermistor or RTD Excitation - |
| Two* | 12 | | 24 VDC Common required for the ADU 211; no connection for the ADU 212 |
| | 13 | 5 | TC, Voltage, Cur rent, or RTD Sense + |
| | 14 | | Channel 5 Common or RTD Sense - |
| | 15 | 6 | TC, Voltage, or Current + |
| | 16 | | Channel 6 Common |
| | 17 | 7 | TC, Voltage, or Current + |
| | 18 | | Channel 7 Common |
| | 19 | 8 | TC, Voltage, or Current + |
| | 20 | | Channel 8 Common |
| | 21 | | Open TC circuit detection or RTD 200 micro A Ex citation + |
| | 22 | | External CJC Thermistor or RTD Excitation - |
| * Signal types may not be mixed within a group. | | | |

## ADU 211/212 Universal Analog Input Module LEDs

The ADU 211/212 module has two front-panel LEDs (light-emitting diodes). When ON, the **Amber** LED signifies that the module is powered-up and has passed power-up diagnostics, and the **Green** LED signifies that the module has established communication with the PLC and is ready to run. More information on the LEDs is provided in *ADU 211/212 Universal Analog Input Module Troubleshooting, p. 128*

## ADU 211/212 Universal Analog Input Module Field Wiring Examples

### Cautions and Warnings

⚠ **CAUTION**

**Unit Failure Hazard**

Do not run PLC without power applied to the ADU 211.

**Failure to follow this instruction can result in injury or equipment damage.**

⚠ **WARNING**

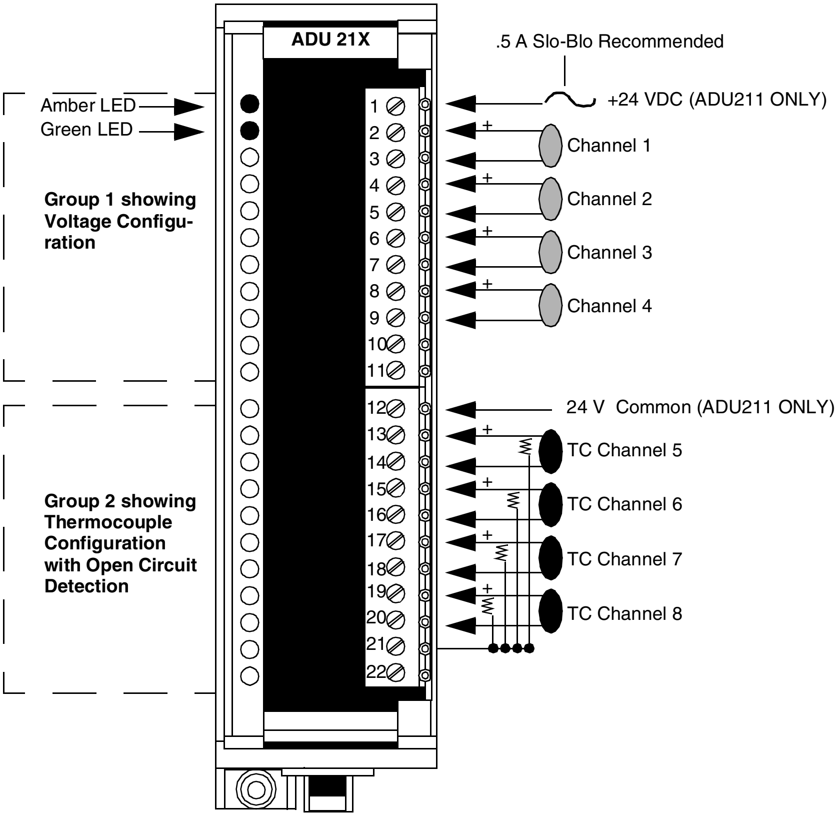
**Unit Wear Hazard**

It is not recommended to leave unpowered modules in the rack.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

## Voltage and Thermocouple Combination

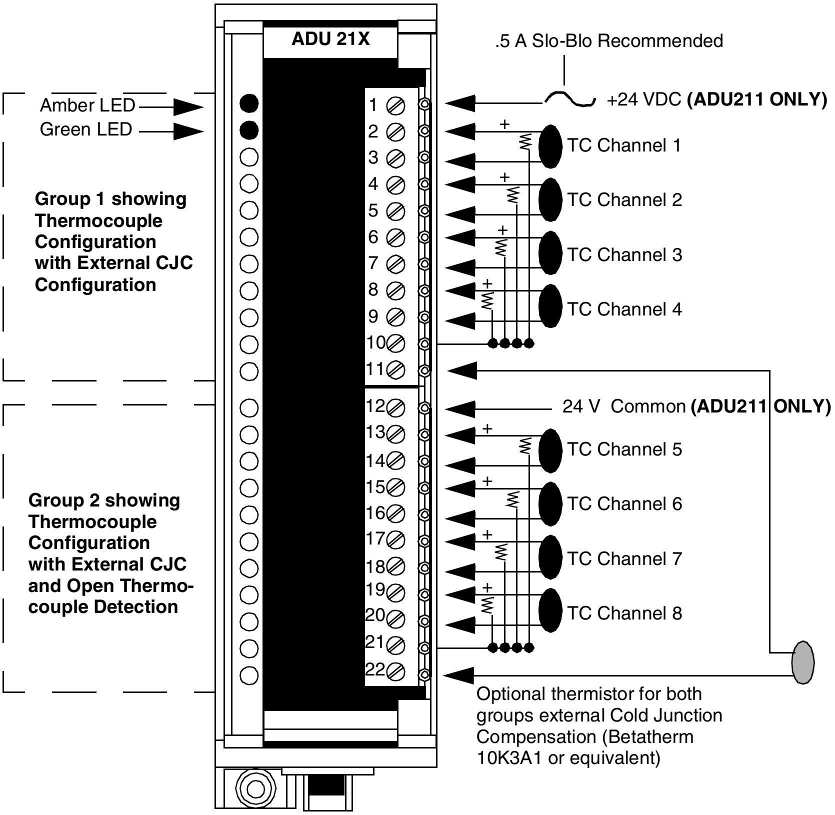
The following figure shows Group 1 configured for voltage and Group 2 configured for thermocouple inputs.



**NOTE:** To detect an open thermocouple (TC) circuit, connect Terminal 10 (if Group 1) or Terminal 21 (if Group 2) to any TC+ channel. To detect individual open circuits, add 22-47 M· to each + side.

## Two Groups of Thermocouples with External CJC

The following illustration shows the module wired for thermocouples on both groups and external Cold Junction Compensation (CJC).



**NOTE:** To detect an individual open thermocouple (TC) circuit, connect Terminal 10 (if Group 1) or Terminal 21 (if Group 2) to any TC + channel. To detect individual open circuits, add 22-47 M· to each + side.

All thermocouples require CJC to work correctly. (RTDs do not require CJC.) In the ADU 211/212, CJC can be performed by the module internally. However, if the ADU 211/212 will be operating under extreme temperatures, or if remote sensing is needed, an external thermistor (a Betatherm 10K3A or equivalent) can be connected as shown to improve CJC accuracy. This external thermistor provides CJC for both Groups 1 and 2.

When using external CJC with two groups of thermocouples, you should set bits 11 and 12 of Control Word 40XXX+1 to 1 (see ADU 211/212 Universal Analog Input Module Switch Settings for more information on proper CJC configuration).

**Note:** The ADU 211/212 is a differential analog input module and, for most applications, this is the best operation mode for reasons of signal accuracy and noise reduction, but in some cases it maybe desirable to have single ended (common ground) operation for either one or both groups of channels to share a common ground.

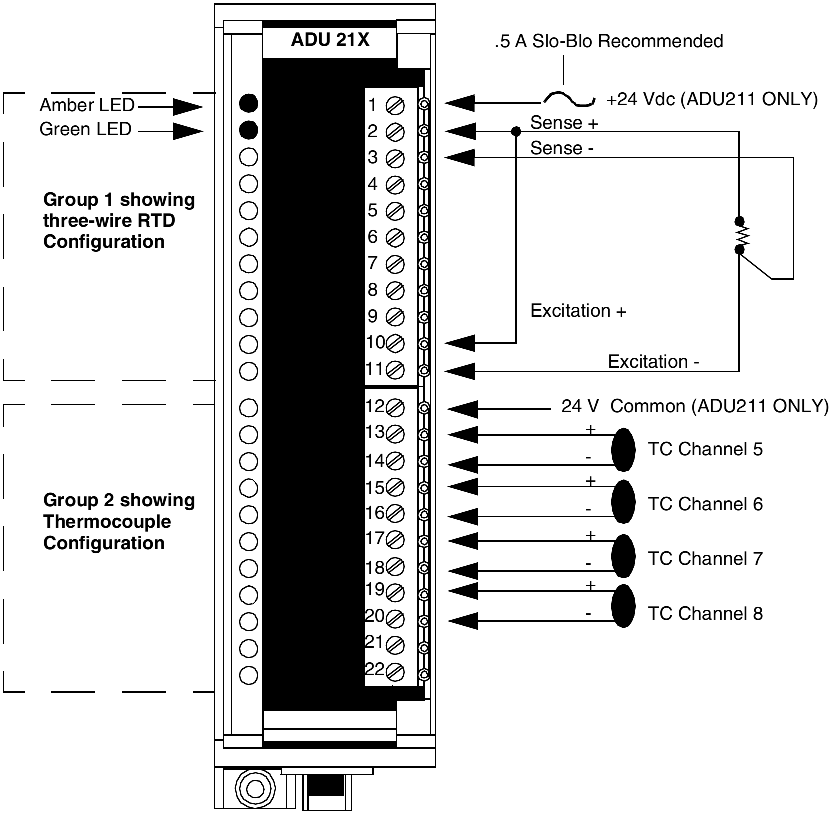
To set up the module to a single-ended mode for a group, voltage or current:

- Leave all of the signal connections for the group open (TB 1 ... 3, 5, 7 and 9 for Group 1 or TB 1 ... 14, 16, 18 and 20 for Group 2).
- Open DIP switch 1 for the group (this floats the channel analog grounds).
- Close DIP switch 4 for the group (this places an analog module ground at TB 1 ... 11 or TB 1 ... 22).
- Connect the group signal common ground to TB 1 ... 11 for group 1 or TB 1 ... 22 for Group 2.

It is recommended that the entire module be utilized in either differential or single ended mode (common ground mode).

## Three-wire RTD and Thermocouple Combination

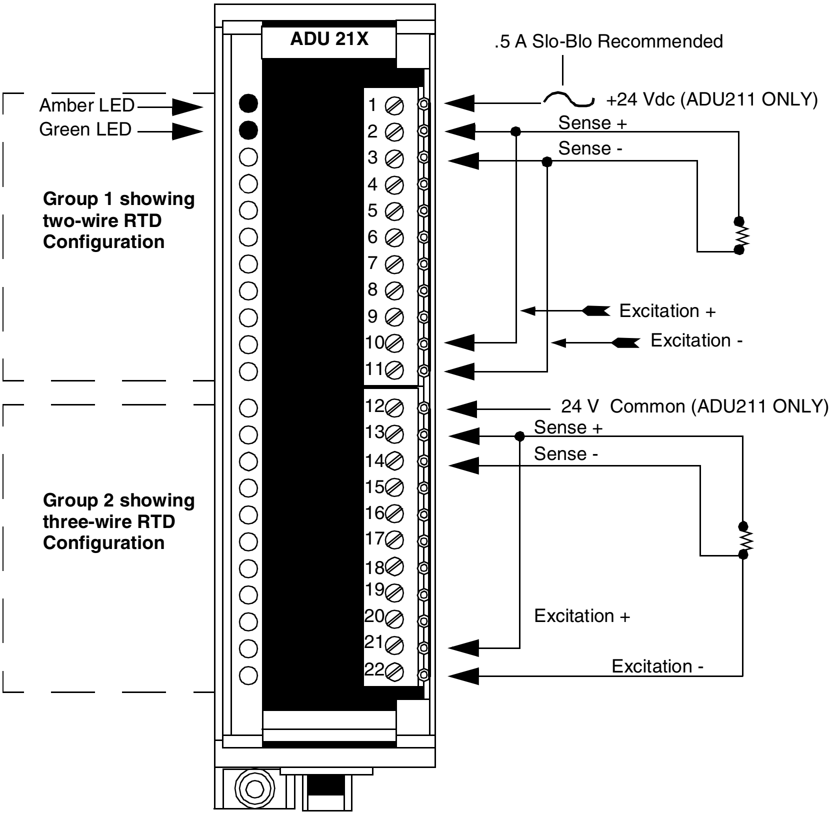
The following illustration shows a three-wire RTD configuration for Group 1 and a thermocouple configuration for Group 2.



In this illustration, the RTD excitation current is sourced from Terminal 11 (Terminal 22 is used if Group 2 is configured for RTDs). For thermocouple configurations, the module can detect open thermocouple circuits with the addition of external pull-up resistors.

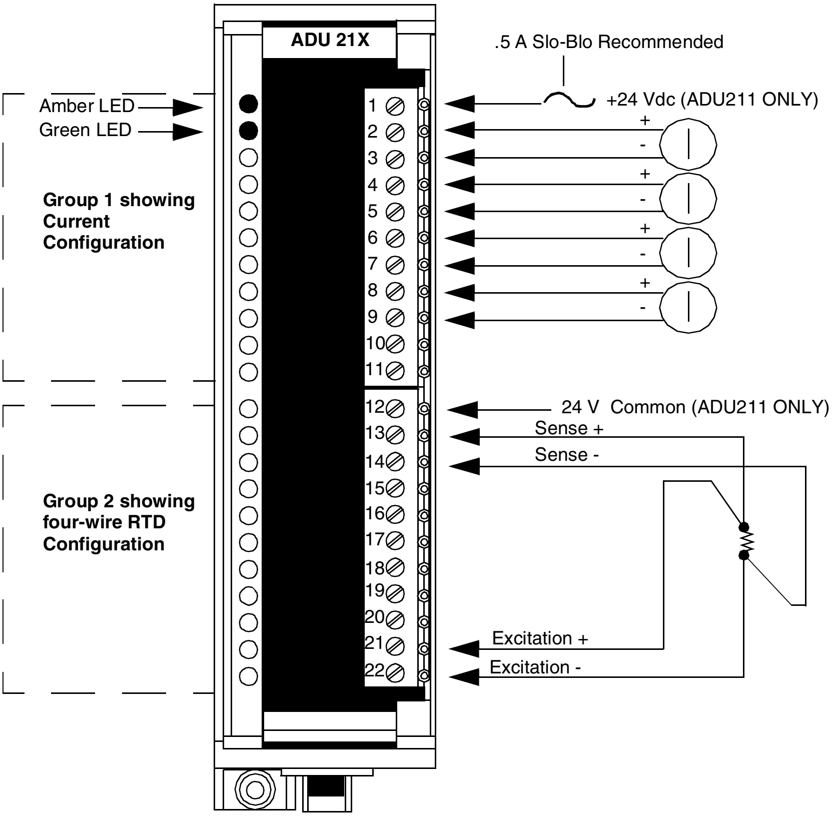
### Two- and Three-wire Combination

The following illustration shows the ADU 211/212 wired for two-wire RTD operation in Group 1 and three-wire RTD operation in Group 2.



### Current and Four-wire RTD Combination

The following illustration shows the ADU 211/212 wired for current in Group 1 and four-wire RTD operation in Group 2.



# ADU 211/212 Universal Analog Input Module Application Notes

**Introduction**

This section contains application notes and usage recommendations in the following categories:

- General
- Current and Voltage Ranges
- RTD Ranges
- Thermocouple Ranges

**General**

- Power the ADU 211/212 module from the same 24 Vdc power supply as the PLC, the unit has an approximate 2 times nominal (4 VA maximum) inrush current for approximately 10 ms during power up.
- Do not leave the module unpowered in the PLC rack.
- Ensure the SVI.DAT DX loadable is installed and is the latest revision.
- Do not install or remove the module when the rack or module is powered.
- Use the on line help file for reference in the configuration screen by using <ALT H>.
- Ensure correct units of measure are selected for temperature, e.g. degrees C or degrees F.  This configures all eight channels.
- Use the highest integration setting possible for your application, this ensures the most stable and accurate readings.

The following table lists integration time settings.

| **For operation at:** | **50 Hz** | **60 Hz** |
|---|---|---|
| Set integration time to: | 40 ms | 33.3 ms |
| | 60 ms | 50 ms |
| | 100 ms | 100 ms |
| | 200 ms | 200 ms |
| NOTE: Integration rates of less than 33.3 ms are not recommended. | | |

- An asterisk in the rack ID indicates that the module is not correctly identified to the PLC; check DX loadable and module power.
- A flashing green RUN LED means the module has not established communications with the PLC.
- The signal inputs are optical/magnetic isolated from rack 500 V 25 micro A maximum at 60 Hz.
- Channel to channel isolation is +/- 30 V at 68 dB typical.
- For unused voltage, current or thermocouple channels, short the positive to negative terminals.  For unused RTD channels, short the sense negative to sense positive terminals.
- Field wiring blocks are not interchangeable due to power and ground, employ keys.
- Observe good field wiring shield termination, typically only at the module end.
- In the temperature mode only, allow a warmup time of up to 10 minutes.  During warmup temperature readings from 0 to 10 degrees above actual thermocouple readings may be seen.

### Current and Voltage Ranges

- The ADU 211/212 module normally operates in a pseudo-differential mode. However, for some voltage sensing applications it may be preferred to configure for common ground. To set this mode of operation:
  - open DIP SW1 for the group (this floats differential ground)
  - close DIP SW4 for the group (this supplies a ground to TB1-11 for group 1 or TB1-22 for group 2)
  - connect all signal commons (grounds) to TB1-11 for group 1 or to TB1-22 for group 2
- As protection to the ADU 21X the module uses an active signal clamp that engages when signal levels are 3-12.5 Vdc or . +12.5 Vdc. Resistance between input terminals will decrease as voltage levels increase in magnitude.
- To reduce the effects of noise on field wiring, external capacitance may be added to the terminal block. A good capacitor for starters would be a 0.1 micro F 50 ... 100 V disc capacitor.
- Use high quality 100 percent shielded twisted-pair field wiring, Belden 8760 or equal.

### Resistance Temperature Detector (RTD) Range

- Ensure that the format type is correctly selected, e.g. 2/4 or 3 wire mode.
- Ensure the total excitation lead resistance is under 10 ohms, in 3 and 4 wire modes.
- Use high quality 100 percent shielded field wiring.
- The 250 ohms internal current shut resistors maybe used to test or simulate a 400 degrees C 392 alpha.
- RTD excitation current is -200 micro A typical, be aware of RTD self heating.
- The RTD and field wiring should be isolated and floating from system grounds, etc.

### Thermocouple Range

- Ensure the thermocouple type is correctly selected and that CJC is enabled.
- Verify thermocouple color coding and terminal block connections, because some thermocouples use red for the negative lead.
- The 250 ohms internal current shut resistors maybe used to simulate a short thermocouple thus yielding CJC/ambient rack temperature.
- Use isolated and shielded thermocouples whenever possible. The shield maybe connected to the thermocouples negative lead.
- Only use thermocouple extension grade wire because other choices may introduce additional thermocouple junctions.
- When possible, use a suitable thermocouple bead forming machine to weld the thermocouple wire.
- Total system accuracy = Thermocouple A/D conversion accuracy + Cold Junction Compensation (CJC) accuracy + thermocouple accuracy (available from the thermocouple manufacturer). The thermocouple A/D conversion accuracy and CJC accuracy specifications are in the last section of this chapter.

  **Example** - For a Type J thermocouple with +/- 0.5 C accuracy, the total system accuracy with internal CJC is:

  A/D conversion accuracy (Type J)    +/-1.5 degrees C (+/-2.7 degrees F)  
  + CJC accuracy    +/-1.7 degrees C (+/-3.0 degrees F)  
  + Thermocouple accuracy    +/-0.5 degrees C (+/-0.9 degrees F)  
  ______________________________________________________  
  Total system accuracy    +/-3.7 degrees C (+/-6.6 degrees F)
- For more than one thermocouple open detection circuit, external 22 M ohms ... 47 M ohms resistors must be used.
- Open thermocouple wiring without open circuit detection resistors will read large over-range or under-range values due to the high input impedance of the ADU 21X. Open thermocouple wiring with open circuit detection resistors will yield a high positive reading.
- The ADU 211/212 requires a warm-up period of about 10 minutes for readings to stabilize. Extreme variations in ambient temperature over short time causes module readings to drift as much as 10 degrees C.
- Ensure correct units are selected for modes of temperature, e.g. degrees C or degrees F.
- Do not select different temperature units for each channel or group, all channels must be either degrees C or degrees F.

## ADU 211/212 Universal Analog Input Module Configuration

**Introduction**

The ADU 211/212 uses three 4x output registers and three 3x input registers, I/O mapped as binary (BIN) data.

You can call up the built-in help screens at any time by highlighting "ADU 211" and then pressing <ALT><H> for more information about the module. Both the ADU 211 and ADU 212 are I/O mapped as an "ADU 211" module.

**Note:** For application-specific concerns refer to the *ADU 211/212 Universal Analog Input Module Application Notes, p. 105*

## ADU 211/212 Universal Analog Input Module Output Registers

### Introduction

The output registers control how the ADU 211/212 operates.

The output registers for the ADU 211/212 are:

| Register | Function |
|---|---|
| 4x | Control Word |
| 4x + 1 | Control Word |
| 4x + 2 | Reserved for Future Use (do not use in user logic) |

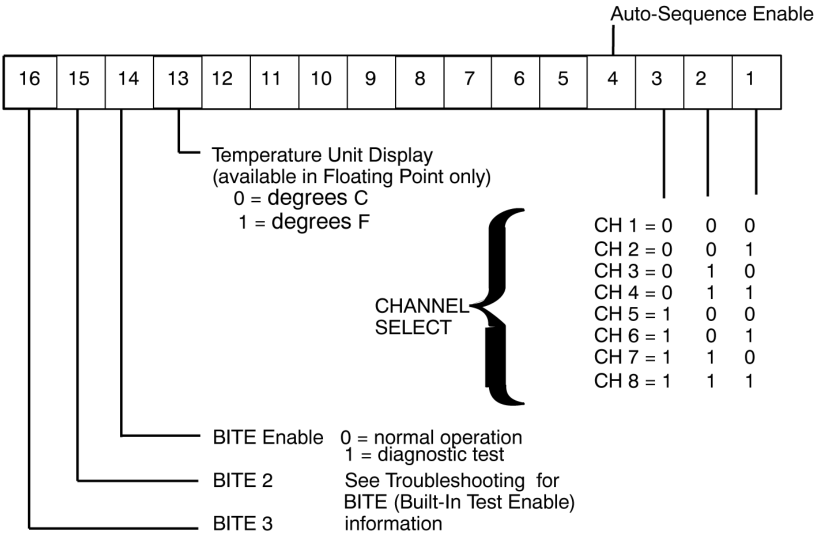
### Control Word

Register 4x is the control word. It is used to:

- Select the type of field device to be used in each of the terminal block groups.
- Manually set the input channel to be displayed or enable auto-sequencing through all channels at a fixed interval.
- Select either Fahrenheit or Centigrade display.
- Enable the built-in test functions.

Control Word 4x is defined in the illustrations that follow.

The following figure illustrates Control Word 4x: Bits 1 ... 4 and 13 ... 16.



**Channel Select (Bits 1 ... 3)**

These bits manually select the channel to be displayed in input registers 3x and 3x + 1. If auto-sequence is enabled (bit 4 = 1), it overrides these bit settings. When the auto-sequence bit is released (bit 4 = 0), the module returns to manual operation.

**Note:** For RTD applications, use only the data provided by Channel 1 (for Group 1) or Channel 5 (for Group 2); the module will use the other channels for its own calculations.

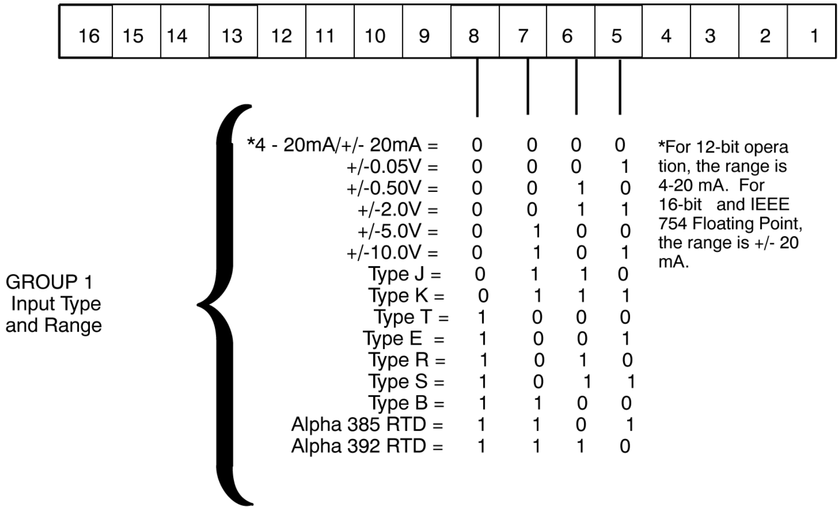
**Auto-Sequence Enable (Bit 4)**

This bit instructs the ADU 211/212 to automatically scan the input channels and present the data to the PLC at fixed intervals. When enabled (1), the module controls the active channel bits (bits 1 ... 3) of input register 3x + 2.

**Temperature Unit Display (Bit 13)**

If this bit is turned OFF (= 0), TC and RTD inputs will be displayed in degrees Centigrade. If this bit is turned ON (= 1), temperature data will be displayed in degrees Fahrenheit. Temperature data can be displayed in any data format, but it can only be displayed in degrees C or degrees F when in IEEE 754 floating point mode.

The following illustration shows the control word 4x: bits 5 ... 8.



GROUP 1 Input Type and Range

| | | | | |
|---|---|---|---|---|
| *4 - 20mA/+/- 20mA = | 0 | 0 | 0 | 0 |
| +/-0.05V = | 0 | 0 | 0 | 1 |
| +/-0.50V = | 0 | 0 | 1 | 0 |
| +/-2.0V = | 0 | 0 | 1 | 1 |
| +/-5.0V = | 0 | 1 | 0 | 0 |
| +/-10.0V = | 0 | 1 | 0 | 1 |
| Type J = | 0 | 1 | 1 | 0 |
| Type K = | 0 | 1 | 1 | 1 |
| Type T = | 1 | 0 | 0 | 0 |
| Type E = | 1 | 0 | 0 | 1 |
| Type R = | 1 | 0 | 1 | 0 |
| Type S = | 1 | 0 | 1 | 1 |
| Type B = | 1 | 1 | 0 | 0 |
| Alpha 385 RTD = | 1 | 1 | 0 | 1 |
| Alpha 392 RTD = | 1 | 1 | 1 | 0 |

*For 12-bit opera tion, the range is 4-20 mA. For 16-bit and IEEE 754 Floating Point, the range is +/- 20 mA.

The following illustration shows the control word 40XXX: bits 9 ... 12.

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

| | | | | |
|---|---|---|---|---|
| *4 - 20mA/+/- 20mA = | 0 | 0 | 0 | 0 |
| +/-0.05V = | 0 | 0 | 0 | 1 |
| +/-0.50V = | 0 | 0 | 1 | 0 |
| +/-2.0V = | 0 | 0 | 1 | 1 |
| +/-5.0V = | 0 | 1 | 0 | 0 |
| +/-10.0V = | 0 | 1 | 0 | 1 |
| Type J = | 0 | 1 | 1 | 0 |
| Type K = | 0 | 1 | 1 | 1 |
| Type T = | 1 | 0 | 0 | 0 |
| Type E = | 1 | 0 | 0 | 1 |
| Type R = | 1 | 0 | 1 | 0 |
| Type S = | 1 | 0 | 1 | 1 |
| Type B = | 1 | 1 | 0 | 0 |
| Alpha 385 RTD = | 1 | 1 | 0 | 1 |
| Alpha 392 RTD = | 1 | 1 | 1 | 0 |

*For 12-bit operation, the range is 4-20 mA. For 16-bit and IEEE 754 Floating Point, the range is +/- 20 mA.

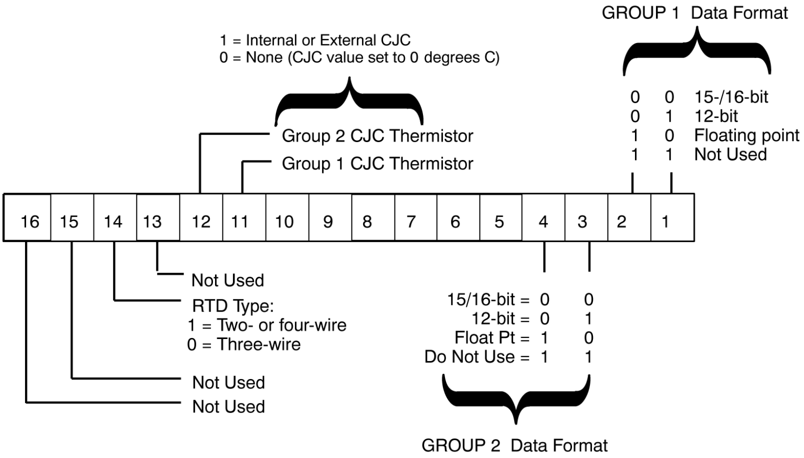
GROUP 2
Input Type
and Range

**Input Type and Range Select (Bits 5 ... 8, Group 1; Bits 9 ... 12, Group 2)**

Register 4x + 1 is a second control word, used to select:

- Data format
- Integration time
- CJC type
- RTD type

The following figure illustrates the control word 40XXX + 1 - Bits 1 ... 4 and 11 ... 16.



**Data Format (Bits 1 and 2, Group 1; Bits 3 and 4, Group 2)**

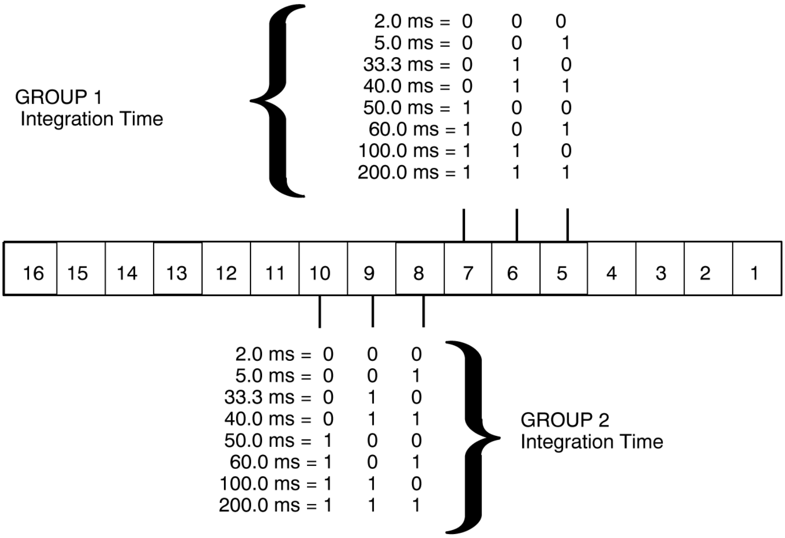
The data format you should select depends on your application. The available data formats are shown in the illustration(s) that follow.

**CJC Type (Bit 11, Group 1; Bit 12, Group 2)**

All thermocouples require Cold Junction Compensation (CJC) to work correctly. The only time you should select no CJC for a group is when you want to apply the CJC value of one group to the other, as explained in Section 6.3.3 for two groups of thermocouples with external CJC.

**RTD Type (Bit 14)** When configured for RTD operation, only one two-wire, three-wire, or four-wire RTD is allowed per group.

The following illustration shows the control word 4x + 1 - Bits 5 ... 10.



## Integration Time (Bits 5 ... 7, Group 1; Bits 8 ... 10, Group2)

Shorter integration times should be used in areas with low electrical noise, and longer integration times should be used in areas with high electrical noise.

Typically, 33.3 ms (minimum) is used with 60 Hz noise, and 40.0 ms (minimum) is used with 50 Hz noise.

A211/212 display mode ranges are listed in the following table.

| **Range** | **Display Modes** | | | |
|---|---|---|---|---|
| | **12-Bit** | **15/16-Bit** | **IEEE 754 Floating Point (16-bit)** | |
| +/- 50 mVDC | 4095 | 32767 | 5.0 E-02 VDC | <- high value |
| | 2048 | 0 | 0 | <- middle value |
| | 0 | -32768 | -5.0 E-02 | <- low value |
| +/- 500 mVDC | 4095 | 32767 | 0.5 VDC | |
| | 2048 | 0 | 0 | |
| | 0 | -32768 | -0.5 | |
| +/- 2000 mVDC | 4095 | 32767 | 2.0 VDC | |
| | 2048 | 0 | 0 | |
| | 0 | -32768 | -2.0 | |
| +/- 5000 mVDC | 4095 | 32767 | 5.0 VDC | |
| | 2048 | 0 | 0 | |
| | 0 | -32768 | -5.0 | |
| +/- 10,000 mVDC | 4095 | 32767 | 10.0 VDC | |
| | 2048 | 0 | 0 | |
| | 0 | -32768 | -10.0 | |
| 4 to 20 mA | 4095 | N/A | N/A | |
| | 2048 | | | |
| | 0 | | | |
| -20 to +20 mA | N/A | 32767 | +2.0 E-02 A | |
| | | 0 | 0 | |
| | | -32768 | -2.0 E-02 | |
| J Type | 4095 | 65535 | 7.60 E02 de grees C | 1.400 E03 de grees F |
| | 2048 | 32768 | 3.80 E02 | 7.16 E02 |
| | 0 | 0 | 0 | 3.2 E01 |
| K Type | 4095 | 65535 | 1.000 E03 de grees C | 1.832 E03 de grees F |
| | 2048 | 32768 | 5.00 E02 | 9.32 E02 |
| | 0 | 0 | 0 | 3.2 E01 |

| | | | | |
|---|---|---|---|---|
| T Type | 4095 | 65535 | 4.00 E02 de grees C | 7.52 E02 de grees F |
| | 2048 | 32768 | 1.50 E02 | 3.02 E02 |
| | 0 | 0 | -1.00 E02 | -1.48 E02 |
| E Type | 4095 | 65535 | 1.000 E03 degrees C | 1.832 E03 degrees F |
| | 2048 | 32768 | 5.00 E02 | 9.32 E02 |
| | 0 | 0 | 0 | 3.2 E01 |
| R Type | 4095 | 65535 | 1.750 E03 degrees C | 3.182 E03 degrees F |
| | 2048 | 32768 | 1.125 E03 | 2.057 E03 |
| | 0 | 0 | 5.00 E02 | 9.32 E02 |
| S Type | 4095 | 65535 | 1.750 E03 degrees C | 3.182 E03 degrees F |
| | 2048 | 32768 | 1.125 E03 | 2.057 E03 |
| | 0 | 0 | 5.00 E02 | 9.32 E02 |
| B Type | 4095 | 65535 | 1.800 E03 degrees C | 3.272 E03 degrees F |
| | 2048 | 32768 | 11.150 E03 | 2.102 E03 |
| | 0 | 0 | 5.00 E02 | 9.32 E02 |
| 100 ohms RTD 385m | 4095 | 65535 | 8.00 E02 de grees C | 1.472 E03 degrees F |
| | 2048 | 32768 | 3.00 E02 | 5.72 E02 |
| | 0 | 0 | -2.00 E02 | -3.28 E02 |
| 100 ohms RTD 392m | 4095 | 65535 | 8.00 E02 de grees C | 1.472 E03 degrees F |
| | 2048 | 32768 | 3.00 E02 | 5.72 E02 |
| | 0 | 0 | -2.00 E02 | -3.28 E02 |

## ⚠ WARNING

**Extreme out-of-range voltage.**

Operating the ADU 21X at an extreme out-of-range voltage (many times greater than the specified range) can permanently damage the module.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

## ADU 211/212 Universal Analog Input Module Input Registers

**Introduction**

The input registers provide channel and status information to the PLC:

The input registers for the ADU 211/212 are:

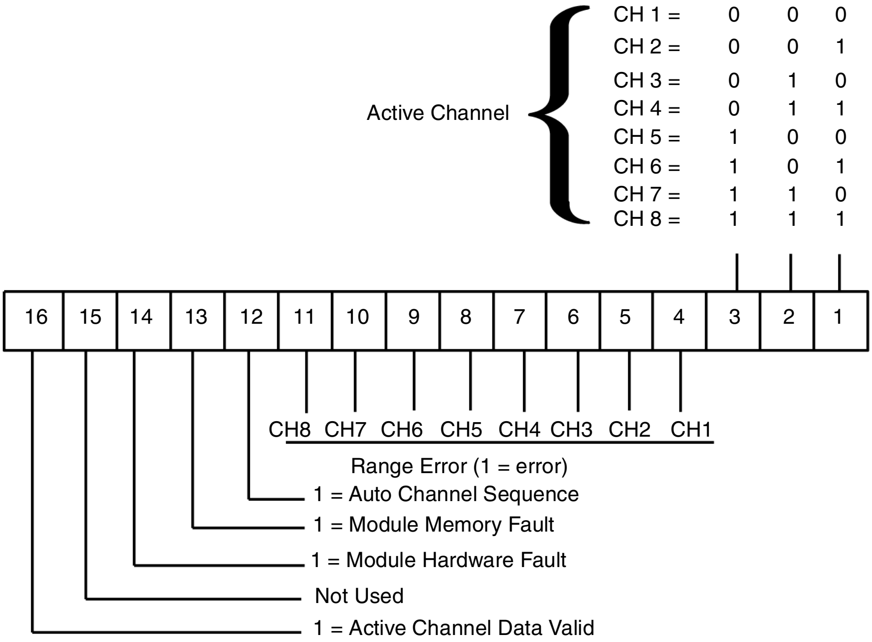
| Input Register | Function |
|---|---|
| 3x | Read Data, Channels 1-8, Integer or IEEE 754 (LowWord)* |
| 3x + 1 | Read Data, Channels 1-8, IEEE 754 (High Word)* |
| 3x + 2 | Status Word |
| * Using IEEE 754 floating point notation requires two 3x input registers (3x and 3x + 1). | |

**Status Word 3x + 2**

This register is a module operating status word, used to:

- Inform the PLC which input channel is active
- Indicate range errors for each of the eight channels
- Monitor the auto-sequence mode
- Indicate module memory faults
- Indicate faults in module hardware

Status word 3x + 2 is shown below:



**Read Data Registers 3x and 3x + 1**

These registers display the data collected from the field source. Data from each channel may be displayed on demand (through ladder logic) or in auto-sequence mode by the ADU 211/212 module. See *Sequentially Reading ADU 211/212 Universal Analog Input Module Channel Data, p. 121*

**Channel Range Error (Bits 4... 11)**

These bits go ON (= 1) if the associated channel experiences one of these conditions:

- A thermocouple input is open (only if a pull-up resistor is used) or over- or under-range
- an RTD input is over-range or has open excitation
- a 12-bit Current input is less than or equal to 3.6 mA or greater than 20 mA +2 percent minimum
- a signed 15-bit or IEEE 754 floating point Current input is less than -20 mA -2 percent minimum, or greater than 20 mA +2 percent minimum
- a Voltage input is over- or under-range

An input is out-of-range if it exceeds the specified range by at least 2 percent.

**Auto-Sequence Mode (Bit 12)**

The ADU 211/212 module can scan and display the data for each input channel automatically. Bit 12 monitors the auto-sequence mode: when ON (= 1), the module is cycling through the eight input channels at a fixed interval. See *Sequentially Reading ADU 211/212 Universal Analog Input Module Channel Data, p. 121* for more information.

**Module Memory Valid (Bit 13)**

This bit is used to inform the PLC that the module has detected a memory parity/ checksum error in its firmware. If this bit is OFF (0), all memory conditions are normal. If this bit is ever ON (1), the module's data or configuration is in question and you should initiate a self-test, power cycle the module, or replace the module.

**Module Error (Bit 14)**

This bit is turned ON (1) when a hardware failure is detected within the module (the amber LED may also be flashing). If this bit is ON (1), the module must be power cycled. If the bit does not clear (0) after a power cycle, the module should be replaced.

**Channel Data Ready (Bit 16)**

If ON (1), the data from the active channel (identified in bits 1... 3) is ready to be read by the PLC. In Auto-Sequence Mode, the Channel Data Ready Bit cycles ON and OFF as new data values are written to the input registers. Any ladder logic acquiring data in the Auto-Sequence Mode should ensure that the Channel Data Ready Bit is set when data is read. See the following section for an application example.

## Sequentially Reading ADU 211/212 Universal Analog Input Module Channel Data

### Auto Sequence Mode

Setting the Control Word 4x auto-sequence enable bit (bit 4) ON (1) causes the ADU 211/212 to scan all eight input channels at a fixed rate: every 240 msec (per channel) if the Group 1 integration time is 2, 5, 33.3, or 40 msec (total cycle time is 2 seconds); 520 ms if the integration time is longer (total cycle time is 4 seconds).

The Channel Active bits (bits 1... 3) in Status Word 3x + 2 identify which channel the module is currently reading. Before accepting this data, you should verify that the Channel Data Ready Bit (bit 16) in Status Word 3x + 2 is ON (1). A ladder logic example is shown below. Register(s) 3x (and 3x + 1 for IEEE 754 Floating Point) provide the actual data to the processor for the channel being scanned.

**Note:** For RTD applications, use only the data provided by Channel 1 (for Group 1) or Channel 5 (for Group 2); the module will use the other channels for its own calculations. Therefore, the Auto Sequence mode should not be used for RTD applications.

### User-Defined Scan Mode

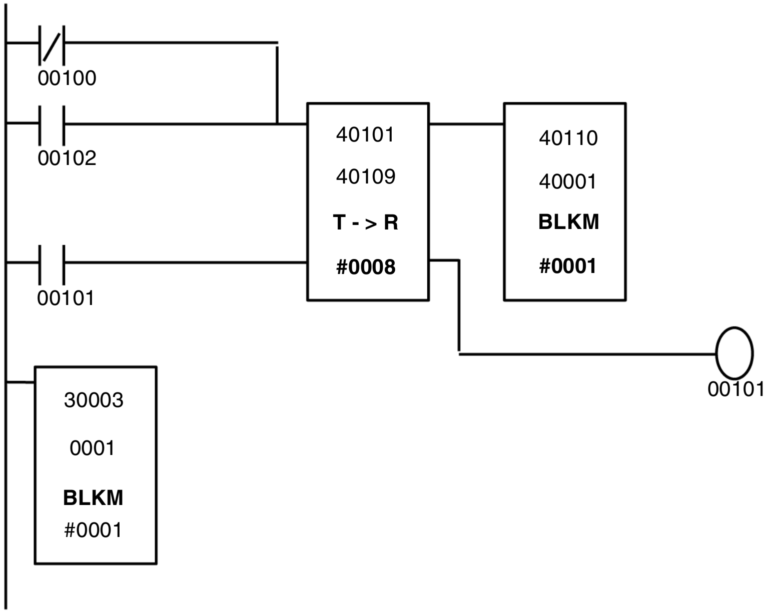
Some users may prefer to read input channel data at a faster or slower rate than is provided by Auto-Sequence. For example, you may want to scan Channels 1... 4 only, and read Channels 5... 8 less frequently or directly. The ladder logic shown in Figure 39 through Figure 45 is one way to do this.

**Note:** In user-defined scan mode, the auto-sequence enable bit (bit 4) in Control Word 4x must be disabled (0).

**Note:** For application specific concerns refer to the ADU 211/212 Universal Analog Input Module Application Notes.

## Ladder Login Screen #1

Ladder Logic Screen #1 is shown below.



The first two rungs of ladder in Figure 39 can be used independently to sequence through the input channels. In this example, a T R move is shown. Note that the Source Table must be entered by the user; here, the desired configurations have been loaded into registers 40101. 40108. Each of these registers must contain the proper bit settings to select one of eight input channels on the ADU 21X, as well as to define the group range. In this example, the Type J thermocouple mode will be used.

Loading 0662 hex into Control Word 40001 selects channel 3 and configures Groups 1 and 2 for Type J thermocouple. The corresponding binary bit pattern is 0000-0110-0110-0010. The appropriate words from the source table are transferred into register 40110.

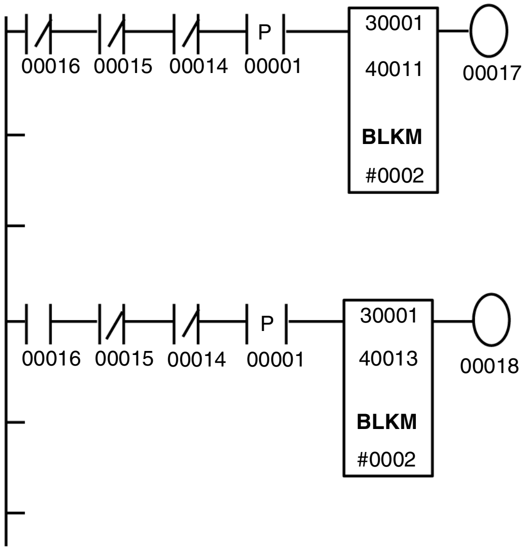
The contents of register 40110 are then block moved into Control Word 40001. This happens eight times, moving the eight predefined configuration words into Control Word 40001 of the ADU 211, effectively selecting and moving all eight input readings into holding registers.

The remaining ladder shown (Figure 40 through Figure 45) illustrates a way to move validated data into independent holding registers. This lets you view and use all channel data at once. In this example, the processor continuously refreshes and loads validated data into the holding registers. In this fashion, ladder logic effectively de-multiplexes the ADU 211/212, making it appear as though each channel really had its own 3x data register.

---

## Ladder Login Screen #2

Ladder Logic Screen #2 is shown below.

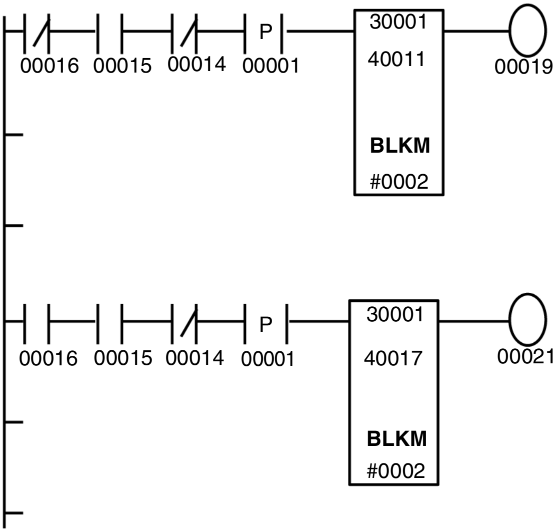


Register 30003 defines the ADU 211/212 Operating Status Word. Using the BLKM function to transfer this word into discrete outputs 00001... 00016 lets you monitor the Channel Active Bits and the Data Ready Bit. Properly decoding bits 00014... 00016 and the Data Ready bit 00001 lets you transfer register 30001 data (the data currently being read) into holding registers for each unique input channel. In this example, two consecutive words are moved for each channel, enabling you to display floating point data if desired. For all other data formats, you only need to move one word.

In Ladder Logic Screen #3, the block move for Channel 1 uses three normally closed contacts, corresponding to the channel select bits (bits 00014... 00016). When these three bits are OFF (0), Channel 1 is the active channel. When the Data Ready bit is ON (1), the contents of registers 30001 and 30002 are moved into holding registers 40011 and 40012.

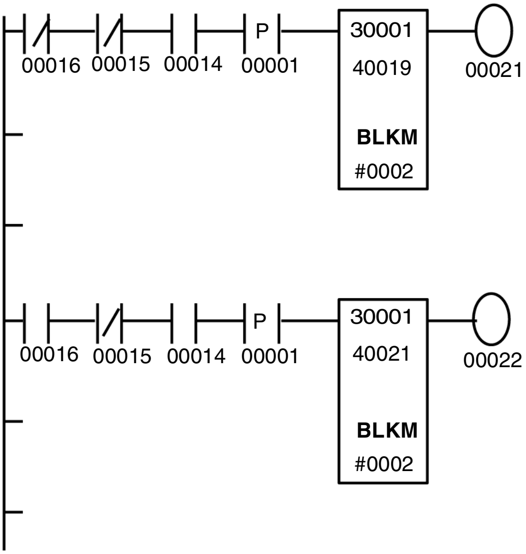
## Ladder Login Screen #3

Ladder Logic Screen #3 is shown below.



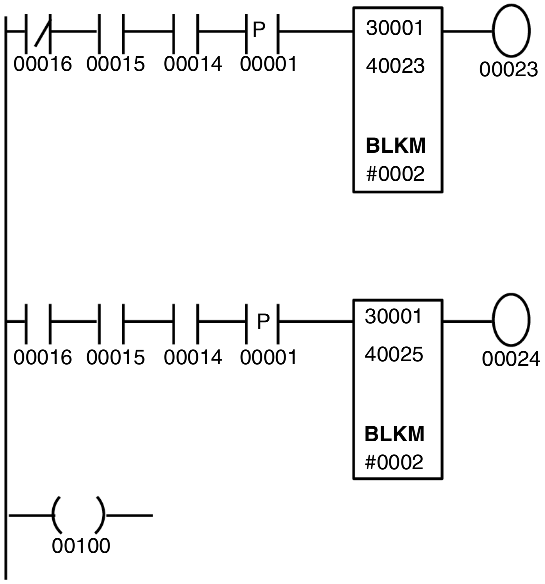
## Ladder Login Screen #4

Ladder Logic Screen #4 is shown below.



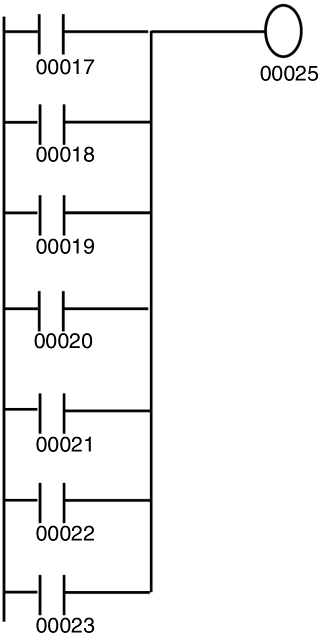
**Ladder Login Screen #5**

Ladder Logic Screen #5 is shown below.



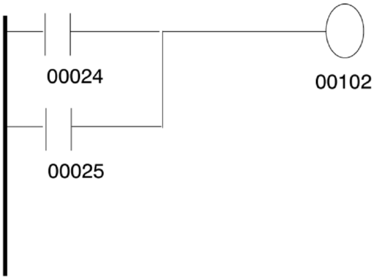
**Ladder Login Screen #6**

Ladder Logic Screen #6 is shown below.



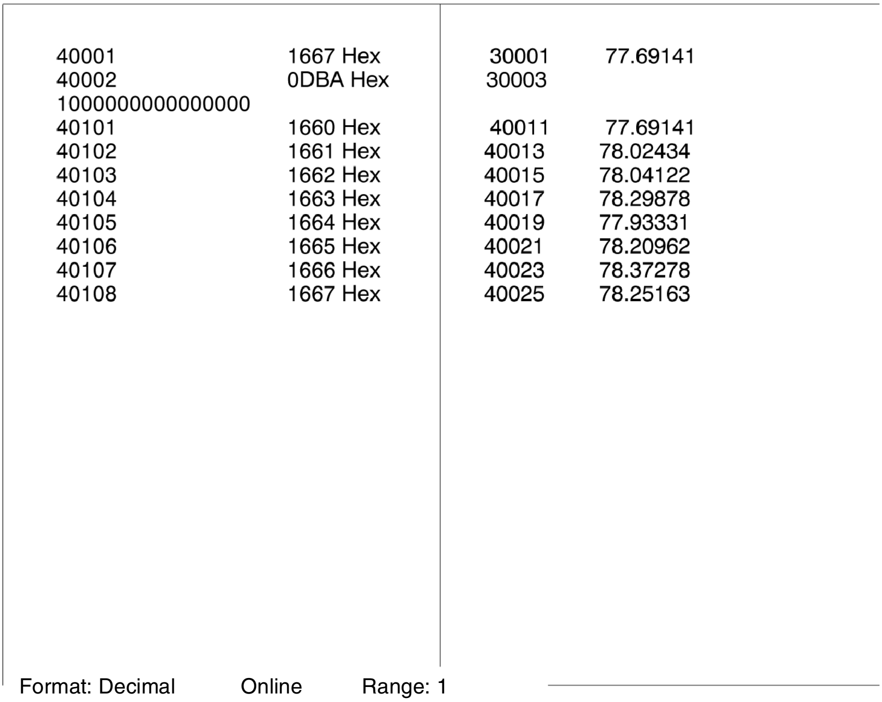
**Ladder Login Screen #7**

Ladder Logic Screen #7 is shown below.



**Source and Results**

The source table and results of de-multiplexing are shown below.



```
40001              1667 Hex        30001     77.69141
40002              0DBA Hex        30003
1000000000000000
40101              1660 Hex        40011     77.69141
40102              1661 Hex        40013     78.02434
40103              1662 Hex        40015     78.04122
40104              1663 Hex        40017     78.29878
40105              1664 Hex        40019     77.93331
40106              1665 Hex        40021     78.20962
40107              1666 Hex        40023     78.37278
40108              1667 Hex        40025     78.25163

Format: Decimal      Online      Range: 1
```

The source table is shown above for this example in Registers 40101... 40108. The results of the demultiplexing are shown in Registers 40011, 40013, 40015, 40017, 40019, 40021, 40023, and 40025 for input Channels 1... 8, respectively. You can move the data to any eight consecutive registers for integer data formats. If floating point data is desired, then two consecutive destination registers are required for each input.

In this example, the ADU 211/212 was configured for Type J thermocouples as defined by register 40001. The demultiplexed holding registers for the eight input channels are displaying temperature in degrees Fahrenheit using the floating point data format.

The ADU 21X is I/O mapped as: 30001-30003 input registers, 40001-40003 output registers, and binary. You can call up the built-in help screens at any time by highlighting "ADU 211" and then pressing <ALT><H> for more information about the module.

## ADU 211/212 Universal Analog Input Module Troubleshooting

### Introduction

This section provides instructions for detecting and correcting ADU 211/212 operating problems. The following topics are covered in this section:

- LEDs
- Invalid Data
- Testing the System
- Built-in Tests

### Amber LEDs

The amber LED on the front of the module provides module status information about the health of the module. A blinking amber LED indicates one of these faults:

- Module watchdog fault
- Module watchdog fault at startup
- Module RAM failure at startup
- Bus interface failure at startup
- Module ROM failure
- Module processor fault at startup
- General module error

If the amber LED begins blinking, try restarting the ADU 21X. If the blinking continues, call Technical Support at 1-800-468-5342.

### Green LEDs

The green LED provides status information about the module's readiness. After the module is powered up, the green LED should begin blinking. If not, check the power connections.

After the module has established communications with the PLC, the green LED should stop blinking and remain ON. If not, ensure that the PLC has been powered up.

**Note:** Do not run PLC without power applied to the module.

**Note:** For application specific concerns refer to the *ADU 211/212 Universal Analog Input Module Application Notes, p. 105*

## Invalid Data

If the module seems to be providing invalid data to the PLC, check:

- Field wiring connections, DIP switch settings, and register settings.
- Integrity of the source device and connections.
- Signal cables are not placed on or near high voltage (120 Vac or higher) control wiring. If the signal cables must pass high voltage cables, make sure that the signal cables pass the high voltage cables at 90degree angle.

If electrical interference seems to be the problem, try to place the module as far as possible from the P120 power supply and relay output modules. These products may generate electrical interference during operation. This won't affect the ADU 21X but may induce noise on the incoming channel wiring.

## Testing the System

For thermocouple applications, you can test the system by temporarily short circuiting each thermocouple at the terminal block-use some wire to connect the + lead to the - lead. Short circuiting a thermocouple channel should cause that channel to read the ambient temperature-i.e., the temperature at the CJC thermistor if CJC is enabled-if not, check the terminal connections and DIP switch settings.

For RTD applications, you can test the system by enabling the internal 250 ohms shunts. Shunting an RTD channel should cause that channel to read approximately 409 degrees C (768 degrees F).

## Built-in Tests

The ADU 21X has built-in tests that can be enabled to check out the module's control electronics. These tests are performed automatically every time the module is powered up, but they can also be run after the module is on-line. Setting the appropriate bits ON (1) will cause the module to enter a self-test mode.

**Note:** When bits 16, 15, or 14 are set ON, the green LED blinks continuously until these bits are set OFF. When bits 16... 14 are set OFF, the module may need to be restarted.

To terminate the self-test mode, simply reset the Built-in Test Enable bit (bit 14 in Control Word 4x) OFF (0). Bits 15 and 16 determine the type of test that will be executed.

| BIT 16 | BIT 15 | BIT 14 | Elements Tested |
|---|---|---|---|
| 0 | 0 | 0 | None (tests disabled) |
| 0 | 1 | 1 | ADU 21X Microprocessor, Dual-Port RAM, ROM, Watchdog Circuit, Ready and Run LEDs, Power Supply |
| 1 | 0 | 1 | EEPROM, Bus Interface Unit, Analog signal conditioning, Isolation communications, Power Supply, Module firm ware |

If the ADU 21X fails any of these tests (amber LED blinks), restart the module. If it continues to fail, call Technical Support at 1-800-468-5342.

## ADU 211/212 Universal Analog Input Module Specifications

**Table of Specifications**

The following table contains a list of ADU 211/212 specifications.

| | | |
|---|---|---|
| Module Topology | Number of Inputs | 8 (2 for RTD) |
| | Number of Groups | 2 |
| | Points/Group | 4 (1 for RTD) |
| | Isolation | Channel-to-bus: 500 volts, 25 micro A max. leakage at 60 Hz. Channel-to-channel: +/- 30 Vdc max. |
| Required Loadable | SW-IODR-001 | |
| Power Supplies | Ext. Source Requirement | 20-30 Vdc for the ADU 211: none for the ADU 212 |
| | Consumption | 2.5 VA typical, 4.0 VA (167 mA at 24 Vdc nominal) maxi mum for the ADU 211 |
| | Power Dissipation | 2.5 VA typical, 3.0 VA maxi mum for the ADU 212 |
| | Internal 5 V from PAB | less than 80 mA (TTL loading) for the ADU 211: 450 mA typical, 600 mA maximum for the ADU 212 |
| DIN Rail Grounding | less than 0.1 ohms | |
| Input protection | Analog multiplexer resident clamps and FETs | |
| Input Impedance | 10 M ohms typical | |

| | | |
|---|---|---|
| Signal Inputs | Thermocouple | |
| | J: | 0 to 760 degrees C (32 to 1400 degrees F) |
| | K: | 0 to 1000 degrees C (32 to 1832 degrees F) |
| | T: | -100 to 400 degrees C (-212 to 752 degrees F) |
| | E: | 0 to 1000 degrees C (32 to 1832 degrees F) |
| | R: | +500 to 1750 degrees C (932 to 3182 degrees F) |
| | S: | +500 to 1750 degrees C (932 to 3182 degrees F) |
| | B: | +500 to 1800 degrees C (932 to 3272 degrees F) |
| | RTD | 3- or 2/4-wire 100 ohms, 385 or 392 alpha |
| | | -200 to 800 degrees C |
| | Voltage | +/-50, 500, 2000, 5000, and 10,000 mVDC |
| | Current | 4-20 mA (12 bit) |
| | | +/- 20 mA (16-Bit and IEEE 754) |
| I/O Map | Register 3x/4x | 3 in/3 out |
| Integer Resolution | 1 part in 4096 counts (12-bit display) 1 part in +32767 to -32768 counts (16-bit) | |
| IEEE754 FP resolution (engineering units) | Thermocouple: (use non-grounded type TCs) | 0.7 degrees C or better |
| | RTD: | 0.15 degrees C or better |
| | Voltage: | 0.035 percent of full scale or better |
| | Current: | 0.035 percent of full scale or better |

| | | |
|---|---|---|
| Accuracy | Thermocouple at module with fixed 0 degrees C CJC | |
| | J: | +/- 1.5 degrees C (2.7 degrees F) |
| | K: | +/- 2.0 degrees C (3.6 degrees F) |
| | T: | +/- 3.0 degrees C (5.4 degrees F) |
| | E: | +/- 1.2 degrees C (2.2 degrees F) |
| | R: | +/- 7.0 degrees C (12.5 degrees F) |
| | S: | +/- 7.0 degrees C (12.6 degrees F) |
| | B: | +/- 15.0 degrees C (27.0 degrees F) |
| | RTD at module | 100 ohms Platinum, 385 alpha: +/- 0.40 degrees C typical, +/- 1.0 degrees C maximum |
| | | 100 ohms Platinum, 392 alpha: +/- 0.40 degrees C |
| | Voltage at module | 50 mVDC: +/- 0.40 percent of full scale |
| | | 0.5, 2, 5 & 10 VDC: +/-0.11 percent of full scale |
| | Current | 4 to 20 mA: +/- 0.20 percent of full scale |
| | | +/- 20 mA: +/- 0.20 percent of full scale |
| Linearization | Thermocouple: | IPTS-68 Standard, NBS MN-125 |
| | RTD: | JIS C 1604, DIN 43760 and IEC 751 |
| Open Circuit Detect | Thermocouple (external 22-47 M ohms resistors required for individual open circuit detection) | |
| Cold Junction Compensation | 10 k ohms internal or external thermistor or fixed value, +/-1.7 degrees C (3.1 degrees F) typical, +/-4.1 degrees C (7.4 degrees F) maximum accuracy | |
| RTD Excitation | 200 micro A typical | |
| Signal Integration Time | 2, 5, 33.3, 40, 50, 60, 100 and 200 msec (group selectable) | |
| Single Channel Update Time | (Integration x 1.5) + 10.0 msec typical | |
| Common Mode Rejection | 68 dB typical at 50 or 60 Hz with integration time set at greater than 100 msec | |
| Calibration | Automatic and continuous | |
| Temperature | Operating: 0 to 60 degrees C (32 to 140 degrees F) | |
| | Storage: -40 to 85 degrees C (-40 to 185 degrees F) | |
| Relative Humidity | 0 to 95 percent at 60 degrees C, non-condensing | |
| Vibration | 3 rotational axes 2G RMS, 10 to 57 Hz 15-minute scan (1 octave per minute) | |

| | | |
|---|---|---|
| Shock | 30G for 11 msec, 1/2 sine, 3 orthogonal axes | |
| Packaged Free Fall | 3 feet (1 meter), 5 iterations each side | |
| Cooling | Free air convection | |
| EMI Susceptibility | 27 to 500 mHz 10 volt/meter (per subset IEC 801-3) | |
| Fast Transient | +/- 1.0 kV (per subset IEC 801-2) | |
| Electrostatic discharge | 8 kV, 10 discharges, no damage | |
| Dimensions | (W x H x D) | 1.6 x 5.6 x 4.5 in. 40.3 x 145.0 x 117.5 mm |
| | Weight | 0.80 lb (360 g) max. |
| Power Connections | 60/75 copper (Cu) | |
| Torque | 4.5 inch-pounds on set screws | |
| Agency Approvals | ADU 211 & ADU 212 | UL 508; CSA 22.2 No.142; FM Class I, Div 2**; and European Directive EMC 89/336/ EEC Standards |
| **This equipment is suitable for use in Class 1, Division 2, Groups A, B, C, and D, or non-hazardous locations only. | | |

## ⚠ WARNING

**Substitution Warning**

Substitution of components may impair suitability for Class 1, Division 2.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

# ADU 214 Analog Input Module

# 7

## At a Glance

**Purpose**

This Chapter gives an overview of the ADU 214 Analog Input Module. This is followed by the physical characteristics of the module; installation and configuration procedures; and, lastly, the specifications of the ADU 214 Module.

**⚠ WARNING**

**Operative Failure Alert**

The ADU 214 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

**Note:** Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft.

**What's in this Chapter?**

This chapter contains the following topics:

## Overview of the ADU 214 Analog Input Module

### Physical Characteristics

The ADU 214 module is used for measuring analog data, and provides up to 8 non-isolated inputs. The main characteristics of the module follow.

**Tip:** This module is suitable for use on Compact 984 with memory size of 4K or more.

- Four 4-wire analog inputs. These inputs can be used for 2-wire measurement, thus allowing up to 8 unipolar inputs, 4 bipolar voltage inputs, or combinations of both.
- Several measuring ranges that may be individually selected and mixed for each input:

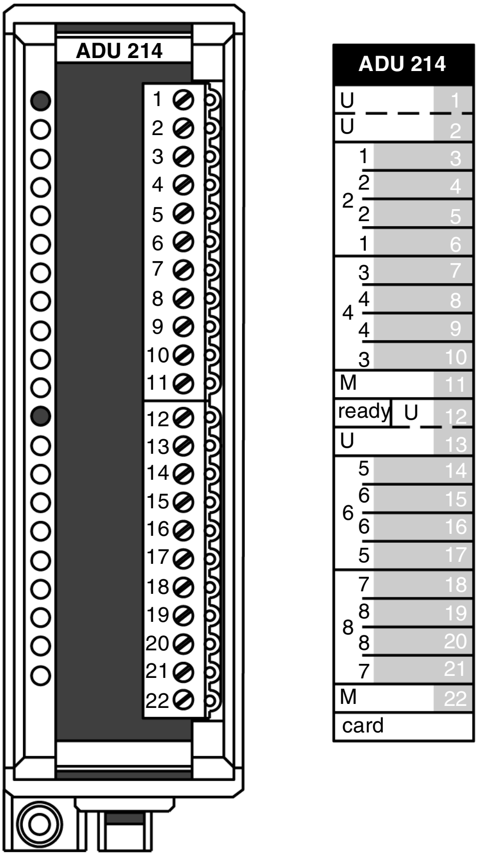
The following Measuring Ranges apply to the ADU 214 Analog Input Module.

| | |
|---|---|
| Voltage measurement | 0 ... 0.5, 0 ... 1, 0 ... 5, 0 ... 10 V, 0.1 ... 0.5, 0.2 ... 1, 1 ... 5, 2 ... 10 V, 0.5, 1, 5, 10 V |
| Current measurement (External precision resistor required) | 0 ... 5, 0 ... 10, 0 ... 20 mA, 1 ... 5, 2 ... 10, 4 ... 20 mA, 5, 10, 20 mA |
| RTD Temperature measurement | -160/-60 ... +160 degrees C (resolution ≤ 0.02 degrees C) -200 ... +320 degrees C (resolution ≤ 0.04 degrees C) -200 ... +640 degrees C (resolution ≤ 0.08 degrees C) |
| Resistance measurement | 0 ... 100, 0 ... 200, 0 ... 500 Ω,, 0 ... 1000, 0 ... 2000 Ω |

The PLC model determines the available ranges. Refer to the tables in this chapter.

**Note:** Only the 15 Bit + sign resolution is supported when using the E984-258/265/275/285 PLC models. The 12, 13 and 15 Bit + sign resolutions are all supported when using the A984-1xx, E984-24x/251/255 PLC models.

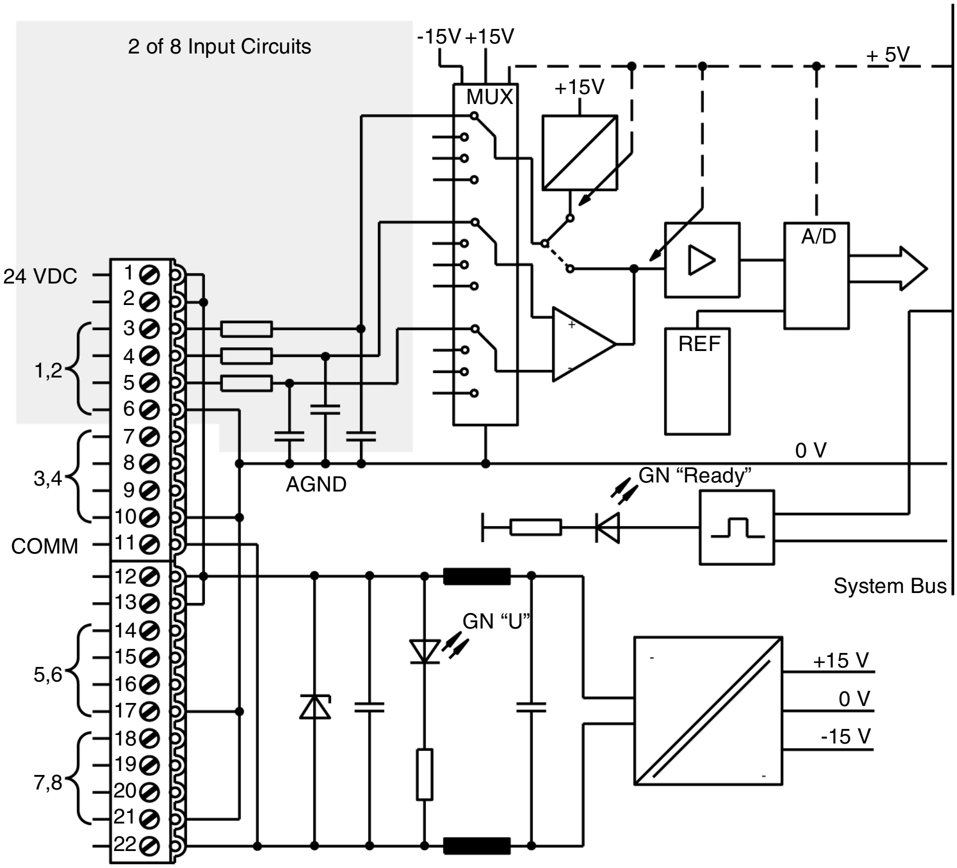
The following illustration is of the Front View and Label of the ADU 214 Module



- Broken wire testing of all 4-wire lines and self-calibration using built-in reference resistances and reference voltages
- Measuring ranges for voltage, current, temperature, and resistance can be set individually for each input
- Switch-selectable 50 ... 60 Hz operation noise suppression

**Simplified Schematic**

The following is a simplified schematic for the ADU 214 Module.



**LEDS**

The ADU 214 has two front panel LEDs:

- One green LED opposite Terminal 1 indicating the module is receiving 24 V power
- One green LED opposite Terminal 12 indicating the module's processor is running

# Conversion Values

## Overview

The following tables provide ADU 214 conversion values for unipolar voltage inputs, bipolar voltage inputs, current inputs, temperature inputs, and resistance inputs.

## Conversion Values of Unipolar Voltage Inputs, Part 1

The following table shows Conversion Values of Unipolar Voltage Inputs.

| **0...0.5 V** | **0...1 V** | **0...5 V** | **0...10 V** | **0.1...0.5 V** | **0.2...1 V** | **1...5 V** | **2...10 V** |
|---|---|---|---|---|---|---|---|
| <-0.008 | <-0.016 | <-0.08 | <-0.16 | <+0.052 | <+0.104 | <+0.52 | <+1.04 |
| | | | | +0.052 | +0.104 | +0.52 | +1.04 |
| -0.008... | -0.016... | -0.08.. | -0.16.. | +0.094... | +0.187... | +0.936... | +1.87... |
| -0.000 | -0.000 | -0.00 | -0.00 | +0.099 | +0.199 | +0.99 | +1.99 |
| 0 | 0 | 0 | 0 | 0.1 | 0.2 | 1 | 2 |
| 0.000 02 | 0.000 03 | 0.000 16 | 0.000 31 | 0.100 0 | 0.200 0 | 1.000 1 | 2.000 3 |
| 0.000 25 | 0.000 5 | 0.002 5 | 0.005 | 0.100 2 | 0.200 4 | 1.002 | 2.004 |
| 0.000 5 | 0.001 | 0.005 | 0.01 | 0.100 4 | 0.200 8 | 1.004 | 2.008 |
| 0.005 | 0.01 | 0.05 | 0.10 | 0.104 | 0.208 | 1.04 | 2.08 |
| 0.025 | 0.05 | 0.25 | 0.50 | 0.12 | 0.24 | 1.20 | 2.40 |
| 0.05 | 0.10 | 0.50 | 1.00 | 0.14 | 0.28 | 1.40 | 2.80 |
| 0.25 | 0.50 | 2.50 | 5.00 | 0.30 | 0.60 | 3.00 | 6.00 |
| 0.50 | 1.00 | 5.00 | 10.00 | 0.50 | 1.00 | 5.00 | 10.00 |
| 0.500 0... | 1.000 0... | 5.000... | 10.000... | 0.500... | 1.000... | 5.00... | 10.00... |
| 0.511 9 | 1.023 9 | 5.119 | 10.239 | 0.509 | 1.019 | 5.09 | 10.19 |
| ≥0.512 | ≥1.024 | ≥5.12 | ≥10.24 | >0.509 | >1.019 | >5.09 | >10.19 |
| **NOTE:** Numbers **not in** parentheses = range with + limit. | | | | | | | |

## Conversion Values of Unipolar Voltage Inputs, Part 2

Conversion Values of Unipolar Voltage Inputs continue in the following table.

| 15-BIT | 13-BIT | 12-BIT | NOTES |
|---|---|---|---|
| -32,767 | | | underflow error |
| 0 (-3,840) | | | overload range |
| 0 (-512) | | | |
| 0 (-1) | | | |
| 0 | 4096 | 2048 | rated value |
| +1 | | | |
| +16 | | | |
| +32 | | | |
| +320 | | | Linear Range |
| +1 600 | | | |
| +3 200 | | | |
| +16 000 | | | |
| +32 000 | 8096 | 4048 | rated value |
| +32 001... | | | |
| +32 766 | | | overload range |
| +32 767 | 8191 | 4095 | overflow error |
| **NOTE:** Numbers **in** parentheses = range with ± limit. | | | |

### Conversion Values of Bipolar Voltage Inputs, Part 1

The following table shows Conversion Values of Bipolar Voltage Inputs:

| 0.5 V | 1 V | 5 V | 10 V |
|---|---|---|---|
| ≤–0.512 | ≤–1.024 | ≤–5.12 | ≤–10.24 |
| –0.511 9 ... | –1.023 ... | –5.119 ... | –10.239 ... |
| –0.500 0 | –1.000 | –5.000 | –10.000 |
| –0.50 | –1.00 | –5.00 | –10.00 |
| –0.25 | –0.50 | –2.50 | –5.00 |
| –0.05 | –0.10 | –0.50 | –1.00 |
| –0.025 | –0.05 | –0.25 | –0.50 |
| –0.005 | –0.01 | –0.05 | –0.10 |
| –0.000 5 | –0.001 | –0.005 | –0.01 |
| –0.000 25 | –0.000 5 | –0.002 5 | –0.005 |
| 0 | 0 | 0 | 0 |
| +0.000 02 | +0.000 03 | +0.000 16 | +0.000 31 |
| +0.000 25 | +0.000 5 | +0.002 5 | +0.005 |
| +0.000 5 | +0.001 | +0.005 | +0.01 |
| +0.005 | +0.01 | +0.05 | +0.10 |
| +0.025 | +0.05 | +0.25 | +0.50 |
| +0.05 | +0.10 | +0.50 | +1.00 |
| +0.25 | +0.50 | +2.50 | +5.00 |
| +0.50 | +1.00 | +5.00 | +10.00 |
| +0.500 0 ... | +1.000 0 ... | +5.000 ... | +10.000 ... |
| +0.511 9 | +1.023 9 | +5.119 | +10.239 |
| ≥+0.512 | ≥+1.024 | ≥+5.12 | ≥+10.24 |

## Conversion Values of Bipolar Voltage Inputs, Part 2

Conversion Values of Bipolar Voltage Inputs continue in the following table:

| *15-BIT | 13-BIT | 12-BIT | NOTES |
|---|---|---|---|
| –32 767 | | | underflow error |
| -32 766 | | | overload range |
| -32 001 | | | |
| -32 000 | 96 | 48 | rated value |
| -16 000 | | | |
| -3 200 | | | |
| -1 600 | | | |
| -320 | | | |
| -32 | | | |
| -16 | | | |
| 0 | 4096 | 2048 | Linear Range |
| +1 | | | |
| +16 | | | |
| +32 | | | |
| +320 | | | |
| +1 600 | | | |
| +3 200 | | | |
| +16 000 | | | |
| +32 000 | 8096 | 4048 | rated value |
| +32 001 ... | | | |
| +32 766 | | | overload range |
| +32 767 | 8191 | 4095 | overflow error |

**Note:** *Only the 15 Bit + sign resolution is supported when using the E984–258/265/275/285 PLC models. The 12, 13, and 15 Bit + sign resolutions are supported when using the A984–1xx, E984--24x/251/255 PLC models.

## Conversion Values of Current Inputs, Part 1

The following table shows Conversion Values of Current Inputs:

| 0...10 mA | 0...20 mA | 2...10 mA | 4...20 mA | 20 mA |
|---|---|---|---|---|
| <–0.16 | <–0.32 | <+1.04 | <+2.08 | ≤–20.479 |
| | | | | –20.478 ... |
| | | | | –20.000 |
| | | +1.04 ... | +2.08 ... | |
| –0.16... | –0.32... | +1.87 ... | +3.74 ... | |
| –0.00 | –0.00 | +1.99 | +3.99 | |
| | | | | –20.00<br>–10.00<br>–2.00<br>–1.00<br>–0.20<br>–0.02<br>–0.01 |
| 0 | 0 | +2 | +4 | 0 |
| +0.005 | +0.01 | +2.004 | +4.008 | +0.01 |
| +0.01 | +0.02 | +2.008 | +4.016 | +0.02 |
| +0.1 | +0.20 | +2.08 | +4.16 | +0.20 |
| +0.5 | +1.00 | +2.40 | +4.80 | +1.00 |
| +1 | +2.00 | +2.80 | +5.60 | +2.00 |
| +5 | +10.00 | +6.00 | +12.00 | +10.00 |
| +10.0 | +20.00 | +10.00 | +20.00 | +20.00 |
| +10.000... | +20.000... | +10.00... | +20.00... | +20.000... |
| +10.239 | +20.478 | +10.19 | +20.38 | +20.478 |
| ≥+10.24 | ≥+20.479 | >+10.19 | >+20.38 | ≥+20.479 |

### Conversion Values of Current Inputs, Part 2

Conversion Values of Current Inputs continue in the following table:

| *15-BIT | 13-BIT | 12-BIT | NOTES |
|---|---|---|---|
| –32 767 | | | underflow error |
| -32 766 | | | overload range |
| -32 001 | | | |
| 0 (-3 840) | | | |
| 0 (-512) | | | |
| 0 (-1) | | | |
| -32 000 | 96 | 48 | rated value |
| -16 000 | | | |
| -3 200 | | | |
| -1 600 | | | |
| -320 | | | |
| -32 | | | |
| -16 | | | |
| 0 | 4096 | 2048 | Linear Range |
| +1 | | | |
| +16 | | | |
| +32 | | | |
| +320 | | | |
| +1 600 | | | |
| +3 200 | | | |
| +16 000 | | | |
| +32 000 | 8096 | 4048 | rated value |
| +32 001 ... | | | |
| +32 766 | | | overload range |
| +32 767 | 8191 | 4095 | overflow error |
| **NOTE:** Numbers **in** parentheses = range with ± limit | | | |

**Note:** *Only the 15 Bit + sign resolution is supported when using the E984–258/265/275/285 PLC models. The 12, 13, and 15 Bit + sign resolutions are supported when using the A984–1xx, E984--24x/251/255 PLC models.

## Conversion Values of Temperature Inputs, Part 1

The following table shows Conversion Values of Temperature Inputs:

| **-60 ... +160°C** | **-160 ... +160°C** | **-200 ... +320°C** | **-200 ... +640°C** |
|---|---|---|---|
| <–60 | <–160 | <–200 | <–200 |
|  | –160 |  |  |
|  | –100 | –200 |  |
| –60 | –60 | –120 |  |
| –50 | –50 | –100 | –200 |
| –16 | –16 | –32 | –64 |
| 0 | 0 | 0 | 0 |
| +0.005 | +0.005 | +0.01 | +0.02 |
| +0.08 | +0.08 | +0.16 | +0.32 |
| +0.16 | +0.16 | +0.32 | +0.64 |
| +8 | +8 | +16 | +32 |
| +16 | +16 | +32 | +64 |
| +80 | +80 | +160 | +320 |
| +160 | +160 | +320 | +640 |
| +160.005 ... | +160.005 ... | +320.01 ... | +640.02 ... |
| +163.83 | +163.83 | +327.66 | +655.32 |
| ≥+163.84 | ≥+163.84 | ≥+327.67 | ≥+655.34 |

## Conversion Values of Temperature Inputs, Part 2

Conversion Values of Temperature Inputs continue in the following table:

| *15-BIT | 13-BIT | 12-BIT | NOTES |
|---|---|---|---|
| –32 767 | | | measuring range underflow (error) |
| -32 000 | 96 | 48 | rated value |
| -22 000 | | | |
| -12 000 | | | |
| -10 000 | | | |
| -3 200 | | | |
| 0 | 4096 | 2048 | Linear Range |
| +1 | | | |
| +16 | | | |
| +32 | | | |
| +320 | | | |
| +1 600 | | | |
| +3 200 | | | |
| +16 000 | | | |
| +32 000 | 8096 | 4048 | rated value |
| +32 001 ... | | | |
| +32 766 | | | overload range |
| +32 767 | 8191 | 4095 | measuring range overflow error |

**Note:** *Only the 15 Bit + sign resolution is supported when using the E984–258/ 265/275/285 PLC models. The 12, 13, and 15 Bit + sign resolutions are supported when using the A984–1xx, E984--24x/251/255 PLC models.

## Conversion Values of Resistance Inputs, Part 1

The following table shows Conversion Values of Resistance Inputs:

| **0...100Ω** | **0...200Ω** | **0...500Ω** | **0...1000Ω** | **0...2000Ω** |
|---|---|---|---|---|
| <–1.6 | <–3.2 | <–8 | <–16 | <–32 |
| 0...–1.6 | 0...–3.2 | 0...–8 | 0...–16 | 0...–32 |
| 0 | 0 | 0 | 0 | 0 |
| 0.003 | 0.006 | 0.015 | 0.03 | 0.06 |
| 0.05 | 0.1 | 0.25 | 0.5 | 1 |
| 0.1 | 0.2 | 0.5 | 1 | 2 |
| 1 | 2 | 5 | 10 | 20 |
| 5 | 10 | 25 | 50 | 100 |
| 10 | 20 | 50 | 100 | 200 |
| 50 | 100 | 250 | 500 | 1000 |
| 100 | 200 | 500 | 1000 | 2000 |
| 100.00 ... | 200.00 ... | 500.01 ... | 1000.03 ... | 2000.06 ... |
| 102.39 | 204.78 | 511.97 | 1023.94 | 2047.88 |
| ≥102.40 | ≥204.79 | ≥511.98 | ≥1023.97 | ≥2047.94 |

## Conversion Values of Resistance Inputs, Part 2

Conversion Values of Resistance Inputs continue in the following table:

| *15-BIT | 13-BIT | 12-BIT | NOTES |
|---|---|---|---|
| –32 767 | | | underflow error |
| 0 | | | overload range |
| 0 | 4096 | 2048 | rated value |
| +1 | | | |
| +16 | | | |
| +32 | | | |
| +320 | | | |
| +1 600 | | | linear range |
| +3 200 | | | |
| +16 000 | | | |
| +32 000 | 8096 | 4048 | rated value |
| +32 001 ... | | | |
| +32 766 | | | overload range |
| +32 767 | 8191 | 4095 | overflow error |
| **NOTE:** Numbers **in** parentheses = range with ± limit. | | | |

**Note:** *Only the 15 Bit + sign resolution is supported when using the E984–258/ 265/275/285 PLC models. The 12, 13, and 15 Bit + sign resolutions are supported when using the A984–1xx, E984--24x/251/255 PLC models.

## Configuration - Concept

**Configured Registers - Modsoft**

The ADU 214 module requires two sequental 4X command registers and 3 sequental 3X status registers all Traffic Copped as BIN. Selecting a channel number higher than 8, or one already included in a channel pair measurement, will result in an ILLEGAL 4X COMMAND" bit to be set in the 3X register response.

The following table shows Configured Registers for the ADU 214 Module.

| Registers | Contents |
|---|---|
| 4x | 50x Decimal, with x = Channel 1 ... 8 |
| 4x + 1 | Configuration Command (Refer to *Register Configuration Commands - Modes - Modsoft, p. 150*) |
| 3x | Configure Command Response (see *Invalid Commands - Modsoft, p. 155* |
| 3x ,+ 1 | 0 |
| 3x + 2 | 0 |

4X output register commands, and resultant 3X register formats are:
- For unipolar measurements, select Channel 1 ... 8 and enter decimal 1 ... 28 for the configuration code in register 4x + 1.
- For bipolar measurements, channel pairs are wired on the field connector, and are also configured in pairs. Either channel of the pair may be selected. For these measurements, the even channel must be used in the 4x read command. The odd channel will be indicated not active or not valid in the 3x status register, and will display zero in its data register. For example, channel pairs are 1/2, 3/4, 5/6, and 7/8. To configure the top input for bipolar operation, select either 1 or 2 for the x value in the 50x command, and enter decimal 33 to 36 for the configuration code in register 4x + 1.
- For RTD or resistance measurements, channel pairs are wired on the field connector and are also configured in pairs. Either channel of the pair may be selected. For these measurements, the even channel must be used in the 4x read command. The odd channel will be indicated not active or valid in the 3x status register, and will display zero in its data register. For example, channel pairs are 1/2, 3/4, 5/6, and 7/8. To configure the top input for these measurements, select either 1 or 2 for the x value in the 50x command, and enter decimal 64 ... 95 (RTD) or 96 ... 116 (Ω) for the configuration code in register 4x + 1.
- If backplane or field power is lost, the module must be reconfigured.

### Register Configuration Commands - Modes - Modsoft

The following tables indicate the 4X+1 Register Configuration Commands, for the ADU 214 Module, in its various modes.

| **Commands (Decimal)** | **Ranges** | | |
|---|---|---|---|
| **Two-wire Unipolar Mode** | | | |
| 1 | 0 ... 10 V | | |
| 2 | 0 ... 5 V | | |
| 3 | 0 ... 1 V | 0 ... 20 mA* | 0 ... 10 mA** |
| 4 | 0 ... 0.5 V | 0 ... 10 mA* | 0 ... 5 mA** |
| 9 | 2 ... 10 V | | |
| 10 | 1 ... 5 V | | |
| 11 | 0.2 ... 1 V | 4 ... 20 mA* | 2 ... 10 mA** |
| 12 | 0.1 ... 0.5 V | 2 ... 10 mA* | 1 ... 5 mA** |
| 17 | 0 ... 10 V | | |
| 18 | 0 ... 5 V | | |
| 19 | 0 ... 1 V | 0 ... 20 mA* | 0 ... 10 mA** |
| 20 | 0 ... 0.5 V | 0 ... 10 mA* | 0 ... 5 mA** |
| 25 | 2 ... 10 V | | |
| 26 | 1 ... 5 V | | |
| 27 | 0.2 ... 1 V | 4 ... 20 mA* | 2 ... 10 mA** |
| 28 | 0.1 ... 0.5 V | 2 ... 10 mA* | 1 ... 5 mA** |
| **Note:** When using Commands 17 ... 28, the message CHANNEL INVALID is displayed if READ 15 BIT command is used. | | | |
| **Two-wire Bipolar Mode** | | | |
| 33 | + 10 V | | |
| 34 | + 5 V | | |
| 35 | + 1 V | + 20 mA* | + 10 mA** |
| 36 | + 0.5 V | + 10 mA* | + 5 mA** |
| * = 50Ω required across input ** = 100Ω required across input | | | |

## Register Configuration Commands - Detectors - Modsoft

The table below gives Register Configuration Commands for the ADU 214 Module, by Four-Wire Temperature Detector.

| Four-wire Temperature detector | |
|---|---|
| 64 | -60 ... +160 o C with Ni 100 |
| 65 | -160 ... +160 o C with Pt 100 |
| 66 | -200 ... +320 o C with Pt 100 |
| 67 | -200 ... +640 o C with Pt 100 |
| 68 | -60 ... +160 o C with Ni 200 |
| 69 | -169 ... +160 o C with Pt 200 |
| 70 | -200 ... +320 o C with Pt 200 |
| 71 | -200 ... +640 o C with Pt 200 |
| 72 | -60 ... +160 o C with Ni 500 |
| 73 | -160 ... +160 o C with Pt 500 |
| 74 | -200 ... +320 o C with Pt 500 |
| 75 | -200 ... +640 o C with Pt 500 |
| 76 | -60 ... +160 o C with Ni 1000 |
| 77 | -160 ... +160 o C with Pt 1000 |
| 78 | -200 ... +320 o C with Pt 1000 |
| 79 | -200 ... +640 o C with Pt 1000 |

Register Configuration Commands follow, for Two- and Three-wire Temperature detector - with wire compensation (10 Ω)

| 80 | -60 ... +160 o C with Ni 100 |
|---|---|
| 81 | -160 ... +160 o C with Pt 100 |
| 82 | -200 ... +320 o C with Pt 100 |
| 83 | -200 ... +640 o C with Pt 100 |
| 84 | -60 ... +160 o C with Ni 200 |
| 85 | -160 ... +160 o C with Pt 200 |
| 86 | -200 ... +320 o C with Pt 200 |
| 87 | -200 ... +640 o C with Pt 200 |
| 88 | -60 ... +160 o C with Ni 500 |
| 89 | -160 ... +160 o C with Pt 500 |
| 90 | -200 ... +320 o C with Pt 500 |
| 91 | -200 ... +640 o C with Pt 500 |
| 92 | -60 ... +160 o C with Ni 1000 |
| 93 | -60 ... +160 o C with Ni 100 |
| 94 | -200 ... +320 o C with Pt 1000 |
| 95 | -200 ... +640 o C with Pt 1000 |

## Register Configuration Commands - Resistance Measuring - Modsoft

The following table provides Register Configuration Commands for the ADU 214 Module, by form of resistance measuring.

| Four-wire Resistance measuring | |
|---|---|
| 96 | 0 ... 500 Ω |
| 97 | 0 ... 500 Ω |
| 98 | 0 ... 500 Ω |
| 99 | 0 ... 1000 Ω |
| 100 | 0 ... 2000 Ω |
| **Two-wire Resistance measuring with wire compensation (10 Ω)** | |
| 112 | 0 ... 100 Ω |
| 113 | 0 ... 200 Ω |
| 114 | 0 ... 500 Ω |
| 115 | 0 ... 1000 Ω |
| 116 | 0 ... 2000 Ω |

## Register Configuration Commands - Read Values - Modsoft

The following table addresses Read Configuration Values for the ADU 214 Module.

| **Read Configuration** | |
|---|---|
| 4X | **4YX** Decimal, with Y and X = Channels to be read (1 ... 8) |
| 4X+1 | Not used |
| 3X | Configure Command Response (Refer to *Invalid Commands - Modsoft, p. 155*) |
| 3X+1 | Channel X Configuration |
| 3X+2 | Channel Y Configuration |

Read Values Table appears next.

| **Read 12-bit Value** | |
|---|---|
| 4X | **4YX** Decimal, with Y and X = Channels to be read (1 ... 8) |
| 4X+1 | Not used |
| 3X | Configure Command Response (Refer to *Invalid Commands - Modsoft, p. 155*) |
| 3X+1 | Channel X Measurement |
| 3X+2 | Channel Y Measurement |
| **Read 13-bit Value** | |
| 4X | **2YX** Decimal, with Y and X = Channels to be read (1 ... 8) |
| 4X+1 | Not used |
| 3X | Measure Command Response (Refer to *Invalid Commands - Modsoft, p. 155*) |
| 3X+1 | Channel X Measurement |
| 3X+2 | Channel Y Measurement |
| **Read 15-bit Value** | |
| 4X | **3YX** Decimal, with Y and X = Channels to be read (1 ... 8) |
| 4X+1 | Not used |
| 3X | Measure Command Response (Refer to *Invalid Commands - Modsoft, p. 155*) |
| 3X+1 | Channel X Measurement |
| 3X+2 | Channel Y Measurement |

The Read Module Status table for the ADU 214 follows.

| **Read Module Status** | |
|---|---|
| 4X | **000** Decimal |
| 4X+1 | Not used |
| 3X | Configure Command Response (Refer to *Invalid Commands - Modsoft, p. 155*) |
| 3X+1 | 0 |
| 3X+2 | 0 |

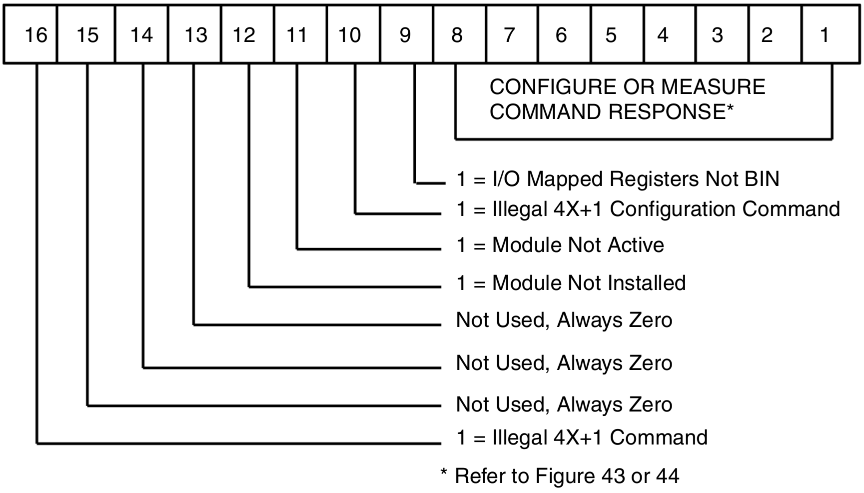
## Invalid Commands - Modsoft

Invalid 4X register commands, and valid commands other than "READ MODULE STATUS" - that are issued when the module is not ready - result in the responses described below.

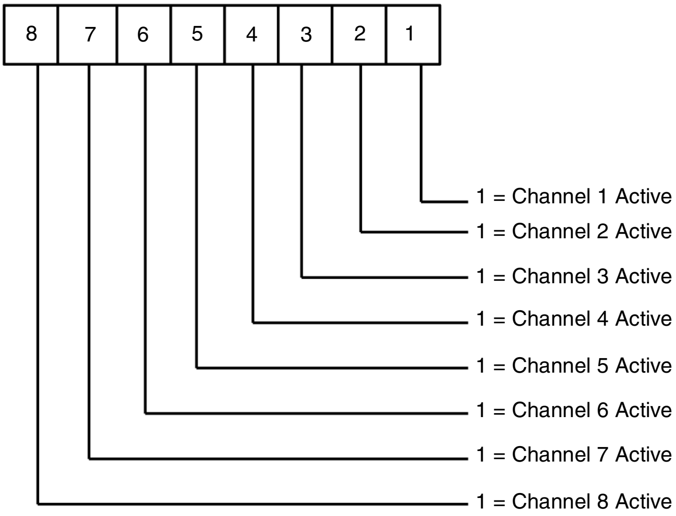
The following is a table of invalid commands, for the ADU 214 Module.

| **Invalid Commands** | |
|---|---|
| 3X | General Status (Bits 9 - 16 only, Bits 1 - 8 = 0); refer to *Invalid Commands - Modsoft, p. 155* |
| 3X+1 | 0 |
| 3X+2 | 0 |

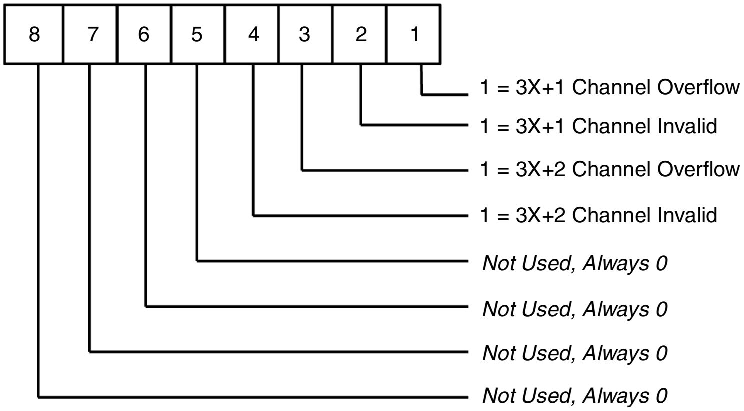
The following figure represents the 3x Status Register.



The following illustration is the Configure Command Response for the ADU 214 Analog Module.



Next is the MEASURE COMMAND Response.



*** For inactive channels: Overflow = 0, Invalid = 1**

The following figure is the Data Input Register Structure for the ADU 214 Analog Module.

**3x + 1 Data Input Register**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |

**3x + 2 Data Input Register**

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | | | |

## Installation

**Introduction**

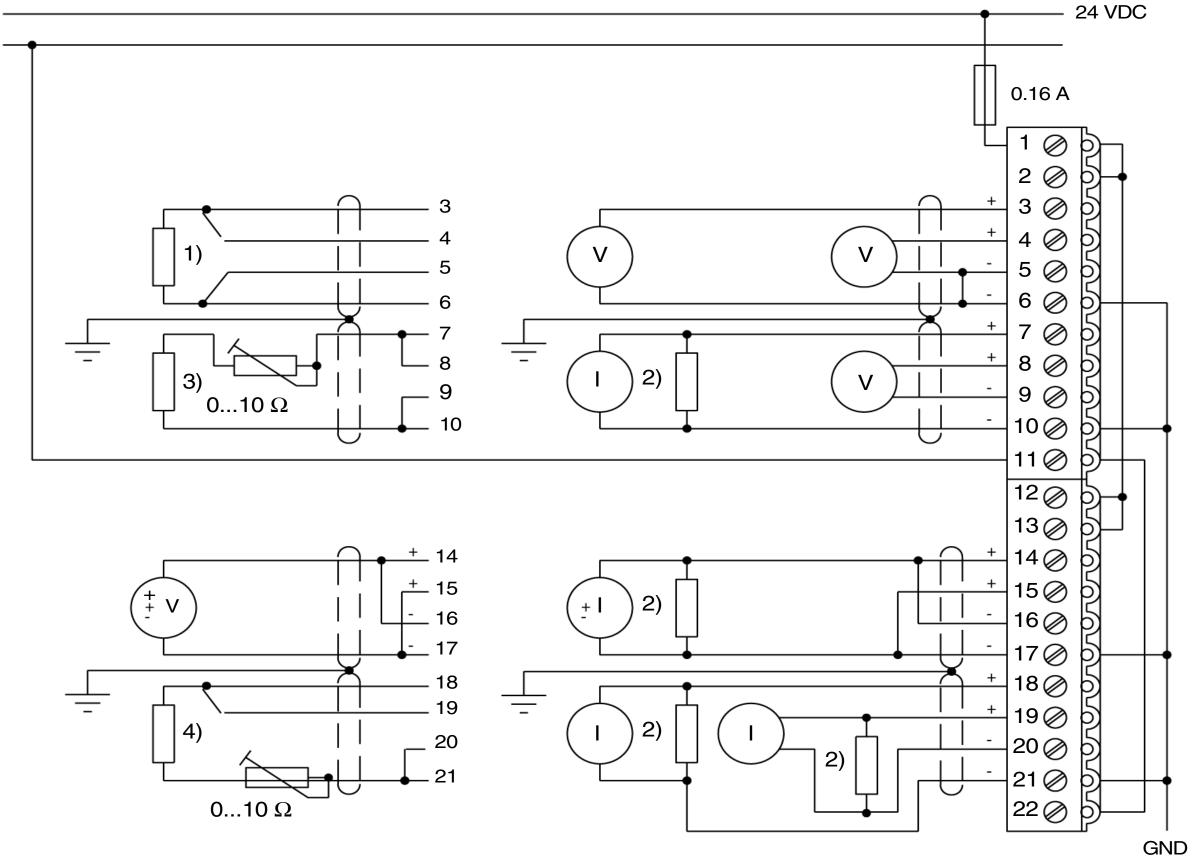
The following information describes how to install the ADU 214.

**Installation Overview**

installing the ADU 214 module consists of:
- Field wiring the module for the application selected
- Setting the DIP switches for appropriate AC noise suppression and contact fretting requirements
- I/O mapping and configuring the module to fit its application

**Field Wiring**

The following illustration is a Wiring Diagram for the ADU 214 Module.



1) Four-wire RTD (Pt 100 ... 1000, Ni 100 ... 1000) or resistance (0 ... 2000 Ω)
2) External reference resistance 50 or 100Ω, 0.1%, 0.125Ω for current measurement
3) Two-wire RTD (Pt 100 ... 1000, Ni 100... 1000) with 10Ω compensation
4) Three-wire RTD (Pt 100 ... 1000, Ni 100 ... 1000) with 10Ω compensation

**Note:** For general wiring and set-up instructions, refer to the *984-A120 Compact Programmable Controllers User Guide (GM-A984-PCS)*.

- Foil-shielded cables (2 or 4 x 0.5 mm twisted pair per channel) must be used for connections. All channels can be run within one joint shielded cable.
- If RTD detectors are connected with 4 wires (e.g., Ni 100, Pt 100), conductors for current and voltage path must be twisted in pairs.
- The connections between the shield and ground must be as short as possible (<20 cm) at one end. If higher noise levels exist, the cable shield must be grounded at both ends.
- The cable must be kept a minimum distance of >0.5 m away from power lines or similar sources of electrical interference.
- When using two- or three-wire RTD configurations, the ADU 214 requires an external adjustable 10 Ω series resistor in the RTD loop. This compensates for the unknown lead resistance, since the normal compensatory lead pair is missing. To calibrate the channel for the RTD configurations with 10 Ω compensation (configuration commands 80-95 decimal), perform the steps in the following procedure.

**Note:** Refer to *Configuration - Concept, p. 149* for information on how to select the two- or three-wire RTD operating mode.

## Calibrating the Channel for RTD Configurations Procedure

To calibrate the channel for the RTD configurations with 10 Ω compensation.

| Step | Action |
|---|---|
| 1 | Set up the RTD loop with the adjustable 10 Ω in the circuit and short the end of the wire run. |
| 2 | Configure the appropriate ADU 214 channel for 0-100 Ω input (configuration command decimal 96). |
| 3 | Adjust the 10 Ω potentiometer for a channel input reading of 3200 in the 15-bit mode-i.e., read 15 BIT VALUE, or the 4x Function Code Register = 3YX. |

**Accuracy Errors**

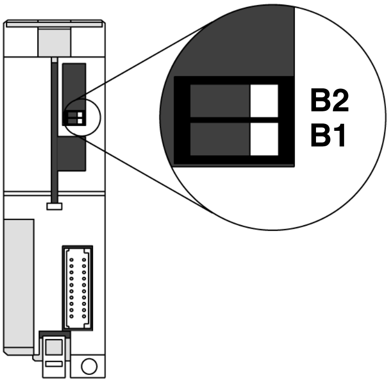
For PT100 measurements, if lead resistance is known to be less than 1 Ω, the uncompensated 4-wire configuration commands 64 ... 79 may be used and the 10 Ω adjustable resistor left out of the circuit. No calibration is required, but the accuracy errors listed in the following table can be expected.

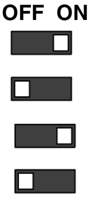
Accuracy Errors

| Lead Resistance | Error |
|---|---|
| 1.0 Ω | +2.605 C |
| 0.10 Ω | +0.255 C |
| 0.01 Ω | +0.0255 C |

**DIP Switch Settings**

The following illustration shows the locations of the DIP Switches.





B1 50 Hz noise suppression (as shipped)

B1 60 Hz noise suppression

B2 Fretting switched on (as shipped)

B2 Fretting switched off

**Noise Suppression (DIP Switch B1)**

The ADU 216 provides suppression of ac power frequencies on the peripheral lines. The module is shipped with 50 Hz suppression, and can be switched to 60 Hz suppression with DIP switch B1.

**Fretting (DIP Switch B2)**

Fretting prevents an increase of contact resistance on peripheral connections. Fretting is accomplished by outputting 10 V across the contacts at defined time intervals. The resulting current (flowing for 1 ms) is limited to < 8 mA. The contacts of the active inputs are fretted cyclically every 30 min. The fretting process is selected with DIP switch B2.

## ADU 214 Input Module Specifications

**Specifications**

The following information describes the ADU 214 Input Module specifications.

The following table provides ADU 214 Specifications for: Power Supply; Required Loadable; Inputs; and I/O Map.

| | | |
|---|---|---|
| Power Supply | External Supply | 24 Vdc typical 70 mA, maximum 150 mA |
| | Internal Power Supply (via system bus) | 5 Vdc typical 45 mA, maximum 100 mA |
| | Power Dissipation | 2 Ω typical, maximum 3 Ω |
| Required Loadable | SW-IODR-001 (See *Requirements for CE Compliance, p. 857*) | |
| Inputs | Number | 4 Inputs (4-pole/2-pole) temperature/ resistance 4 Inputs, two-wire current/ voltage bipolar or 8 Inputs, two-wire current/voltage unipolar; inputs may be mixed |
| | Potential Isolation | Non-isolated, channel-to-channel |
| I/O Map | Register 3x/4x | 3 in/2 out |

The following table shows the Voltage Measurements for the ADU 214 Module.

| | | | |
|---|---|---|---|
| Voltage Measurement | Input Impedance | >1 M Ω | |
| | Unipolar Measuring Ranges | 0 ... 0.5 V, 0 ... 1 V, 0 ... 5 V, 0 ... 10 V,<br>0.1 ... 0.5 V, 0.2 ... 1 V, 1 ... 5 V, 2 ... 10 V | |
| | Bipolar Measuring Ranges | +0.5 V, +1 V, +5 V, +10 V | |
| | Resolution | approx. 0.003% of final value, 15-bit plus sign | |
| | Measuring Fault at 25°C | For measuring ranges 0.5 V / 1 V | ±0.02% of Measuring Range Final Value (MFV), ±0.15% of Measured Value (MV) |
| | | For measuring ranges 5 V/10 V | ±0.01% of MFV, ±0.02% of MV |
| | Measuring Fault at 0 ... 60°C | For measuring ranges 0.5 V/1 V | ±0.10% of MFV, ±0.35% of MV |
| | | For measuring ranges 5 V/10 V | ±0.02% of MFV, ±0.11% of MV |
| | Typical Measuring Error | ≤0.5 above maximal errors | |
| | Inphase Voltage Range (Differential input for voltage measuring) Voltage of each input against GND | ≤+11 V | |
| | In-phase suppression | ≥60 dB | |
| | Maximum Overvoltage Static (1 Input for each module) | +30 V (24V power supply ON) +20 V (24V power supply OFF) | |
| | Maximum Overvoltage Dynamic | +50 V for ≤100 ms | |

This table gives the Current Measurements for the ADU 214 Module

| | | |
|---|---|---|
| Current Measurement | Measuring ranges with external 50 Ω reference resistance 0.1%, 0.1 Ω, TC 25 ppm | 0 ... 10 mA (0 ... 0.5 V), 0 ... 20 mA (0 ... 1 V), 2 ... 10 mA (0.1 ... 0.5 V), 4 ... 20 mA (0.2 ... 1 V), ±10 mA (+0.5 V), ±20 mA (±1 V) |
| | Measuring ranges with external 100 Ω measuring resistance 0.1%, 0.1 Ω, TC 25 ppm | 0 ... 5 mA (0 ... 0.5 V), 0 ... 10 mA (0 ... 1 V), 1 ... 5 mA (0.1 ... 0.5 V), 2 ... 10 mA (0.2 ... 1 V), ±5 mA (±0.5 V), ±10 mA (±1 V) |
| | Resolution | Approximately 0.003% of final value, 15-bit plus sign |
| | Critical values | See the various tables that descirbe Voltage Ranges. Load capacity of reference resistance must be considered, i.e., 50 Ω 0.1 Ω maximum 40 mA continuous |

The following table describes Temperature Measurement for the ADU 214 Module

| | | | | |
|---|---|---|---|---|
| Temperature Measurement (RTD 4-wire wire) | Input impedance | >1 M Ω | | |
| | Resolution | < 0.012% of Final Value ≥ 13 Bit + sign | | |
| | Measuring ranges with Pt 100 Pt 200, Pt 500, Pt 1000 | -160 ... +160°C, resolution ≤0.02°C -200 ... +320°C, resolution ≤0.04°C -200 ... +640°C, resolution ≤0.08°C | | |
| | Measuring ranges with Ni 100 Ni 200, Ni 500, Ni 1000 | Measuring Fault at 25°C (excluding inaccuracy of detector) for measuring ranges -60 / -160 ... +160°C | with Pt 100 ... Pt 1000 | ±0.35°C (= ±0.22 % of Measuring Range Final Value MFV) |
| | | | with Ni 100 ... Ni 1000 for measuring range -200 ... +320°C | ±0.3°C (= ±0.2 % of MFV) |
| | | | with Pt 100 ... Pt 1000 for measuring range -200 ... +640°C | ±0.5°C (= ±0.16 % of MFV) |
| | | | with Pt 100 ... Pt1000 | ±0.8°C (= ±0.13% of MFV) |
| | | Measuring Fault at 0 ... 60°C for measuring ranges -60 / -160 ... +160°C | with Pt 100, Ni 100 | ±0.8°C (= ±0.5 % of MFV) |
| | | | with Pt 200, Pt 500, Pt 1000 | ±0.65°C (= ±0.4 % of MFV) |
| | | | with Ni 200 | ±0.5°C (= ±0.32 % of MFV) |
| | | | with Ni 500, Ni 1000 | ±0.45°C (= ±0.3 % of MFV) |
| | | Measuring Fault at 0 ... 60°C for measuring range -200 ... +320°C | with Pt 100 | ±1.1°C (= ±0.35 % of MFV) |
| | | | with Pt 200 | ±0.95°C (= ±0.3 % of MFV) |
| | | | with Pt 500, Pt 1000 | ±0.9°C (= ±0.28 % of MFV) |
| | | Measuring Fault at 0 ... 60°C for measuring range -200 ... +640°C | with Pt 100 | ±1.6°C (= ±0.25 % of MFV) |
| | | | with Pt 200 | ±1.5°C (= ±0.23 % of MFV) |
| | | | with Pt 500, Pt 1000 | ±1.4°C (= ±0.22 % of MFV) |

The following table displays Resistance Measurement (4-wire wire), for the ADU 214 Module.

| | | | |
|---|---|---|---|
| Resistance Measurement (4-wire wire) | Input Impedance | >1 M Ω | |
| | Measuring Ranges | 0 ... 100 Ω, 0 ... 200 Ω, 0 ... 500 Ω, 0 ... 1000 Ω, 0 ... 2000 Ω | |
| | Resolution | ≤ 0.005% of final value, >14 Bit | |
| | Measuring Fault at 25°C for measuring range 100 ... 2000 Ω | ±0.1% of Measuring Range Final Value (MFV) | |
| | Measuring Fault at 0 ... 60°C | for measuring range 100 Ω | ±0.30% of MFV |
| | | for measuring range 200 Ω | ±0.25% of MFV |
| | | for measuring range 500...2000 Ω | ±0.20% of MFV |
| | Constant current | Approx. 1.5 mA for measuring range 0 ... 2000 Ω; approx. 2.5 mA for measuring ranges 0 ... 100 Ω, 0 ... 200 Ω, 0 ... 500 Ω 0 ... 1000 Ω | |

The following table addresses various aspects of the ADU 214 Module: Input Characteristics; Connections; Weight; and Agency Approvals.

| | | |
|---|---|---|
| Dynamic Characteristics of Inputs | Conversion time for all 8 inputs | 300 ms max |
| | Input Delay Time constant for HF suppression | 0.12 ms, typ |
| | Measurement Integration Time | 20 or 16.66 ms switchable |
| | Selectable AC Power Interference Suppression for f = n x 50/ 60 Hz | n = 1, 2 ...push-pull interferences >60 dB (peak value of interference voltage and measuring voltage ≤ final value x 1.1) |
| Connections | 4-wire Cable Length | max. 50 m for voltage detector |
| | 2-wire Cable Length | max. 100 m for voltage detector |
| | 4-wire Line Resistance | max. 25 Ω for each conductor |
| | 4-wire Line Capacitance | max. 10 nF for each conductor |
| Weight | .5lb (.22kg) | |
| Agency Approvals | UL 508; and CSA 22.2 No.142 | |

# ADU 216 Analog Input Module

# 8

## At a Glance

**Introduction**

This chapter describes the ADU 216 analog input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What Is the ADU 216 Analog Input Module?

**Brief Product Description**

The ADU 216 is an eight-channel analog input module with opto-isolation, designed to be used in thermocouple temperature and low-voltage measurement applications. It performs analog-to-digital conversions using a dual-slope integrating conversion method, converting analog input signals into digital values based on the principle of successive approximation.

**Note:** Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW—IODR—001) for proper operation when using certain PLCs (A984—1xx, E984—24x/251/255) with Modsoft.

The ADU 216 module has the following features:
- Operates off the 5 V supply voltage provided internally over the I/O bus, with no user-supplied external power source required.
- 16-bit resolution
- All eight channels are periodically strobed with a 1 mA current pulse to detect and report open circuits.

**Note:** You may use an ADU 257 module with its DIP switch set to the ADU 216 mode. In this mode the ADU 257 module performs just like an ADU 216 module.

**⚠ WARNING**

**Compatibility Warning**

The ADU 216 module will operate properly only when used with an A984, E984, or Micro 512/612 controller.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

## ADU 216 Analog Input Module Conversion Ranges

**Introduction**

The PLC model determines the ranges.

**Conversion Ranges**

A table is provided below for each of the following:

- A984-1xx and E984-24x/251/255
- E984-258/265/275/285

The ranges for A984-1xx and E984-24x/251/255 are listed below.

| Signal | Conversion | Resolution |
|---|---|---|
| K Thermocouple | (NiCrNi, IEC 584) | 0.05 degrees C |
| J Thermocouple | (FeCuNi, IEC 584) | 0.05 degrees C |
| Unipolar voltage | (linear) | 1.11 micro V |

The ranges for A984-1xx and E984-24x/251/255 are listed below.

| **Input (J TC degrees C)** | **Input (K TC degrees C)** | **Input (L TC C)** | **Decimal Value 15bits+sign** | **Operating Results** |
|---|---|---|---|---|
| <-210 | <-270 | <-200 | 0 | Under range |
|  | -270 |  | 27368 | Rated value range |
| -210 | -210 |  | 28568 |  |
| -200 | -200 | -200 | 28768 |  |
| 0 | 0 | 0 | 32768 |  |
| +900 | +900 | +900 | 50768 |  |
| +1200 | +1200 |  | 56768 |  |
|  | +1370 |  | 60168 |  |
| >+1200 | >+1370 | >+900 | +65535 | Over range |

Selection of the correct input conversion algorithm is done via the application program and the 4x holding register that is I/O mapped to this module (see *ADU 216 Analog Input Module Programming Modes, p. 178*.

**Note:** The ADU 216 module has open wire detection. If a channel is not wired, the READY (fault) LED will illuminate.

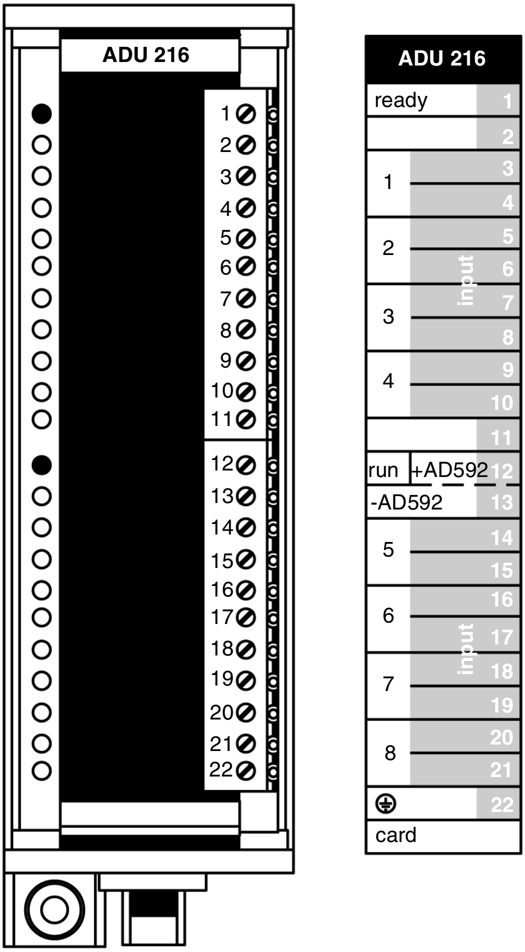
**Note:** The ADU 216 does not support bipolar mode.

## ADU 216 Analog Input Module Physical Characteristics

**Front View**

The ADU 216 can be installed in any slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and peripheral connections on the front. The blank label, which fits in the module cover, can be completed with information such as the signal values, etc., in the spaces provided.

The following illustration shows a front view of the ADU 216 including the label.



## LEDs

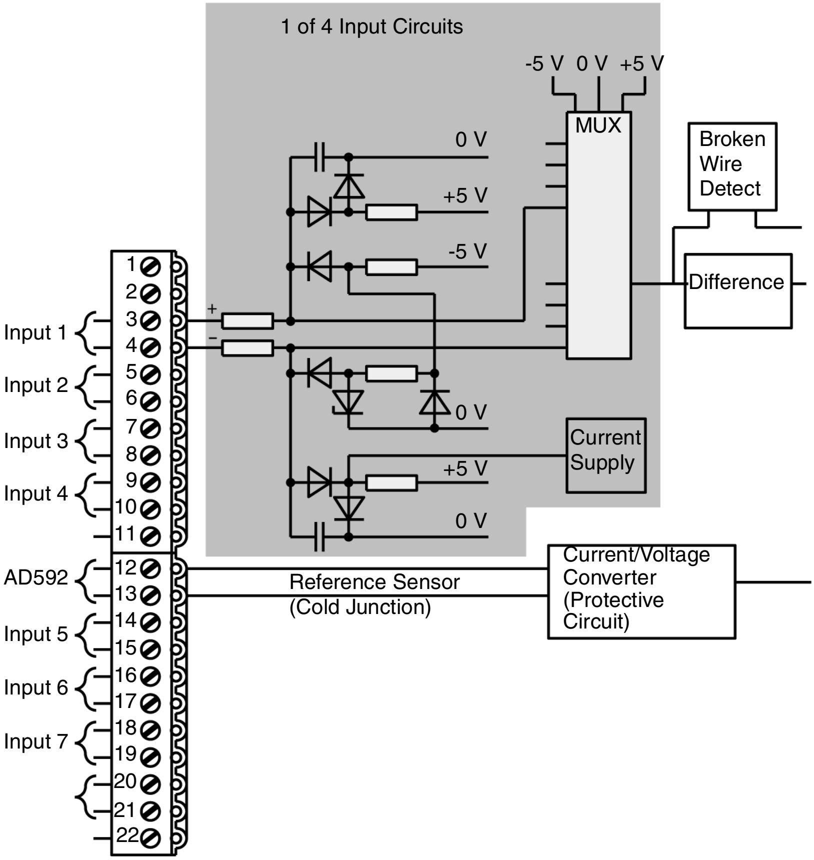
The ADU 216 has two green LEDs.

- READY (fault): One LED opposite terminal #1, if on or flashing, indicates that the on-board processor detected a fault condition, such as over range, open circuit, and so forth. For more information, see the Note.
- RUN: One green LED opposite terminal #12, if on, indicates that the on-board processor was initialized properly and is operating normally (i.e., continuously resetting the watchdog timer controlling the LED), and that the PLC is communicating with the module.

**Note:** Although the LED opposite terminal #1 is labeled READY, it actually indicates a fault condition. Note that this LED may be either green or red, but its function remains the same regardless of its color.

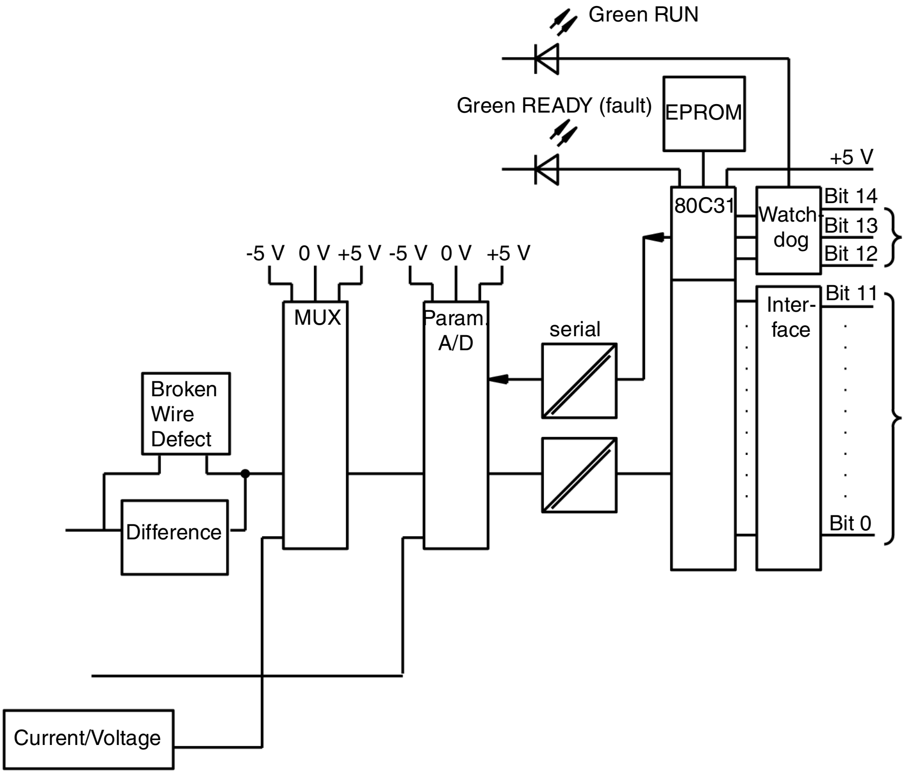
### Simplified Schematic

The following illustration is a simplified schematic for the ADU 216.



**Block Diagram**

The following illustration is a block diagram for the ADU 216.



## ADU 216 Analog Input Module Configuration

**Introduction**

The following items must be addressed when configuring the ADU 216:

- The module must be I/O Mapped as five 30XXX Input Registers and one 40XXX Output/Control Register, and Binary data type.
- Make connections and assignments of input addresses.
- Identify overall mode of operation, type of input, and error indication.
- Cabling guidelines.

**Note:** You may not use both type J and type K thermocouples with the same module.

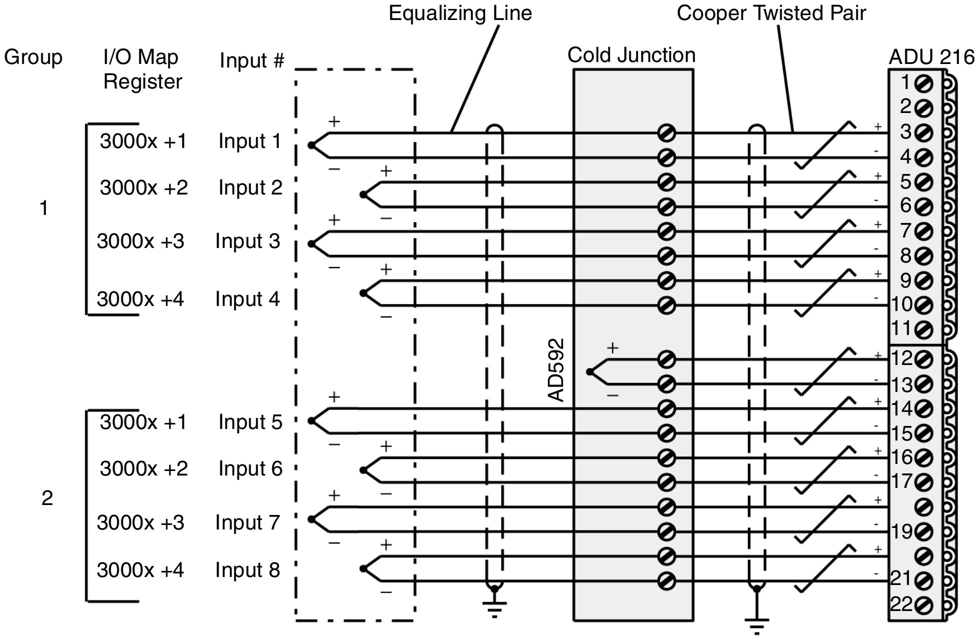
**Note:** The measured temperatures using type J or type K thermocouples must be higher than the reference sensor (cold junction) temperature to produce proper results.

**Cabling**

Shielded, twisted pair cable (2 or 4 x 0.5mm per channel) should be used. All channels can be connected with a common shielded cable.

**Note:** Unused inputs must be short circuited (jumper supplied).

An ADU 216 wiring example and associated registers for inputs is provided below.



**Note:** Voltages induced into cables (noise, etc.) must not exceed + 0.5 V measured at the input terminal versus GND.

**Note:** The reference sensor (cold junction) is factory-installed between terminals 12 and 13. For greater distances between the ADU 216 and the object of temperature measurement, the sensor can also be mounted at the remote terminal as shown (remember to observe correct polarity). The cable should be shielded twisted-pair to reduce susceptibility to induced noise signals.

## ADU 216 Analog Input Module Programming Modes

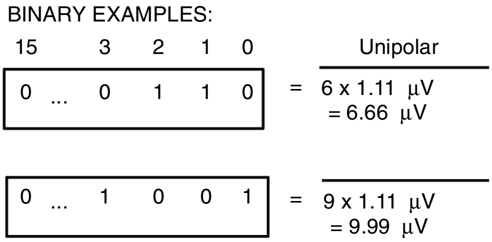
**Raw Module Data**

The ADU 216 module provides unipolar data.

Data modes are outlined below.

| Modes | Unipolar |
|---|---|
| Full Scale | 0 ... 65535 Dec<br>0 ... FFFF Hex |
| Analog Value | 0 ... 728.155 V |
| Value per Digit | 1.11 micro V |

Binary Example relates to the module. Modsoft loadables may change these values.



**General**

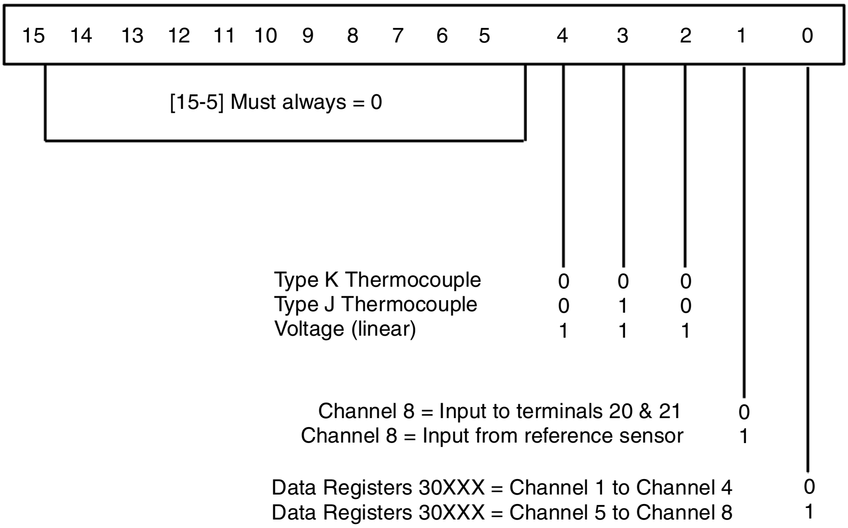
The ADU 216 is an 8-channel analog input module. The module operates in one of several modes, and the type of input signal that it processes is software selectable. The mode and signal type are set by the Traffic Copped 40XXX output register.

Five sequential 30XXX registers must also be Traffic Copped. The first register is used to read module operating status, and the remainder contain data from four of the eight channel inputs (the control register determines which inputs are reflected in the 30XXX input registers). Channel input data is updated every 1.5 seconds.

## 40XXX Control Register

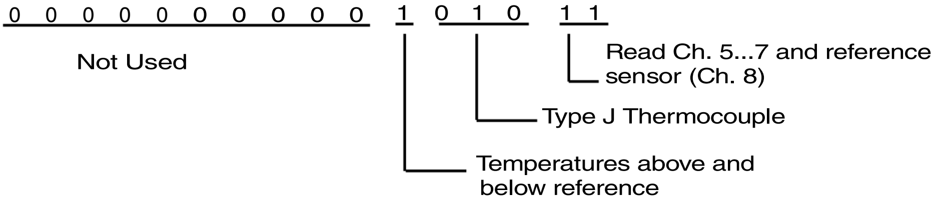
Bits in the ADU 216 control word and their meanings are shown in the following illustration.

**40XXX CONTROL WORD**



Bits 2 ... 4 must not be changed during operation. However, bits 0 and 1 may be changed during operation. Bits 5 ... 15 must always be set to 0.

**Example:**



## 30XXX Status and Data Registers

The figure above (bits in the ADU 216 control word and their meanings) describes the bit significance of the first 30XXX input register which displays the module status. The next four registers contain data representative of the individual channel input values. Refer to *Types of Modes and Their Functions, p. 182* for information on the values that may be expected.

Data values are the result of the type of input signal selected and the module operating mode selected.

| **Traffic Cop Registers** | **Data** |
|---|---|
| 30XXX | Module Status Information |
| 30XXX + 1 | Ch #1 Data/Ch #5 Data |
| 30XXX + 2 | Ch #2 Data/Ch #6 Data |
| 30XXX + 3 | Ch #3 Data/Ch #7 Data |
| 30XXX + 4 | Ch #4 Data/Ch #8 Data |

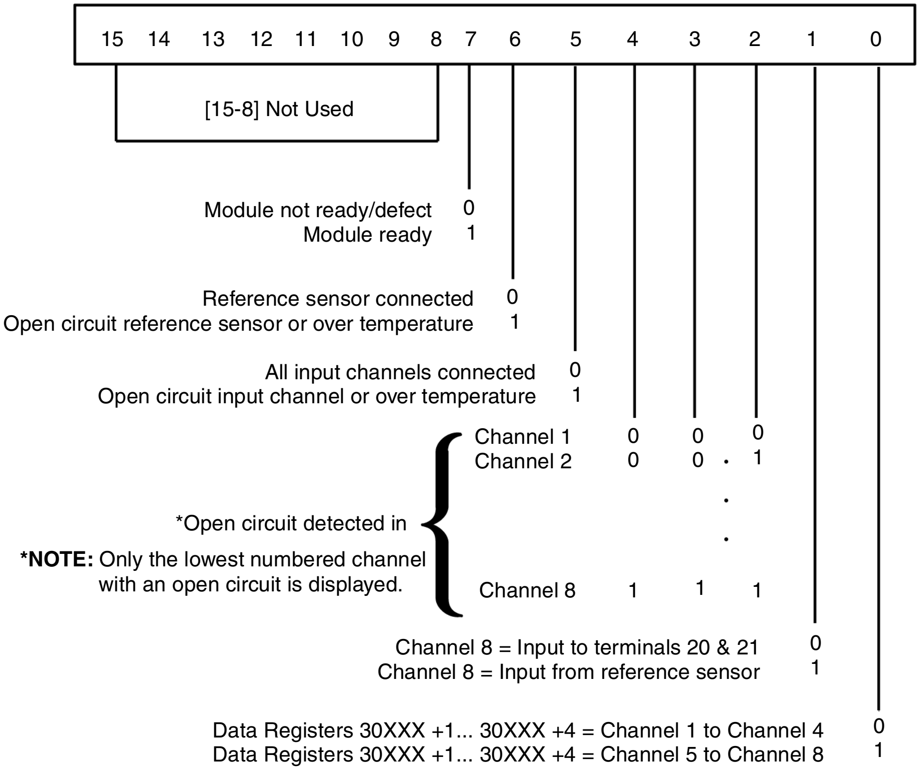
Channel #8 data can be either the result of the input signal applied to terminals 20 and 21, or the reference sensor (cold junction) connected to terminals 12 and 13 depending on the bit settings in the 40XXX control register. To use Channel #8 (30xxx + 4) as the reference sensor (cold junction) value, ensure Bits 0 and 1 are set to a one.

**Note:** The module scan rate is 1.5 seconds when you change the control word. It may take up to 1.5 seconds until the requested information is available in the status word. Therefore, the measured values taken within this time frame is invalid.

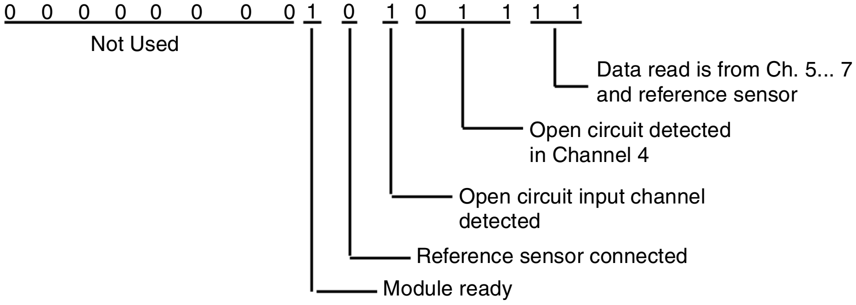
**Note:** The values of the 3x register(s) always reflect the reference sensor value (cold junction) of unused (jumpered) inputs.

Bits in the ADU 216 status word and their meanings are illustrated below.

**3x Status Register**



The following figure shows the Bits in the ADU 216 Control Word and their meanings



### Types of Modes and Their Functions

When power is first applied to the module, it will be in a state equivalent to that before power down. As long as power to the unit is maintained, the operating mode of the module will be unchanged through a stop/start cycle.

When the module goes out of range-either over or under range-and then returns to a valid operating range, the module will resume proper operations unless your out-of-range condition reaches or exceeds the safe operating range of +30 VDC.

**⚠ CAUTION**

**Unit Overload Hazard**

We do not recommend measuring high ohmic voltage sources, because the ADU 216 may heat up the sensor.

**Failure to follow this instruction can result in injury or equipment damage.**

**⚠ WARNING**

**Unit Damage Hazard**

Operation at an extreme out-of-range voltage - at or beyond +30 Vdc - will cause permanent damage to the module.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

## ADU 216 Analog Input Module Calibration

### Introduction

### ⚠ CAUTION

**Calibration caution.**

Modicon recommends that units requiring recalibration be returned to the factory, since inaccuracies could be due to faulty components. However, users who wish to perform their own calibration should use the following procedure.

**Failure to follow this instruction can result in injury or equipment damage.**

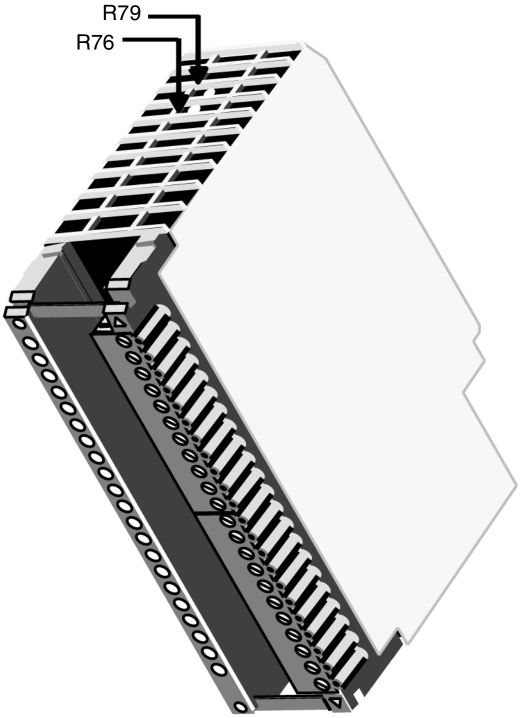
By adjusting the two potentiometers on the top of the ADU 216 module, you can calibrate the signal conversion of the eight input channels and the reference sensor.

In this procedure, R76 is used to calibrate the input channels, and R79 is used to calibrate the compensation by the reference sensor. Items required for calibration are:

- A dc Power Supply (+ 72.8 mV)
- A precision thermometer

## Calibrating the Analog Input Channels

The following illustration shows the location of the potentiometers on the ADU 216.



## Procedure for Adjusting Potentiometers

The following is the procedure for adjusting  the potentiometers:

| Step | Action |
|---|---|
| 1 | Connect a DC source (+72.800 mV) to one input channel.  Set the module for Voltage Input (linear).  Adjust R76 for a reading of FFF2 Hex. |
| 2 | Set the module read the reference sensor input at Channel 8. |
| 3 | Measure the exact temperature of the AD592 reference sensor element. |
| 4 | Adjust the reading for Channel 8 with R79 to the temperature measured in Step 3 (divide the reading by 20 for the module resolution of 0.05 degrees C/digit). |

## ADU 216 Analog Input Module Specifications

**Table of Specifications**

The following table contains a list of ADU 216 specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Channels | 8 | |
| | Data Format | Voltage or temperature value | |
| | Isolation | Channel-to-Bus: +/- 300 Vdc Non-isolated channel-to-channel | |
| Required Load able | SW-IODR-001 | | |
| Power Supply | Internal Source (from I/O bus) | 5 Vdc, 100 mA typ., 150 mA max. | |
| | Power Dissipation | 0.5 Ohm typical; 1 Ohm max. | |
| Voltage and Thermocouple Input Capabilities | Linear Measuring Range | Unipolar | 0 to 72.8 mV (1.1 micro V/digit) |
| | Ranges | Type J: Ambient ... 1100degrees C<br>Type K: Ambient ... 1370 degrees C | |
| | Compensated Measuring Range | Type J, K Thermocouple; resolution 0.05 degrees C | |
| | Max. Input Impedance | ≤ 500 ohms for Thermocouple and cold junction sensor | |
| | Cold Junction Sensor Type | AD 592 CN, -26 degrees C ... +106 degrees C | |
| | Noise Voltage of the in put to Common | +/- 0.5 V maximum | |
| | Wire Size, Max. | One wire: 14 AWG | |
| | | Two wires: 20 AWG | |
| I/O Map | Register 3x/4x | 5 in/1 out | |
| A/D Conversion | Conversion Time | 1.5 seconds for all 8 inputs, maximum | |
| | Resolution | 16-bit, unipolar | |
| | In-range Error Limit | @ 25 degrees C ambient | 0.1% of input value +/- 0.15 degrees C |
| | | @ 0 ... 60 degrees C ambient | +/- 0.3% of input value +/- 0.75 degrees C (with calibration of compensation by reference sensor input) |
| Noise Suppression | Common Mode Rejection | 55 dB @ 50 Hz, 60 Hz, 1 kHz minimum | |
| Operating Temperature | 0 ... 60 degrees C (32 ... 140 degrees F) | | |
| Relative Humidity | 0 ... 95% (non-condensing) @ 60 degrees C | | |

| | | |
|---|---|---|
| Dimensions | W x H x D | 40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 330 g (.725 lb.) |
| Agency Approvals | UL 508; and CSA 22.2 No.142 Standards | |

# Overview of the ADU 257 Analog Input Module

# 9

## At a Glance

**Purpose**

The purpose of this chapter is to describe the ADU 257 analog input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the ADU 257 Analog Input Module?

**Brief Product Description**

The ADU 257 is an eight-channel thermocouple or four-channel RTD input module with opto-isolation. The ADU 257 provides linearization for Thermocouples and Resistance Temperature Device inputs. The ADU 257 operates at extended temperature and has the following characteristics:

- Thermocouple types B,E,J,K,N,R,S,T are supported.
- RTD types Pt100,200,500,1000 American, Pt100,200,500,1000, and Ni100,200,500,1000 are supported.
- 2-wire, 3-wire, 4-wire RTD connections are supported.
- Linear ranges include 0... 4000 Ohms and +/-100mV.
- 12-bit, 16-bit, 15-bit plus sign, and 32-bit resolutions are available for all inputs.
- Both Celsius and Fahrenheit temperature units are available.
- Factory installed CJC sensors (AD592) provide ambient temperature at the ADU 257s location. The CJC sensor temperature values are stored in two 3x input registers for your application needs.
- Errors noted via the Concept I/O Map Status Word.
- The module may be used in two different modes via a DIP switch -- either as an ADU 257, or as an ADU 216.

**Note:** The ADU 257 mode requires Concept 2.2 (or higher) panel software. The ADU 216 mode requires Modsoft 2.6.1 (or higher) panel software and the ADU 216.DAT Loadable (available on the Modicon.com website).

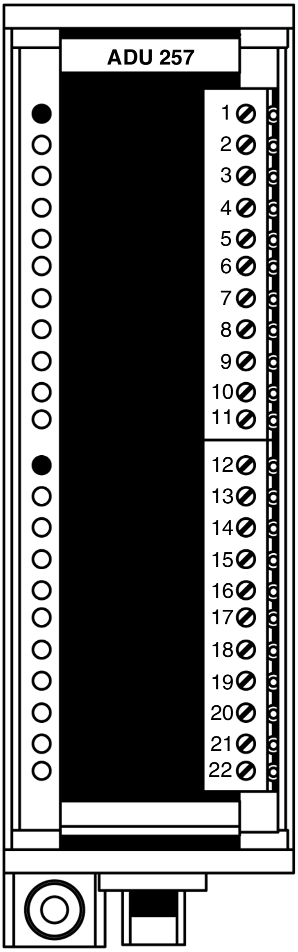
- Input selection and range can be set independently via the panel software.

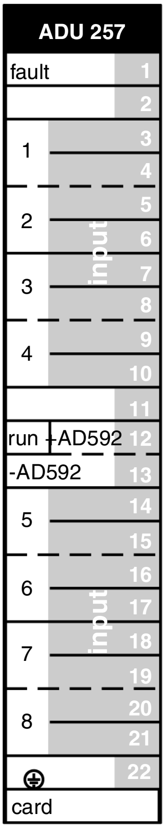
## ADU 257 Analog Input Module Physical Characteristics

**Illustration**

The ADU 257 can be installed in any I/O slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and peripheral connections on the front. The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided.

A front view with the ADU 257 label is provided below.





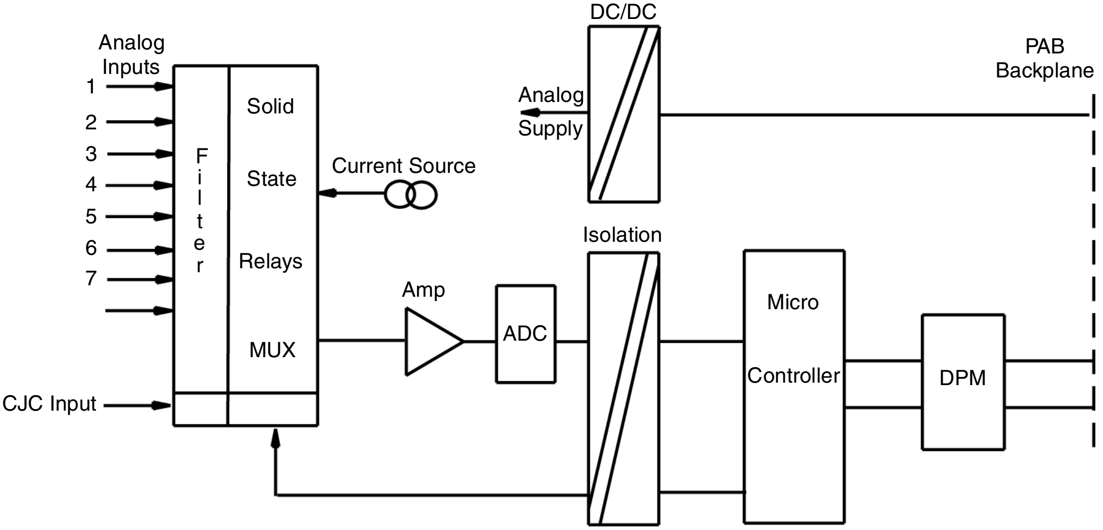
## LEDs

The following table contains descriptions of the ADU 257 LEDs.

| LED# | LED Name | Color | Function |
|---|---|---|---|
| 1 | Fault | Red | Pertains to a fault:<br>ON= Fault detected (over range, under range, broken wire)<br>OFF=No fault detected |
| 12 | Run | Green | Pertains to the processor operation:<br>ON=Processor operating between the ADU 257 and the PLC without fault<br>OFF=Fault in processor operation |

## Block Diagram

A block diagram for the ADU 257 is provided below.



## Installing the ADU 257 Analog Input Module

**Introduction**

The following procedures are necessary when installing the ADU 257:

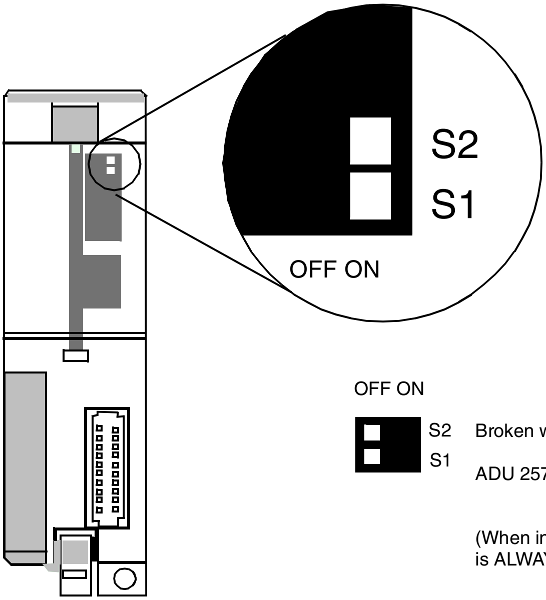
- Set DIP switches.
- Make connections and assign input addresses.
- I/O map the module as 20-3x input registers.
- Identify overall mode of operation and type of input.

## Setting Switches

The module may be used in two different modes (ADU 216 or ADU 257). Switch 1 is used to set the mode. The ADU 257 is shipped with Switch 1 in the OFF position -- in ADU 257 mode.

The module may be used with broken wire detection activated or deactivated. Switch 2 is used to activate or deactivate broken wire detection.The ADU 257 is shipped with Switch 2 in the OFF position -- with broken wire detection active.

The following illustration shows the ADU 257, with both switches OFF (S1 OFF = ADU 257 mode, S2 OFF = broken wire detection activated).



**DIP Switch Settings for S1 and S2:**

S2 Broken wire detection active=OFF or No broken wire detection=ON

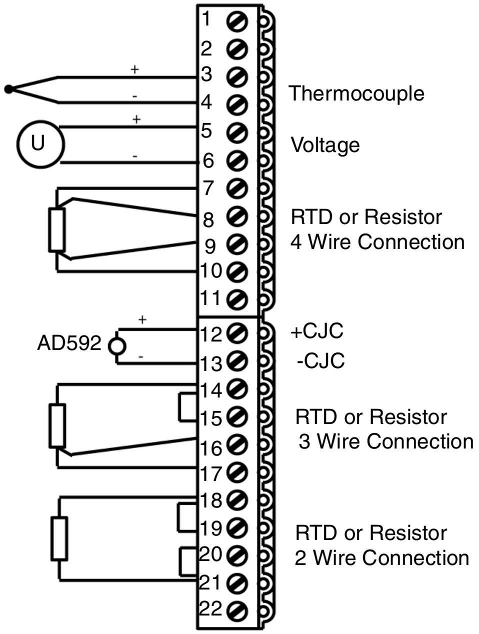
S1 ADU 257 mode=OFF or ADU 216 mode=ON

(When input is configured as 100mV range, the broken wire detection is ALWAYS OFF)

To change to ADU 216 mode, move Switch 1 to the ON position. For details on the ADU 216 Analog Input module, refer to the chapter for that module.

**Note:** The ADU 257 mode requires Concept 2.2 (or higher) panel software. The ADU 216 mode requires Modsoft 2.6.1 (or higher) panel software and the ADU 216.DAT Loadable (available on the Modicon.com website).

**Wiring Diagram** An ADU 257 wiring diagram is provided below.



**Note:** The factory installed cold junction sensor located between terminals 12 and 13 may be mounted at a remote terminal for greater distances between the ADU 257 and the object of temperature measurement. Please observe correct polarity.

# ADU 257 Isolated Analog Input Module Operation

**Introduction**

The ADU 257 is an eight-channel analog input module. Its field connector is wired depending on the type of input to be measured, either TC or RTD. Two connections are used per RTD; therefore, only four channels may be used. Otherwise, you have eight channels available for TC devices or linear measurements. Any of the inputs may be either TC, linear, or RTD, and any combination of the three may be used.

The module can operate in one of several modes, and the input channel ranges are individually selectable. The mode and ranges are set via the panel software. Channel input data is updated every 800 ms. When power is first applied to the module, its inputs are inactive.

**I/O Map**

The ADU 257 requires 20-3x input registers addressed in sequence, beginning with two module status 3x registers, 16 data channel 3x registers (channels 1... 8), and two cold junction sensor 3x registers

| I/O Map Registers | Data |
|---|---|
| 3x | Input status word |
| 3x + 1 | Input status word |
| 3x + 2 | Input #1 data (low word) |
| 3x + 3 | Input #1 data (high word) |
| ...<br>... | ...<br>... |
| 3x + 17 | Input #8 data (low word) |
| 3x + 18 | Input #8 data (high word) |
| 3x + 19 | Input #9 data (cold junction sensor) (low word) |
| 3x + 20 | Input #9 data (cold junction sensor) (high word) |

## Conversions

The following tables detail the various voltage and current conversions for the ADU 257 module.

| +/- 100mV Range and Data Display Format | | | | | |
|---|---|---|---|---|---|
| Millivoltage | 12 bit | 16 bit | 15 bit + sign high resolution | IEEE 754 floating point | Range |
| <+102.4mV | +4095 | +65535 | +32767 | +1.024 E02 | Overrange |
| >+100mV... +102.4mV | +4095 | +65535 | +32001... +32766 | +1.0 E02... +1.024 E02 | Pos. tolerance range |
| +100mV | +4095 | +65535 | +32000 | +1.0 E02 | Nominal |
| 0mV | +2048 | +32768 | 0 | 0 | |
| -100mV | 0 | 0 | -32000 | -1.0 E02 | |
| <-100mV... -102.4mV | 0 | 0 | -32001... -32766 | <-1.0 E02... -102.4 E02 | Neg. tolerance range |
| <-102.4mV | 0 | 0 | -32767 | -1.024 E02 | Underrange |

## 0... 4000Ω

0... 4000Ω Range and Data Display Format

| Resistance | 12 bit | 16 bit | 15 bit + sign high resolution | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >4095Ω | +4095 | +65535 | +32767 | +4.096 E03 | Overrange |
| >4000... 4095Ω | +4095 | +65535 | +32001... +32766 | >+4.0 E03... +4.095 E03 | Pos. tolerance range |
| 4000Ω | +4095 | +65535 | +32000 | +4.0 E03 | Nominal |
| 0Ω | 0 | 0 | 0 | 0 | |
| | 0 | 0 | -2 | -2.0 E00 | Broken wire |

## IEC 751 Pt100,200,500,1000 -200... +850 C

IEC 751 Pt100,200,500,1000 -200... +850 C (-328... +1562 F) Range and Data Display Format

| RTD | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+850C (+1562F) | +4095 | +65535 | +8501 (+15621) | 8.501 E02 (1.5621 E03) | Overrange |
| +850C (+1562F) | +4095 | +65535 | +8500 (+15620) | 8.500 E02 (1.562 E03) | Nominal |
| 0 (+32F) | +780 | +12483 | 0 (+320) | 0 (3.20 E01) | |
| -200C (-328F) | 0 | 0 | -2000 (-3280) | -2.00 E02 (-3.28 E02) | |
| <-200C (-328F) | 0 | 0 | -2001 (-3281) | -2.001 E02 (-3.281 E02) | Underrange |
| | 0 | 0 | -2002 (-3282) | -2.002 E02 (-3.282 E02) | Broken wire |

## SAMA (US) Pt100,200,500, 1000 -200... +650 C

SAMA (US) Pt100,200,500,1000 -200... +650 C (-328... +1112 F) Range and Data Display Format

| RTD | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+600C (+1112F) | +4095 | +65535 | +6001 (+11121) | 6.001 E02 (1.113 E03) | Overrange |
| +600C (+1112F) | +4095 | +65535 | +6000 (+11120) | 6.000 E02 (1.112 E03) | Nominal |
| 0C (+32F) | +1024 | +16384 | 0 (+320) | 0 (3.20 E01) | |
| -200C (-328F) | 0 | 0 | -2000 (-3280) | -2.00 E02 (-3.28 E02) | |
| <-200C (-328F) | 0 | 0 | -2001 (-3281) | -2.001 E02 (-3.281 E02) | Underrange |
| | 0 | 0 | -2002 (-3282) | -2.002 E02 (-3.282 E02) | Broken wire |

**DIN43760 Ni100,200,500, 1000 -60... +250 C**

DIN43760 Ni100,200,500,1000 -60... +250 C (-76... +482 F) Range and Data Display Format

| RTD | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+250C (+482F) | +4095 | +65535 | +2501 (+4821) | 2.501 E02 (4.821 E02) | Overrange |
| +250C (+482F) | +4095 | +65535 | +2500 (+4820) | 2.500 E02 (4.820 E02) | Nominal |
| 0C (+32F) | +793 | +12684 | 0 (+320) | 0 (3.20 E01) | |
| -60C (-76F) | 0 | 0 | -600 (-760) | -6.00 E01 (-7.6 E01) | |
| <-60C (-76F) | 0 | 0 | -601 (-761) | -6.01 E01 (-7.61 E01) | Underrange |
| | 0 | 0 | -602 (-762) | -6.02 E01 (-7.62 E01) | Broken wire |

**Thermocouple Type R,S -50... +1768 C**

Thermocouple Type R,S -50... +1768 C (-58... +3214.4 F) Range and Data Display Format

| TC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+1768C (+3214.4F) | +4095 | +65535 | +17681 (+32146) | 1.7681 E03 (3.2146 E03) | Overrange |
| +1768C (+3214.4F) | +4095 | +65535 | +17680 (+32144) | 1.7680 E03 (3.2144 E02) | Nominal |
| 0C (+32F) | +113 | +1802 | 0 (+320) | 0 (3.20 E01) | |
| -50C (-58F) | 0 | 0 | -500 (-580) | -5.00 E01 (-5.80 E01) | |
| <-50C (-58F) | 0 | 0 | -501 (-582) | -5.01 E01 (-5.82 E01) | Underrange |
| | 0 | 0 | -502 (-584) | -5.02 E01 (-5.84 E01) | Broken wire |

## Thermocouple Type B +50... +1800 C

Thermocouple Type B +50... +1800 C (+122... +3272 F) Range and Data Display Format

| TC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+1800C (+3272F) | +4095 | +65535 | +18001 (+32722) | 1.8001 E03 (3.2722 E03) | Overrange |
| +1800C (+3272F) | +4095 | +65535 | +18000 (+32720) | 1.8000 E03 (3.2720 E03) | Nominal |
| 50C (+122F) | 0 | 0 | +500 (+1220) | 5.00 E01 (1.220 E02) | |
| <50C (+122F) | 0 | 0 | +499 (+1218) | 4.99 E01 (1.218 E02) | Underrange |
| | 0 | 0 | +498 (+1216) | 4.98 E01 (1.216 E02) | Broken wire |

## Thermocouple Type J -210... +1200 C

Thermocouple Type J -210... +1200 C (-346... +2192 F) Range and Data Display Format

| TC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+1200C (+2192F) | +4095 | +65535 | +12001 (+21922) | 1.2001 E03 (2.1922 E03) | Overrange |
| +1200C (+2192F) | +4095 | +65535 | +12000 (+21920) | 1.2000 E03 (2.1920 E03) | Nominal |
| 0C (+32F) | +610 | +9761 | 0 (+320) | 0 (3.20 E01) | |
| -210C (-346F) | 0 | 0 | -2100 (-3460) | -2.100 E02 (-3.460 E02) | |
| <-210C (-346F) | 0 | 0 | -2101 (-3462) | -2.101 E02 (-3.462 E02) | Underrange |
| | 0 | 0 | -2102 (-3464) | -2.102 E02 (-3.464 E02) | Broken wire |

### Thermocouple Type T -270... +400 C

Thermocouple Type T -270... +400 C (-454... +752 F) Range and Data Display Format

| TC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+400C (+752F) | +4095 | +65535 | +4001 (+7522) | 4.001 E02 (7.522 E02) | Overrange |
| +400C (+752F) | +4095 | +65535 | +4000 (+7520) | 4.000 E02 (7.520 E02) | Nominal |
| 0C (+32F) | +1650 | +26410 | 0 (+320) | 0 (3.20 E01) | |
| -270C (-454F) | 0 | 0 | -2700 (-4540) | -2.700 E02 (-4.540 E02) | |
| <-270C (-454F) | 0 | 0 | -2701 (-4542) | -2.701 E02 (-4.542 E02) | Underrange |
| | 0 | 0 | -2702 (-4544) | -2.702 E02 (-4.544 E02) | Broken wire |

### Thermocouple Type E -270... +1000 C

Thermocouple Type E -270... +1000 C (-454... +1832 F) Range and Data Display Format

| TC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+1000C (+1832F) | +4095 | +65535 | +10001 (+18322) | 1.0001 E03 (1.8322 E03) | Overrange |
| +1000C (+1832F) | +4095 | +65535 | +1000 (+18320) | 1.0000 E03 (1.8320 E03) | Nominal |
| 0C (+32F) | +871 | +13933 | 0 (+320) | 0 (3.20 E01) | |
| -270C (-454F) | 0 | 0 | -2700 (-4540) | -2.700 E02 (-4.540 E02) | |
| <-270C (-454F) | 0 | 0 | -2701 (-4542) | -2.701 E02 (-4.542 E02) | Underrange |
| | 0 | 0 | -2702 (-4544) | -2.702 E02 (-4.544 E02) | Broken wire |

## Thermocouple Type K -270... +1372 C

Thermocouple Type K -270... +1372 C (-454... +2501.6 F) Range and Data Display Format

| TC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+1372C (+2501.6F) | +4095 | +65535 | +13721 (+25018) | 1.3721 E03 (2.5018 E03) | Overrange |
| +1372C (+2501.6F) | +4095 | +65535 | +13720 (+25016) | 1.3720 E03 (2.5016 E03) | Nominal |
| 0C (+32F) | +673 | +10776 | 0 (+320) | 0 (3.20 E01) | |
| -270C (-454F) | 0 | 0 | -2700 (-4540) | -2.700 E02 (-4.540 E02) | |
| <-270C (-454F) | 0 | 0 | -2701 (-4542) | -2.701 E02 (-4.542 E02) | Underrange |
| | 0 | 0 | -2702 (-4544) | -2.702 E02 (-4.544 E02) | Broken wire |

## Thermocouple Type N -270... +1300 C

Thermocouple Type N -270... +1300 C (-454... +2372 F) Range and Data Display Format

| TC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+1300C (+2372F) | +4095 | +65535 | +13001 (+23722) | 1.3001 E03 (2.3722 E03) | Overrange |
| +1300C (+2372F) | +4095 | +65535 | +13000 (+23720) | 1.3000 E03 (2.3720 E03) | Nominal |
| 0C (+32F) | +704 | +11270 | 0 (+320) | 0 (3.20 E01) | |
| -270C (-454F) | 0 | 0 | -2700 (-4540) | -2.700 E02 (-4.540 E02) | |
| <-270C (-454F) | 0 | 0 | -2701 (-4542) | -2.701 E02 (-4.542 E02) | Underrange |
| | 0 | 0 | -2702 (-4544) | -2.702 E02 (-4.544 E02) | Broken wire |

**Cold Junction Sensor AD592 -25... +105 C**

Cold Junction Sensor AD592 -25... +105 C (-13... +221 F) Range and Data Display Format

| CJC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+125C (+257F) | +4095 | +65535 | +1051 (+2212) | 1.051 E02 (2.212 E02) | Overrange |
| +125C (+257F) | +4095 | +65535 | +1050 (+2210) | 1.050 E02 (2.210 E02) | Nominal |
| 0C (+32F) | +683 | +10923 | 0 (+320) | 0 (3.20 E01) | |
| -25C (-13F) | 0 | 0 | -250 (-130) | -2.50 E01 (-1.30 E01) | |
| <-25C (-13F) | 0 | 0 | -251 (-132) | -2.51 E01 (-1.32 E01) | Underrange |
| | 0 | 0 | -252 (-134) | -2.52 E01 (-1.34 E01) | Broken wire |

## ADU 257 Analog Input Module Specifications

**Table of Specifications**

The following table contains a list of ADU 257 specifications.

| | | |
|---|---|---|
| Module Topology | Number of channels | 8 TC, 4 RTD |
| | Data Format | TC, RTD, mV linear, Ohms linear inputs |
| | Isolation test voltage channel to channel | 400Vdc maximum via solid state relays |
| | Isolation test voltage channel to bus | 500Vac maximum |
| | Isolation test voltage channel to earth | 500Vac maximum |
| Power Supply | Internal Source (from I/O bus) | 5VIO; 120mA typical |
| I/O Map | Register 3x/4x | 20 in/0 out |
| TC Inputs | TC types | B,E,J,K,N,R,S,T |
| | Linear Measuring Range | +/-100mV |
| | CJC sensor | Factory installed reference sensor to terminals 12 and 13 |
| | Cold junction sensor type (factory installed) | AD 592 CN, -26 degrees C ... +106 degrees C |
| | Overload protection | +30Vdc continuously |
| | Resolution | 12Bits, 16Bits, 15Bits plus sign, 32Bits |
| | Accuracy for TC ranges @ 0 ... 60 degrees C, includes CJC, offset, gain error | For J,K,N,E,T types:<br>+/-2 degrees C +/-0.1 percent of reading (+/-1.5 degrees C for temp. less than 100) (assumes no delta between CJC and CJ sensor) |
| | Accuracy for TC ranges @ 0 ... 60 degrees C, includes CJC, offset, gain error | For S,R,B types:<br>+/-4 degrees C +/-0.1 percent of reading (assumes no delta between CJC and CJ sensor) |

| | | |
|---|---|---|
| RTD Inputs | RTD types | 2/3/4 wire IEC Pt100/200/500/1000,<br>2/3/4 wire American Pt100/200/500/1000,<br>2/3/4 wire Ni100/200/500/1000 |
| | Linear Measuring Range | 0 ... 4000 ohms |
| | Overload protection | +30Vdc continuously |
| | Resolution | 12Bits, 16Bits, 15Bits plus sign, 32Bits |
| | Accuracy for RTD ranges @ 25 degrees C ambient temperature | 0.5 degrees C |
| | Accuracy for RTD ranges @ 60 degrees C ambient temperature | 0.9 degrees C |
| | Derating of accuracy for -25 ... +70 degrees C | 1.25C |
| Dynamic Characteristics of Inputs | Conversion time for all inputs | 800mS maximum |
| | Interference voltage suppression (main suppression) for f=nx50 or 60Hz | n=1,2 ... |
| | Common-mode rejection | less than 110dB |
| Physical Characteristics | Format | 1 slot |
| | Dimensions (W x H x D) | 40.3 x 145 x 117.5 mm<br>1.6 x 5.6 x 4.5 in |
| | Weight | 320g, 0.710 lb |
| | Wire Size | 1-14AWG, 2-20AWG |
| Environmental Characteristics | Operating Temperature | -40 ... +70 degrees C |
| Agency Approvals | ADU 257: VDE 0160; UL 508; CSA 22.2 No.142; and European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 857*) Standards | |
| | ADU 257C: VDE 0160; UL 508; CSA 22.2 No.142; and European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 857*) Standards | |

# AS-BDEA 203 Profibus-DP Coupler Module Description

# 10

## At a Glance

**Overview**

This chapter describes the AS-BDEA Profibus-DP Coupler Module.

**What's in this Chapter?**

This chapter contains the following topics:

## Configuration

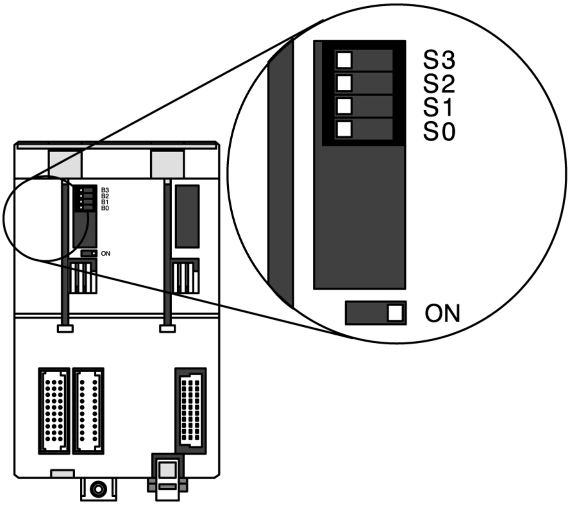
### Overview

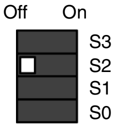
To configure the AS-BDEA the following tasks must be performed

### Settings (Slave Address, Disconnection Behavior)

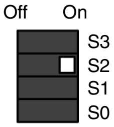
**Slave Address**-The slave address (node address) is to be set on the front panel "x10, x1" rotary switches. Addresses from 1 ... 99 are allowed (0=as shipped ).

**Disconnection Behavior**- See the following figure for disconnection behavior. Switches S0 and S1are meaningless

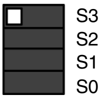




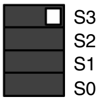
Forced cutoff



Halt with value retention
(outputs remain unchanged)



Firmware Standard*



Reserved for AEG service specialists
(Test bay setting)

* As shipped

## I/O Expansion Limitations

Arbitrary I/O combinations are only possible with discrete I/O modules. Use of analog I/O modules restricts total data volume to a particular level. Total data volume is the sum of data from the PROFIBUS master to the AS–BDEA 203 (D out), and from the AS–BDEA 203 to the PROFIBUS master (D in).The feasibility of a particular combination can be verified with the followingtables. The first table lists data volume by respective module (D out / D in) in bytes.The data volume of all employed modules through the AS–BDEA 203 to the PROFIBUS master (D in sums) must </= 244 bytes.

In accordance with the (D in) data volume, this table permits the data volume calculation for PROFIBUS master to AS–BDEA 203 (D out). With the second table the (D out) data volumes of all employed modules is to be checked against the max. permissible (D out) data volume.

Data volume by module

| Module | D In Data Volume (Bytes | D Out Data Volume (Bytes |
|---|---|---|
| DEP 208, DEP 210, DEP 211 | 1 | 0 |
| DAP 204, DAP 208, DAP 210 | 0 | 1 |
| DAP 212, DAP 220, DAP 292 | 1 | 1 |
| DEO 216, DEP 214, DEP 215, DEP 216, DEP 217, DEP 218, DEP 220, DEP 296, DEP 297, DEX 216 | 2 | 0 |
| DAO 216, DAP 216, DAP 217, DAP 218, DAX 216 | 0 | 2 |
| DAU 202 | 0 | 4 |
| DAU 208 | 0 | 16 |
| ADU 204, ADU 205 | 10 | 0 |
| ADU 206,ADU 216 | 10 | 1 |
| ADU 210 | 10 | 4 |
| ADU 214 | 18 | 8 |

Max permissible "D Out" data volume in respect to "D In" data volume.

| Data In Data volume Sums (Bytes) | Max Data Out Volume Sums (Bytes) |
|---|---|
| 241...244 | 144 |
| 233...240 | 152 |
| 225...232 | 160 |
| 217...224 | 168 |
| 209...216 | 176 |
| 0...208 | 184 |

## Subtrack Mounting Slot

Enter system relevant power supply information in the label inlay.Noise immunity can be improved when by–pass capacitors are installed at the power supply module U and M terminals.

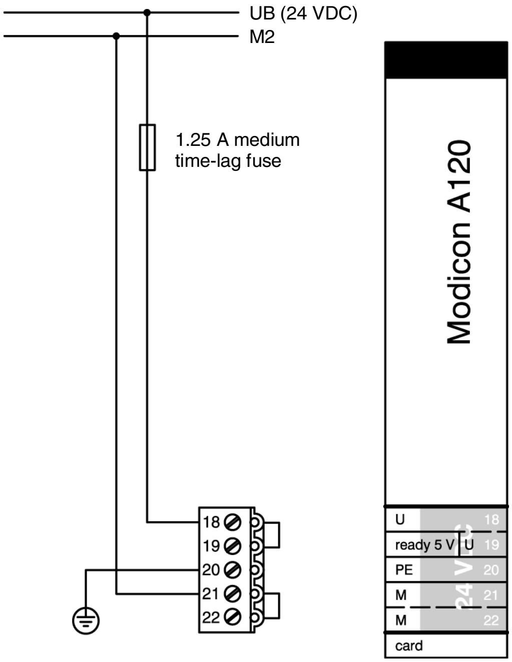
## Power Supply Connection

**⚠ CAUTION**

The module's integrated power supply is non–isolated. Improper connection, e.g. absence of the M2 connection, can lead to module destruction.

**Failure to follow this instruction can result in injury or equipment damage.**

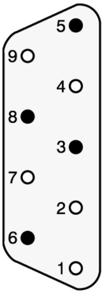
Enter system relevant power supply information in the label inlay. Noise immunity can be improved when by–pass capacitors are installed at the power supply module U and M terminals.



### Profibus Connection

The PROFIBUS port utilizes varied Sub–D9 plug connectors:

- 490 NAD 911 02 for transmission rates up to 12 Mbps.
- PBS1 for transmission rates up to 500kbps.
  The individual installation steps are to be carried out in adherence with the accompanying user documentation.



| Pin | Signal | Function |
|---|---|---|
| 3 | RxD/TxD-P | Receive/transmit data (+) |
| 5 | DGND | Signal ground |
| 6 | VP | +5 VDC supply |
| 8 | RxD/TxD-N | Receive/transmit data negated (-) |

● Pin occupied

○ N/C

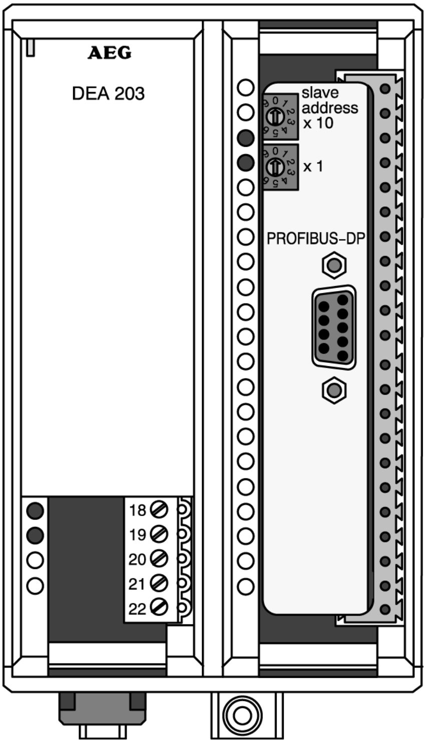
## Features and Functions

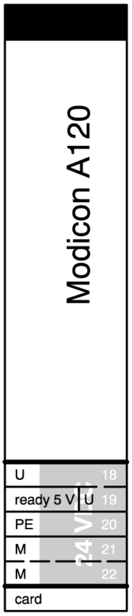
**Overview**

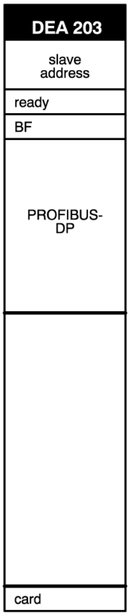
The AS–BDEA 203 is a PROFIBUS–DP coupling module adhering to DIN 19 245 Parts 1 and 3 with integrated (non–isolated) power supply. It is used to drive the remote I/O modules of the Modicon TSX Compact family. It provides a 5 VDC supply at 1.6 A for the modules on the parallel I/O bus.

The AS–BDEA 203 can address a maximum of 18 I/O modules (288 I/Os) via the subracks DTA 200, DTA 201 or DTA 202. With the exception of intelligent modules, all analog and discrete Compact I/O modules can be employed. When analog modules are utilized, there is a particular total data volume which may not be exceeded.

The device master data file from the 381 SWA 000 00 diskette must be utilized for AS-BDEA 203 configuration.







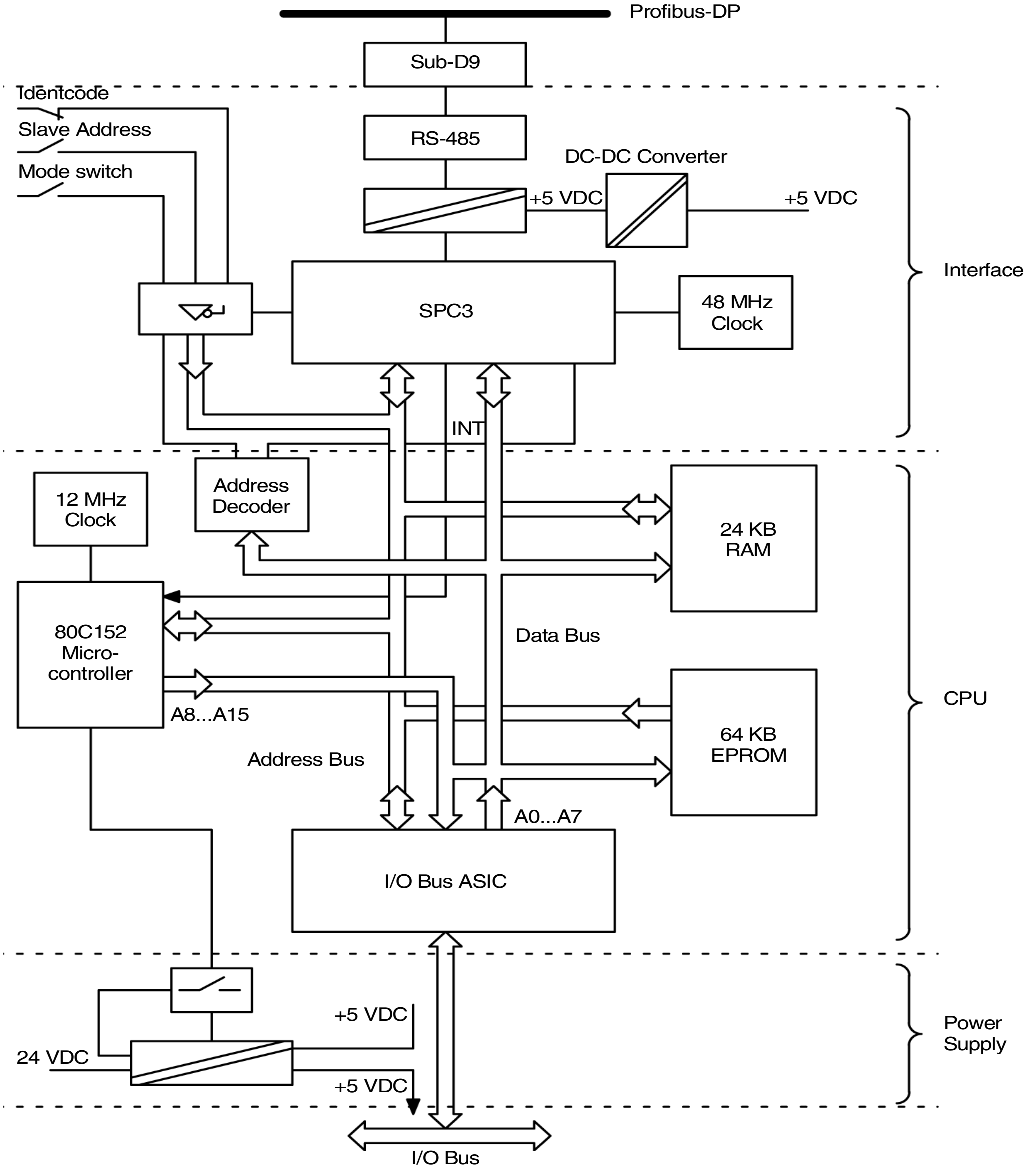
**Features**

- Standardized, isolated PROFIBUS Port
- Transmission rates of up to 12 Mbps
- Automatic adaptation to master transmission rate setting
- Slave address adjustment per rotary switch
- DIP switch adjustment of disconnection behavior

**Functional Details**

The AS–BDEA 203 serves as the coupling element between the PROFIBUS–DP and the internal I/O bus.

The set disconnection behavior is activated by watchdog when PROFIBUS communication is interrupted longer then the supervision time set by the master. The AS–BDEA 203 collects messages from the associated modules and reports these further to the master as diagnostic information.


Profibus-DP
Sub-D9
Identcode
Slave Address
Mode switch
RS-485
DC-DC Converter
+5 VDC
+5 VDC
SPC3
48 MHz Clock
INT
Interface
12 MHz Clock
Address Decoder
24 KB RAM
80C152 Micro-controller
Data Bus
A8...A15
64 KB EPROM
CPU
Address Bus
A0...A7
I/O Bus ASIC
+5 VDC
24 VDC
+5 VDC
Power Supply
I/O Bus

## Diagnosis

### Overview

The module front plate contains the following displays:

| No | Label Inlay Identifier | Color | Function |
|---|---|---|---|
| 18 (left) | U | Green | 24 VDC supply prsent |
| 19 (left) | ready 5V | Green | module ready for service, 5VDC output voltage present |
| 3 (right) | ready | Green | Coupler ready |
| 4 (right) | BF | Red | Bus coupling faulty (bus failure), Probable cause: The AS–BDEA is not parameterized and in-itialized, the PROFIBUS–DP protocol is not running |

# Technical Specifications

**AS-BDEA 203**

Technical specifications for the AS-BDEA 203.

### Assignment

| | |
|---|---|
| System | TSX Compact (A120, 984) |
| Module Area | Slot 0 of DTA 200 primary backplane |
| Identicode | Hex A203, entry through the device master data file type 381 SWA 000 00 |

### Power Supply

| | |
|---|---|
| External input voltage | UB = 24 VDC, max. 0.85 A |
| Primary fusing | 1.25 A medium time–lag fuse |
| Power on current | 20 A, time constant = 1 ms |
| Tolerances, limiting values | Refer to the TSX Compact User Manual, "Technical Specifications" |
| Reference potential M | M2 |
| Protective earth | PE |
| Secondary voltage | 5.15 VDC, max. 1.6 A, non–isolated |
| Buffering time | Typically 5 ms for 24 VDC |
| Overload protection | Through current limiting |

### Data Interface

| | |
|---|---|
| Profibus-DP | Through a potential–free RS–485 interface up to 12 Mbps |
| Pin assignments | Refer to PROFIBUS Connection Figure |
| Back plane | Parallel I/O bus, refer to TSX Compact User Manual, "Technical Specifications" |

### Processor

| | |
|---|---|
| Processor type | Intel 80C152 / 12 MHz |
| Data memory | 32 KB RAM |
| Firmware | 64 KB EPROM |

### Mechanical Design

| | |
|---|---|
| Module | Standard double–size module |
| Format | 3 HE, 16 T |
| Weight | Approx. 500 g |

## Connection Styles

| | |
|---|---|
| Power Supply | 5–pole screw/plug–in terminal block |
| Profibus | Sub–D9 socket, matching to 490 NAD 911 |
| Back plane | 2 plug connectors 1/3 C30M, 1 socket connector 1/3 R30F |

## Environmental Characteristics

| | |
|---|---|
| Regulations | Meets VDE 0160, UL 508 |
| System data | Refer to TSX Compact User Manual, "Technical Specifications" |
| Permissible ambient temperatures | 0 ... +60 degrees C. |
| Power dissipation | Typically 6 W |

**Profibus- DP**

Specifications for the AS-BDEA 203 on the Profibus-DP.

### Transmission Specifications

| | |
|---|---|
| Nodes per bus | Max. 32 |
| Bus lengths, transmission rates | ● max 1.2 km at 9.6 kbps or at 19.2 Kbps or at 93.75 Kbs<br>● max 1 km at 187.5 Kbps<br>● max 0.5 km at 500 Kbps<br>● max 0.2 r at 1.5 Kbps<br>● max 0.1 km at 3 Mbps or at 6 Mbps or at 12 Mbps rigid |
| Bulk transmission media | Shielded twisted pair (S–UTP)KAP PROFIB, PROFIBUS cable up to 12 Mbps, rigid |
| Connection interface | Adhering to EIA RS–485 |
| Cable termination | As per Norm 390 / 220 / 390 W |
| Stub cabling | None |
| Data security | Hamming distance, HD = 4 |

### Bus Specifications

| | |
|---|---|
| Node type | Slave |
| Node Addresses | 1...99 |

### Operation

| | |
|---|---|
| DP Bus Byte Output | Output reference 0x (Boolean, packed<br>Output Reference 4x (Integer8, unpacked; Unsigned8, unpacked;RAW, packed e.g. ASCII) |
| DP Bus Byte Input | Input Reference 1x (Boolean, packed)<br>Input Reference 3x (Integer8, unpacked; Unsigned8, unpacked; RAW, packed e.g. ASCII) |
| Bus Word Output | Output Reference 0x (Boolean)<br>Output Reference 4x (Integer16 = Unsigned16 = RAW) |
| Bus Word Input | Input Reference 1x (Boolean)<br>Input Reference 3x (Integer16 = Unsigned16 = RAW) |

# BKF 201 (16W) & (64W) InterBus S Master Module

# 11

## At a Glance

**Introduction**

The information in this chapter describes the BKF 201 (16W) & (64W) InterBus S Master Module.

**What's in this Chapter?**

This chapter contains the following topics:

## What Is the BKF 201 (16W) & (64W) InterBus S Master Module?

### Brief Product Description

The BKF 201 links the Compact PLC and the Remote bus nodes. The following lists describes the key features of the BKF 201:

- Up to 63 3x input register and 63 4x output register data words can be addressed for a total of 126 TIOs (63 input TIOs and 63 output TIOs), with 16 Bits each within an Interbus frame
- Supports up to 15 BKF 201 modules in the BKF 201 (16) (Ident Code 92) mode or up to 3 BKF 201 modules in the BKF 201 (64) (Indent Code 93) mode
- Use and Programming for the BKF 201 is done via the RS 232C-port of the PLC, therefore saving a port on the BKF 201
- All outputs are automatically set to 0 (zero) upon detection of configuration errors or other bus problems
- A restart can be performed manually or automatically after error correction
- Changes to the Interbus S configuration are easy (Fast "Plug and Play")
- Monitoring of the module using a watchdog function
- Mode settings using two DIP switches
- The Interbus S status is shown via the modules LEDs

Interbus loop nodes are not supported.

Modules with Peripheral Communication Protocol (PCP) Channel (1, 2, and 4 PCP words within the Interbus loop) can be used in the BKF 201. However, the BKF 201 does not support the PCP Channel.

**Note:** Interbus loop nodes are not supported.

**Note:** Modbus with Peripheral Communication Protocol (PCP) Channel (1, 2, and 4 PCP words within the Interbus loop) can be used in the BKF 201. However, the BKF 201 does not support the PCP Channel.

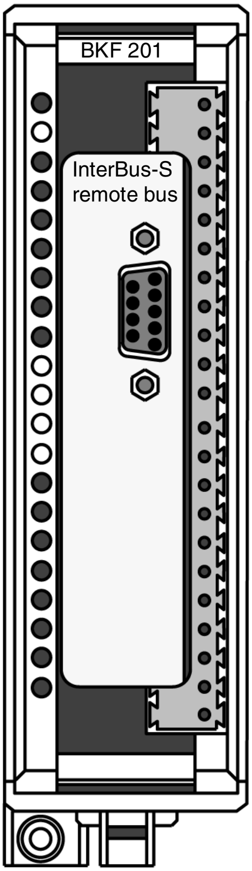
## Physical Characteristics of the BKF 201 (16W) & (64W) InterBus S Master Module

**Overview**

The following information describes the physical characteristics of the BKF 201.

**Front View and Label**

The following figure shows the front view of the BKF 201 and the label.



| BKF 201 |
|---|
| ready |
| |
| IBS ready |
| IBS run |
| IBS error |
| module error |
| config. error |
| |
| |
| error 1 |
| error 2 |
| error 4 |
| error 8 |
| error 10 |
| error 20 |
| error 40 |
| error 80 |
| |
| card |

## LEDs

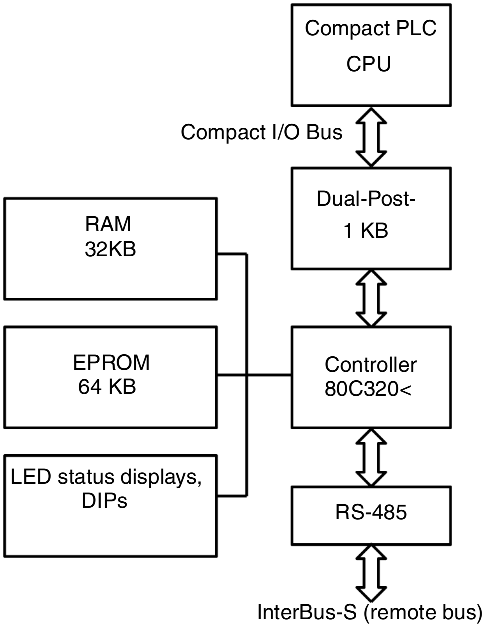
The following table describes the BKF 201 LED displays.

| LED # | LED Name | Color | Function |
|---|---|---|---|
| 1 | ready | Green | Module ready for service |
| 3 | IBS ready | Green | Interbus ready for service |
| 4 | IBS run | Green | Interbus transmission active |
| 5 | IBS error | Red | Interbus transmission error |
| 6 | Module error | Red | Module error (on Interbus slave device) |
| 7 | config. error | Red | The configuration changed during operation, or an error occurred during loading of the configuration. |
| 14<br>15<br>16<br>17<br>18<br>19<br>20<br>21 | error 1<br>error 2<br>error 4<br>error 8<br>error 10<br>error 20<br>error 40<br>error 80 | Red | Displays the physical number of the Interbus node with error condition (BCD, Node # = sum of error numbers displayed).* See also, the *Front View and Label, p. 219*.<br>No display: Neither error nor node number can be found. |

**Note:** *For example, if device#6 (node#6) has a error condition LED#15 (error 2) and LED#16 (error 4) turn red. Add the two together (error 2 + error 4= 6). This indicates that the error condition pertains to device#6 (node#6).

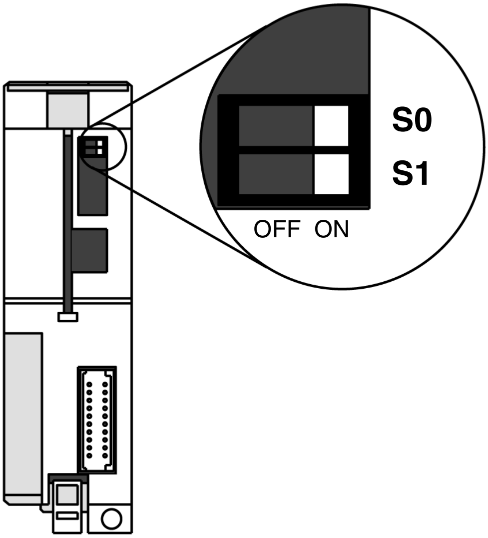
**Block Diagram of the BKF 201**

The following figure describes the architecture of the BKF 201.

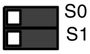


## Switch Settings for the BKF 201

**Operating Mode** The following figure shows the DIP Switch Settings for the operating mode. The switches are located on the rear of the BKF 201.



**DIP Switch Setting for S0 and S1:**

| OFF ON | Ident-Code | Module | 3x Input words | 4x Output words | Programming with |
|---|---|---|---|---|---|
|  | **99** | reserved | reserved | reserved | reserved |
|  | **92** | BKF201(16) | 1 3x status word &<br>15 3x data words | 1 4x control word &<br>15 4x data words | Concept 2.1 and higher |
|  | **93** | BKF201(64) | 1 3x status word &<br>63 3x data words | 1 4x control word &<br>63 4x data words | Concept 2.1 and higher |
|  | not used (default settings for field testing by manufacturer only) | | | | |

## Installation of the BKF 201 (16W) & (64W) Interbus Master Module

**Overview**

The following information describes how to install the BKF 201.

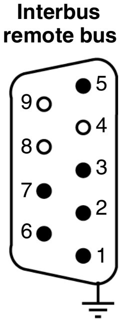
**Operating Mode**

If the operating mode for the BKF 201 module is set to BKF 201 (16) (Indent Code 92), the module can reside in any I/O slot in any backplane (DTA 201 or DTA 202). In contrast, if the operating mode for the BKF 201 module is set to BKF 201 (64) (Indent Code 93), the module can reside only in an I/O slot in the primary backplane (DTA 200).

## Interbus Connection

Refer to the *Interbus S Quantum 140 NOA 611 00 User Manual* (P/N 840 USE 419 00).

The following diagram shows the pin assignments as viewed from the solder side.



● Pin present
○ No pin present

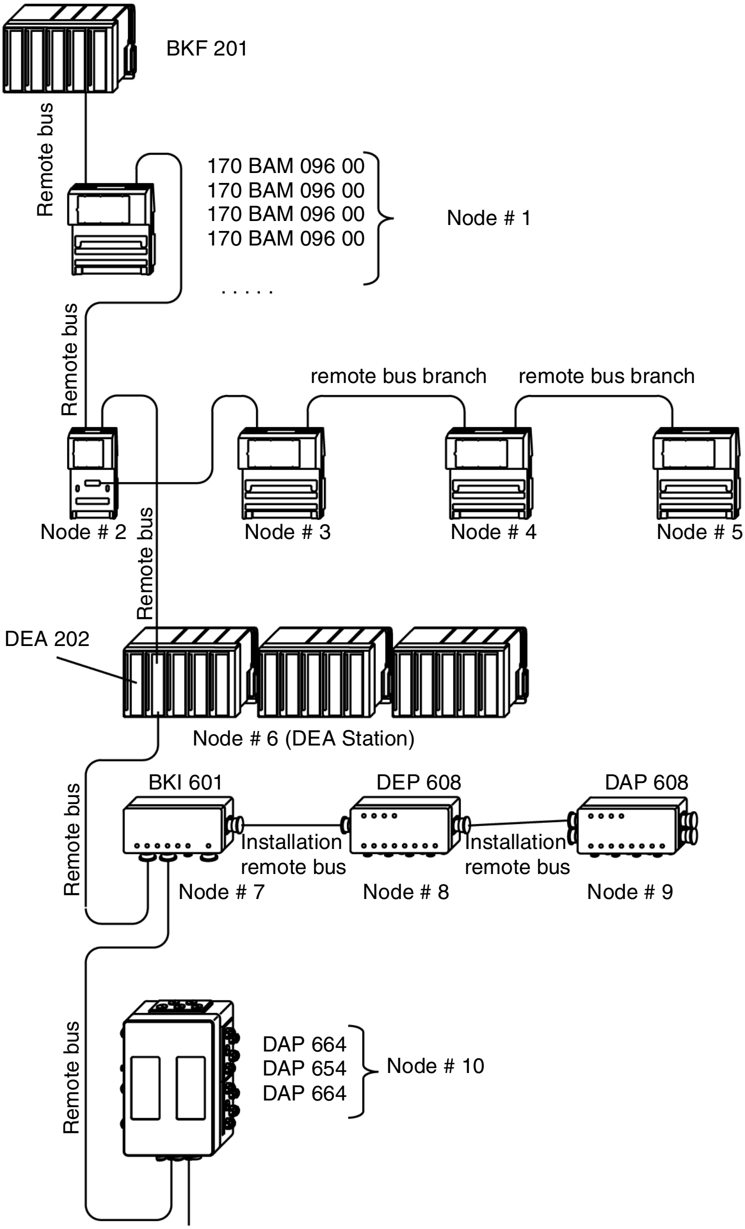
The following table shows the pinout assignments.

| Socket | Signal | Function |
|---|---|---|
| 1 | DO | Transmit data (+) |
| 2 | DI | Receive data (+) |
| 3 | GND | Reference ground |
| 5 | 5 V Out | For Fiber Optic Interface |
| 6 | DO | Transmit data (-) |
| 7 | DI | Receive data (-) |

**Note:** When using branch interfaces, it is not possible to group and to handle errors (that is, turning off the branch in case of error).
For example, a branch interface is useful when using a fiber-optic interface because most slaves do not provide power for this type of interface. Additionally, a branch interface is required to connect slaves to peripheral buses, or to install remote buses.

### Hardware Configuration of the BKF 201

The following figure illustrates an example BKF 201 hardware layout showing nodes.



## Operation of the BKF 201 Master Module: I/O Map

**BKF 201(16) Operating Mode**

The BKF 201(16) (Ident Code 92) module requires a total of 16 3x input registers and a total of 16 4x output registers. The first 3x input register is the Status Word and the following 3x input registers are Data Words starting with 3x+1 and ending with 3x+15. The first 4x output register is the Control Word and the following 4x output registers are Data Words starting with 4x+1 and ending with 4x+15. Refer to the other information in this map.

**BKF 201(64) Operating Mode**

The BKF 201(64) (Ident Code 93) module requires a total of 64 3x input registers and a total of 64 4x output registers. The first 3x input register is the Status Word and the following 3x input registers are Data Words starting with 3x+1 and ending with 3x+63. The first 4x output register is the Control Word and the following 4x output registers are Data Words starting with 4x+1 and ending with 4x+63. Refer to the other information in this map.

**3x Input Registers**

The following table describes the 3x Input Registers (1 3x Status Word & Up to 15 3x Data Words) or (1 3x Status Word & Up to 63 3x Data Words).

| State RAM | Bit 15-8 | Bit 7-5 | Bit 4-0 |
|---|---|---|---|
| 3xxxxx (Status Word) | Config. Checksum; see *3x Configuration Checksum Byte Structure (High Byte), p. 227* | 0<br>not used | Status; see *3x Configuration Checksum Byte Structure (High Byte), p. 227* |
| 3xxxxx +1 | Process data - Input word 1 | | |
| 3xxxxx +2 | Process data - Input word 2 | | |
| 3xxxxx +3 | Process data - Input word 3 | | |
| 3xxxxx +4 | Process data - Input word 4 | | |
| : | : | | |
| 3xxxxx + 15BKF201 (16) | Process data - Input word 15 BKF201 (16) mode | | |
| : | : | | |
| 3xxxxx + 15BKF201 (64) | Process data - Input word 63 BKF201 (64) mode | | |

### 3x Configuration Checksum Byte Structure (High Byte)

The following table describes the 3x Status Word, High Byte for Configuration Checksum Error #. For information about the meanings of the LEDs, see *LEDs, p. 220*.

| **Bit 15** | **Bit 14** | **Bit 13** | **Bit 12** | | **Bit 11** | **Bit 10** | **Bit 9** | **Bit 8** | **Function** |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | 8 | 4 | 2 | 1 | Decimal value of block 1 (max. 9), same meaning as LEDs #14 ... #17 |
| 80 | 40 | 20 | 10 | | | | | | Decimal value of block 2 (max. 90), same meaning as LEDs #18 ... #21 |

**Note:** For example, if device#6 (node#6) has a error condition, LED#15 (error 2) and LED#16 (error 4) turn red. Add the two together (error 2 + error 4= 6). This indicates that the error condition pertains to device#6 (node#6).

## 3x Status Byte Structure (Low Byte)

The following table describes the 3x Status Word, Low Byte for Status. For information about the meanings of the LEDs, see *LEDs, p. 220*.

| Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Function |
|---|---|---|---|---|---|
| | | | | 1 | **"IBS ready"**<br>(same meaning as LED#3) Interbus ready to use (no "IBS error" or "config. error") |
| | | | 1 | | **"IBS run"**<br>(same meaning as LED#4) Process data exchange on the Interbus |
| | | 1 | | | **"IBS error"**<br>(same meaning as LED#5)A bus error occurred. Possible causes: Broken cable, short circuit, a node lost power, data transfer was interrupted. In case of a permanent interruption, the BKF will trace the node, which was interrupted. |
| | 1 | | | | **"Module error"**<br>(same meaning as LED#6) Module error of a node (slave). Current error does not stop the Interbus. |
| 1 | | | | | **"config. error"**<br>(same meaning as LED#7) Interbus configuration error. Possible causes: The configuration could not be determined after power-on of the BKF 201 (node not ready for operation, cabling wrong, etc.) The configuration was changed during operation. An example would be the removal of a node. The standard configuration checksum does not concur with the actual configuration checksum, when Bit 6 was set in the control byte. |

## 4x Output Registers

The following table describes the4x Output Registers (1 4x Control Word and up to 15 4x or (1 4x Control Word & up to 63 4x Data Words).

| State RAM | Bit 15-8 | Bit 7-0 |
|---|---|---|
| 4xxxxx (Control Word) | Config. Checksum; see *4x Control Byte Structure (Low Byte), p. 230* | Status; see *4x Control Byte Structure (Low Byte), p. 230* |
| 4xxxxx +1 | Process data - Input word 1 | |
| 4xxxxx +2 | Process data - Input word 2 | |
| 4xxxxx +3 | Process data - Input word 3 | |
| 4xxxxx +4 | Process data - Input word 4 | |
| : | : | |
| 4xxxxx + 15 BKF201 (16) | Process data - Input word 15 BKF201 (16) mode | |
| : | : | |
| : | : | |
| 4xxxxx + 63 BKF201 (64) | Process data - Input word 63 BKF201 (64) mode | |

## 4x Standard Configuration Checksum Byte Structure (High Byte)

The following table describes the 4x Control Word, High Byte for Configuration Checksum.

| Bit 15 | Bit 14 | Bit 13 | Bit 12 | | Bit 11 | Bit 10 | Bit 9 | Bit 8 | Function |
|---|---|---|---|---|---|---|---|---|---|
| x | x | x | x | | x | x | x | x | Enter your bus configuration checksum returned by the BKF 201 upon initialization into this register and set Bit 6 =1 (check config.) in (4x control word low byte) to compare configuration input (3x status config. check sum, high byte) to (4x control word low byte check sum). When they do not match Bit 4 (config. error) results in (3x status low byte). |

## 4x Control Byte Structure (Low Byte)

The following table shows the 4X Control Word, Low Byte for Control.

| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Function |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | 0 | Not used |
| | | | | | | 1 | | **"alarm-stop"**<br>Setting Bit 1 stops the Interbus immediately, and all outputs are set to zero. While this Bit is set, all other control bits have no effect. Inputs are held in last state. |
| | | | | | 1 | | | **"start-cycle"**<br>Starts the data transfer to the nodes. If the bit is cleared, no more data cycles are performed through the BKF master, and the outputs of the nodes are "frozen", meaning that the input information will stay resident in the signal memory. If alarm-stop Bit1=1, then the bus stops and all outputs are turned off. |
| | | | | 1 | | | | **"quit-error"**<br>Confirms errors occurred ("IBS error", "module error", "config. error"). Setting this bit permanently results in immediate error acknowledgment. Therefore, it should not be used during normal operation. When an error occurs and the network problem is corrected, this bit needs to be set to confirm and clear the error condition. If alarm-stop Bit1=1, then quit-error is not active. |
| | | | 0 | | | | | Not used |

| Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Function |
|---|---|---|---|---|---|---|---|---|
|  |  | 1 |  | 1 |  |  |  | **"get-configuration"**<br>Determine new Interbus configuration. This is useful, if for example a node is removed/ added to the Bus, meaning Bit 4 of status byte (config. error) = 1. When checking for a new configuration, all other bits must be = 0, except you must set Bit 3=1. |
|  | 1 |  |  |  |  |  |  | **"check-configuration"**<br>When Bit 6 is set, the BKF compares the checksum of the 4x control high byte and the standard configuration (3x status word, high byte checksum). In case of no match, the INTERBUS is stopped and Bit 4 (config. error) is set in the (3x status word, low byte for status). Make sure, the standard configuration checksum was entered into the (4x control word, high byte for standard config. checksum) prior to setting bit 6(check-config). The checksum is determined by reading the checksum of the actual configuration in the (3x status word, high byte checksum). |
| 1 |  |  |  |  |  |  |  | **"show-configuration"**<br>Display of: Number of Interbus nodes, total number of Input/ Output words, Identcode and the number of the process data words of the nodes in the signal memory (3x data words, up to 15 for BKF202(16) (Ident code 92), and up to 63 for BKF202(64) (ident code 93)). NOTE: All other bits must be=0. |

## Show Configuration

The following table is an example using the show configuration feature. This function is available only if the 4x control word bits are set as follows: Bit 7=1 (show configuration), Bit 1=0 (alarm-stop), Bit 2=0 (start-cycle)

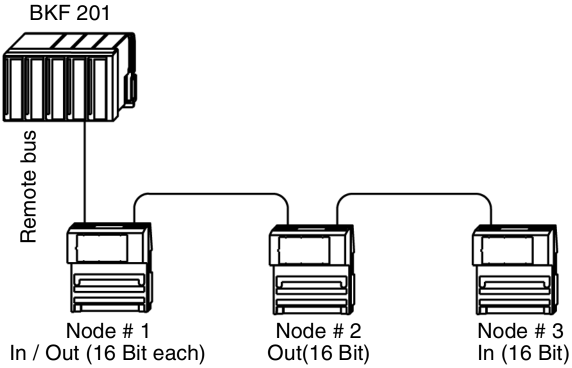
| **State RAM** | **Bit 15-8** | **Bit 7-5** | **Bit 4-0** |
|---|---|---|---|
| 3xxxxx (Status Word) | Config. Checksum; see *3x Status Byte Structure (Low Byte), p. 228* | 0 (not used) | Status; see *3x Status Byte Structure (Low Byte), p. 228* |
| 3xxxxx +1 | 0 | | Number of IBS nodes (slaves) |
| 3xxxxx +2 | Number of process 3x input data words | | Number of process 4x input data words |
| 3xxxxx +3 | Number of process data words of slave 1 | | Ident code of slave 1 |
| 3xxxxx +4 | Number of process data words of slave 2 | | Ident code of slave 2 |
| : | : | | : |
| 3xxxxx + 15BKF201 (16) | Number of process data words of slave 13 | | Ident code of slave 13 |
| : | : | | : |
| : | : | | : |
| 3xxxxx + 15BKF201 (64) | Number of process data words of slave 61 | | Ident code of slave 61 |

**Note:** The number of process data words also includes the Peripheral Communication Protocol (PCP) communication words, if slaves with PCP Channel are used. Unlike other Interbus masters, these PCP communication words are also reflected in the signal memory.

## Example of Hardware and I/O Mapping for the BKF 201

**BKF 201 Module Using TIO Modules as Nodes**

This is an example of how to use three TIO modules as nodes off the BKF 201 module. Notice the correlation between the hardware and I/O mapping structure shown in the tables that follow the figure.



The following tables show the data structure of the 3x input registers and 4x output registers, as well as the hardware configuration for the three TIO devices/nodes shown in the figure.

The following table describes the 3x Input I/O Mapping Presentation.

| | |
|---|---|
| Config. -checksum | Status byte |
| Inputs 1 ... 16 of node 1 | |
| Inputs 1 ... 16 of node 3 | |

The following table describes the 4x Output I/O Mapping Presentation.

| | |
|---|---|
| Stand. config. -checksum | Control byte |
| Outputs 1 ... 16 of node 1 | |
| Outputs 1 ... 16 of node 2 | |

# Specifications

**Specifications**

The following table lists specifications for the BKF 201 (16W) & (64W) InterBus S Master Module.

| **Power supply** | |
|---|---|
| Internally through I/O-Bus | 5VDC I/O Bus, 190mA typically, 250mA max. (w/o fiber-optic Interface) |
| **Data Interface** | |
| Field bus | as RS 485 port, non-isolated (150Ohm) |
| **Processor** | |
| Processor type | Dallas 80C320 / 32 MHz |
| Data memory | 32KB RAM |
| Firmware | 64KB EPROM |
| **I/O Map** | |
| Register 3x/4x | 16 in/16 out BKF-201 (16W) |
| | 64 in/64 out BKF-201 (64W) |
| **Physical Structure** | |
| Module | Standard-size module |
| Format | I Slot |
| Weight | 210 g |
| **Type of Connection** | |
| Remote bus | Sub-D9 socket (9 pins) |
| Backplane | Plug connector1/3 C30M |
| Environmental Characteristics | |
| Regulations | VDE 0160, UL 508 |
| Power dissipation | 1.3W max., typically 1W |

# BKF 202 InterBus S Slave Module

# 12

## At a Glance

**Introduction**

The purpose of this chapter is to describe the BKF 202 InterBus S slave Module.

**What's in this Chapter?**

This chapter contains the following topics:

## What Is the BKF 202 InterBus S Slave Module?

**Brief Product Description**

The BKF 202 links the Compact PLC and the Remote Bus nodes. The following list describes the key features of the BKF 201:

- Up to 15 3x input register and up to 15 4x output register data words can be exchanged with an Interbus S master.
- Monitoring of the module using a watchdog function.
- Mode settings using a rotary switch and two DIP switches.
- The Interbus S status is shown via the module’s LEDs.
- Supports up to 15 BKF 202 modules in the BKF 202 (Indent Code 94) mode.

**Note:** The BKF 202 module does not support Peripheral Communication Protocol (PCP) channels.

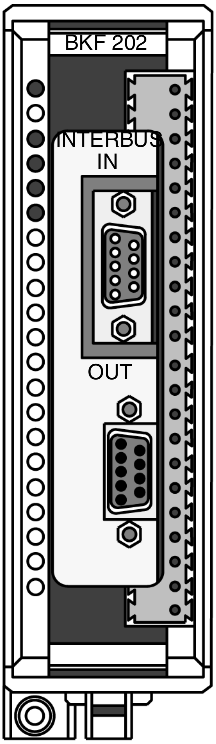
# Physical Characteristics of the BKF 202 InterBus S Slave Module

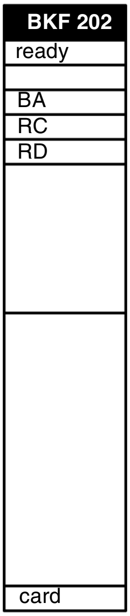
**Overview**

The following information describes the physical characteristics of the BKF 202.

**Front View and Label**

The following figure shows the front view of the BKF 202 and the label.





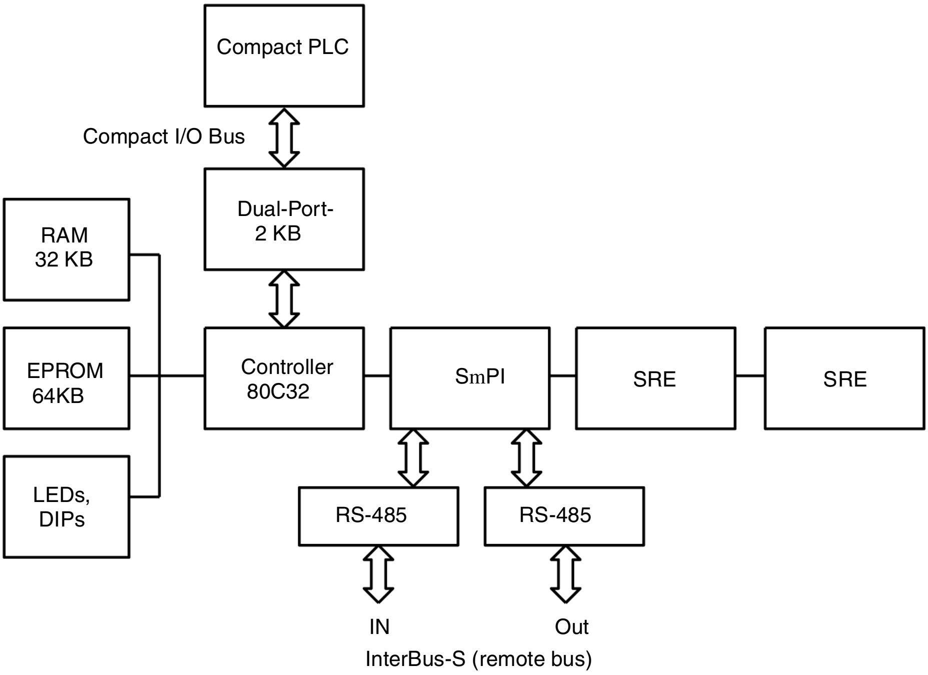
## LED Displays

The following table describes the LED displays for the BKF 202.

| LED # | LED Name | Color | Function |
|---|---|---|---|
| 1 | READY | Green | Operating mode<br>on: Current power for internal logic within the allowable range and the module has not been reset to mode<br>off: Current power missing or outside of the allowable range, or module has been reset |
| 3 | BA | Green | bus active<br>on: Data telegrams are transmitted<br>off: Data telegrams are not transmitted |
| 4 | RC | Green | Remote Bus Check<br>on: incoming remote bus connection is correct and the Bus Reset of the Busmaster is inactive<br>off. incoming remote bus connection is wrong/ not corrected or the Bus Reset of the Bus Reset of the Busmaster is active |
| 5 | RD | Red | Remote Bus Disabled<br>on: Extended remote bus is switched off<br>off: Extended remote bus is not turned off |

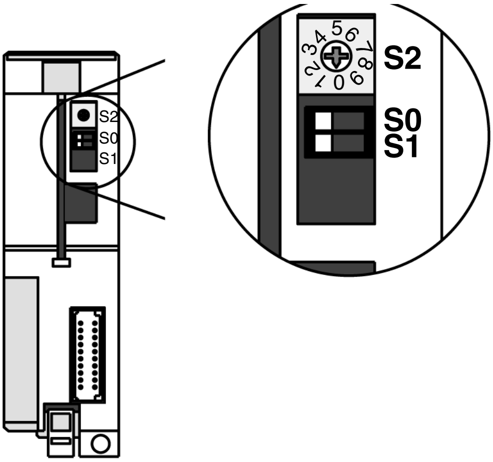
**Block Diagram of the BKF 202**

The following block diagram provides an overview of the BKF 202 architecture.



# Switch Settings for the BKF 202 InterBus S Slave Module

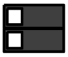
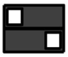
**Operating Mode** The following figure shows the Rotary Switch settings and the Dip Switch settings for the operating mode. The switches are located on the rear of the BKF 202.



**Rotary Switch Settings for S2:**

| Switch position | Number of words |
|---|---|
| 1 | 2 words |
| 2 | 4 words |
| 3 | 6 words |
| 4 | 8 words |
| 5 | 10 words |
| 6 | 12 words |
| 7 | 14 words |
| 8 | 16 words (15 data words) |
| 9 | not used |
| 0 | not used |

## DIP Switch Setting for S0 and S1:

| OFF ON | | Ident-Code | Module | 3x Input words | 4x Output words | Programming with |
|---|---|---|---|---|---|---|
|  | S0<br>S1 | reserved | reserved | reserved | reserved | reserved |
|  | S0<br>S1 | 94 | BKF202 | 1 3x status word & 15 3x data words | 1 4x control word & 15 4x data words | Concept 2.1 and higher |
|  | S0<br>S1 | reserved | | | | |
|  | S0<br>S1 | not used (default settings for field testing by manufacturer only) | | | | |

# Installation of the BKF 202 InterBus S Slave Module

**Overview**

The following information describes how to install the BKF 202.

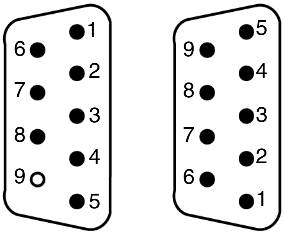
**Interbus Connection**

The BKF 202 modules located at the inline sites on the Interbus remote bus cable have two connections. One connection is for the incoming bus cable; the other is for the outgoing bus cable. BKF 202 modules located at the end sites on the network cable have only one connection. This is for the incoming bus cable.

You should have a complete cabling diagram for your network installation, showing the cable routing path and methods of securing the cables. It should identify incoming and outgoing cables at each BKF 202 module site.

**Pin Placements**

The following figure shows the pin placements as viewed from the solder side.



Sub-D9 Port
“in” (top)

Sub-D9 Port
“out” (bottom)

| Pin | Signal | Meaning |
|---|---|---|
| 1 | DO | Transmit data (+) |
| 2 | DI | Transmit data (+) |
| 3,4 | GND | reference ground |
| 5,8 | | (5 V Out) for Opto. Sub. |
| 6 | DO | Transmit data (-) |
| 7 | DI | Receive data (-) |
| 9* | RBST | Plug identifier |

*) incoming remote bus = not used

● Pin present

○ No pin present

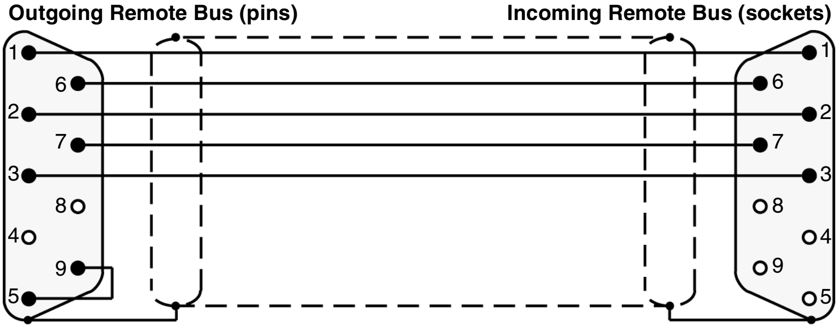
## Cabling

Modicon provides two prefabricated Interbus cables (170 MCI 101 00, 1m, 39 inches) and (170 MCI 007 00, 11.5cm, 4.5 inches). Each cable has two connectors for direct interconnection between two modules. Modicon also provides a connector kit (170 XTS 009 00) for use with user supplied cables. The kit contains one pin and one socket connector.

Please note the following general requirements.

- The maximum remote bus cable length is 13 km (8mi.). The cable length between two remote bus nodes must not exceed 400 m (1200 ft).
- The connectors for the outgoing bus are always pins, those for the incoming remote bus are always sockets.
- Connect the cable shield to the connector.
- You need a 5 wire cable, twisted pair type, shielded cable for the remote bus. We recommend a Belden 8103 cable or equivalen; this cable is available by the meter (KAB 3225 LI).

Wire the connectors of the remote bus cable as shown in the following figure.



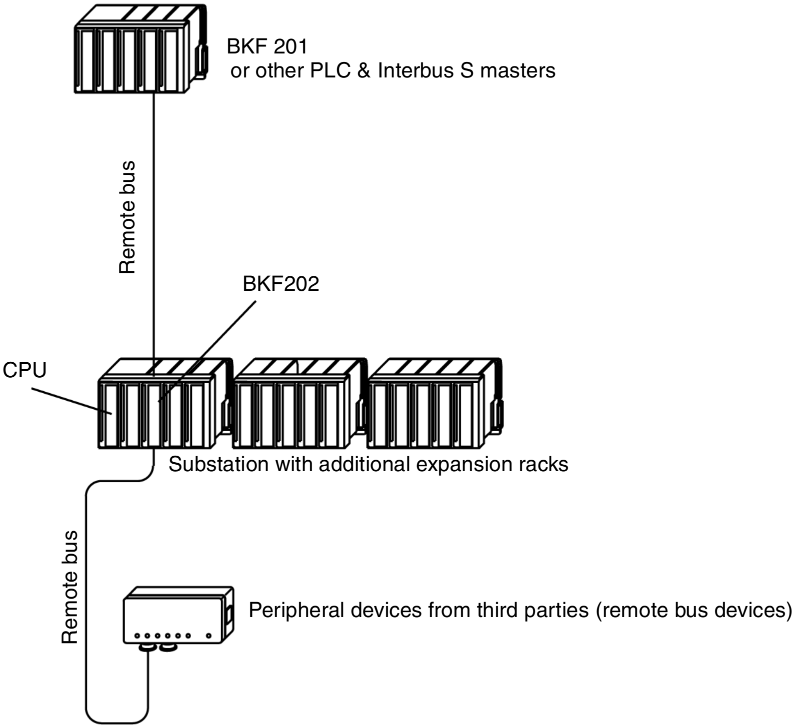
The following tables show the pinouts for the Interbus cable construction. The information in the first table describes pinouts for an outgoing remote bus connection; the second table describes the pinouts for an incoming remote bus connection.

| Pin | Wire Color | Connection outgoing remote bus |
|---|---|---|
| 1 | yellow | DO: Data Out |
| 2 | grey | DI: Data In |
| 3 | brown | Common |
| 4 | | GND: Reference conductor, fiber optic adapter |
| 5 | | Vcc: Power supply for fiber optic adapter. |
| 6 | green | DO_N: Data Out Negated |
| 7 | pink | DI_N: Data In Negated |
| 8 | | Vcc: Additional power supply for fiber optic adapter |
| 9 | | Plug identification |

| Pin | Wire Color | Connection incoming remote bus |
|---|---|---|
| 1 | yellow | DO: Data Out |
| 2 | grey | DI: Data In |
| 3 | brown | Common* |
| 4 | | GND*: Reference conductor, fiber optic adapter |
| 5 | | Vcc*: Power supply for fiber optic adapter. |
| 6 | green | DO_N: Data Out Negated |
| 7 | pink | DI_N: Data In Negated |
| 8 | | Vcc*: Additional power supply for fiber optic adapter |
| 9 | | (not used) |
| | | * = physically isolated |

## Hardware Configuration of the BKF 202

The following figure illustrates an example BKF 202 hardware layout showing nodes.



## Operation of the BKF 202 InterBus S Slave Module

### I/O Map

The BKF 202 module requires a total of 16 3x input registers and a total of 16 4x output registers. The first 3x input register is the Status Word, and the following 3x input registers are Data Words starting with 3x+1 and ending with 3x+15. The first 4x output register is the Control Word, and the following 4x output registers are Data Words starting with 4x+1 and ending with 4x+15. Refer to the other information in this map.

### 3x Input Registers

The following table describes the 3x Input Registers (1 3x Status Word & Up to 15 3x Data Words) or (1 3x Status Word & Up to 63 3x Data Words).

| State RAM | Bit 8-15 | Bit 7-4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
|---|---|---|---|---|---|---|
| 3xxxxx (Status Word) | Number of words; see *Front View and Label, p. 237* | 0<br>(not used) | | RD | RC | BA |
| | | | | For more information, see *3x Status Word Byte Structure, p. 244* | | |
| 3xxxxx +1 | Process data - Input word 1 | | | | | |
| 3xxxxx +2 | Process data - Input word 2 | | | | | |
| 3xxxxx +3 | Process data - Input word 3 | | | | | |
| 3xxxxx +4 | Process data - Input word 4 | | | | | |
| : | : | | | | | |
| 3xxxxx + 15 | Process data - Input word 15 | | | | | |

### 3x Status Word Byte Structure

The following table describes the 3x Status Word Byte Structure.

| State RAM | Bit 7-4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 | Function |
|---|---|---|---|---|---|---|
| **3xxxxx (Status Word)** | **0<br>(not used)** | | | | **1** | **BA; see *LED Displays, p. 238*** |
| | | | | 1 | | RC; seesee*LED Displays, p. 238* |
| | | | 1 | | | RD; see see*LED Displays, p. 238* |

## 4x Output Registers

The following table describes the4x Output Registers (1 4x Control Word & Up to 15 4x or (1 4x Control Word & Up to 63 4x Data Words)

| **State RAM** | **Bit 15 : Bit 2** | **Bit 1** | **Bit 0** |
|---|---|---|---|
| 4xxxxx (Control Word) | - | PLC-Stop Module Faults | Module Error) |
| | | See *4x Control Word Byte Structure, p. 245* | |
| 4xxxxx +1 | Process data - Output word 1 | | |
| 4xxxxx +2 | Process data - Output word 2 | | |
| 4xxxxx +3 | Process data - Output word 3 | | |
| 4xxxxx +4 | Process data - Output word 4 | | |
| : | : | | |
| 4xxxxx +15 | Process data - Output word 15 | | |

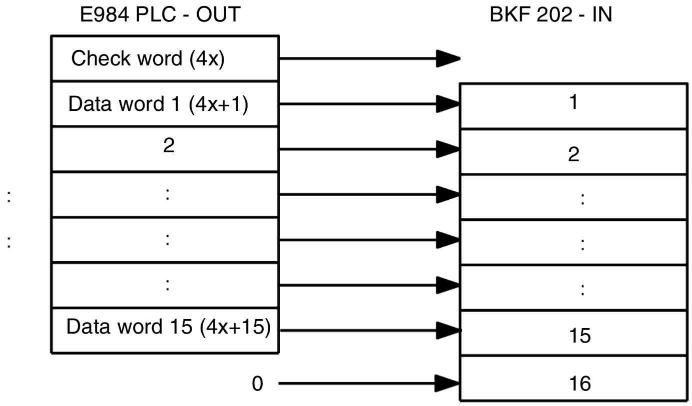
## 4x Control Word Byte Structure

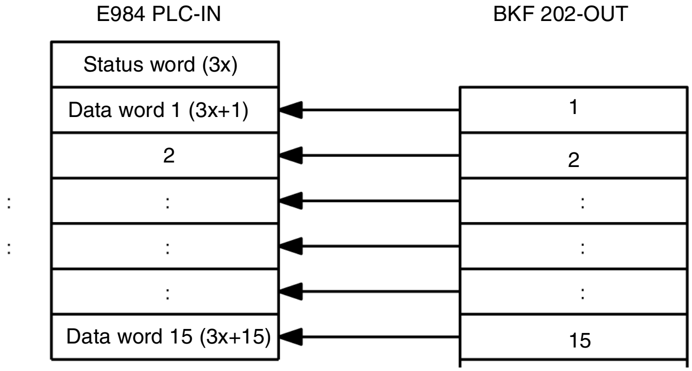
The following table shows the 4x Control Word Byte Structure.

| **State RAM** | **Bit 15-2** | **Bit 1** | **Bit 0** | **Function** |
|---|---|---|---|---|
| 4xxxxx (Control Word) | (not used) | | 1 | Module Error<br>Setting Bit 0 transmits a "Module-Error" to the Interbus master. |
| | | 1 | | PLC-Stop Module Faults:<br>Setting of Bit 1 transmits a "Module-Error" to the Interbus master, when the PLC is stopped. |

**Interbus Bi-Directional Communication between the E984 PLC and the BKF 202 IBS Slave Module**

The following figure shows the process data exchange between the PLC and the Interbus.





## Specifications of the BKF 202 InterBus S Slave Module

### Specifications

The following table lists specifications for the BKF 202 InterBus S Slave Module.

| **Power supply** | |
|---|---|
| Internally from I/O-Bus | 5VDC, 300 mA max. (w/o fiber-optic Interface) |
| **Data Interface** | |
| Field bus | as RS 485 Interface<br>remote in: potentialfree 150 Ohm<br>remote out: potentialbound 150 Ohm |
| **Processor** | |
| Processor type | 80C32 16 MHz |
| Data memory | 32KB RAM |
| Firmware | 64KB EPROM |
| **I/O Map** | |
| Register 3x/4x | 16 in/16 out |
| **Physical Characteristics** | |
| Module | in standard-size case |
| Format | I Slot |
| Weight | 250 g |
| **Type of Connection** | |
| Remote bus | 9-pin DSUB socket/connector bar |
| Backplane | Connector bar 1/3 C30M |
| Environmental Characteristics | |
| Regulations | VDE 0160, UL 508 |
| Permissible ambient temperature | 0 ... +60 degrees C. |
| Power dissipation | max. 1.5W |
| **Option** | Fiber-optic adapter |

# DAO 216 Discrete Output Module

# 13

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAO 216 discrete output module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DAO 216 Discrete Output Module?

### DAO 216 Discrete Output Module

### ⚠ WARNING

**Operational Hazard**

The DAO 216 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

The DAO 216 is a discrete output module with 16 independent 24 Vdc output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads. The module is structured in one group of 16 outputs. The outputs are not isolated.

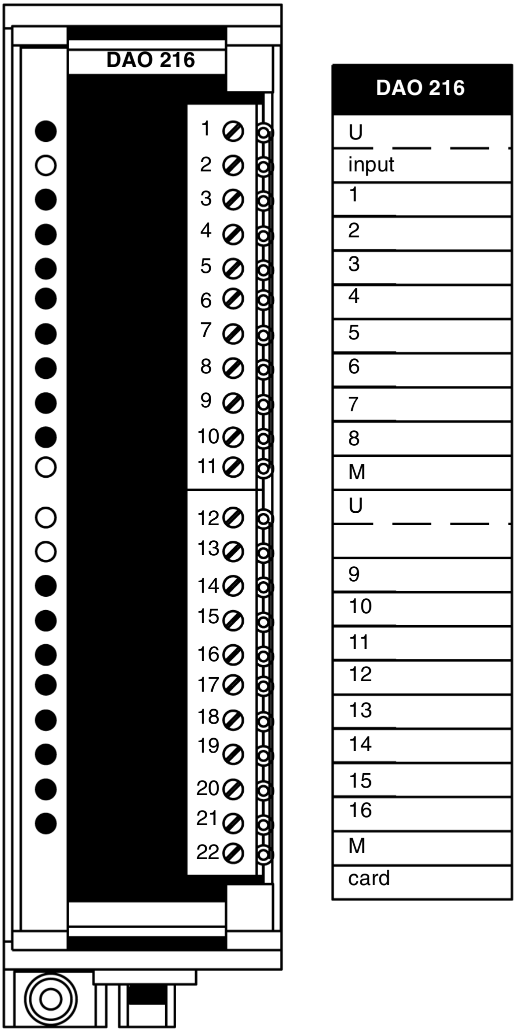
The DAO 216 can be installed in any slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and field connections on the front. The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided. Refer to the diagram in *LEDs, p. 251*

## DAO 216 Discrete Output Module Physical Characteristics

**LEDs**

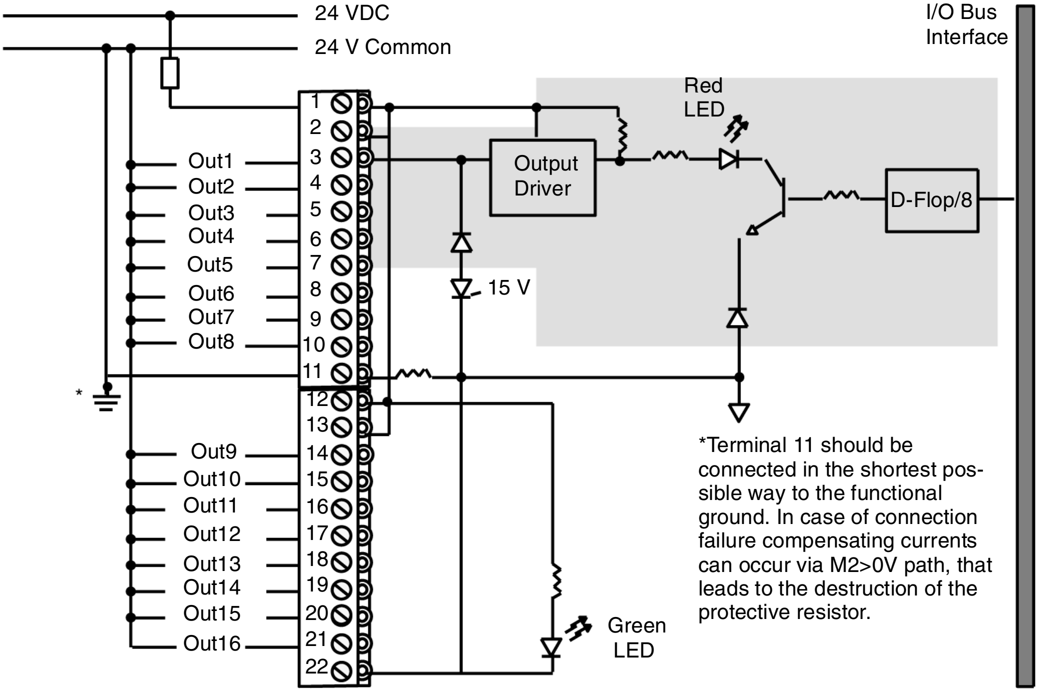
The DAO 216 has 17 LEDs. One green LED opposite terminal screw #1 indicates presence of external working voltage to the 16 outputs (ON = voltage available; OFF = voltage not available). There are 16 red LEDs opposite terminal screws 3 ... 10 and 14 ... 21, indicating when ON that 24 Vdc is present at the adjacent discrete output.

## Front View and Fill-in Label of the DAO 216 Module



## Simplified Schematic

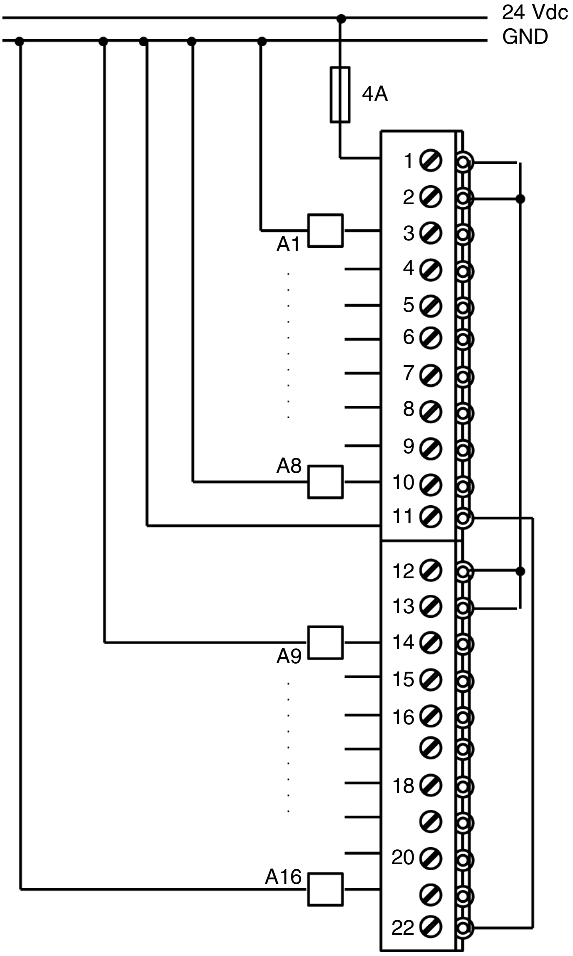
Simplified Schematic for the DAO 216 Output Module



*Terminal 11 should be connected in the shortest possible way to the functional ground. In case of connection failure compensating currents can occur via M2>0V path, that leads to the destruction of the protective resistor.

## Wiring Diagram

Wiring the DAO 216



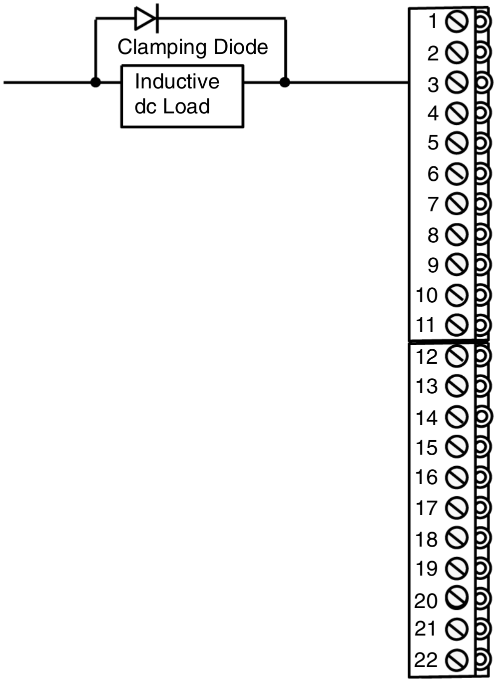
## Protecting the DAO 216 Discrete Output Module from Inductive Back EMF

**Instructions**

If you have inductive loads on longer lines with logic elements located in the output loads, it is essential to install an external clamping diode in parallel with the operating coil to protect the module from reverse EMF.

**Clamping Diode**

Clamping Diode on an Inductive Load



## DAO 216 Discrete Output Module Specifications

### DAO 216 Specifications

The following table contains a list of DAO 216 specifications

| | | |
|---|---|---|
| Module Topology | Number of Outputs | 16 |
| | Number of Groups | 1 |
| | Points/Group | 16 |
| | Isolation | No isolation provided |
| Power Supplies | External Source Requirement | 24 Vdc (20 to 30 Vdc), 5 A @30 Vdc |
| | Internally Provided Source | 5 V from I/O bus, 30 mA max. |
| | Internal Power Dissipation | 5 W (typical) |
| Electrical Characteristics | Operating Mode | True High |
| | ON State Signal Level | Source voltage minus 3 V |
| | OFF State Signal Level | 0 ... +2 V, less than 1mA |
| | Load Current/Output | 10 mA ... 500 mA |
| | Max Load Current/Module | 4 A |
| | Response Time | less than 1 msec. |
| | Reverse-EMF Protection | Built-in circuitry limits inductive spikes to a maximum of -15 V |
| | Switch Capacity for Bulbs | Max. 5 W (Surge current = Nor mal current x 10) |
| | OFF-ON Operations | 1000/hour for inductive load @ maximum load current |
| | Wire Size/Terminal | One wire = 14 AWG |
| | | Two wires = 20 AWG |
| I/O Map | Discrete 1x/0x | 0 in/16 out |
| Dimensions | W x H x D | 40.3 x 145 x 117.5mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 250 g (.55 lb) |
| Agency Approval | VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards | |

# Overview of the DAP 204 Relay Output Module

# 14

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAP 204 Relay Output Module.

**What's in this Chapter?**

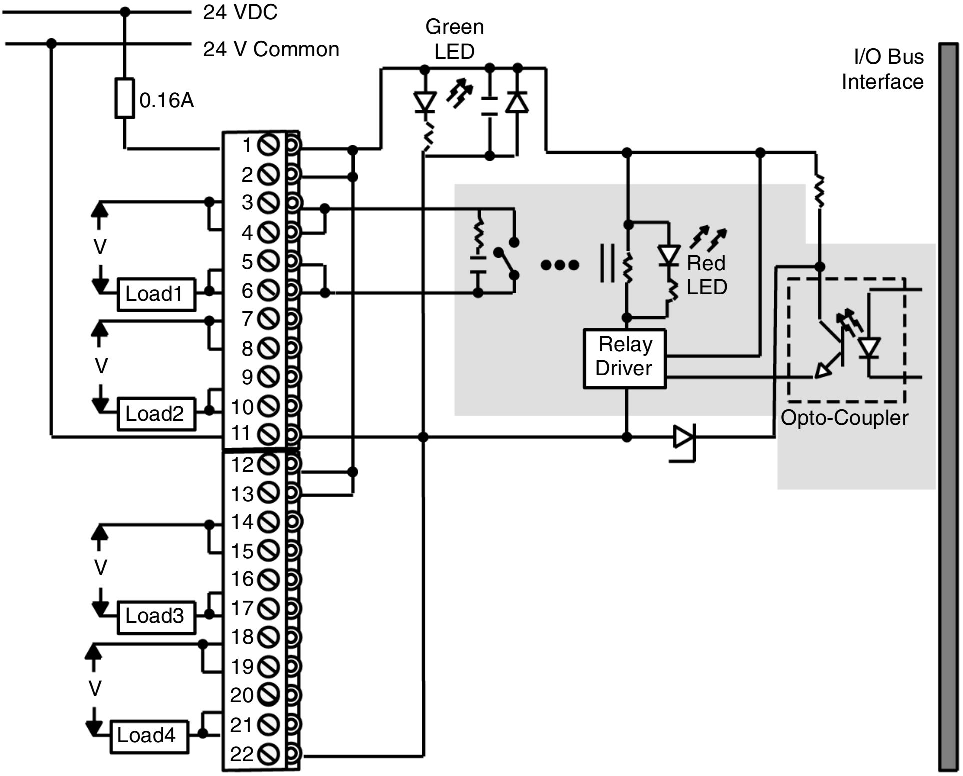
This chapter contains the following topics:

## What is the DAP 204 Relay Output Module?

**Brief Product Description**

The DAP 204 is a four point relay output module. It utilizes logic signals within the PLC to activate four independent, individually isolated, normally open relay contacts. Source voltage for any output load may be 24 ... 154 Vdc or 24 ... 250 Vac.

Wiring Diagram and Simplified Schematic for the DAP 204 Output Module



## DAP 204 Relay Output Module LEDs

**LEDs**

The DAP 204 has five LEDs. One green LED opposite terminal screw 1 indicates the presence of relay coil voltage when ON. Four red LEDs opposite terminal screws 3, 7, 14, and 18 indicate when ON that the relay coils are energized at outputs 1 ... 4, respectively, and suggest that the contacts are closed and the loads energized. These LEDs are in parallel with the relay coils, not the load.

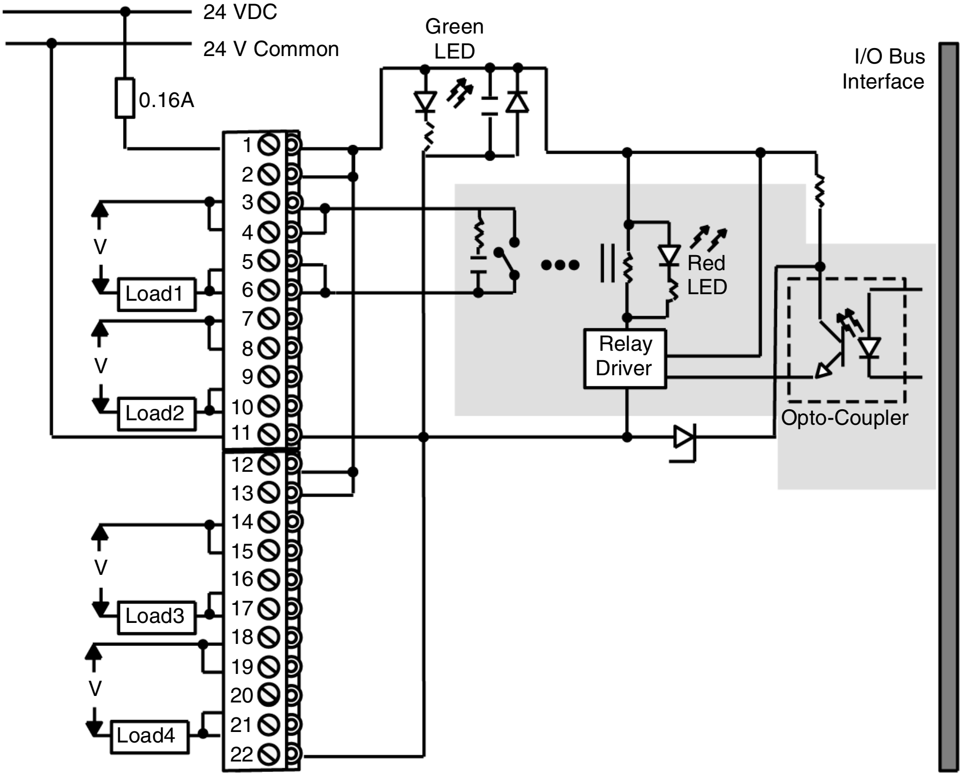
# DAP 204 Relay Output Module Field Wiring

**Introduction**

Field wiring to each output connects to a double screw terminal. This module requires power from an external 24 Vdc source to support the relay driver (even if all the outputs switch ac power).

**DAP 204 Relay Output Module**

A wiring diagram and simplified schematic for the DAP 204 relay output module is provided below.



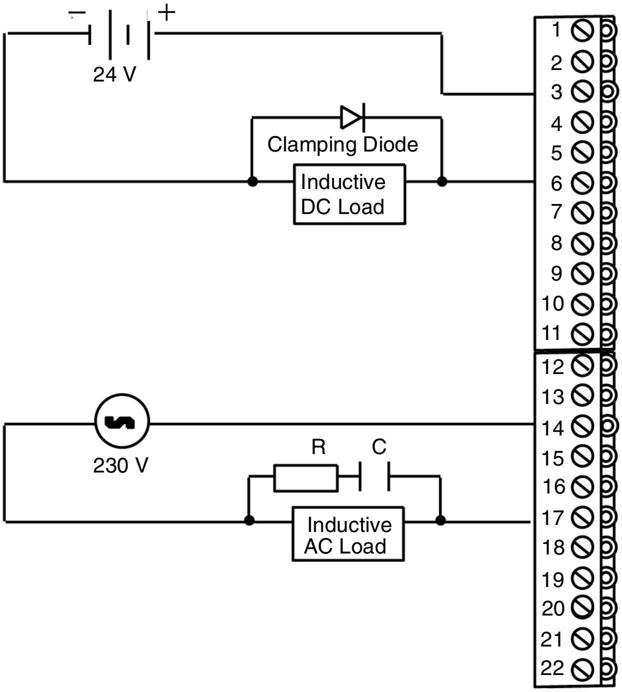
## Protecting the DAP 204 Relay Output Module from Inductive Back EMF

### Instructions

In order to increase the service life of your contacts and protect the DAP 204 module from potential reverse-EMF damage, externally connect a clamping diode in parallel with each inductive dc load and externally connect an RC snubber circuit in parallel with each inductive ac load.

### Illustration of Clamping Diode and Snubber Circuit

The following illustration is an example of clamping diode and snubber circuit on inductive loads.



**Suggested Component Values**

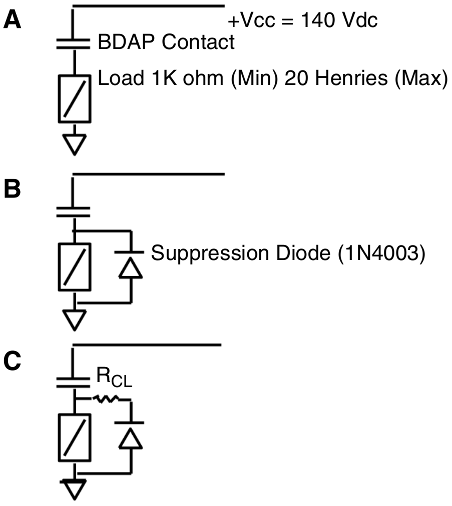
The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be three or four times greater than supply voltage at 24 Vdc and 8 ... 10 times greater than supply voltage at 110 Vdc. The unpolarized (ac) snubber capacitor should have a voltage rating two or three times greater than the supply voltage.

Values may be:

| | |
|---|---|
| 25 ... 70 mH | .50 microF |
| 70 ... 180 mH | .25 microF |
| 180 mH | .10 microF |

Snubber resistors may be 1 ... 3 ohms, 2 W. Resistor values should be increased up to 47 ohms, 1/2 W for RL exceeding 100 ohms.

Operational range options are shown in the following diagram.



Calculations:
Given: Vcc = 140Vdc
I (Max) = .15 A
Then: R(L)(Min) = 140/.15 = 1Kohm
Since L/R = .02 Sec, and R = 1Kohm
Then L(Max) = (.02) X 1000 = 20H

Voltage rating of diode = 1.5 X Vcc
Current rating of diode = 2 X I (Max)
Must be "slow," rectifier, vs logic

$R_{CL}$ = Current Limiting Resistor (.5 Load R)
Here, 470 ohms
If carbon film, .25 watt,
If metal film, .50 watt

A shows the consequences of ohmic load and L/R ratios
B shows the application of the suppression diode
C shows the application of a current limiting resistor in series with the diode to protect the diode from contact bounce

## DAP 204 Relay Output Module Specifications

### DAP 204 Specifications

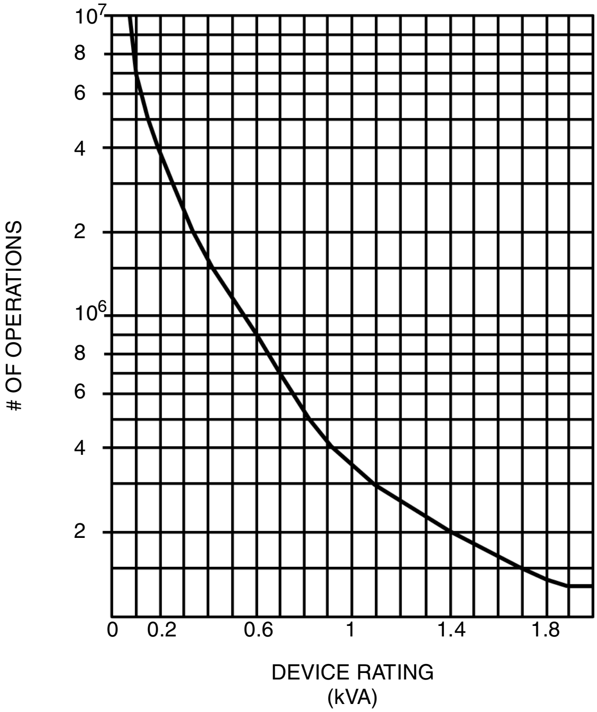
The following table contains a list of DAP 204 relay output module specifications.

| | | |
|---|---|---|
| Module Topology | Number of Relay Outputs | 4 |
| | Number of Groups | 4 |
| | Points/Group | 1 |
| | Isolation | Four individually isolated relay contacts |
| Power Supplies | External Source Requirement | 24 Vdc, 150 mA maximum |
| | Internally Provided Source | 5 V from I/O bus @ 25 mA max. |
| | Internal Power Dissipation | 2 W (typical) |
| Electrical Characteristics | Output Voltage Ranges | 24 ... 154 Vdc; 24 ... 250 Vac |
| | Operating Mode | Normally Open |
| | Response Time | 10 ms (typical) |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |
| Environmental Characteristic | Operating Temperature | -25 ... +70 degrees C (-13 ... +158 degrees F) |

| | | | |
|---|---|---|---|
| Output Characteristics | Load Currents @ 230 Vac | 2 A continuous (maximum, resistive load) | |
| | | 4 A instantaneous (maximum, resistive load) | |
| | | 1 A continuous (maximum, Cos = 0.5) | |
| | Load Current @ dc | Working Voltage @ 24 Vdc | 2 A continuous maximum (resistive load) |
| | | | 4 A instantaneous maximum (resistive load) |
| | | | 1 A continuous maximum<br>(L/R* = 30 ms) |
| | | Working Voltage @ 60 Vdc | 1 A continuous maximum (resistive load) |
| | | | 0.6 A maximum<br>(L/R* = 30 ms) |
| | | Working Voltage @ 140 Vdc | 0.3 A continuous (resistive load) |
| | | | 0.15 A (L/R* = 20 ms) |
| | Wetting Current | 5 mA for closed contacts | |
| | Leakage | 1 mA | |
| | Internal Protective Circuitry | 68 ohms +15 nF in parallel with each contact | |
| * L = Load Inductance in Henries; R = Load Resistance in ohms | | | |
| I/O Map | Discrete 1x/0x | 0 in/8 out | |

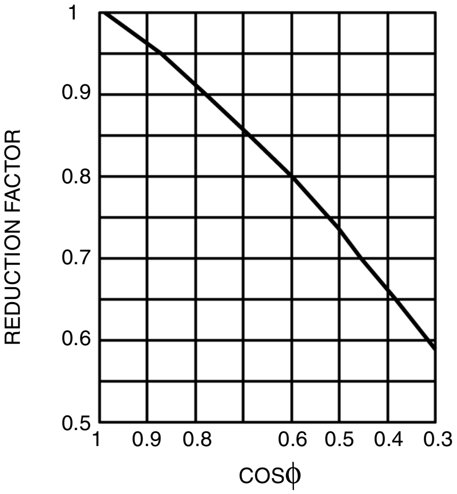
| | | | |
|---|---|---|---|
| Service Life of Contacts | Mechanical switching cycles | 20,000,000 | |
| | Electric switching cycles | 10,000,000 @ 230 Vac/0.2 A | |
| | | (Resistive Loads) | 7,000,000 @ 230 VAC / 0.5 A |
| | | | 8,000,000 (typical) @ 30 VDC / 2 A, with clamping diode |
| | | | 1,000,000 (typical) @ 60 VDC / 1 A, with clamping diode, 3000 cycles/hr max |
| | Electric switching cycles | 5,000,000 @ 230 Vac/0.5 A | |
| | | (Inductive Loads, Cos = 0.5*) | |
| | Overload Protection | Should be provided externally | |

Service Life for Resistive Loads



The maximum number of switching cycles is reduced when inductive loads are encountered. Reference the load device manufacturer's catalog for steady state and inrush VA ratings to determine the number of operations derating factor. If the frequency of operations is relatively high, use the inrush VA to calculate Cos f: Effective number of operations = # of operations (resistive load) x reduction factor:

Reduction Factor for Inductive Loads



Cos = Watts divided by VA.

| | | |
|---|---|---|
| Dimensions | WxHxD | 40.3 x 145 x 117.5 mm<br>(1.6 x 5.6 x 4.5 in) |
| | Weight | 240 g (0.52 lb) |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | |

# Overview of the DAP 208/258 Relay Output Module

# 15

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAP 208/258 relay output module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DAP 208/258 Relay Output Module?

**Brief Product Description**

The DAP 208/258 is an eight point relay output module. It utilizes logic signals within the controller to activate eight individually isolated, normally open relay contacts. Source voltage for any output load may be 24 ... 154 Vdc or 24 ... 250 Vac.

## DAP 208/258 Relay Output Module LEDs

**LEDs**

The DAP 208/258 has nine LEDs. One green LED opposite terminal screw 1 indicates the presence of relay coil voltage when ON. Eight red LEDs opposite terminal screws 3, 5, 7, 9, 14, 16, 18, and 20 indicate when ON that the relay coils are energized at outputs 1 ... 8, respectively, and suggest that the contacts are closed and the loads energized. These LEDs are in parallel with the coils, not the load.

## DAP 208/258 Relay Output Module Field Wiring

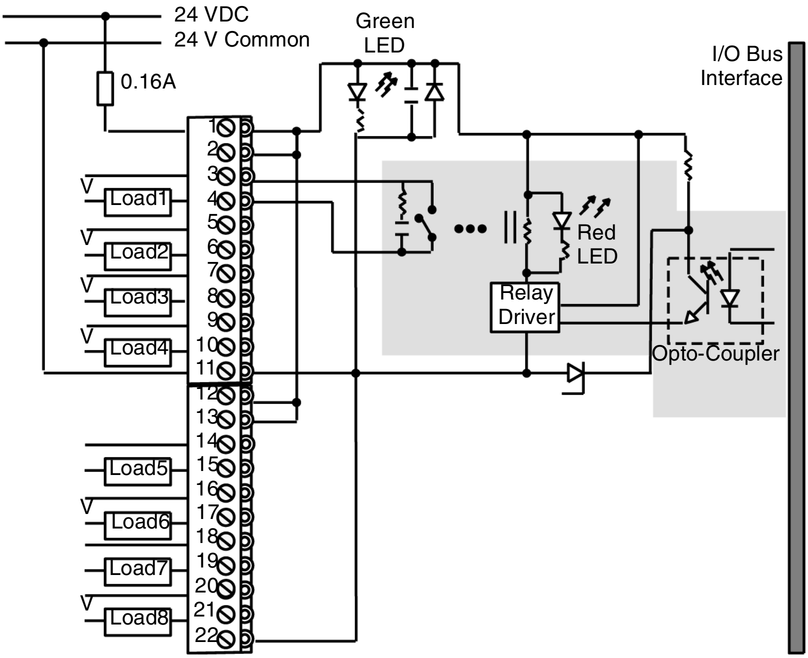
**Introduction**

Field wiring to each output connects to a double screw terminal. This module requires power from an external 24 Vdc source to support the relay driver (even if all the outputs use ac power). The DAP 258 functions just like the DAP 208 except that the DAP 258 operates at extended temperature.

**Note:** DAP 258 model is available with conformal coating. The conformal coating model is DAP 258C and it meets Railway standard EN 50 155.

**DAP 208/258 Wiring Diagram and Simplified Schematic**

A wiring diagram and simplified schematic for the DAP 208/258 relay output module is provided below.



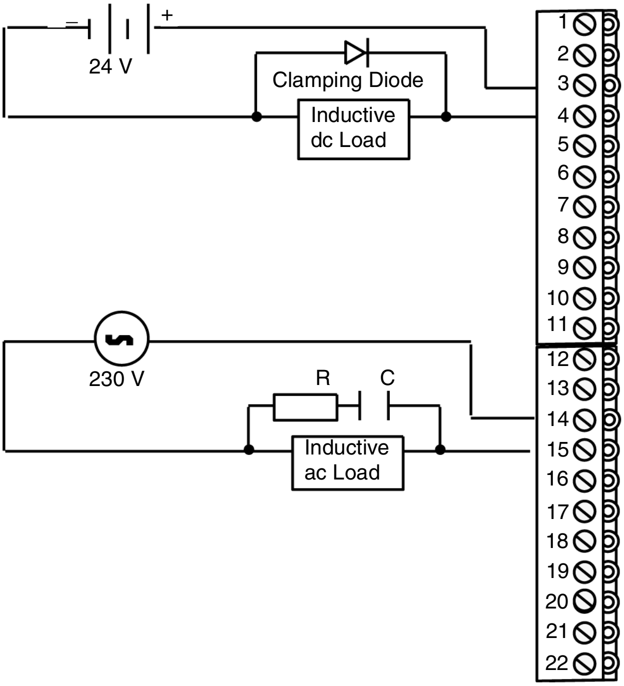
# Protecting the DAP 208/258 Relay Output Module from Inductive Back EMF

## Instructions

To increase the service life of your contacts and protect the DAP 208/258 module from potential reverse-EMF damage, externally connect a clamping diode in parallel with each inductive dc load and externally connect an RC snubber circuit in parallel with each inductive ac load.

## Clamping Diode and Snubber Circuit

The following illustration is an example of clamping diode and snubber circuit on inductive loads.



## Suggested Component Values

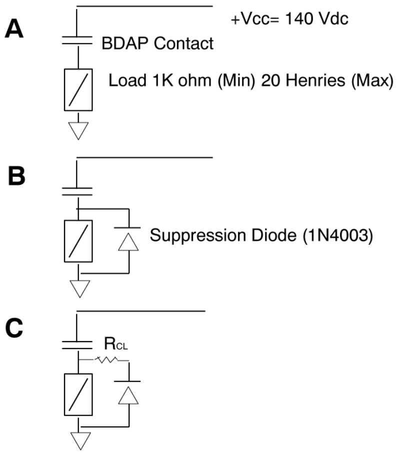
The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be three or four times greater than supply voltage at 24 Vdc and 8 ... 10 times greater than supply voltage at 110 Vdc. The unpolarized (ac) snubber capacitor should have a voltage rating two or three times greater than the supply voltage.

Values may be:

| Load Inductance | Capacitance |
|---|---|
| 25 ... 70 mH | .50 microF |
| 70 ... 180 mH | .25 microF |
| 180 mH | .10 microF |

Snubber resistors may be 1 ... 3 W, 2 W. Resistor values should be increased up to 47 ohms, 1/2 W for RL exceeding 100 ohms.

Operational Range Options Using 140 Vdc Example



Calculations:
Given: Vcc= 140Vdc
I (Max)= .15 A

Then: R(L)(Min)= 140/.15=1Kohm
Since L/R=.02 Sec, and R=1Kohm,
Then L(Max)= (.02) X 1000=20H

Voltage rating of diode = 1.5 X Vcc
Current rating of diode = 2 X I (Max)
Must be "slow", rectifier, vs logic

$R_{CL=}$ Current Limiting Resistor (.5 Load R)
Here, 470 ohms
If carbon film, .25 watt,
If metal film, .50 watt

A shows the consequences of ohmic load and L/R ratios
B shows the application of the suppression diode
C shows the application of a current limiting resistor in series with the diode to protect the diode from contact bounce

## DAP 208/258 Relay Output Module Specifications

### DAP 208/258 Tables and Diagrams

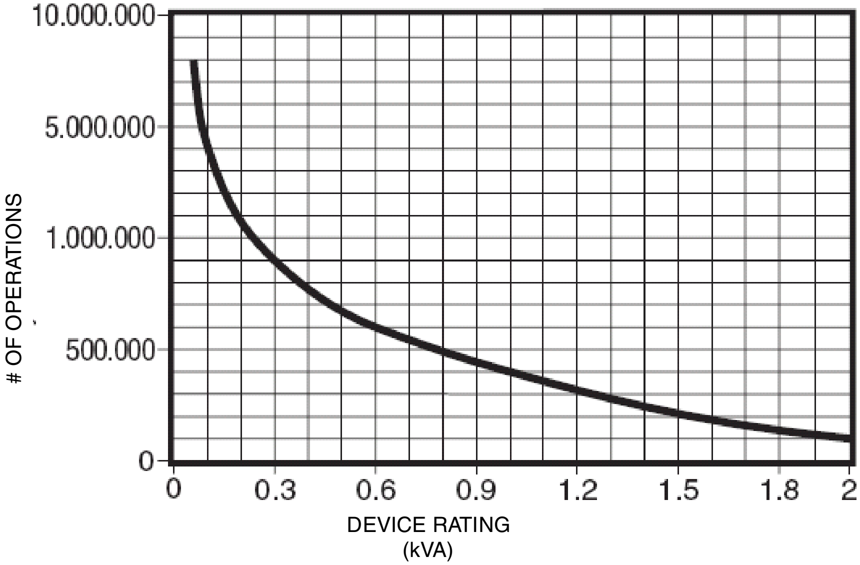
The following table contains a list of DAP 208/258 relay output module specifications.

| | | |
|---|---|---|
| Module Topology | Number of Relay Outputs | 8 |
| | Number of Groups | 8 |
| | Points/Group | 1 |
| | Isolation | Eight individually isolated relay contacts |
| Power Supplies | External Source Requirement | 24 Vdc, 150 mA maximum |
| | Internally Provided Source | 5 V, less than 60 mA from I/O bus |
| | Internal Power Dissipation | 2 W (typical) |
| Electrical Characteristics | Output Voltage Ranges | 24 ... 154 Vdc;  24 ... 250 Vac |
| | Operating Mode | Normally Open |
| | Response Time | 10 ms (typical) |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |
| Environmental Characteristic | Operating Temperature | 0 ... 60 degrees C for DAP 208<br>-40 ... +70 degrees C for DAP 258 |

| | | | |
|---|---|---|---|
| Output Characteristics | Load Currents at 230 Vac | 2 A continuous (maximum, resistive load) | |
| | | 4 A instantaneous (maximum, resistive load) | |
| | | 1 A continuous (maximum, Cos = 0.5) | |
| | Load Current at dc | Working Voltage @ 24 Vdc | 2 A continuous maximum (resistive load) |
| | | | 4 A instantaneous maximum (resistive load) |
| | | | 1 A continuous (maximum, Cos = 0.5) |
| | | Working Voltage @ 60 Vdc | 1 A continuous maximum (resistive load) |
| | | | 0.6 A maximum (L/R* = 30 ms) |
| | | Working Voltage @ 140 Vdc | 0.3 A continuous (resistive load) |
| | | | 0.15 A (L/R* = 20 ms) |
| | Wetting Current | 5 mA for closed contacts | |
| | Leakage | 1 mA | |
| | Internal Protective Circuitry | 68 ohms +15 nF in parallel with each contact | |
| | Overload Protection | Should be provided externally | |
| | | * L = Load Inductance in Henries; R = Load Resistance in ohms | |
| I/O Map | Discrete 1x/0x | 0 in/8 out | |

| | | | |
|---|---|---|---|
| Service Life of Contacts | Mechanical switching cycles | 20,000,000 | |
| | Electric switching cycles | 8,000,000 @ 230 Vac/0.2 A | |
| | | (Resistive Loads) | 3,000,000 @ 230 VAC / 0.5 A |
| | | | 4,000,000 (typical) @ 30 VDC / 2 A, with clamping diode |
| | | | 1,000,000 (typical) @ 60 VDC / 1 A, with clamping diode, 3000 cycles/hr max |
| | Electric switching cycles | 2,000,000 @ 230 Vac/0.5 A | |
| | | (Inductive Loads, Cos = 0.5) | |

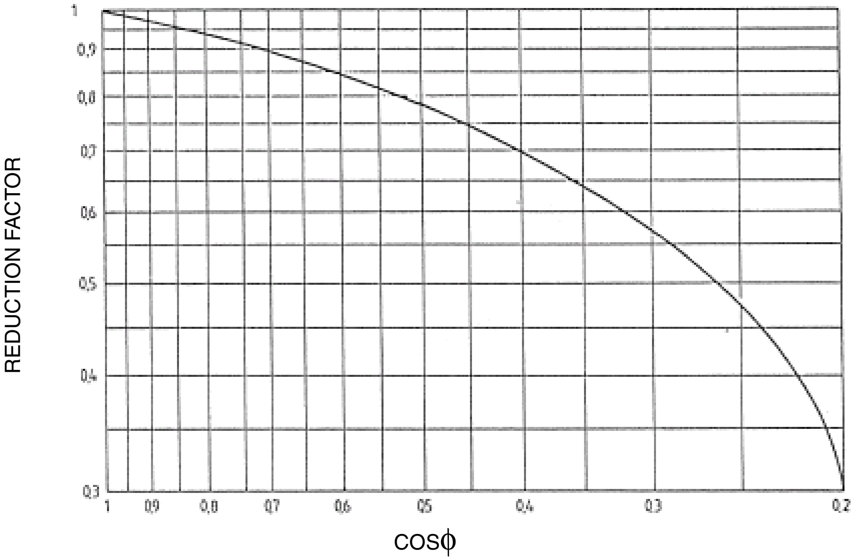
The following graph shows Service LIfe for Resistive Loads.



SERVICE LIFE FOR RESISTIVE LOADS

The maximum number of switching cycles is reduced when inductive loads are encountered. Reference the load device manufacturer's catalog for steady state and inrush VA ratings to determine the number of operations derating factor. If the frequency of operations is relatively high, use the inrush VA to calculate Cos: Effective number of operations = # of operations (resistive load) x reduction factor:

The chart below shows Reduction Factor for Inductive Loads.



REDUCTION FACTOR FOR INDUCTIVE LOADS

Cos = Watts divided by VA.

| | | |
|---|---|---|
| Dimensions | WxHxD | 40.3 x 145 x 117.5  mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 240 g (0.52 lb) |
| Agency Approvals | DAP 208: VDE 0160; UL 50; CSA 22.2 No.142; and FM Class I, Div 2 Standards | |
| | DAP 258C: Railway standard EN 50 155: EMC 89/336/EEC (See *Requirements for CE Compliance, p. 857*). UL 50; CSA 22.2 No.142; and FM Class I, Div 2 pending | |

# Overview of the DAP 209 Output Module

# 16

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAP 209 output module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DAP 209 Output Module?

**Brief Product Description**

The DAP 209 is a discrete output module with eight independent 120 Vac output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads of up to 1 A/channel. The module is structured in one group of eight outputs, each output electrically isolated from the I/O bus by an opto coupler.

## DAP 209 Output Module LEDs

**LEDs**

The DAP 209 has nine LEDs. One green LED opposite terminal screw 1 indicates the presence of AC line voltage when ON. Eight red LEDs opposite terminal screws 3, 5, 7, 9, 14, 16, 18, and 20 indicate an AC ON condition for load at the field wiring side of the system for outputs 1 ... 8, respectively. Depending on local conditions, users may notice LEDs on unused outputs exhibiting a dim glow. To eliminate this condition, connect a 39K ohms, 1/2 W resistor from the unused output terminal to ac neutral.

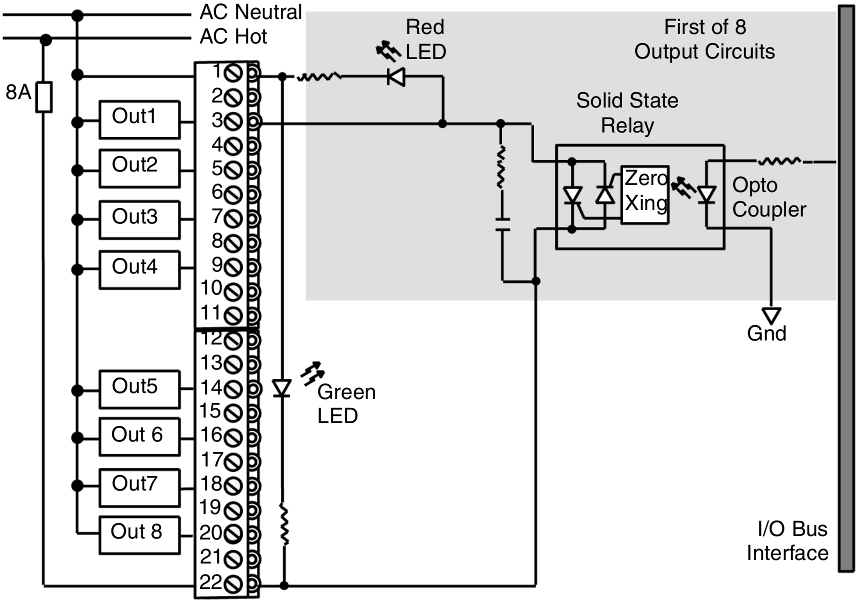
## DAP 209 Output Module Field Wiring

**Introduction**

The DAP 209 is a discrete output module with eight independent 120 Vac output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads of up to 1 A/channel. The module is structured in one group of eight outputs, each output electrically isolated from the I/O bus by an opto coupler.

**Wiring Diagram for DAP 209**

A wiring diagram and simplified schematic for the DAP 209 output module is provided below.



## DAP 209 Output Module Specifications

### DAP 209 Tables of Specifications

The following tables contain DAP 209 output module specifications.

| | | |
|---|---|---|
| Module Topology | Number of Outputs | 8 |
| | Number of Groups | 1 |
| | Points/Group | 8 |
| | Isolation | Optocoupler on each output point |
| Power Supplies | External Source Requirement | 120 Vac |
| | Internally Provided Source | 5 V from I/O bus; 55 mA max. |
| | Internal Power Dissipation | 2 W (typical) |
| Electrical Characteristics | Working Voltage Range | 85 ... 138 Vac continuous, 47 ... 63 Hz |
| | Output Voltage | 150 Vac RMS maximum for 10 s<br>200 Vac RMS maximum for 1 cycle |
| | Operating Mode | True High |
| | OFF State Leakage Current | 1.9 mA maximum |
| | ON State Voltage Drop | 1.5 Vac RMS maximum |
| | Load Current | Up to 1 A/channel 5 mA mini mum |
| | Response Time | 8.34 ms maximum @ 60 Hz |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |
| I/O Map | Discrete 1x/0x | 0 in/8 out |
| Dimensions | W x H x D | 40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 450 g (1 lb) |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | |

DAP 209 Load Current (Amps)@60 Degrees C, Ambient

| **Number of Outputs in Use** | **Max. Allowable Load/Output @ 60 degrees, Ambient** |
|---|---|
| 8 | 0.6 A |
| 6 | 0.67A |
| 4 | 0.71 A |
| 2 | 0.87 A |
| 1 | 1.0 A |

DAP 209 1 A Load Current vs. Temperature

| **Number of Outputs @ 1 A** | **Allowable Ambient Temperature** |
|---|---|
| 8 | 35 degrees C |
| 6 | 40 degrees C |
| 4 | 45 degrees C |
| 2 | 51 degrees C |
| 1 | 60 degrees C |

# Overview of the DAP 210 Output Module

# 17

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAP 210 output module.

**What's in this Chapter?**

This chapter contains the following topics:

## DAP 210 Output Module LEDs

**LEDs**

The DAP 210 has nine LEDs. One green LED opposite terminal screw 1 indicates the presence of system power to the module. Eight red LEDs opposite terminal screws 3, 5, 7, 9, 14, 16, 18, and 20 indicate that the output points have been enabled on the module's logic side.

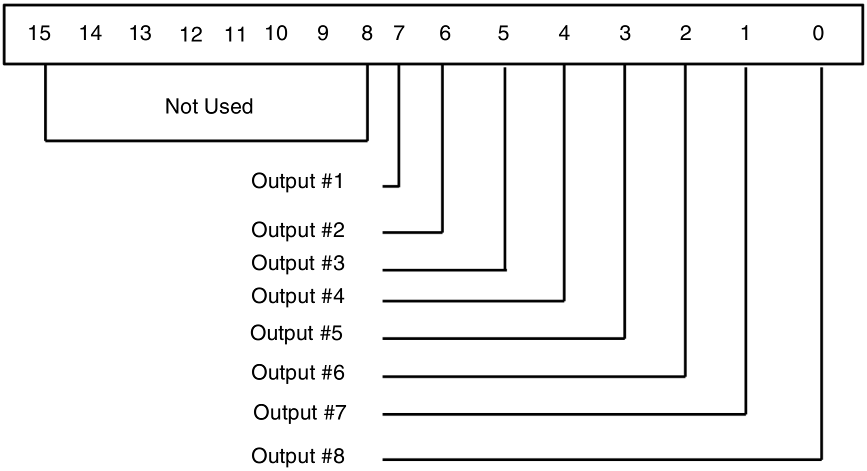
⚠ **CAUTION**

**Operational Hazard**

Each output group is fused to protect against catastrophic failure. For protection against triac failure, each output must be individually fused with a fast-acting fuse rated at 1.5 times user continuous current (fuse must not exceed 2 A).

**Failure to follow this instruction can result in injury or equipment damage.**

The following diagram illustrates bit assignment for the DAP 210 output module.



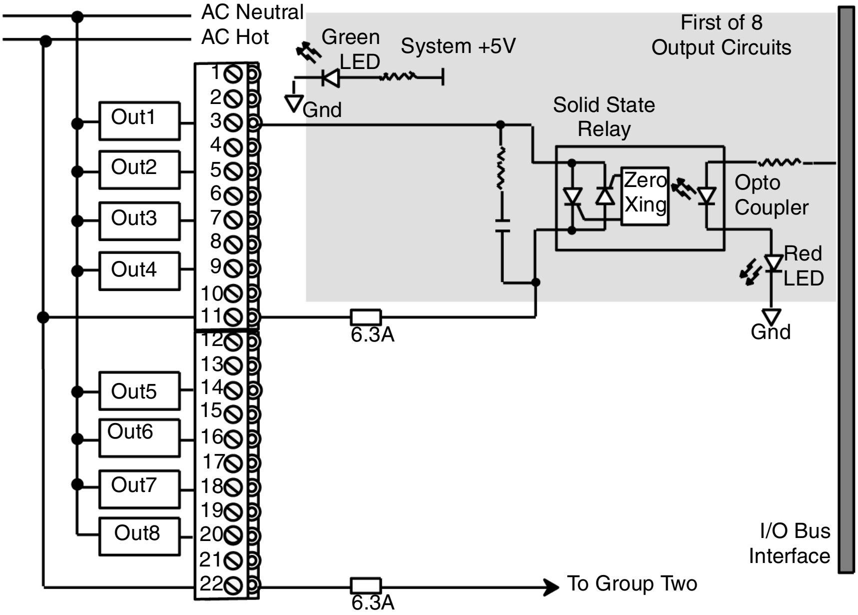
## DAP 210 Output Module Field Wiring

**Introduction**

The DAP 210 is a discrete output module with two independent groups of four 24 ... 230 Vac output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads of up to 1 A/channel. The module outputs are optically isolated from the system.

**DAP 210 Wiring Diagram**

A wiring diagram and simplified schematic for the DAP 210 output module is provided below.



# DAP 210 Output Module Specifications

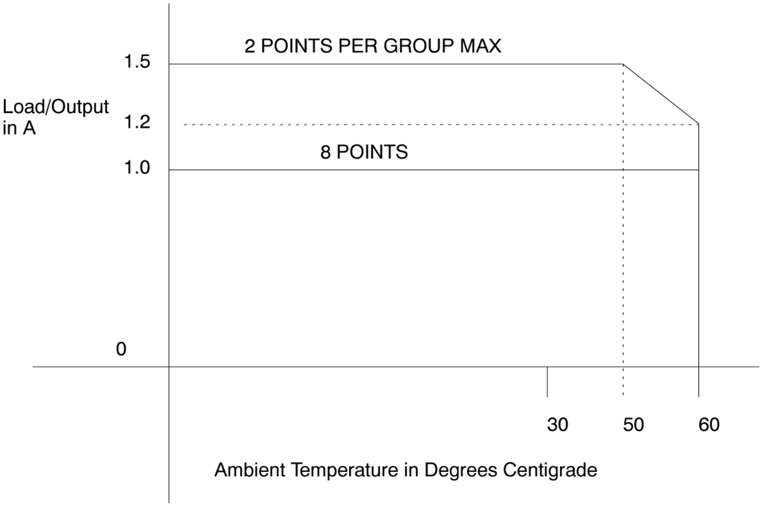
## DAP 210 Specifications

The following table and illustrations contain DAP 210 output module specifications.

| | | |
|---|---|---|
| Module Topology | Number of Outputs | 8 |
| | Number of Groups | 2 |
| | Points/Group | 4 |
| | Isolation | Field to bus; 1500 Vac RMS @ 47 ... 63 Hz, 2500 Vdc, both for a period of 60 s without breakdown |
| Power Supplies | *External Source Requirement | 24 ... 230 Vac, 47 ... 63 Hz |
| | Internally Provided Source | 5 V, less than 70 mA from the I/O bus |
| | Power Dissipation | 7.2 W with all points ON |
| | Fusing (per group) | One 250 Vac, 6.3 A time-lag fuse (Wickmann TR5-T Fuse; Modicon Part # 57-0110-000) |
| Electrical Characteristics | *Working Voltage Range | 24 ... 230 Vac continuous, 47 ... 63 Hz |
| | Maximum Output Voltage | 300 Vac RMS maximum for 10 s<br>400 Vac RMS maximum for 1 cycle |
| | Operating Mode | True High |
| | OFF State Leakage Current | 3.75 mA maximum |
| | ON State Voltage Drop | 1.5 Vac RMS maximum |
| | Maximum Load Current | Up to 1.0 A/channel (see graph) |
| | Maximum Surge Current | 15 A/1 cycle, 1 surge/min maximum |
| | Minimum Load Current | 50 mA RMS |
| | Response Time | 8.34 ms maximum OFF to On and ON to OFF @ 60 Hz |
| | Maximum Rate of Applied DV/DT | 400 V/msec |
| | Maximum Rate of Commutating DV/DT | 5 V/micros |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |
| I/O Map | Discrete 1x/0x | 0 in/8 out |

| | | |
|---|---|---|
| Environmental | Operating Temperature | 0 ... 60 degrees C |
| | Storage Temperature | -40 ... +80 degrees C |
| | Humidity | 0 ... 95 percent relative humidity @ 0 ... 60 degrees C |
| Dimensions | W x H x D | 40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in) |
| Weight | 1 lb (.45kg) | |
| *Agency Approvals | VDE 0160; UL 508; CSA 22.2 No.142; and European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 857*) Standards | |
| *The module is labelled both as a 24 VAC to 115 VAC or 24 VAC to 230 VAC. When used in a VDE 0160 environment the voltage range is reduced to 24 VAC to 115 VAC. When used in a non VDE 0160 environment the module meets specification IEC 1131; UL 508; and CSA 22.2 No.142 and operates over the full range of 24 VAC to 230 VAC. | | |

The graph below shows DAP 210 Power Output.



## What is the DAP 210 Output Module?

**Brief Product Description**

The DAP 210 is a discrete output module with two independent groups of four 24 ... 230 Vac output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads of up to 1 A/channel. The module outputs are optically isolated from the system.

**⚠ WARNING**

**Operational Hazard**

The DAP 210 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

# Overview of the DAP 211 Combined I/O Module

# 18

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAP 211 combined I/O module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DAP 211 Combined I/O Module?

### Brief Product Description

**Note:** Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft.

The DAP 211 is a 120 Vac, mixed I/O (4 binary isolated input points/4 binary isolated short-circuited protected Triac output points) module. An external operating voltage of 120 Vac for sensor supply (inputs) and an external working voltage of 120 Vac for the outputs must be provided.

The DAP 211 module is unique in its design. It may be used in two different applications:

1. Non-voted (single) application, where the DAP 211 monitors its own outputs using a single module.
2. Voted (dual) application, where the output of the first DAP 211 is monitored through an input of the second DAP 211 using a two-module configuration.

When used for voted (dual) applications, such as clutch and brake, the modules operate in pairs. That is, the interconnection of two modules makes it possible for the output of the first module to be monitored through an input of the second module. This results in logical states.

**Note:** This module corrects a current problem of false indication of inputs being in the on" state due to leakage currents in monitored output systems as applied in safety circuits like clutch and brake I/O circuits.

# DAP 211 Combined I/O Module Logical Input Routine

### Logical States for Voted (Dual) Operations

The five possible outputs for module 1 appear at the top of the table. The five possible outputs for module 2 appear on the left side of the table. The input states for module 2 and module 1 appear in the center as noted.

<table>
<tr><th colspan="7">Module 1</th></tr>
<tr><td colspan="2">Output States</td><td>Triac On</td><td>Triac as Diode</td><td>AUX Broken</td><td>Load Broken</td><td>Triac Off</td></tr>
<tr><td rowspan="5">Module 2</td><td>Triac On</td><td>Module2=H<br>Module1=H</td><td>Module2=H<br>Module1=H</td><td>Module2=L<br>Module1=H</td><td>Module2=H<br>Module1=H</td><td>Module2=H<br>Module1=H</td></tr>
<tr><td>Triac as Diode</td><td>Module2=H<br>Module1=H</td><td>Module2=H<br>Module1=H</td><td>Module2=H<br>Module1=H</td><td>Module2=H<br>Module1=H</td><td>Module2=H<br>Module1=H</td></tr>
<tr><td>AUX Broken</td><td>Module2=H<br>Module1=L</td><td>Module2=H<br>Module1=H</td><td>Module2=H<br>Module1=H</td><td>Module2=L<br>Module1=L</td><td>Module2=H<br>Module1=H</td></tr>
<tr><td>Load Broken</td><td>Module2=H<br>Module1=H</td><td>Module2=H<br>Module1=H</td><td>Module2=L<br>Module1=L</td><td>Module2=H<br>Module1=H</td><td>Module2=H<br>Module1=H</td></tr>
<tr><td>Triac Off</td><td>Module2=H<br>Module1=H</td><td>Module2=H<br>Module1=H</td><td>Module2=H<br>Module1=H</td><td>Module2=H<br>Module1=H</td><td>Module2=L<br>Module1=L</td></tr>
<tr><td colspan="7">KEY: H=High, L=Low, Triac On= Traic is on or defected (shorted), Triac as Diode= Triac is defected, works as a diode (any direction), AUX Broken= AUX connection between the 2 modules is broken, Load Broken= Load connection between the 2 modules is broken.</td></tr>
</table>

For voted (dual) applications, ensure the two modules are wired as shown in DAP 211 Combined I/O Module Field Wiring. The logical states table is an absolute MUST in programming/configuration, since only those modules with a defined operating state have a "LOW-LOW" combination.

## DAP 211 Combined I/O Module Error Checking Procedure for Output States

### Error Checking Procedure

Perform the following steps to ensure you have no output errors:

| Step | Action |
|---|---|
| 1 | Set all outputs to OFF. Input 1 and Input 2 must be low, if not you have an error. |
| 2 | Test Output 1: Output 1 is set to ON, Output 2 remains at OFF. Result Input 1 is HIGH (input 2 is not tested in this step), if not, you have an error. |
| 3 | Test Output 2: Output 2 is set to ON, Output 1 remains at OFF. Result Input 2 is HIGH (input 1 is not tested in this step), if not, you have an error. |
| 4 | Set all outputs to OFF: Input 1 and Input 2 must be low, if not, you have an error. |
| 5 | If no error, start the press. |

## DAP 211 Combined I/O Module Setup Options

### Setup Options

The way you setup your DAP 211 depends upon the application. Refer to the wiring diagram for Non-Voted (Single) applications. This application requires one PLC and one DAP 211 module. Refer to the wiring diagram for Voted (Dual) applications. This application requires two PLCs and two DAP 211 modules.

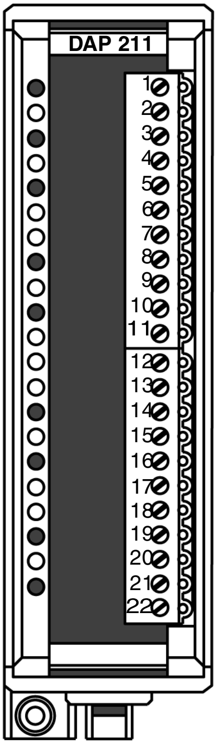
## DAP 211 Combination I/O Module LEDs

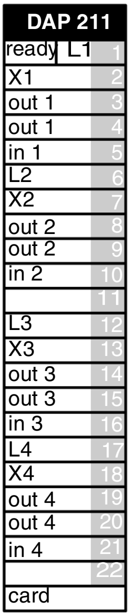
**LEDs**

The DAP 211 module has LEDs opposite terminal screws 1 ... 22.

| Location of LED | Label | Color | Description |
|---|---|---|---|
| 1 | Ready | Green | Working voltage of 4 out puts:<br>On: Working voltage exist<br>Off: No working voltage |
| 3, 8, 14, 19 | Out1 ... Out4 | Red | Output signals:<br>On: Output=1<br>Off: Output=0 |
| 5, 10, 16, 21 | In1 ... In4 | Red | Input signals:<br>On: Input=1<br>Off: Input=0 |

A front view with DAP 211 label is provided below.





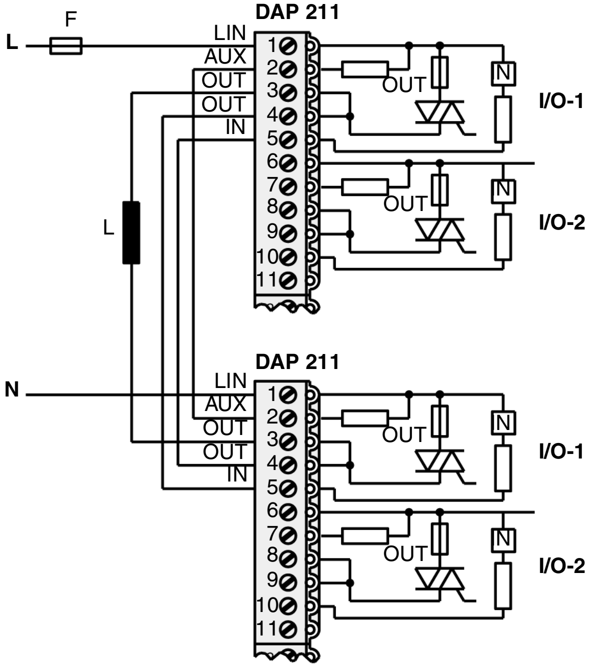
## DAP 211 Combined I/O Module Field Wiring

### Setup Options

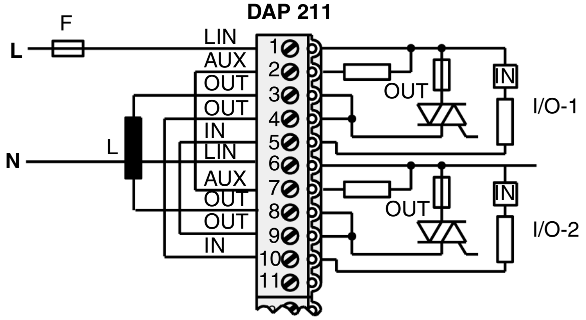
The way you setup your DAP 211 depends upon the application. Non-voted (single) applications require one PLC and one DAP 211 module. Voted (dual) applications require two PLCs and two DAP 211 modules.

### Wiring Diagrams for DAP 211

A DAP 211 wiring diagram for voted (dual) applications is provided below.



A DAP 211 wiring diagram for non-voted (single) applications is provided below.



## DAP 211 Combined I/O Module Specifications

### Table of Specifications for DAP 211

The following table contains DAP 211 combined I/O module specifications.

| | | |
|---|---|---|
| Module Topology | Number of Inputs | 4 (separated from logic through optical coupler) |
| | Number of Triac Outputs | 4 |
| | Number of Groups | 4 |
| | Points/Group | 1 in/1 out |
| Required Loadable (for Modsoft ONLY) | SW-IODR-001 | |
| | Isolation | One group is isolated from the other group. Within a group there is no isolation between inputs and outputs. |
| Power Supplies | External Sensor Requirement | 120 Vac |
| | External Working Requirement | 120 Vac |
| | Internally Provided Source | 5 V from I/O bus; 35 mA typical |
| | Power Dissipation | 5 W typical |
| Input Characteristics | Sensor Power Supply | 120 Vac -15 percent, +10 percent @ 47 ... 63 Hz |
| | Signal Rated Value | 120 Vac |
| | Input Delay | 1 period |
| | Type of Networking | Potential isolation per group (group=1 input/1output) |
| Output Characteristics | Working Voltage | 120 Vac -15 percent, +10 percent @ 47 ... 63 Hz for all 4 outputs |
| | Allocation | Short-circuit protection by internal fuse |
| | Type of Networking | Potential isolation per group (group=1 input/1output) |
| I/O Map | Discrete 1x/0x | 4 in/4 out |
| Environmental Characteristics | Operating Temperature | 0 ... 60 degrees C |
| Dimensions | WxHxD | 40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 190 g (.4 lb.) |

| | |
|---|---|
| Agency Approvals | VDE 0160; UL 508; CSA 22.2 No. 142, European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 857*) Standards |

# Overview of the DAP 212/252 Combined I/O Module

# 19

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAP 212/252 combined I/O module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DAP 212/252 Combined I/O Module?

**Brief Product Description**

The DAP 212/252 is a 24 Vdc, mixed I/O (8 points in/4 relays out) module. It senses eight discrete input signals received by field sensing devices-such as pushbuttons, limit switches, or other 24 Vdc sources-and converts those signals into logic that can be used by the controller. It utilizes logic signals within the controller to activate four independent and individually isolated normally open relay contacts. The module requires power from an external 24 Vdc source to operate. The DAP 252 functions just like the DAP 212 except that the DAP 252 operates at extended temperature -40 ... +70 degrees C.

**Note:** DAP 252 model is available with conformal coating. The conformal coating model is DAP 252C and it meets Railway standard EN 50 155.

## DAP 212/252 Combined I/O Module LEDs

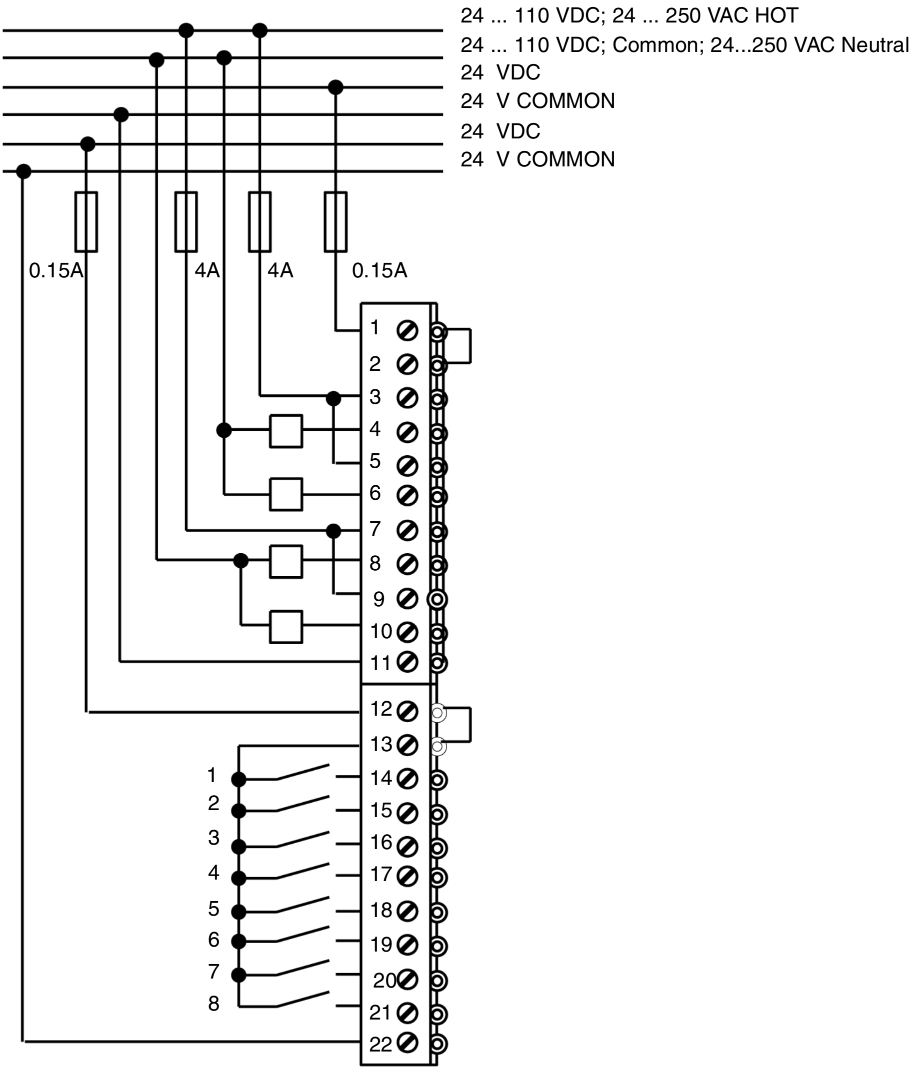
**LEDs**

The DAP 212/252 module has two green LEDs opposite terminal screws 1 and 12; when one of these LEDs is ON, it indicates power available to the input or output points directly below it. Below terminal screw 1 are four red LEDs opposite terminal screws 3, 5, 7, and 9 indicating relay output points 1 ... 4, respectively. Below terminal screw 12 are eight red LEDs opposite terminal screws 14 ... 21 indicating inputs 1 ... 8, respectively.

## DAP 212/252 Combined I/O Module Field Connections

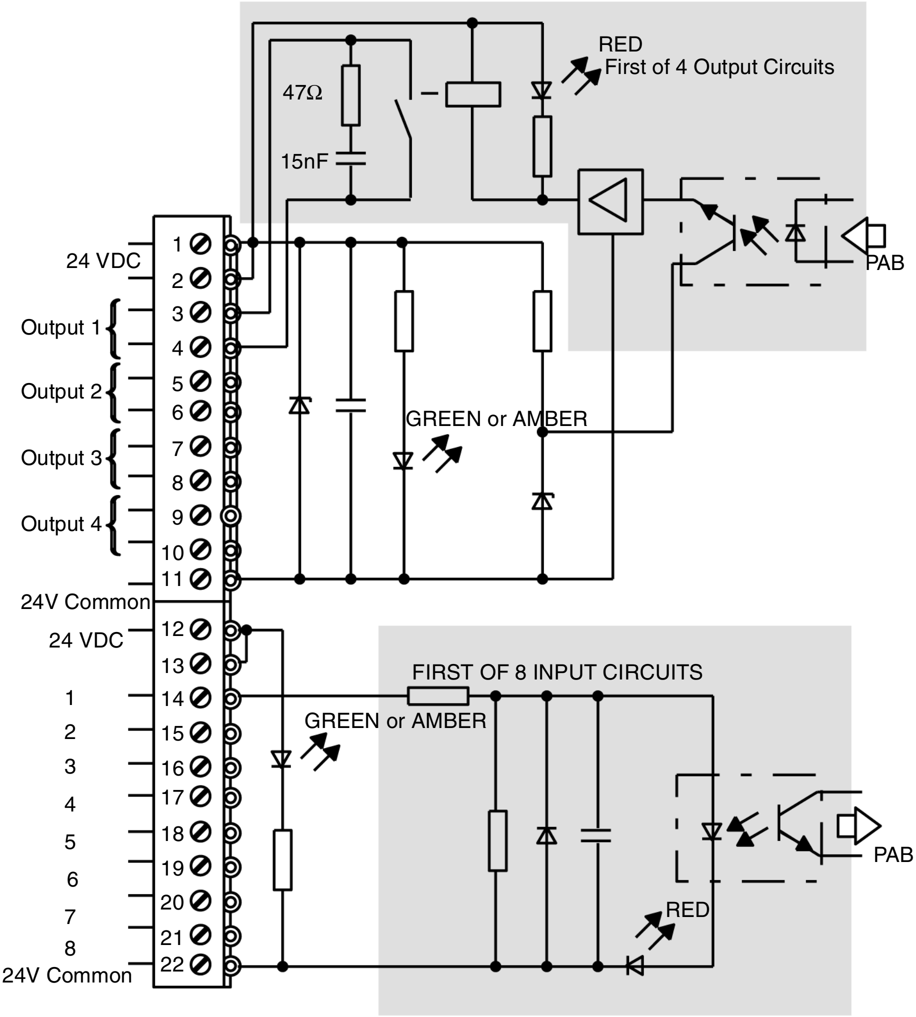
**DAP 212/252 Wiring Diagram**

A wiring diagram for the DAP 212/252 combined I/O module is provided below.



**Simplified Schematic**

A simplified schematic for the DAP 212/252 combined I/O module is provided below.



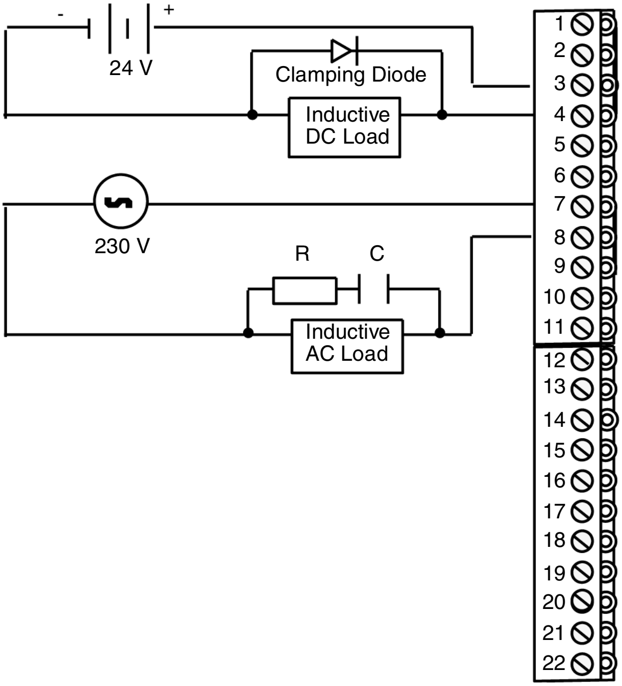
## Protecting the DAP 212/252 Combined I/O Module from Inductive Back EMF

### Instructions

To increase the service life of the relay output contacts and protect the DAP 212/252 module from potential reverse-EMF damage, externally connect a clamping diode in parallel with each inductive dc load and externally connect an RC snubber circuit in parallel with each inductive ac load.

### Illustration of Clamping Diode and Snubber Circuit

The following illustration is an example of clamping diode and snubber circuit on inductive loads.



## Suggested Component Values

The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be three or four times greater than supply voltage at 24 Vdc and 8 ... 10 times greater than supply voltage at 110 Vdc. The unpolarized (ac) snubber capacitor should have a rating two or three times greater than the supply voltage.

Values may be:

| **Snubber Values** | |
|---|---|
| **Load Inductance** | **Capacitance** |
| 25 ... 70 mH | .50 microF |
| 70 ... 180 mH | .25 microF |
| 180 mH | .10 microF |

**Note:** To I/O Map the DAP 252 module in Modsoft you must select DAP 212. Both modules share a host driver and have similar characteristics.

## DAP 212/252 Combined I/O Module Specifications

**Module Specifications**

The following tables and diagrams contain DAP 212/252 combined I/O module specifications.

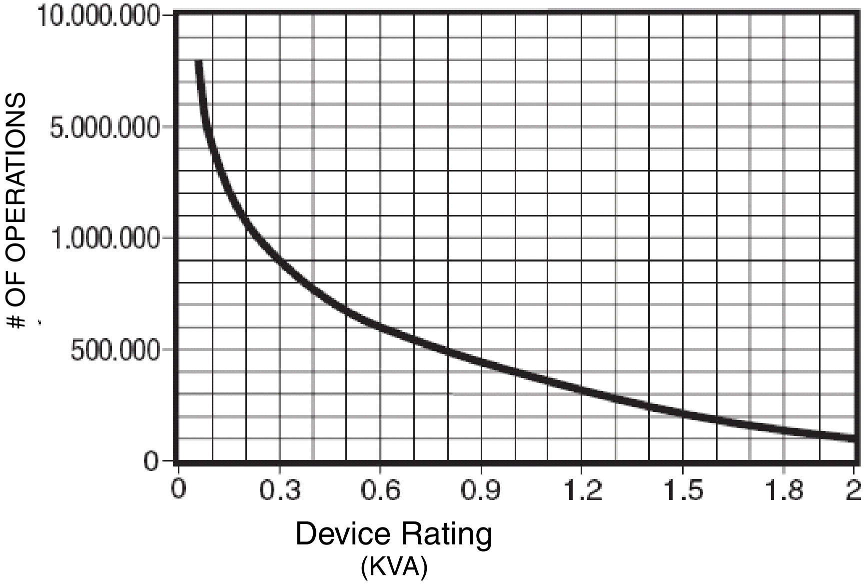
| | | |
|---|---|---|
| Module Topology | Number of Inputs | 8 |
| | Number of Relay Outputs | 4 |
| | Number of Groups | 2 |
| | Points/Group | 8 in/4 out |
| | Isolation | Relay output contacts are individually isolated; the input group is isolated from the out put group |
| Power Supplies | External Source Requirement | 24 Vdc, 150 mA maximum |
| | Internally Provided Source | 5 V from I/O bus; 25 mA max. |
| | Internal Power Dissipation | 2 W (typical) |
| Input Characteristics | Working Voltage Range | 20 ... 30 Vdc |
| | Signal Rated Value | +24 V |
| | ON State Signal Level | +12 V ... +30 V |
| | OFF State Signal Level | -2 V ... +5 V |
| | Input Wetting Current | 7 mA |
| | Input Current | 4 mA @ 24 V; 6 mA @ 37 V |
| | Response Time | 4 ms (typical) for DAP212<br>7 ms (typical) for DAP252 |
| | Operating Mode | True High |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |

| | | |
|---|---|---|
| Output Characteristics | Output Voltage Ranges | 24 ... 110 Vdc; 24 ... 250 Vac |
| | Operating Mode | Normally Open |
| | Response Time | 10 ms (typical) |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |
| | Load Currents at 115/230 Vac | 2 A continuous (maximum, resistive load) |
| | | 4 A instantaneous (maximum, resistive load) |
| | | 1 A continuous (maximum, Cos = 0.5) |
| | Load Current at 24 Vdc | 2 A continuous maximum (resistive load) |
| | | 4 A instantaneous maximum (resistive load) |
| | | 1 A continuous maximum (L/ R* = 30 ms) |

DAP 212/252 Specifications (continued)

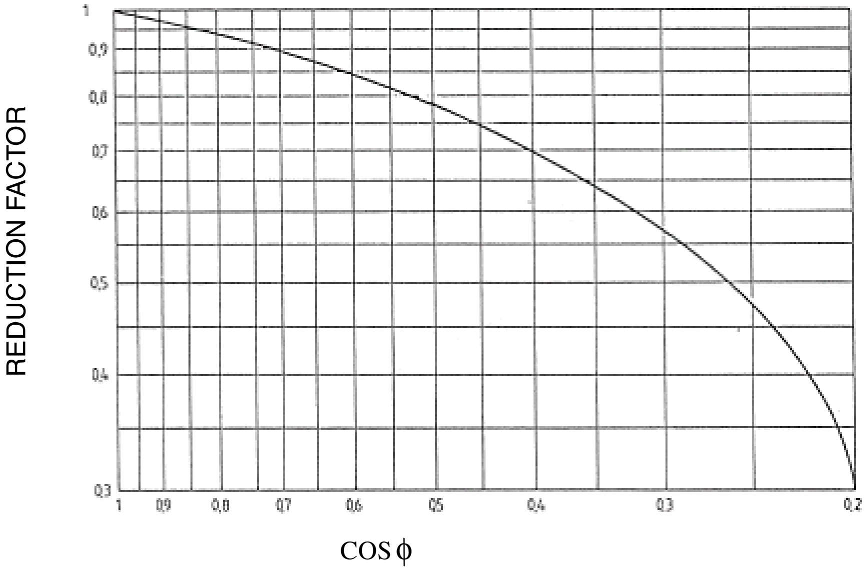
| | | |
|---|---|---|
| Output Characteristics (continued) | Load Current at 60 Vdc | 1 A continuous maximum (resistive load) |
| | | 0.6 A maximum (L/R* = 30 ms) |
| | Load Current at 110 Vdc | 0.45 A continuous maximum (resistive load) |
| | | 0.25 A maximum (L/R* = 30 ms) |
| | Wetting Current | 5 mA for closed contacts |
| | Leakage | 1 mA |
| | Internal Protective Circuitry | 68 ohms +15 nF in parallel with each contact |
| | Overload Protection | Should be provided externally |
| Environmental Characteristics | Operating Temperature | 0 ... 60 degrees C for DAP212<br>-40 ... +70 degrees C for DAP252 |
| I/O Map | Discrete 1x/0x | 8 in/4 out |
| * L = Load Inductance in H R = Load Resistance in ohms | | |
| Service Life of Relay Contacts | Mechanical switching cycles | 20,000,000 |
| | Electric switching cycles (Re sistive Loads) | 8,000,000 @ 230 VAC / 0.2 A 3,000,000 @ 230 VAC / 0.5 A, 4,000,000 (typical) @ 30 VDC / 2 A, with clamping diode, 1,000,000 (typical) @ 60 VDC / 1 A, with clamping diode, 3000 cycles/hr max |
| | Electric switching cycles (In ductive Loads, Cos = 0.5) | 2,000,000 @ 230 VAC / 0.5 A |

This chart shows the Service Life for Resistive Loads.



The maximum number of switching cycles is reduced when inductive loads are encountered. Reference the load device manufacturer's catalog for steady state and inrush VA ratings to determine the number of operations derating factor. If the frequency of operations is relatively high, use the inrush VA to calculate Cos: Effective number of operations = # of operations (resistive load) x reduction factor:

This chart shows the Reduction Factor for Inductive Loads.



REDUCTION FACTOR FOR INDUCTIVE LOADS

Cos = Watts divided by VA.

| | | |
|---|---|---|
| Dimensions | WxHxD | 40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 190 g (.4 lb) |
| Agency Approvals | DAP 212: VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards | |
| | DAP 252C: Railway standard EN 50 155: EMC 89/336/EEC. UL 50; CSA 22.2 No.142; and FM Class I, Div 2 pending | |

# Overview of the DAP 216/216N Discrete Output Module

20

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAP 216/216N discrete output module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DAP 216/216N Discrete Output Module?

**Brief Product Description**

The DAP 216/DAP216N is a discrete output module with 16 independent 24 Vdc output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads. The module is structured in two group of eight outputs, each output electrically opto-isolated from the I/O bus, and each group is protected against short circuit and overload.

**Note:** The AS-BDAP-216 has been enhanced. The enhancements have resulted in the AS-BDAP-216 being superseded by the AS-BDAP216N.

## DAP 216/216N Discrete Output Module LEDs

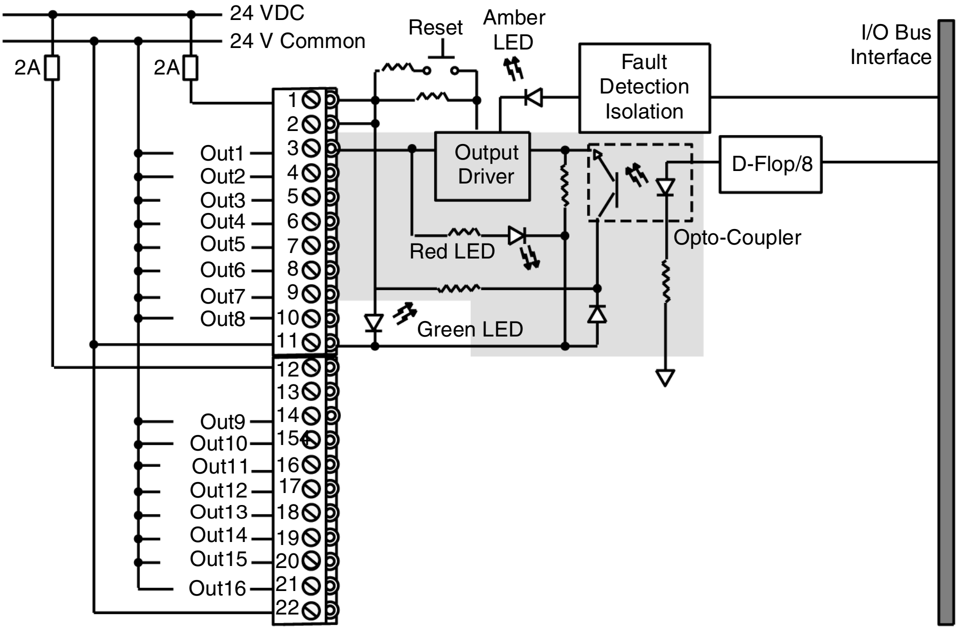
**LEDs**

The DAP 216/DAP216N has 20 LEDs. Two green LEDs opposite terminal screws 1 and 12 indicate when ON that working voltage is available to the two groups of eight discrete outputs below them. Two amber LEDs opposite terminal screws 2 and 13 go ON to indicate a short circuit or overload problem in the output group below them. There are 16 red LEDs opposite terminal screws 3 ... 10 and 14 ... 21, indicating when ON that the adjacent discrete output is in an ON condition.

## DAP 216/216N Field Wiring

**Wiring Diagram and Simplified Schematic for DAP 216/216N**

A wiring diagram and simplifed schematic for the DAP 216/DAP216N is provided bleow.



## Resetting the DAP 216 Module After an Overload of Short Circuit

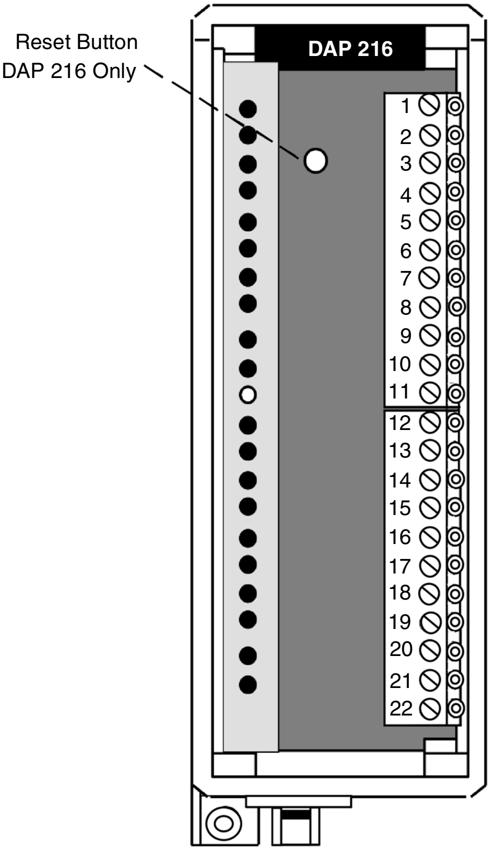
**Instructions**

A short circuit or overload condition will cause an output point to turn itself off. The degree of overcurrent that causes the device to shut off is determined by thermal characteristics unique to the individual point switching device. When overheated due to overload conditions, the device turns off to protect itself.

The two amber LEDs display short circuit or overload conditions on the two discrete output groups. After you have taken corrective measures to remove the cause of the overload or short circuit, push the yellow reset button on the front of the module to reactivate it.

## Front View of DAP 216/DAP 216N Module

A front view with DAP 216 label is provided below.



**Note:** No reset button exists on DAP 216N.

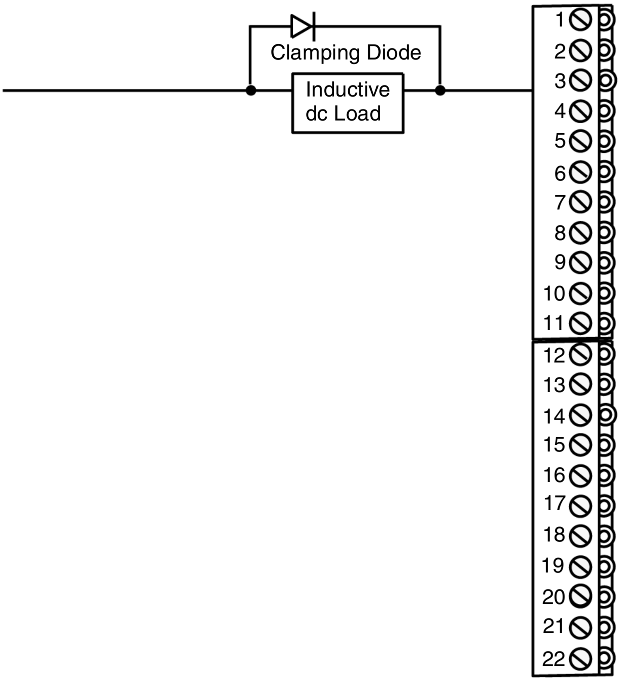
## Protecting the DAP 216/216N Discrete Output Module from Inductive Back EMF

**Instructions**

If you have inductive loads on longer lines with logic elements located in the output loads, install an external clamping diode in parallel with the operating coil to protect the module from reverse EMF.

**Clamping Diode on an Inductive Load**

The following illustration is an example of clamping diode on inductive loads.



**Suggested Component Values**

The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be 70 ... 100 V.

## DAP 216N Discrete Output Module Differences

### Introduction

**Note:** The AS-BDAP-216 has been enhanced. The enhancements have resulted in the AS-BDAP-216 being superseded by the AS-BDAP216N.

⚠ **WARNING**

**Over Current Hazard.**

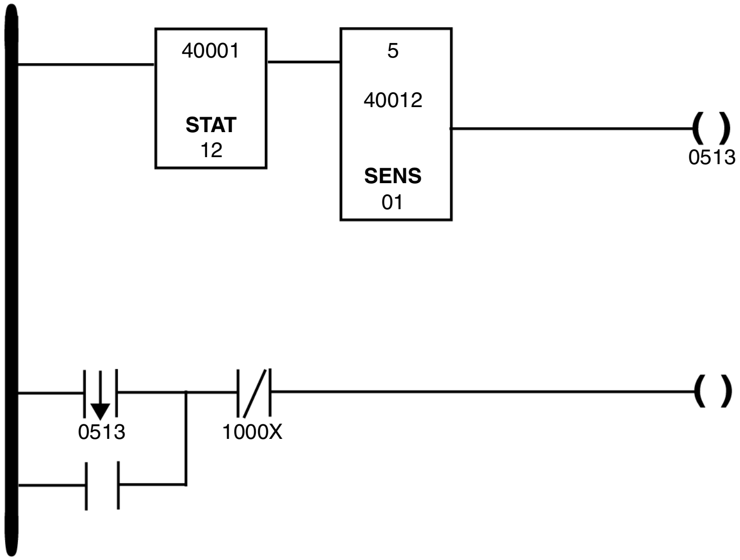
In the event of an enabled output sensing an over current condition, the output will disable, until the over current condition is removed. The output will then re-enable itself, if still set ON in the logic program.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

1. The manual reset button of the BDAP-216 has been replaced by a solid state retry on a shorted output.
2. The module restarts field devices automatically when the output is set ON in the User Logic and the detected field over current condition is removed. Refer to the user logic example in the figure below if detection and manual reset is still desired.
3. You may now apply the full 0.5A per point for 4A per Group and 8A per Module.
4. The input impedance of the electronic circuity that handles the 24Vdc power for the outputs was lowered to accommodate long runs of the power supply cable. As a result, the inrush current draw from the power supply is increased from about 6A for 2 microseconds to 54A for 12 microseconds. This increase, however, is well below the inrush current that the module draws from the external power supply when outputs are switched on.

## User Logic Example

A user logic example to detect module overload condition is provided below.



Each Compact I/O Module returns a Health Bit to the controller when in use. This bit is a single bit in a register that shows the slot position of the module and its status. When the module is functioning correctly this bit is set to "1". User logic can be attached to the state of this bit to hold the logic associated with this module in an OFF condition until an operator pushes a switch to reactivate the user logic.

In the illustration above, a STAT function is used to read 12 registers of which register 12 is the status word for the modules in the primary rack 1. The BDAP216N has been placed in slot number 5, so a SENS function block is used to sense bit 5 of this register. The output is tied to coil 0513 which turns OFF when the module becomes unhealthy. To trap this condition even if coil 0513 turns ON again, it is latched into coil 0514. This coil can then be used by the programmer as an enable/ disable to ladder logic associated with the BDAP216N in this particular slot and particular process. The user logic is restarted by the operator pressing a button attached to input 1000X.

**Note:** The BDAP216N will automatically restart and reset the Health Bit when the overload condition is removed. This network only holds the reset condition of any user logic programmed OFF under the control of coil 0514 in the above example.

## DAP 216/216N Discrete Output Module Specifications

### DAP 216/216N Specifications

The following table contains a list of the DAP 216/216N discrete output module specifications.

| | | |
|---|---|---|
| Module Topology | Number of Outputs | 16 |
| | Number of Groups | 2 |
| | Points/Group | 8 |
| | Isolation | Each point opto-isolated from the I/O bus Each output group isolated from the other |
| Power Supplies | External Source Requirement | 24 Vdc |
| | Internally Provided Source | 5 V,less than 50 mA from the I/O bus |
| | Internal Power Dissipation | 1 W (typical) |
| Electrical Characteristics | Operating Mode | True High |
| | ON State Signal Level | External supply -3V |
| | OFF State Signal Level | 0 ... +2 V, less than 1mA |
| | Load Current/Output | 0.5 A max. |
| | Max Load Current/Group | 2 A (DAP 216),<br>4 A (DAP 216N) |
| | Response Time | less than 1 ms |
| | Reverse-EMF Protection | Clamping diode recommended across inductive loads. |
| | Switch Capacity for Bulbs OFF-ON Operations at Maxi mum Power | 5 W (surge current = normal current x 10) 1000/h (inductive load @ maximum load current) 100/s (resistive load) 8/s (max imum lamp load) |
| | Wire Size/Terminal | One wire:  14 AWG |
| | | Two wires:  20 AWG |
| I/O Map | Discrete 1x/0x | 0 in/16 out |
| Dimensions | W x H x D | 40.3 x 145 x 117.5  mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 220 g (.5 lb) |
| Agency Approval | VDE 0160; UL 508; and cUL Standards | |

# Overview of the DAP 217 Discrete Output Module

# 21

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAP 217 discrete output module.

**Note:** Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/ 211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DAP 217 Discrete Output Module?

**Brief Product Description**

The DAP 217 is a discrete output module with 16 independent 5 ... 24 Vdc sink output circuits. It can operate relays, motor starters, pilot lamps, valves, solenoids and other similar loads. The module is structured in two group of eight outputs, each output electrically opto-isolated from the I/O bus.

## DAP 217 Discrete Output Module LEDs

**LEDs**

The DAP 217 has 18 LEDs. Two green LEDs opposite terminal screws 1 and 12 indicate when ON that working voltage is available to the two groups of eight discrete outputs below them. There are 16 red LEDs opposite terminal screws 3 ... 10 and 14 ... 21, indicating when ON that the adjacent discrete output is in an ON condition.

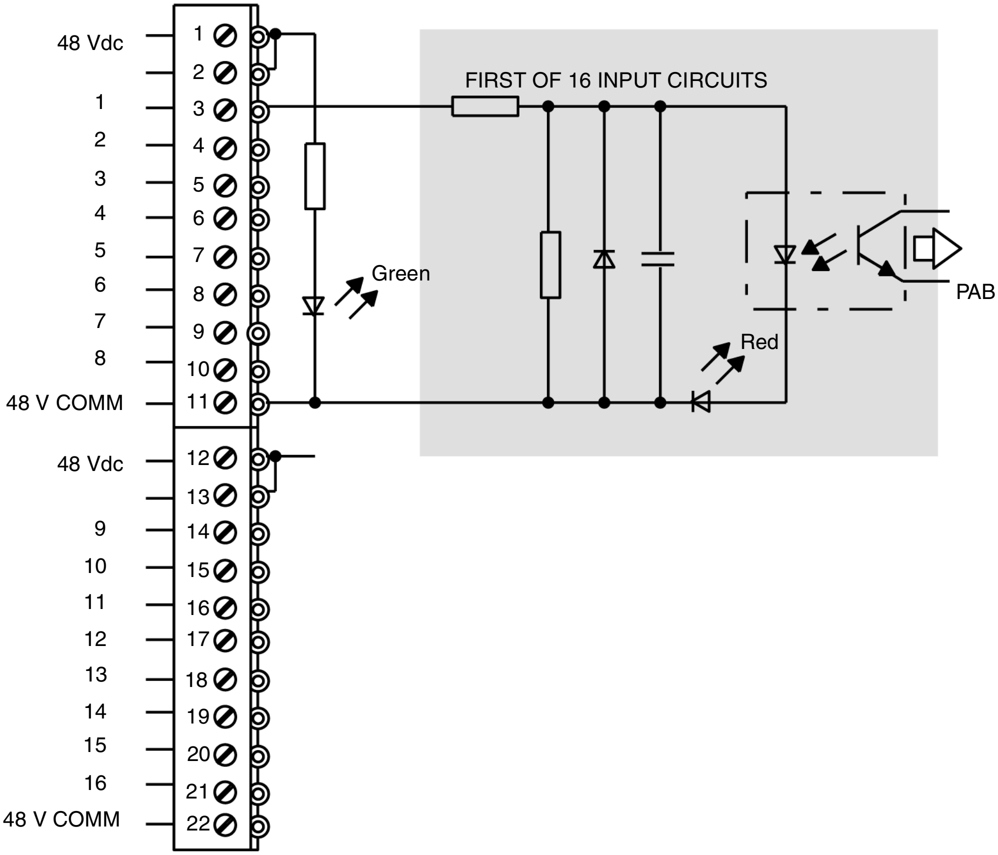
## DAP 217 Discrete Output Module Field Wiring

**Introduction**

The DAP 217 is a discrete output module with 16 independent 5 ... 24 Vdc sink output circuits. It can operate relays, motor starters, pilot lamps, valves, solenoids and other similar loads. The module is structured in two group of eight outputs, each output electrically opto-isolated from the I/O bus.

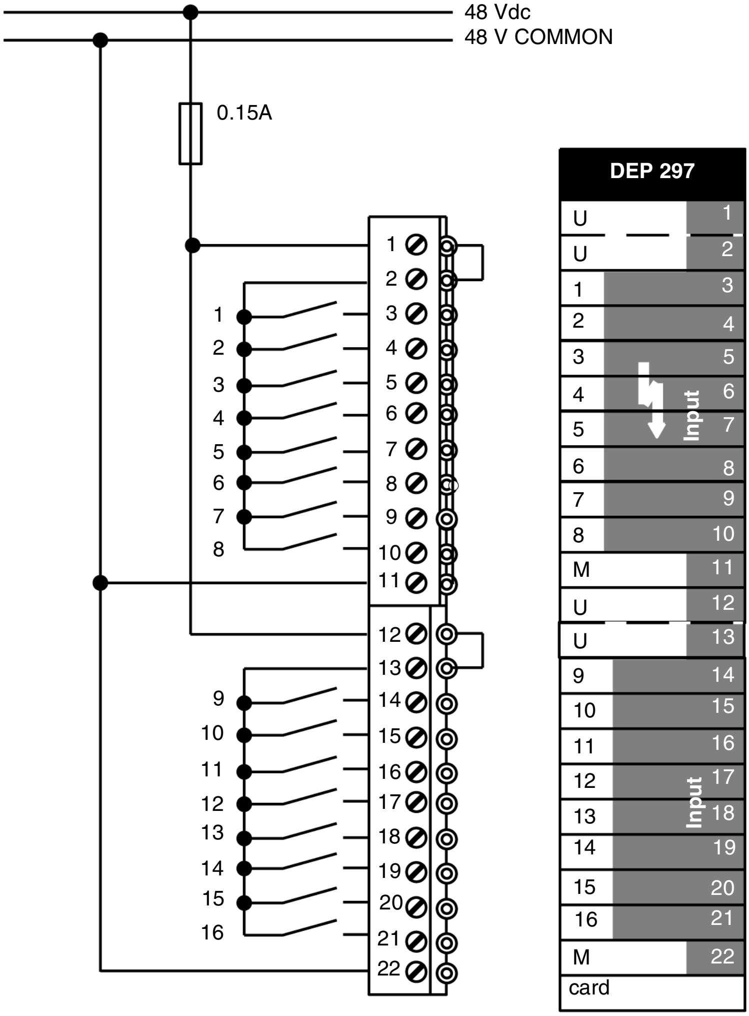
**Simplified Schematic**

A simplified schematic for the DAP 217 is provided below.



**Wiring Diagram**

A wiring diagram for the DAP 217 is provided below.



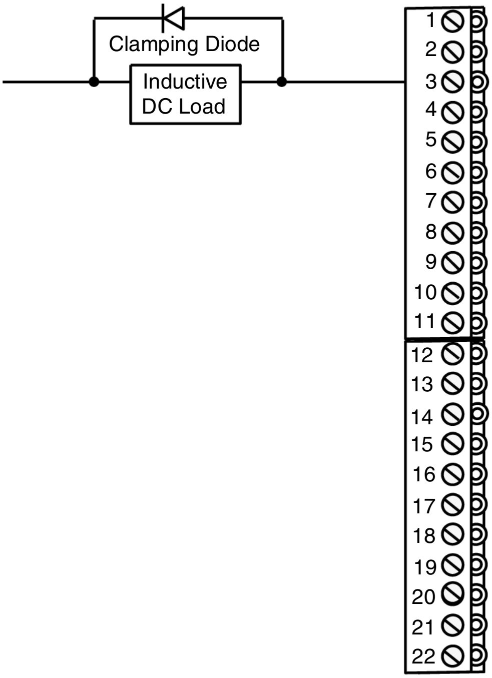
# Protecting the DAP 217 Discrete Output Module from Inductive Back EMF

**Instructions**

If you have inductive loads on longer lines with logic elements located in the output loads, install an external clamping diode in parallel with the operating coil to protect the module from reverse EMF.

**Clamping Diode on an Inductive Load**

The following illustration is an example of a clamping diode on an inductive load.



**Suggested Component Values**

The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be 70 ... 100 V.

## DAP 217 Discrete Output Module Specifications

### DAP 217 Specifications

The following table contains a list of DAP 217 discrete output module specifications.

| | | |
|---|---|---|
| Module Topology | Number of Outputs | 16 |
| | Number of Groups | 2 |
| | Points/Group | 8 |
| | Isolation | Each point opto-isolated from the I/O bus Each output group isolated from the other |
| Required Loadable | SW-IODR-001 (See *Requirements for CE Compliance, p. 857*) | |
| Power Supplies | External Source Requirement | 5 ... 24 VDC |
| | Internally Provided Source | 5 V, 60 mA max. from the I/O bus |
| | Internal Power Dissipation | 3.5 W (typical) |
| Electrical Characteristics | Operating Mode | True Low |
| | Output OFF | 5 Vdc (External Source) |
| | Output ON | less than or equal to 0.7V @ 4 mA |
| | Load Current/Output | 0.1 A up to 0.3 A when the total current of 0.8 A per group is not exceeded |
| | Max Load Current/Group | 0.8 A max. |
| | Off State Leakage Current | less than or equal to 100 microA/point |
| | Response Time | less than 1 ms |
| | Reverse-EMF Protection | Clamping diode recommended across inductive loads. |
| | Switch Capacity for Bulbs OFF-ON Operations at Maximum Power | Surge current = normal current x 10 2/s (inductive load @ maximum load current) 100/s (resistive load) 8/s (maximum lamp load) |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |
| I/O Map | Discrete 1x/0x | 0 in/16 out |

| | | |
|---|---|---|
| Dimensions | W x H x D | 40.3 x 145 x 117.5  mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 220 g (.5 lb) |
| Agency Approval | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | |

# Overview of the DAP 218 Output Module

# 22

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAP 218 output module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DAP 218 Output Module?

**Brief Product Description**

The DAP 218 is a discrete output module with two independent groups of eight 24 ... 240 Vac output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads of up to 0.5 A/output. The module outputs are optically isolated from the system.

**⚠ WARNING**

**Operational Hazard**

The DAP 218 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

## DAP 218 Output Module LEDs

**LEDs**

The DAP 218 has 17 LEDs. One green LED opposite terminal screw 1 indicates the presence of bus power to the module. Sixteen red LEDs opposite terminal screws 3 ... 10 and 14 ... 21 indicate that the output points have been enabled on the module's logic side.

⚠ **CAUTION**

**Fuse Protection Hazard**

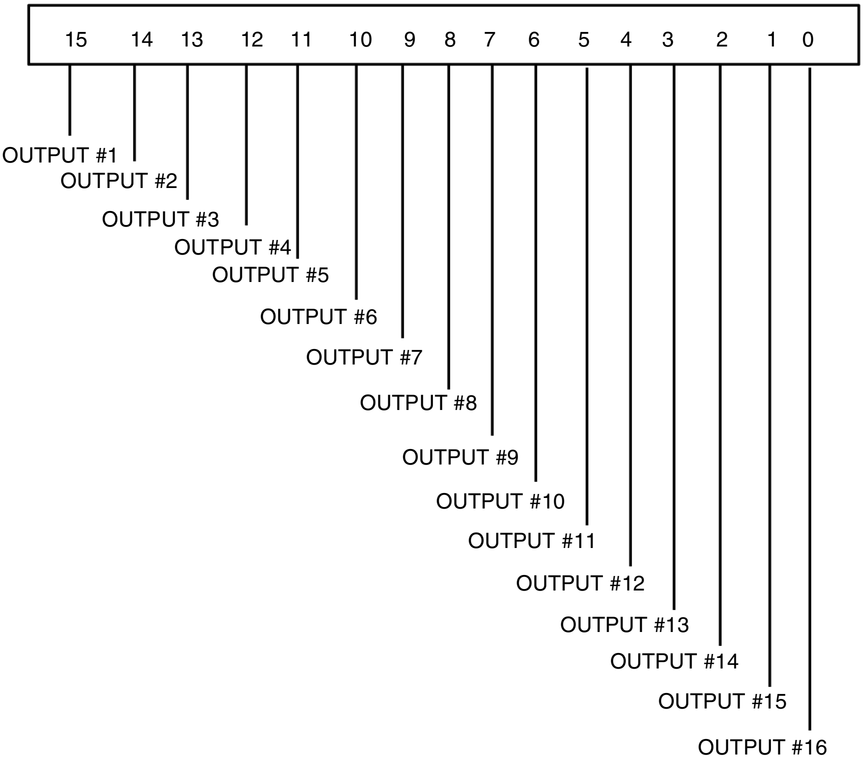
Each output group is fused to protect against catastrophic failure. For protection against triac failure, each output must be individually fused with a 1 A fast-acting fuse.

**Failure to follow this instruction can result in injury or equipment damage.**

## 4x Bit Assignment

A bit assignment diagram for the DAP 218 output module is provided below.

**4x Bit Assignment**



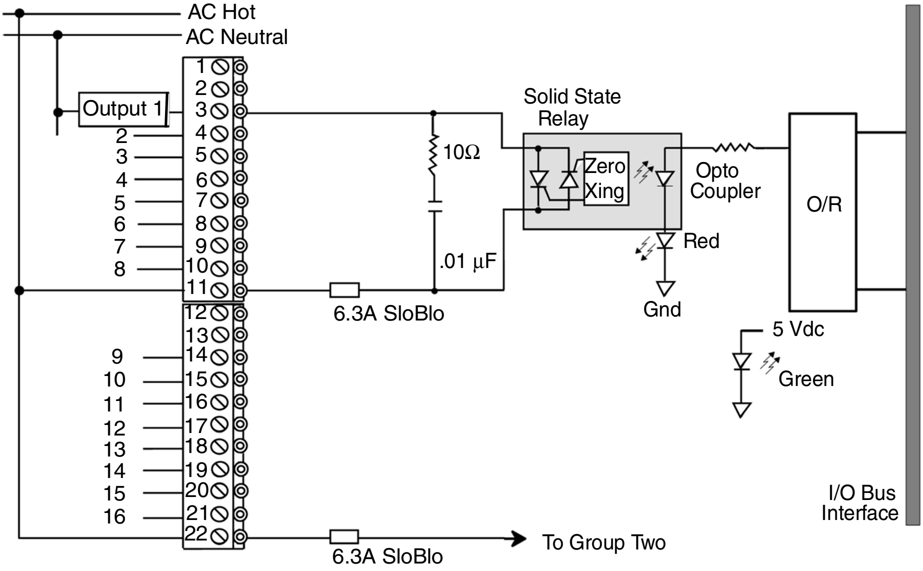
## DAP 218 Output Module Field Wiring

**Introduction**

The DAP 218 is a discrete output module with two independent groups of eight 24 ... 240 Vac output circuits. It can drive relays, motor starters, pilot lamps, valves, solenoids and other similar loads of up to 0.5 A/output. The module outputs are optically isolated from the system.

**Wiring Diagram and Simplified Schematic**

A wiring diagram and simplified schematic for the DAP 218 is provided below.



# DAP 218 Output Module Specifications

## DAP 218 Table of Specifications

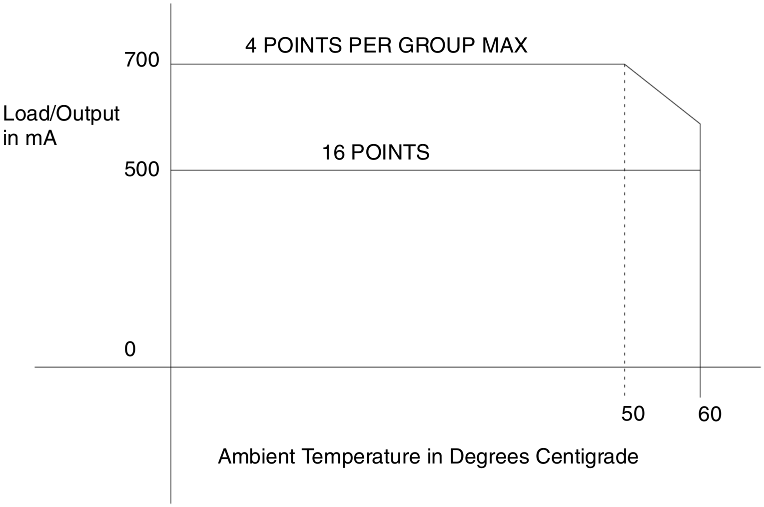
The following table contains a list of DAP 218 output module specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Outputs | 16 | |
| | Number of Groups | 2 | |
| | Points/Group | 8 | |
| | Isolation | Field to bus; 1780 Vac RMS @ 47-63 Hz, or 2500 VDC, both for a period of 60 s without breakdown | |
| Power Supplies | *External Source Requirement | 24 ... 230 Vac, 47 ... 63 Hz | |
| | Internally Provided Source | 5 Vdc from I/O bus; 175 mA maximum | |
| | Power Dissipation | 13 W with all points ON | |
| | Fusing (per group) | One 250 Vac, 6.3 A time-lag fuse (Wickmann TR5-T Fuse; Modicon Part # 57-0110-000) | |
| Electrical Characteristics | *Working Voltage Range | 24 ... 240 Vac continuous, 47 ... 63 Hz | |
| | Maximum Output Voltage | 300 Vac RMS maximum for 10 s 400 Vac RMS maximum for 1 cycle | |
| | Operating Mode | True High | |
| | OFF State Leakage Current | 3.75 mA maximum | |
| | ON State Voltage Drop | 1.5 Vac RMS maximum | |
| | Maximum Load Current | Up to 0.5 A/channel | |
| | Maximum Surge Current | 15 A/output, 1 cycle max., 1 surge/min | |
| | Minimum Load Current | 30 mA RMS | |
| | Response Time | 8.34 ms maximum OFF -> ON and ON -> OFF @ 60 Hz | |
| | Switch Point | +/- 10 Vac of zero line crossing | |
| | Maximum Rate of | Applied DV/DT | 400 V/micros |
| | | Commutating DV/DT | 5 V/micros |
| | Wire Size/Terminal | One wire: 14 AWG | |
| | | Two wires: 20 AWG | |
| I/O Map | Discrete 1x/0x | 0 in/16 out | |

| | | |
|---|---|---|
| Environmental | Operating Temperature | 0 ... 60 degrees  C |
| | Storage Temperature | -40 ... +80 degrees C |
| | Humidity | 0 ... 93 perc ent relative humidity, noncondensing,  @  0 to 60 degrees C |
| Dimensions | W x H x D | 40.3 x 145 x 117.5  mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 900 g (2 lb) |
| *Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards; and European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 857*) Standards | |
| *The module is labelled both as a 24 VAC to 115 VAC or 24 VAC to 230 VAC.  When used in a VDE 0160 environment the voltage range is reduced to 24 VAC to 115 VAC.  When used in a non VDE 0160 environment the module meets specification IEC 1131; UL 508: and CSA 22.2 No.142 and operates over the full range of 24 VAC to 230 VAC. | | |

## Illustration

A DAP 218 power output graph is provided below.



# Overview of the DAP 220/250 Combined I/O Module

# 23

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAP 220/250 combined I/O module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DAP 220/250 Combined I/O Module

**Brief Product Description**

The DAP 220/250 is a 24 Vdc, discrete mixed eight-point input/eight-point output module. The DAP 250 functions just like the DAP 220 except that the DAP 250 operates at extended temperature.

**Note:** DAP 250 model is available with conformal coating. The conformal coating model is DAP 250C and it meets Railway standard EN 50 155.

**⚠ CAUTION**

**Equipment Hazard**

Modicon recommends using two separate power sources with the DAP 220/250-one for outputs and one for inputs-in order to avoid electrical switching noise.

**Failure to follow this instruction can result in injury or equipment damage.**

**Note:** Inputs do not work if output supply is disconnected.

## DAP 220/250 Combined I/O Module LEDs

**LEDs**

The DAP 220/250 module has 19 LED displays. It has two green LEDs, one opposite terminal screw 1, which indicates when ON that working voltage is available to the group of eight discrete outputs directly below it, and one opposite terminal screw 12, which indicates when ON that working voltage is available to the group of eight discrete inputs below it. There is also an amber LED opposite terminal screw 2 that goes ON to indicate a short circuit or overload problem in the output group below it.

There are 16 red LEDs. Eight LEDs are opposite terminal screws 3 ... 10; when ON, they indicate that the discrete outputs adjacent them are in an ON condition, and eight opposite terminal screws 14 ... 21 which indicate when ON that the discrete inputs adjacent to them are in an ON condition.

### ⚠ WARNING

**Operational Hazard**

If the short/overload protection device in the DAP 220/250 senses an error condition, the module becomes "unhealthy." When Executive Software Prom Combination 1001, Revision B, is installed in the 984 C951 PCB, all other outputs will retain their last healthy status, except the shorted/overloaded channel, until the failure is cleared. If Prom Combination 1002 or higher is installed, the healthy outputs may be manipulated at will.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

## DAP 220/250 Combined I/O Module Field Wiring

**Introduction**

The DAP 220/250 is a 24 Vdc, discrete mixed eight-point input/eight-point output module. The DAP 250 functions just like the DAP 220 except that the DAP 250 operates at extended temperature.

**Note:** DAP 250 model is available with conformal coating. The conformal coating model is DAP 250C and it meets Railway standard EN 50 155.

**⚠ CAUTION**

**Operational Hazard**

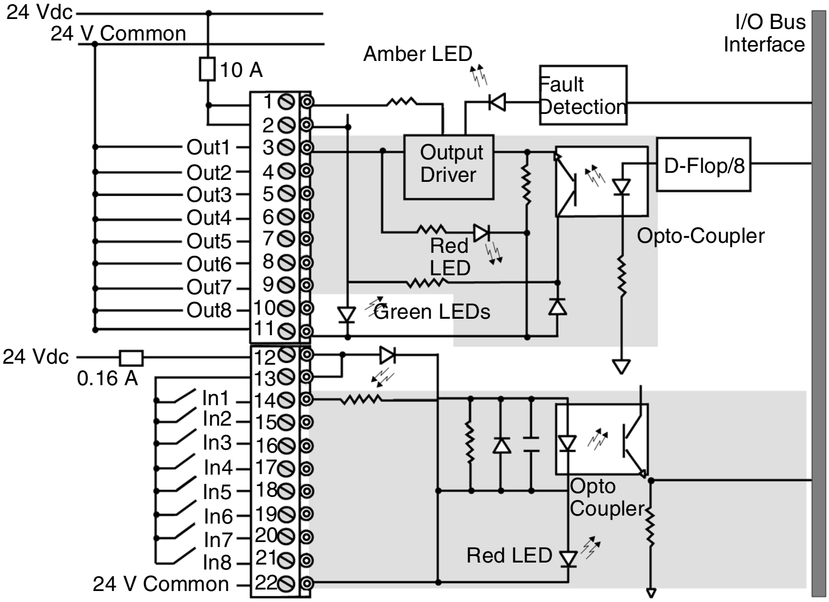
Modicon recommends using two separate power sources with the DAP 220/250-one for outputs and one for inputs-in order to avoid electrical switching noise.

**Failure to follow this instruction can result in injury or equipment damage.**

**Note:** Inputs do not work if output supply is disconnected.

## Wiring Diagram and Simplified Schematic for DAP 220/250

A wiring diagram and simplified schematic for the DAP 220/250 is provided below.



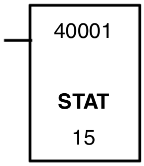
## DAP 220/250 Combined I/O Module Recovery After Error

**Instructions**

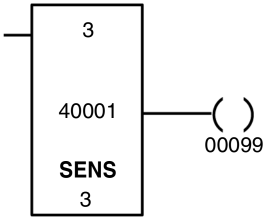
The protective device will eventually recover from the fail state if the cause of failure is removed, and the module will become healthy. If the error condition still exists, it will cause the module to shut down again. To avoid damage to the module, the logic shown in the following diagrams may be used to clear the failed output.

**Ladder Logic Examples**

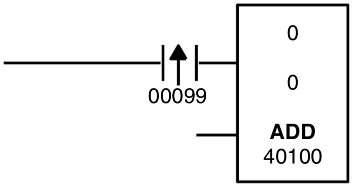
The following diagram is a DAP 220/250 Ladder Logic Example for Prom Combination 1001.



The STAT block will put the module health information for the 4 racks in registers 40012 ... 40015.

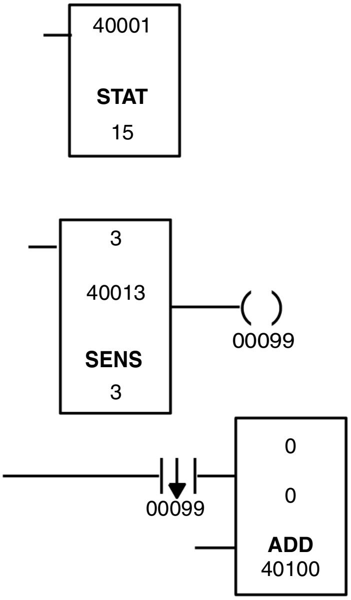


Coil 99 is turned ON when the module in Rack 2, Slot 3 becomes healthy.



If register 40100 is traffic copped to the DAP 220 in Rack 2, Slot 3, when it becomes healthy again the 0 in register 40100 will be written to the module.

The following illustration is a DAP 220/250 Ladder Logic Example for Prom Combination 1002.



The STAT block will put the module health information for the 4 racks in registers 40012 ... 40015.

Coil 99 is turned OFF when the module in Rack 2, Slot 3 becomes unhealthy.

If register 40100 is traffic copped to the DAP 220 in Rack 2, Slot 3, when it becomes unhealthy, the 0 in register 40100 will be written to the module.

## DAP 220/250 Combined I/O Module Specifications

**Table of Specifications for DAP 220/250**

The following table contains a list of DAP 220/250 combined I/O module specifications.

| | | |
|---|---|---|
| Module Topology | Number of Inputs | 8 |
| | Number of Outputs | 8 |
| | Number of Groups | 2 |
| | Points/Group | 8 |
| | Isolation | Each point opto-isolated from the I/O bus. |
| Power Supplies | External Source Requirement | 20 ... 30 Vdc |
| | Internal Source Requirement | less than 60 mA @ 5 V from I/O bus |
| | Internal Power Dissipation | 2 W (typical) |
| Input Characteristics | ON State Signal Level | +12 V ... +30 V |
| | OFF State Signal Level | -2 V ... +5 V |
| | Input Wetting Current | 7 mA @ 24 Vdc; 8.5 mA @ 30 Vdc |
| | Response Time | 4 ms (typical) |
| | Operating Mode | True High |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |

| | | |
|---|---|---|
| Output Characteristics | Operating Mode | True High |
| | ON State Signal Level | External Supply - 0.4V |
| | OFF State Signal Level | 0 ... 2 V, less than 1mA |
| | Load Current/Output | 10 mA ... 2 A |
| | Max Load Current/Group | 8 A |
| | Response Time | less than 1 ms |
| | Reverse EMF Protection | Clamping diode recommended across inductive loads, or if load current exceeds 1A |
| | Switch Capacity for Bulbs OFF -> ON Operations @ Maximum Power | 10W (Max Surge Current = Normal Current x 10) 1000/hour inductive load 100/s resistive load 10/s bulb load |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |
| Environmental Characteristics | Operating Temperature | 0 ... 60 degrees C for DAP220<br>-40 ... +70 degrees C for DAP250 |
| I/O Map | Discrete 1x/0x | 8 in/8 out |
| Dimensions | WxHxD | 40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 220 g (.48 lb.) |
| Agency Approvals | DAP 220: VDE 0160; UL 50; CSA 22.2 No.142; and FM Class I, Div 2 Standards | |
| | DAP 250C: Railway standard EN 50 155: EMC 89/336/EEC (See *Requirements for CE Compliance, p. 857*). UL 50; CSA 22.2 No.142; and FM Class I, Div 2 pending | |

# Overview of the DAP 253 Combined I/O Module

# 24

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAP 253 combined I/O module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DAP 253 Combined I/O Module?

**Brief Product Description**

The DAP 253 is an extended temperature, 110 Vdc +/-40 percent, eight-point isolated input/four-point relay output module. The full operational range of this module is 66 ... 154 Vdc for inputs.  Relay voltage and current ratings are documented in the specifications of this module. It senses eight discrete input signals received by field sensing devices such as pushbuttons, limit switches, or other dc input sources and converts those signals into logic that can be used by the PLC. It utilizes logic signals within the PLC to activate four independent and individually isolated normally open relay contacts.

The module requires power from an external 24 Vdc source to operate the relay outputs. The operating temperature range of this module, -25 ... +70 degrees C (-13 ... +158 degrees F), exceeds typical module operating temperatures of 0 ... 60 degrees C.

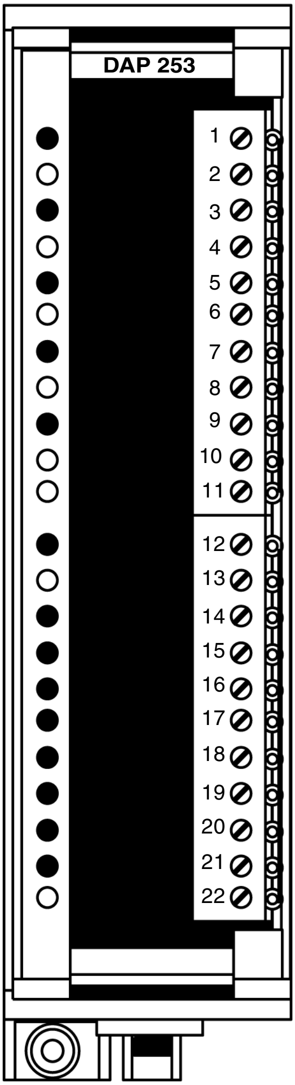
**Note:** The DAP 253 model is available with conformal coating. The conformal coating model is DAP 253C.

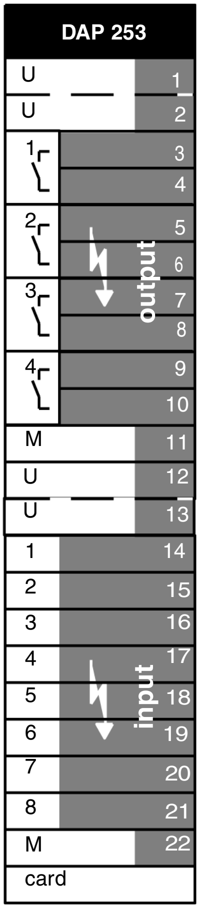
## DAP 253 Combined I/O Module LEDs

**DAP 253 LEDs**

The DAP 253 module has two amber LEDs opposite terminal screws 1 and 12; when one of these LEDs is ON, it indicates power available to the input or output points directly below it. Below terminal screw 1 are four red LEDs opposite terminal screws 3, 5, 7, and 9 indicating the signal condition of relay output points 1 ... 4, respectively. Below terminal screw 12 are eight red LEDs opposite terminal screws 14 ... 21 indicating the signal condition of inputs 1 ... 8, respectively.

A front view with DAP 253 label is provided below.

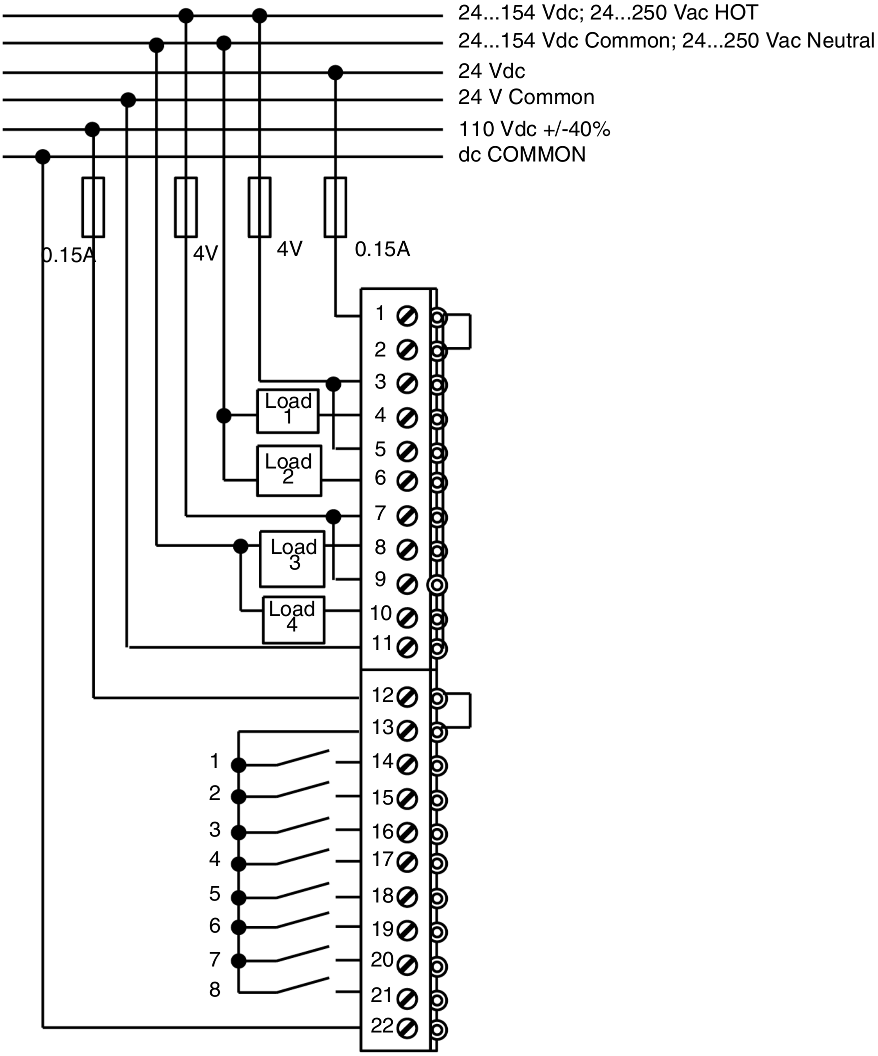




## DAP 253 Combined I/O Module Field Wiring

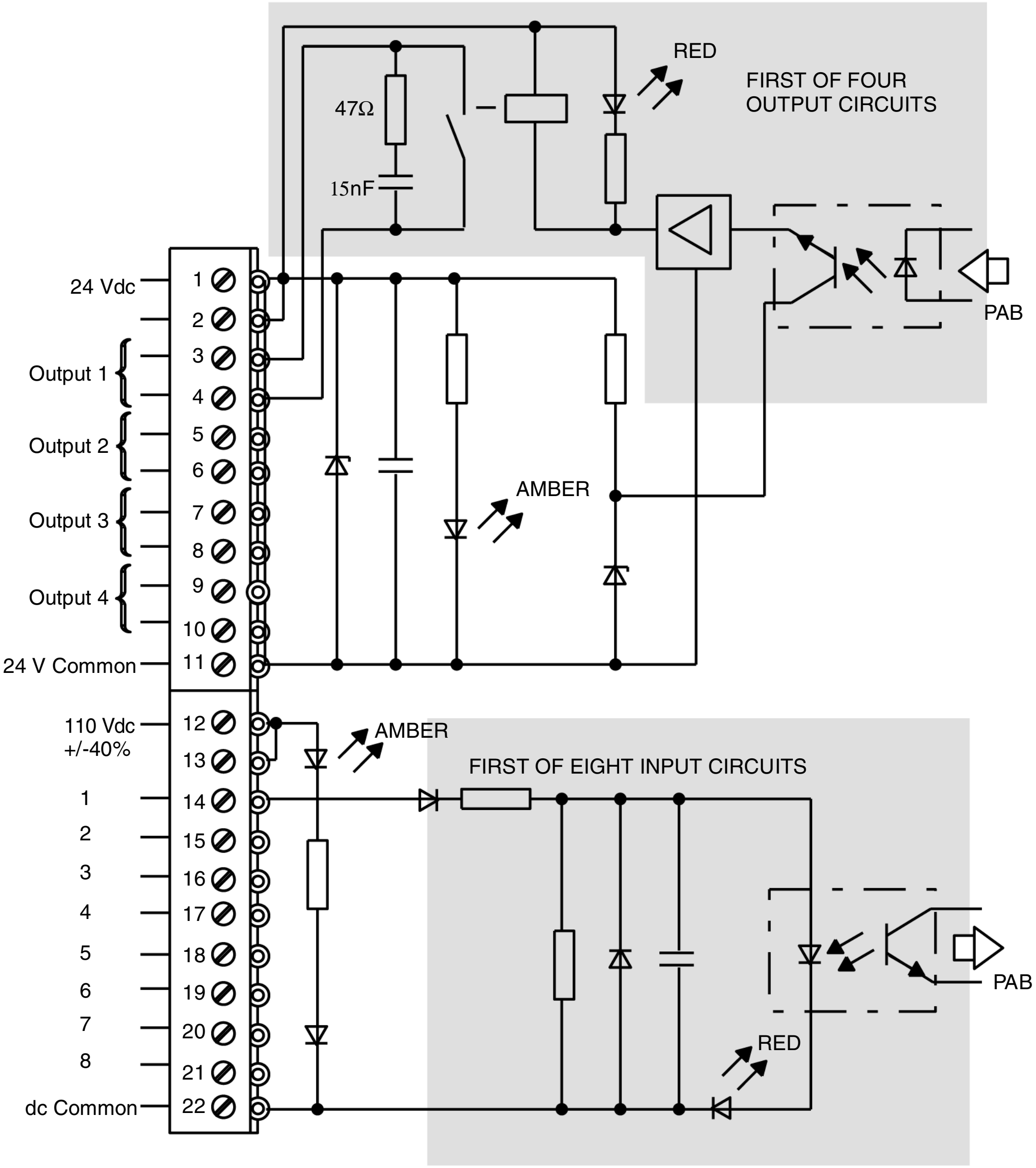
**Wiring Diagram for DAP 253**

A wiring diagram for the DAP 253 combined I/O module is provided below.



## Simplified Schematic for DAP 253

A simplified schematic for the DAP 253 combined I/O module is provided below.



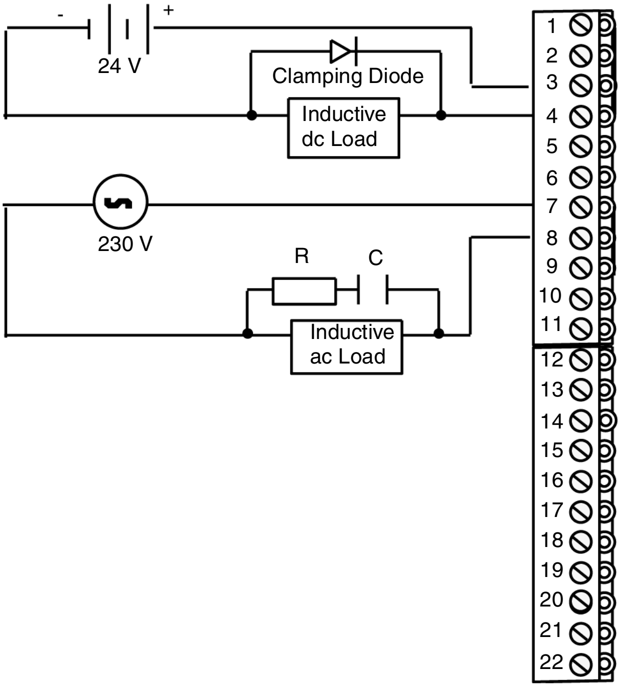
## Protecting the DAP 253 Combined I/O Module from Inductive Back EMF

**Instructions for DAP 253**

In order to increase the service life of the relay output contacts and protect the DAP 253 module from potential reverse-EMF damage, externally connect a clamping diode in parallel with each inductive dc load and externally connect an RC snubber circuit in parallel with each inductive ac load.

**Illustration of Clamping Diode and Snubber Circuit**

The following illustration is an example of clamping diode and snubber circuit on inductive loads.



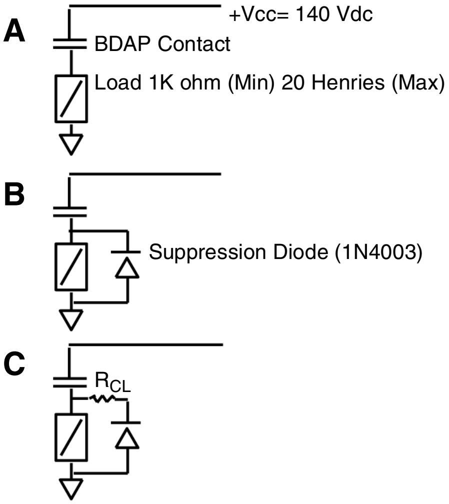
### Suggested Component Values

The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be three or four times greater than supply voltage at 24 Vdc and 8 ... 10 times greater than supply voltage at 110 Vdc. The unpolarized (ac) snubber capacitor should have a rating two or three times greater than the supply voltage.

Values may be:

| Snubber Values | |
|---|---|
| Load Inductance | Capacitance |
| 25 ... 70 mH | .50 microF |
| 70 ... 180 mH | .25 microF |
| 180 mH | .10 microF |

An example of Operational Range Options Using 140 Vdc is provided below.



Calculations:
Given: Vcc= 140Vdc
I (Max)= .15 A
Then: R(L) (Min)= 140/.15=1Kohm
Since L/R=.02 Sec, and R=1Kohm
Then L(Max)= (.02) X 1000=20H

Voltage rating of diode = 1.5 X Vcc
Current rating of diode = 2 X I (Max)
Must be “slow”, rectifier, vs logic

$R_{CL=}$Current Limiting Resistor (.5 Load R)
Here, 470 ohms
If carbon film, .25 watt,
If metal film, .50 watt

A shows the consequences of ohmic load and L/R ratios
B shows the application of the suppression diode
C shows the application of a current limiting resistor in series with the diode to protect the diode from contact bounce

Snubber resistors may be 1 ... 3 ohms, 2 W. Resistor values should be increased up to 47 ohms, 1/2 W for RL exceeding 100 ohms.

**Note:** To I/O Map the DAP 253 module in Modsoft you must select DAP 212. Both modules share a host driver and have similar characteristics.

# DAP 253 Combined I/O Module Specifications

## DAP 253 Specifications

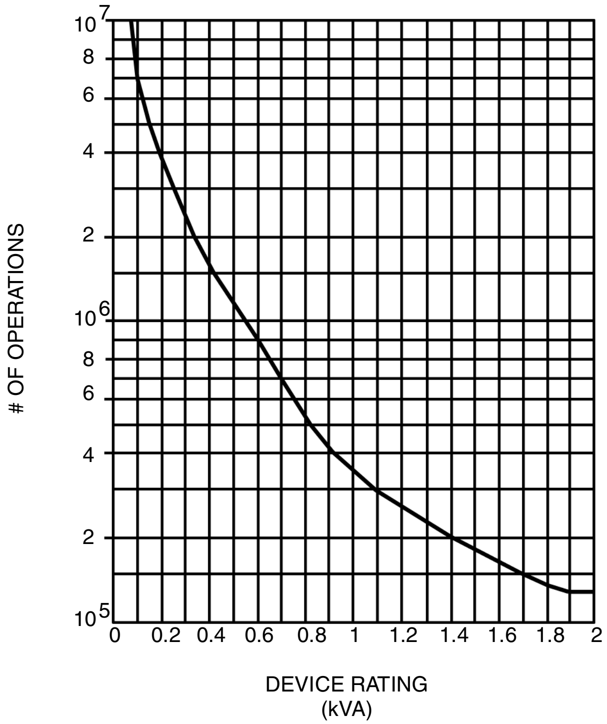
The following tables and diagrams contain DAP 253 combined I/O module specifications.

| | | |
|---|---|---|
| Module Topology | Number of Inputs | 8 |
| | Number of Relay Outputs | 4 |
| | Number of Groups | 1 in/4 out |
| | Points/Group | 8 in/1 out |
| | Isolation | Relay output contacts individually isolated Input group isolated from output group |
| Power Supplies | External Source Requirement | 110 Vdc+40 percent, 20 mA @ 24 Vdc, 70 mA |
| | Internally Provided Source | 5 V from I/O bus @ 15 mA maxi mum |
| | Internal Power Dissipation | 2 W (typical) |
| Input Characteristics | Working Voltage Range | 66 ... 154 Vdc |
| | ON State Signal Level | 55 ... 170 V |
| | OFF State Signal Level | -2 ... +10 V |
| | Input Current | 2.2 mA (typical) @ 110 Vdc |
| | Response Time | 6 ms (typical) |
| | Operating Mode | True High |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |
| Environmental Characteristic | Operating Temperature | -25 ... +70 degrees C<br>(-13 ... +158 degrees F) |

DAP 253 Specifications (continued)

| | | |
|---|---|---|
| Output Characteristics | Output Voltage Ranges | 24 ... 154 Vdc; 24 ... 250 Vac |
| | Operating Mode | Normally Open |
| | Response Time | 10 ms (typical) |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |
| | Load Currents @ 230 Vac | 2 A continuous (maximum, resistive load) 4 A instantaneous (maximum, resistive load) 1 A continuous (maximum, Cos = 0.5) 1.5 A / 240 V max (AC11, VDE 0660, part 200) |
| | Load Current @ 24 Vdc | 2 A continuous maximum (resistive load) 4 A instantaneous maximum (resistive load) 1 A continuous maximum (L/R* = 30 ms) 1.5 A / 240 V max (DC11, VDE 0660, part 200) |
| | Load Current @ 60 Vdc | 1 A continuous maximum (resistive load) 0.6 A maximum (L/R* = 30 ms) |
| Output Characteristics Cont. | Load Current @ 140 Vdc | 0.3 A continuous maximum (resistive load) 0.15 A maximum (L/R* = 20 ms) |
| | Wetting Current | 5 mA for closed contacts |
| | Leakage | 1 mA |
| | Internal Protective Circuitry | 68 ohms +15 microF in parallel with each contact |
| | Overload Protection | Should be provided externally |
| I/O Map | Discrete 1x/0x | 8 in/4 out |
| * L = Load Inductance in H; R = Load Resistance in ohms | | |
| Service Life of Relay Contacts | Mechanical switching cycles | 20,000,000 |
| | Electric switching cycles (Resistive Loads) | 7,000,000 @ 230 Vac/0.5 A 8,000,000 (typical) @ 30 Vdc/2 A, with clamping diode 1,000,000 (typical) @ 60 Vdc/1 A, with clamping diode, 3000 cycles/hr maximum |
| | Electric switching cycles (Inductive Loads, Cos = 0.5) | 5,000,000 @ 230 Vac/0.5 A |

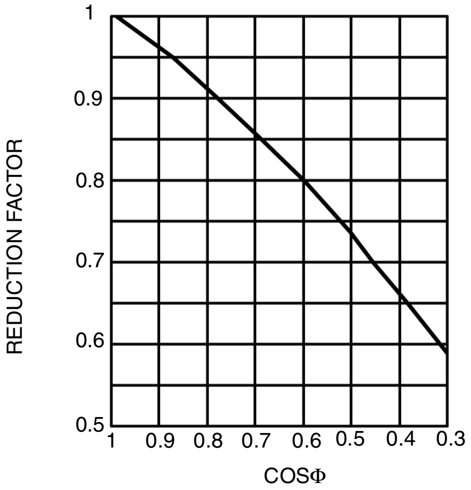
Diagram of Service Life for Resistive Loads.



SERVICE LIFE FOR RESISTIVE LOADS

The maximum number of switching cycles is reduced when inductive loads are encountered. Reference the load device manufacturer's catalog for steady state and inrush VA ratings to determine the number of operations derating factor. If the frequency of operations is relatively high, use the inrush VA to calculate Cos: Effective number of operations = # of operations (resistive load) x reduction factor:

Graph of Reduction Factor for Inductive Loads.



REDUCTION FACTOR FOR INDUCTIVE LOADS

Cos = Watts divided by VA.

| | | |
|---|---|---|
| I/O Map | Discrete 1x/0x | 8 in/8 out |
| Dimensions | WxHxD | 40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 240 g (.52 lb.) |
| Agency Approvals | DAP 253: European Directive EMC 89/336/EEC Standards | |
| | DAP 253C: Railway standard EN 50 155: European Directive EMC 89/336/EEC Standards. | |

# Overview of the DAP 292 Combined I/O Module

# 25

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAP 292 combined I/O module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DAP 292 Combined I/O Module?

**Brief Product Description**

The DAP 292 is a 60 Vdc, eight-point isolated input/four-point relay output module. It senses eight discrete input signals received by field sensing devices-such as pushbuttons, limit switches, or other 60 Vdc sources-and converts those signals into logic that can be used by the PLC.

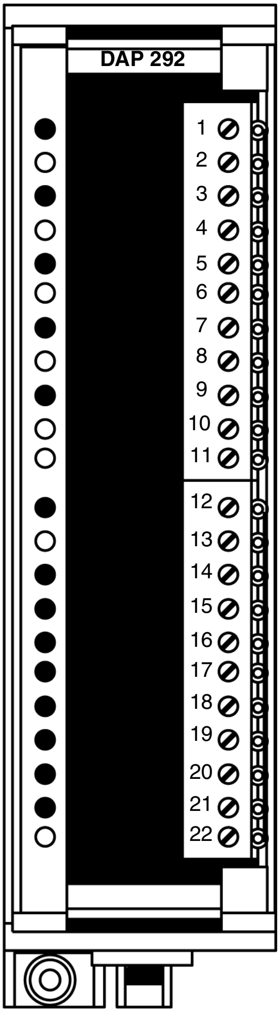
It utilizes logic signals within the PLC to activate four independent and individually isolated normally open relay contacts. The module requires power from an external 24 Vdc source to operate.

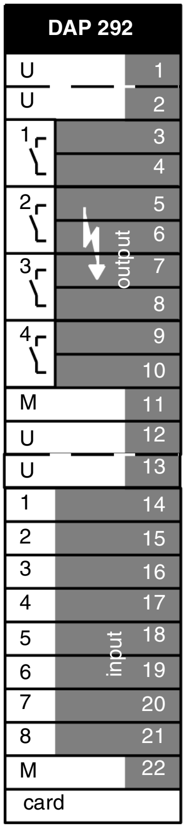
## DAP 292 Combined I/O Module LEDs

**LEDs**

The DAP 292 module has two amber LEDs opposite terminal screws 1 and 12; when one of these LEDs is ON, it indicates power available to the input or output points directly below it. Below terminal screw 1 are four red LEDs opposite terminal screws 3, 5, 7, and 9 indicating the signal condition of relay output points 1 ... 4, respectively. Below terminal screw 12 are eight red LEDs opposite terminal screws 14 ... 21 indicating the signal condition of inputs 1 ... 8, respectively.

A front view with DAP 292 label is provided below.

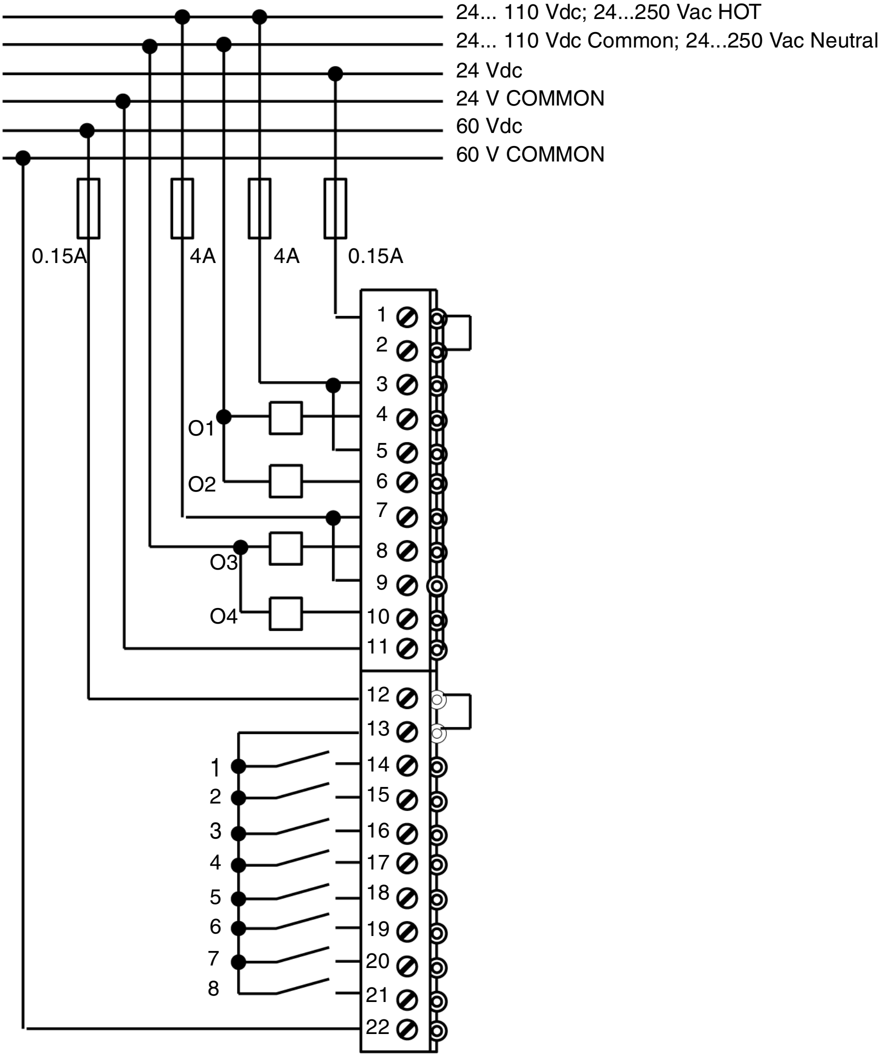




# DAP 292 Combined I/O Module Field Wiring

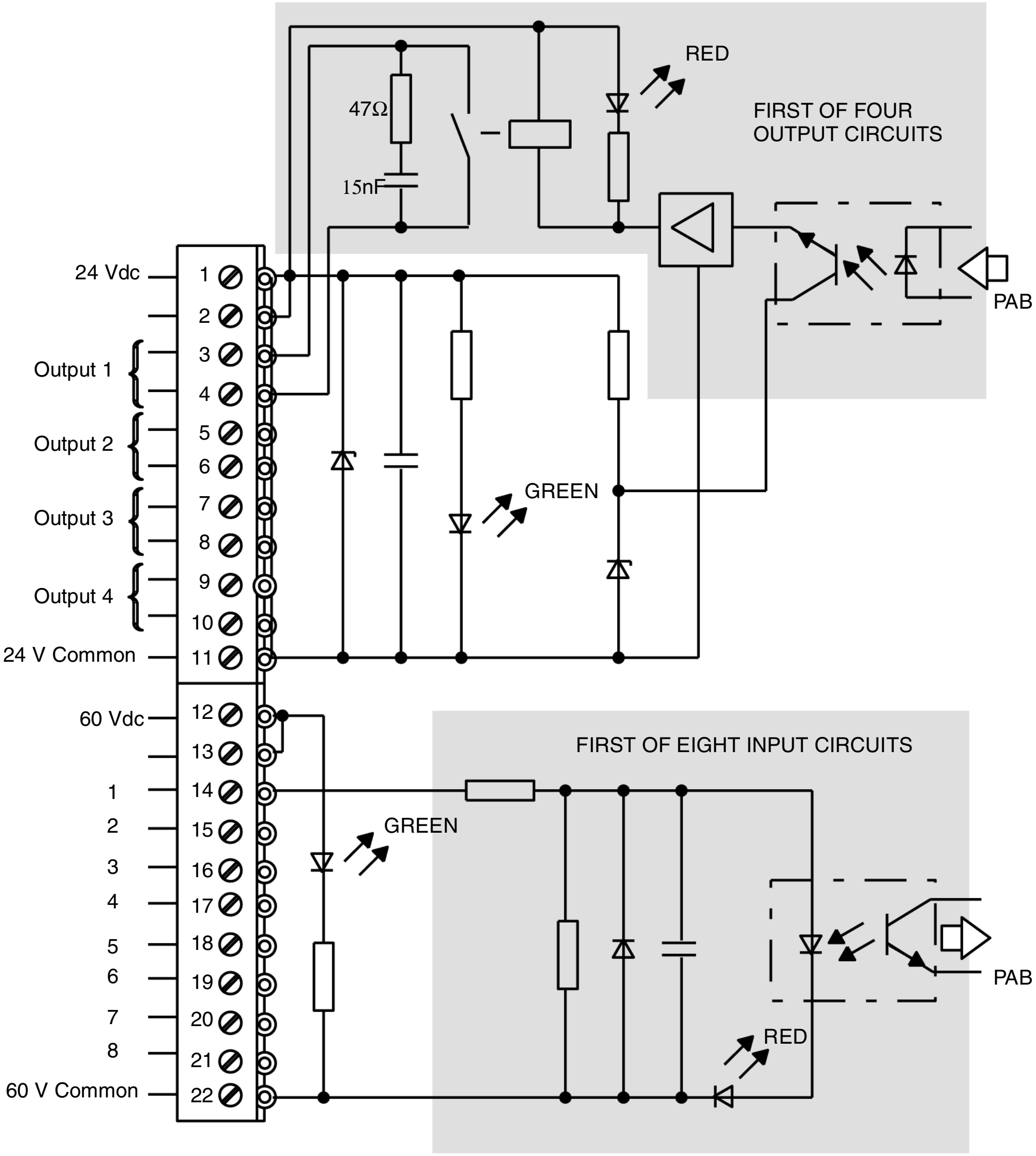
**Wiring Diagram for DAP 292**

A wiring diagram for the DAP 292 combined I/O module is provided below.



## Simplified Schematic for DAP 292

A simplified schematic for the DAP 292 combined I/O module is provided below.



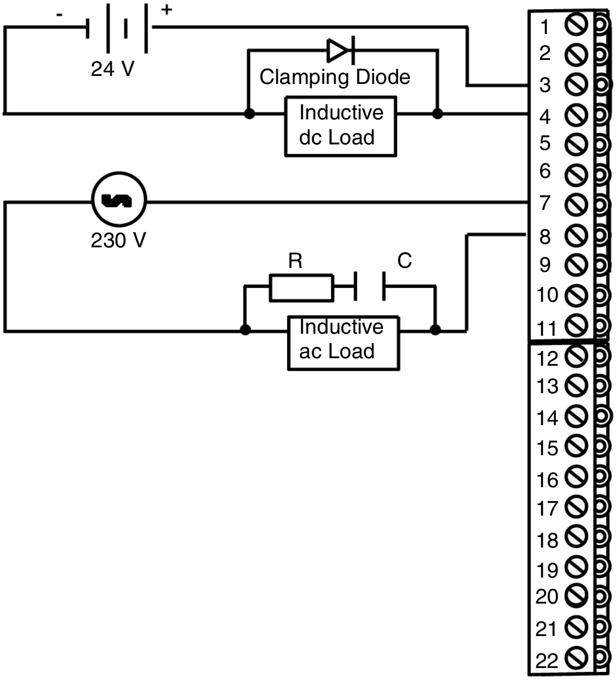
## Protecting the DAP 292 Combined I/O Module from Inductive Back EMF

**Instructions**

In order to increase the service life of the relay output contacts and protect the DAP 292 module from potential reverse-EMF damage, externally connect a clamping diode in parallel with each inductive dc load and externally connect an RC snubber circuit in parallel with each inductive ac load.

**Illustration of Clamping Diode and Snubber Circuit for DAP 292**

The following illustration is an example of clamping diode and snubber circuit on inductive loads.



## Suggested Component Values

The clamping diode forward current rating must be equal to or greater than load current. Diode PIV rating must be three or four times greater than supply voltage at 24 Vdc and 8 ... 10 times greater than supply voltage at 110 Vdc. The unpolarized (ac) snubber capacitor should have a rating two or three times greater than the supply voltage.

Values may be:

| Snubber Values | |
|---|---|
| Load Inductance | Capacitance |
| 25 ... 70 mH | .50 microF |
| 70 ... 180 mH | .25 microF |
| 180 mH | .10 microF |

Snubber resistors may be 1 ... 3 ohms, 2 W. Resistor values should be increased up to 47 ohms, 1/2 W for RL exceeding 100 ohms.

**Note:** To I/O Map the DAP 292 module in Modsoft you must select DAP 212. Both modules share a host driver and have similar characteristics.

## DAP 292 Combined I/O Module Specifications

### DAP 292 Tables and Diagrams

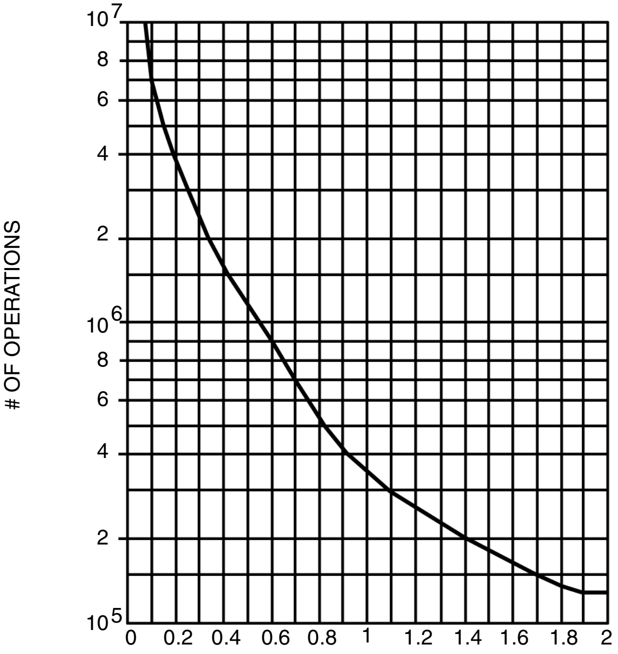
DAP 292 Specifications

| | | |
|---|---|---|
| Module Topology | Number of Inputs | 8 |
| | Number of Relay Outputs | 4 |
| | Number of Groups | 2 |
| | Points/Group | 8 in/4 out |
| | Isolation | Relay output contacts individually isolated Input group isolated from output group |
| Power Supplies | External Source Requirement | 60 Vdc, 150 mA maximum; 24 Vdc, 150 mA maximum |
| | Internally Provided Source | 5 Vdc from I/O bus; 25 mA maximum |
| | Internal Power Dissipation | 2 W (typical) |
| Input Characteristics | Working Voltage Range | 60 Vdc |
| | Signal Rated Value | +60 V |
| | ON State Signal Level | 35 ... 70 V |
| | OFF State Signal Level | -4 ... +13 V |
| | Input Current | 7 mA at 60 V |
| | Response Time | 4 ms (typical) |
| | Operating Mode | True High |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |

DAP 292 Specifications (continued)

| | | |
|---|---|---|
| Output Characteristics | Output Voltage Ranges | 24 ... 110 Vdc; 24 ... 250 Vac |
| | Operating Mode | Normally Open |
| | Response Time | 10 ms (typical) |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |
| | Load Currents @ 230 Vac | 2 A continuous (maximum, resistive load) 4 A instantaneous (maximum, resistive load) 1 A continuous (maximum, Cos = 0.5) 1.5 A/240 V max (AC11, VDE 0660, part 200) |
| | Load Current @ 24 Vdc | 2 A continuous maximum (resistive load) 4 A instantaneous max maximum (resistive load) 1 A continuous maximum (L/R* = 30 ms) 1.5 A/240 V max (DC11, VDE 0660, part 200) |
| | Load Current @ 60 Vdc | 1 A continuous maximum (resistive load) 0.6 A maximum (L/R* = 30 ms) |
| | Load Current @ 110 Vdc | 0.45 A continuous maximum (re resistive load) 0.25 A maximum (L/ R* = 30 ms) |
| | Wetting Current | 1 mA |
| | Internal Protective Circuitry | 68 ohms +15 microF in parallel with each contact |
| | Overload Protection | Should be provided externally |
| I/O Map | Discrete 1x/0x | 8 in/4 out |
| * L = Load Inductance in Henries; R = Load Resistance in Ohms | | |
| Service Life of Relay Contacts | Mechanical switching cycles | 20,000,000 |
| | Electric switching cycles (Resistive Loads) | 10,000,000 @ 230 Vac/0.2 A 7,000,000 @ 230 Vac/0.5 A 8,000,000 (typical) @ 30 Vdc/2 A, with clamping diode 1,000,000 (typical) @ 60 Vdc/1 A, with clamping diode, 3000 cycles/hr max |
| | Electric switching cycles (Inductive Loads, Cos = 0.5) | 5,000,000 @ 230 Vac/0.5 A |

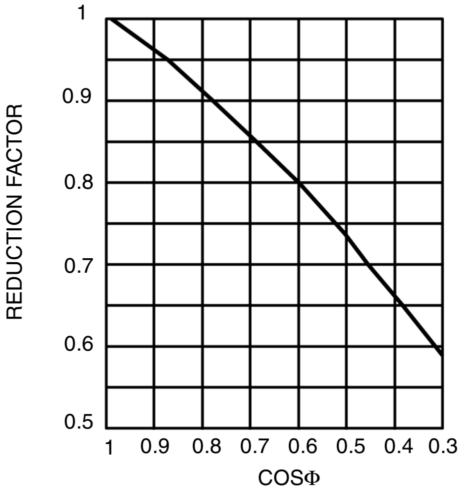
## Service Life for Resistive Loads



SERVICE LIFE FOR RESISTIVE LOADS

The maximum number of switching cycles is reduced when inductive loads are encountered. Reference the load device manufacturer's catalog for steady state and inrush VA ratings to determine the number of operations derating factor. If the frequency of operations is relatively high, use the inrush VA to calculate Cos: Effective number of operations = # of operations (resistive load) x reduction factor:

Reduction Factor for Inductive Loads



REDUCTION FACTOR FOR INDUCTIVE LOADS

Cos = Watts divided by VA.

| | | |
|---|---|---|
| I/O Map | Discrete 1x/0x | 8 in/8 out |
| Dimensions | WxHxD | 40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 240 g (.52 lb.) |
| Agency Approvals | DAP 253: European Directive EMC 89/336/EEC Standards | |
| | VDE 0160; UL 508; and CSA 22.2 No. 142 Standards. | |

# DAU 202/252 Analog Output Module

# 26

## At a Glance

**Introduction**

This chapter describes the DAU 202/252 analog output module.

**What's in this Chapter?**

This chapter contains the following topics:

## What Is the DAU 202/252 Analog Output Module?

**Brief Product Description**

The DAU 202/252 is a two–channel analog output module. Each channel supports voltages in the range +10 ... -10 V and currents in the range +20 ... -20 mA. The operations of the DAU 202 and the DAU 252 are alike except for the DAU 252's ability to operate at extended temperatures. The output channels can be isolated individually. The valid output data range is from 0 ... 4000.

**Note:** The DAU 252 model is available with conformal coating. The conformal coating model is DAU 252C, and it meets Railway standard EN 50 155.

**Conversion Ranges**

Different PLC models support different temperature ranges. The following tables present the different PLC models and describe the voltage and temperature ranges that they support.

The following table lists operating information for the A984- 1XX and E984- 24x/251/255 PLC models.

| Output Signals Voltage | Output Signals Current | Data Count (decimal) | Operating Results |
|---|---|---|---|
| -10 V | -20 mA | 0 | In Range |
| 0 V | 0 mA | 2000 | |
| +10 V | +20 mA | 4000 | |
| 0 V | 0 mA | 4001 | Over Range |

The following table lists operating information for the E984-258/265/275/285 PLC models.

| Voltage (VDC) | Current (mA) | 12-bits | 15-bits + sign | Range |
|---|---|---|---|---|
| 10.24 ...<br>-10.005 | -20.48 ...<br>-20.01 | 0<br>47 | -32768<br>-32016 | Under-range |
| -10.00<br>0<br>+10.00 | -20.00<br>0<br>+20.00 | 48<br>2048<br>4048 | -32000<br>0<br>+32000 | Nominal range |
| +10.005 ...<br>+10.24 | +20.01 ...<br>+20.48 | 4049<br>4095 | +32016<br>+32752 | Overrange |

**LEDs**

The DAU 202/252 has two green LED indicators on its front panel:

- If the LED opposite terminal screw 1 is ON, user-supplied voltage is present.
- If the LED opposite terminal screw 12 is ON, a D/A conversion has occurred.

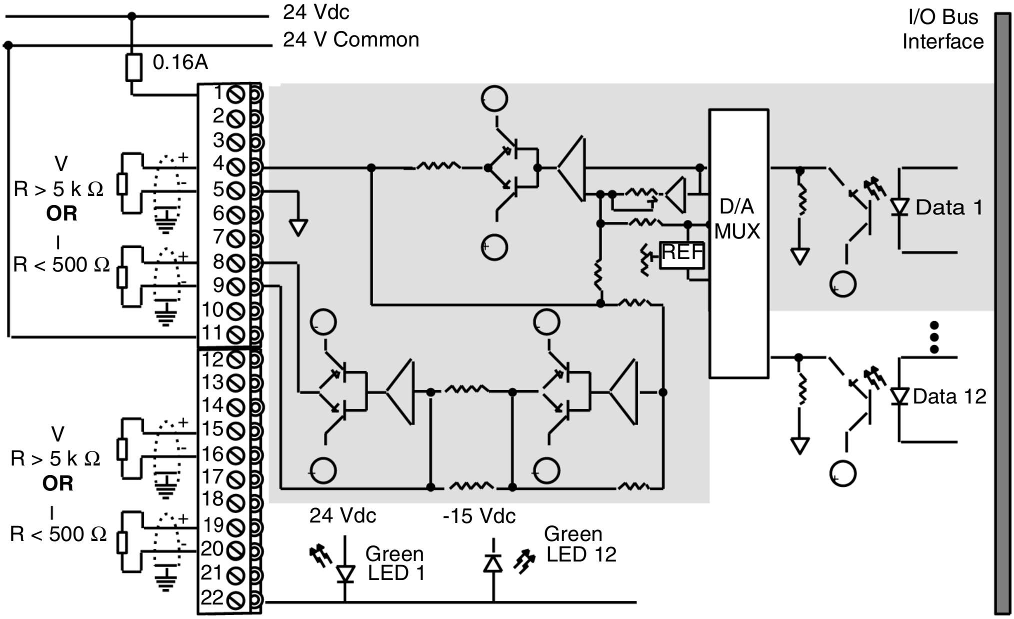
## DAU 202/252 Analog Output Module Field Wiring

**Introduction**

The DAU 202/252 can be field wired to two current output devices, to two voltage output devices, or to one current and one voltage device.

**Wiring Diagram**

The following illustration is a wiring diagram and simplified schematic for the DAU 202/252 analog output module.

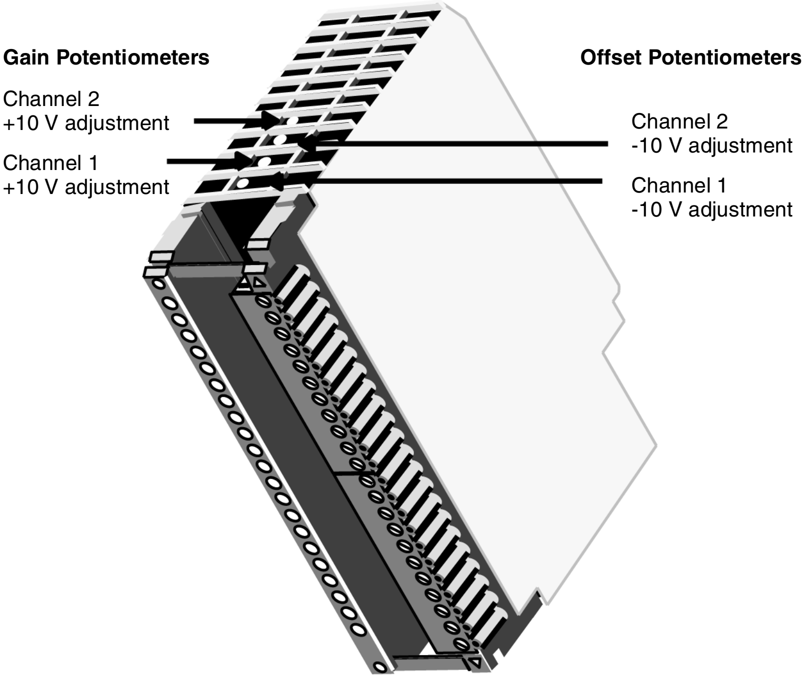


## DAU 202/252 Analog Output Module Calibration

**Introduction**

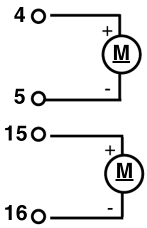
By adjusting the four potentiometers on the top of the DAU 202/252 module, you can calibrate the gain and offset on each of the two analog channels over the absolute count range of the module (0 ... 4000).

The following illustration shows the location of the potentiometers on the ADU 202/252.



## Procedure for Adjusting the Potentiometers

Use the following procedure to adjust the Potentiometers.t

| Step | Action |
|---|---|
| 1 | Wire terminal 4 to the positive side and terminal 5 to the negative side of a voltmeter for analog channel 1 (as shown in the following figure.)<br><br> |
| 2 | Enter 4000 into the module output register and adjust the channel 1 gain potentiometer (+10 V adjustment) for a reading of +10 V on the meter. |
| 3 | Enter 0 into the module output register and adjust the channel 1 offset potentiometer (-10 V adjustment) for a reading of -10 V on the meter. |
| 4 | Check module operation by entering 2000 into the module output register. The meter reading should be 0 V. |
| 5 | To fine-tune the calibration adjustment, you may want to repeat steps 2 ... 4 until you have your best reading. If you are satisfied with the reading, drop a bead of sealing varnish on the two readjusted potentiometers. |
| 6 | To calibrate analog channel 2, wire terminal 15 to the positive side and terminal 16 to the negative side of the voltmeter, and repeat steps 2 ... 5 of this procedure, this time making the adjustments to the gain and offset potentiometers for channel 2. |

## DAU 202/252 Analog Output Module Specifications

### Table of Specifications

The following table lists the DAU 202/252 specifications.

| | | |
|---|---|---|
| **Module Topology** | | |
| Number of Outputs | 2 opto-isolated | 700 V Channel-to-Channel |
| | | 700 V Channel-to-Bus |
| Data Format | Two's complement, left justified | |
| **Power Supplies** | | |
| Internally Provided Source | 5 V, less than 60 mA from the I/O bus | |
| External Source Requirement | 24 Vdc, 150 mA maximum | |
| Internal Power Dissipation | 2 Ω (typical) | |
| **Electrical Characteristics** | | |
| Voltage Output | +/- 10 V greater than 5 k ohms | |
| Current Output | +/- 20 mA less than 500 ohms | |
| Over Range | Approximately 2.4 percent | |
| D/A Resolution | 11 bits plus sign | |
| Wire Size | One wire: 14 AWG | |
| | Two wires: 20 AWG | |
| **Accuracy** | | |
| Overall | +/- .4 percent of full scale | |
| Output Error Range | +/- .6 percent @ 0... 60 degrees C | |
| Update Interval | Approximately 2 ms/output | |
| Settling Time | 25 ms/output | |
| **Environmental Characteristics** | | |
| **Operating Temperature** | 0 ... 60 degrees C for DAU202<br>-40 ... +70 degrees C for DAU252 | |
| **I/O Map** | | |
| Register 3x/4x | 0 in/2 out | |
| **Dimensions** | | |
| W x H x D | 40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in) | |
| Weight | 300 g (0.6 lb) | |
| **Agency Approvals** | | |
| DAU202: VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards. | | |
| DAU252C: Railway standard EN 50 155; European Directive EMC 89/336/EEC Standards. UL 508; CSA 22.2 No.142; and FM Class I, Div 2 pending. | | |

# DAU 204 Analog Output Module

# 27

## At a Glance

**Introduction**

This chapter describes the DAU 204 analog output module.

**Note:** Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation if using certain PLCs (A984- -1xx, E984- -24x/251/255) with Modsoft.

**⚠ WARNING**

**DAU 204 module must be powered when in rack.**

Do not leave this module unpowered in the rack. This may affect the proper operation of the CPU and other I/O modules.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

**What's in this Chapter?**

This chapter contains the following topics:

## What Is the DAU 204 Analog Output Module?

**Brief Product Description**

The DAU 204 is a 4-channel analog output module designed to control adjustable frequency drives, positioning valves, dampers, and so forth. Each channel can provide either voltage or current loop output, in any one of the following ranges:

- 0 ... 1, 0 ... 5, or 0 ... 10 V and +/-1, +/- 5, or +/-10 V
- 4 ... 20 or 0 ... 20 mA (sourcing)

**Note:** For proper operation, the module requires power from an external source (250 mA @ 24 Vdc). If an external source is NOT used, the module pulls power from the internal bus and gives a false green LED indication.

## DAU 204 Analog Output Module Conversion Ranges

### Overview

Different PLC models require different voltage ranges. The following tables present the different PLC models and describe their power requirements and capabilities. Refer to *Controlling Output Signal Levels, p. 393* for ranges for A984- 1XX and E984- 24x/251/255 PLC models.

### Conversion Ranges

The following table lists voltage range information -- 0 ...1 VDC, 0 ... 5 VDC, 0 ...10 VDC -- for E984- 24x/258/265/275/285 PLC models.

| 0 ... 1 VDC | 0 ... 5 VDC | 0 ... 10 VDC | 11-bits | 12-bits | 15-bits + sign | 16-bits | Range |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | Nominal range |
| 0.5 | 2.5 | 5 | 1024 | 2048 | 16000 | 32768 | |
| 1 | 5 | 10 | 2047 | 4095 | 32000 | 65520 | |

The following table lists voltage range information -- 0/4 ... 20 mA -- for E984- 58/265/275/285 PLC models.

| 0 ... 20 mA | 4 ... 20 mA | 11-bits | 12-bits | 15-bits + sign | 16-bits | Range |
|---|---|---|---|---|---|---|
| 0 | 4 | 0 | 0 | 0 | 0 | Nominal range |
| 10 | 12 | 1024 | 2048 | 16000 | 32768 | |
| 20 | 20 | 2047 | 4095 | 32000 | 65520 | |

The following table lists voltage range information -- +/- 1 VDC, +/- 5 VDC, +/- 10 VDC -- for E984- 258/265/275/285 PLC models.

| +/- 1 VDC | +/- 5 VDC | +/- 10 VDC | 11-bits | 12-bits | 15-bits + sign | 16-bits | Range |
|---|---|---|---|---|---|---|---|
| -1 | -5 | -10 | 0 | 0 | -32000 | 0 | Nominal range |
| 0.5 | 2.5 | 0 | 1024 | 2048 | 0 | 32768 | |
| +1 | +5 | +10 | 2047 | 4095 | +32000 | 65520 | |

## DAU 204 Analog Output Module Special Features

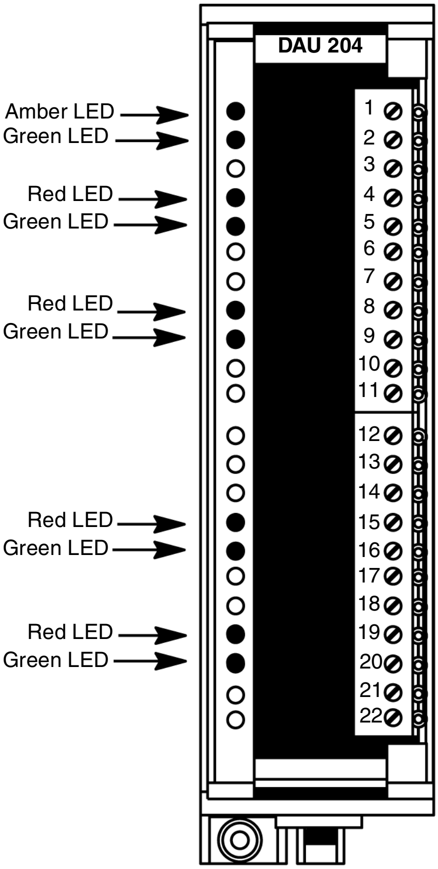
**Special Features**

The DAU 204 module provides the following features:

- 4 independently configurable channels (i.e., the DAU 204 can provide any combination of voltage and current outputs)
- Group-to-group isolation (channel 1 and 2 are optically and magnetically isolated from channels 3 and 4) to 500 Vac
- True 12-bit resolution (0 ... 4095) on all scales
- High accuracy (+/-0.2 percent of full scale @ 25 degrees C)
- Open current loop (broken wire) detection and warnings via LEDs and registers
- Software calibration (no potentiometers)
- Built-in diagnostics

An additional special feature of the DAU 204 is the outputs. For detailed information, see *Conversion Ranges, p. 378*.

The following figure shows a front view with the DAU 204 label.



| DAU 204 | | |
|---|---|---|
| ready | U | 1 |
| run | +I1 | 2 |
| | -I1 | 3 |
| open | +U1 | 4 |
| active | -U1 | 5 |
| shield 1 | | 6 |
| shield 2 | | 7 |
| open | +I2 | 8 |
| active | -I2 | 9 |
| | +U2 | 10 |
| | -U2 | 11 |
| | M | 12 |
| | +I3 | 13 |
| | -I3 | 14 |
| open | +U3 | 15 |
| active | -U3 | 16 |
| shield 3 | | 17 |
| shield 4 | | 18 |
| open | +I4 | 19 |
| active | -I4 | 20 |
| | +U4 | 21 |
| | -U4 | 22 |
| card | | |

## DAU 204 Analog Output Module Installation

**Overview**

The following information describes preparatory tasks to complete before you install the DAU 204.

**Before You Install the Module**

Before installing the DAU 204, be sure to complete the following items:
- Set the DIP switches.
- Field wire the terminal blocks.

For detailed information about how to complete these tasks, see *DAU 204 Analog Output Module Switch Settings, p. 382*.

**⚠ CAUTION**

**You must observe all rack and module power state requirements.**

Never insert or remove the DAU 204 from the rack while the rack is powered up or while the module is connected to an external power source or active output device. Failure to observe this precaution can result in equipment damage.

**Failure to follow this instruction can result in injury or equipment damage.**

**Note:** After installing the DAU 204, you must load the DAU 204 software driver (SVI.DAT Rev 3, or higher) and set at least one output range via I/O Mapped register (40xxx+4). These registers are described in *DAU 204 Analog Output Module Configuration, p. 390*.

## DAU 204 Analog Output Module Switch Settings

**Overview**

Setting DIP switches must be done before the DAU 204 can be installed. The following information describes how to perform these tasks. For general information about setting DIP switches on the DAU 204, see *DAU 204 Analog Output Module Installation, p. 381*.

**⚠ CAUTION**

**You must observe all rack and module power state requirements.**

Never change DIP switch settings while the rack is powered or while the module is connected to an external power source or active field device. Failure to observe this precaution can cause unintended equipment operation.

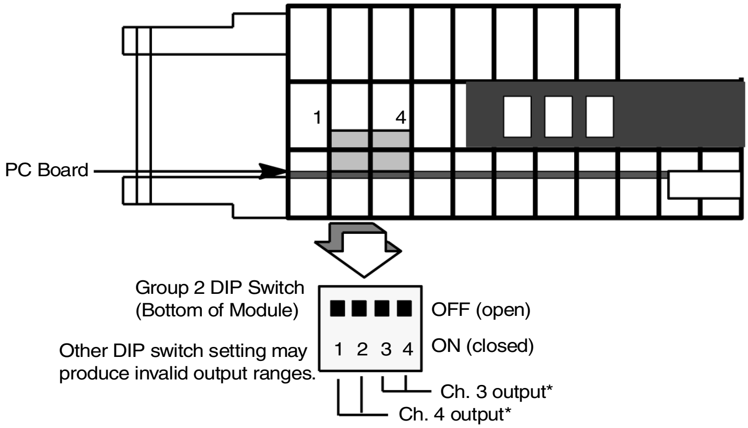
**Failure to follow this instruction can result in injury or equipment damage.**

## Setting DIP Switches

This procedure describes how the dip switches are set.

<table>
<tr><th>Step</th><th>Action</th></tr>
<tr><td>1</td><td>
With the DAU 204 not in the rack, find the DIP switches at the top and bottom of the module. (Both views are shown in the following illustrations. Note also that the DIP switches are visible through the vents.)<br>
The module ships in current mode.<br>
The following illustration is a bottom view of the module, showing the DIP switch for channels 3 and 4.

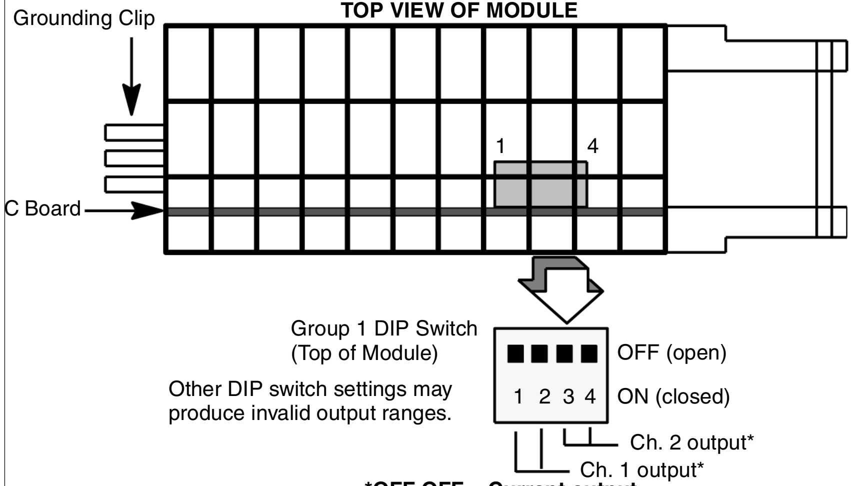
**BOTTOM VIEW OF MODULE**



***OFF OFF = Current output**<br>
**ON ON = Voltage output**

The following illustration is a top view of the module, showing the DIP switch for channels 1 and 2.

**TOP VIEW OF MODULE**



***OFF OFF = Current output**<br>
**ON ON = Voltage output**
</td></tr>
</table>

| Step | Action |
|---|---|
| 2 | Select the output mode for each channel by properly setting the DIP switches (Refer to the preceding figures.)<br>The DIP switch poles located at the top of the module control channels 1 and 2. The switches located on the bottom of the module control channels 3 and 4. Notice that channel 1 is set using poles 1 & 2, and channel 2 is set using poles 3 & 4; but channel 4 is set using poles 1 & 2, and channel 3 is set using poles 3 & 4. |

### Settings for Unused Channels

It is recommended that unused channels be set to voltage mode. This setting shuts off the red LED current loop error indicator and alarm bit. Alternatively, unused current output channels should be shorted.

You must use both poles together to properly set a channel's mode; not doing so will generate invalid results.

## DAU 204 Analog Output Module Field Wiring

**Introduction**

For this module, use 60/75 copper (Cu) for the power connections and 4.5 in-lb. of torque for the set screws.

To prevent errors in field device operation, follow these guidelines:
- Use shielded, twisted-pair cable (such as Belden 9418).
- Ground the shield of each signal cable at the DAU 204 only. At the other end each signal cable, peel back the shield and insulate it from contact with the signal-carrying wires.
- Route each signal cable as far as possible from sources of electrical noise (such as motors, transformers, contactors and especially AC devices).
- Route the signal cables in a conduit different from the AC and power cables.
- If the signal cables must cross AC or power cables, ensure that they cross at right angles.
- When connecting field devices to the module, keep the unshielded portions of the signal-carrying wires as short as possible.

After wiring the terminal blocks, use the supplied keys to prevent the blocks from being switched inadvertently.

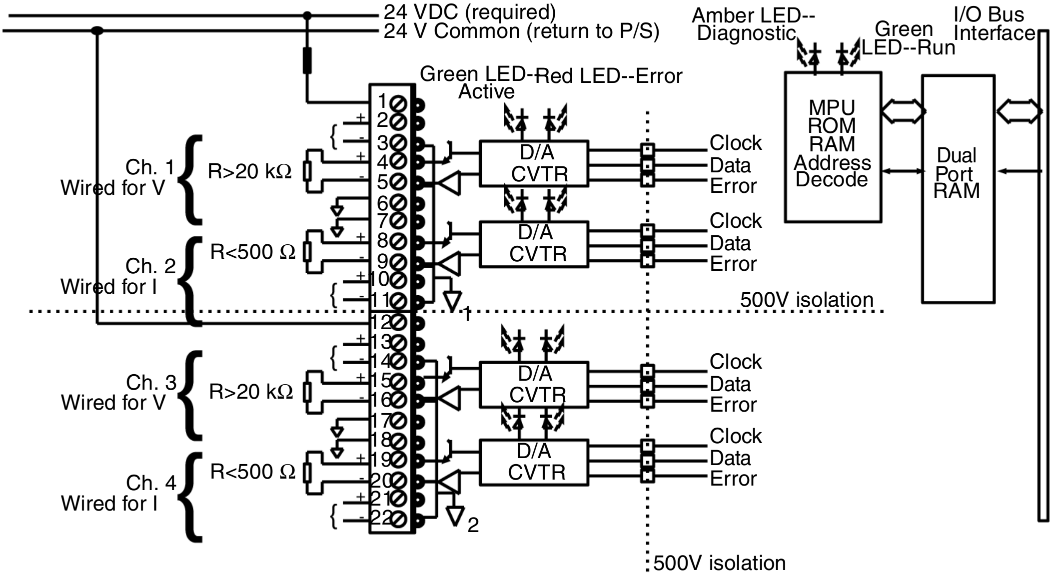
### ⚠ WARNING

**Module must be powered while in rack.**

Do not leave this module unpowered in the rack. This may affect the proper operation of the CPU and other I/O modules.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

**Wiring Diagram** The following illustration is a wiring diagram and simplified schematic for the DAU 204 analog output module.



## ⚠ CAUTION

**Observe all precautions when configuring a channel for current output.**

When you configure a channel for current output, do not connect anything to that channel's voltage output terminals (and vice versa). Failure to observe these precautions can cause unintended equipment operation.

**Failure to follow this instruction can result in injury or equipment damage.**

**Note:** We recommend that you connect the DAU 204 to the same 24 Vdc power supply used to power the PLC (even if the DAU 204 is in the rack but not being used). If this is not possible, we recommend that you supply power to the PLC before the DAU 204 using a power supply similar to the P120 (quick startup voltage). Failure to observe this precaution can cause abnormal operation.

**Note:** Ensure that voltage loads driven by the module can tolerate transients during rack and module startup. During startup, transients as great as 2 V may appear on the voltage output terminals for as long as 5 ms due to the characteristics of semiconductor devices. This does not occur with the module's current output terminals.

**Note:** Terminals 3, 5, 9 and 11 (- current out, and - voltage out) are internally tied as a group. Terminals 14, 16, 20 and 22 (- current out, and - voltage out) are internally tied as a group. Be sure not to cross groups.

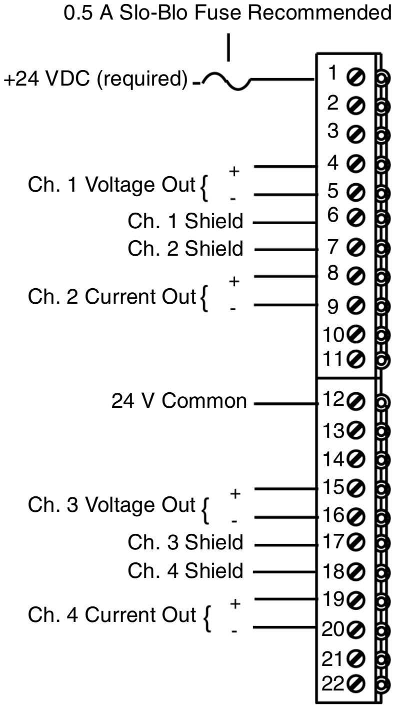
**Note:** You should short all unused current output terminals to disable the red current loop LEDs and alarm bits.

The following table lists terminal descriptions.

| Terminal | Channel | Description |
|---|---|---|
| 1 | | + 24Vdc (required) |
| 2 | 1 | + current out<br>- current out<br>+ voltage out<br>- voltage out<br>shield 1 |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | 2 | shield 2 |
| 8 | | + current out |
| 9 | | - current out |
| 10 | | + voltage out |
| 11 | | - voltage out |
| 12 | | 24 V common |
| 13 | 3 | + current out |
| 14 | | - current out |
| 15 | | + voltage out |
| 16 | | - voltage out |
| 17 | | shield 3 |

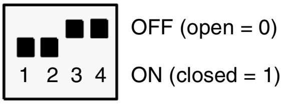
| Terminal | Channel | Description |
|---|---|---|
| 18 | 4 | shield 4 |
| 19 | | + current out |
| 20 | | - current out |
| 21 | | + voltage out |
| 22 | | - voltage out |

The following illustration is an example of the DAU 204 wired for voltage output on channels 1 and 3 and current output on channels 2 and 4.

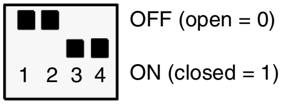


The DIP switch settings for this configuration are shown in the following illustration.

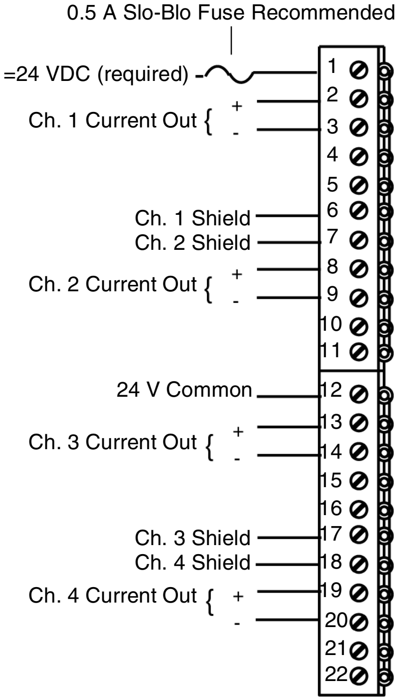
Group 1 DIP Switch
(Top of Module)



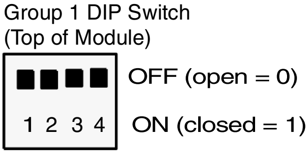
Group 2 DIP Switch
(Bottom of Module)

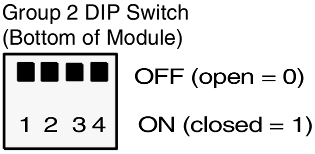


An example of the DAU 204 wired for current output on all channels (1 through 4) is shown in the following illustration. Turn all DIP switch poles off for this configuration.



For example, to select current output for channels 1 and 3, and current output for channels 2 and 4, set the DIP switch poles as shown in the following illustration.





## DAU 204 Analog Output Module Configuration

### Introduction

The DAU 204 is configured using the I/O map and its input and holding registers.

### I/O Mapping

The DAU 204 uses one 30xxx input register and six 40xxx output registers, I/O mapped as binary (BIN) data.

**Note:** A software loadable driver (SVI.DAT, Revision 3, or higher) is required to operate this module.

The registers and their functions used by the DAU 204 are shown in the table below, with more details following.

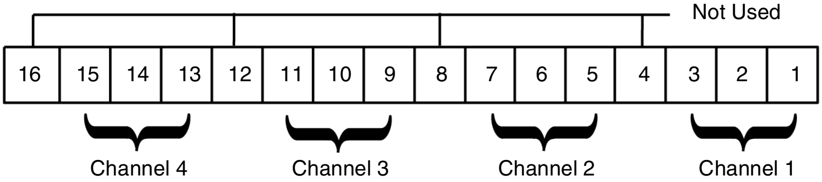
| Registers and their functions | |
|---|---|
| 30xxx | Module status word |
| 40xxx | Channel 1 data, output signal levels, 12 bit |
| 40xxx + 1 | Channel 2 data, output signal levels, 12 bit |
| 40xxx + 2 | Channel 3 data, output signal levels, 12 bit |
| 40xxx + 3 | Channel 4 data, output signal levels, 12 bit |
| 40xxx + 4 | Control word 0, range select (NOT avail able for E984-258/265/275/285 PLCs) |
| 40xxx + 5 | Control word 1, fault state |

From the I/O Map screen in Modsoft, you can call up the built-in help screens by highlighting DAU 204 and pressing <ALT><H>.

## Setting Output Ranges

Output register 40xxx + 4 controls the output range for each channel.

**Output Register 40XXX + 4 (range select)**



| | | | | |
|---|---|---|---|---|
| 0 | 0 | 0 | (0 hex) | = 4...20 mA |
| 0 | 0 | 1 | (1 hex) | = 0...20 mA |
| 0 | 1 | 0 | (2 hex) | = 0...1 V |
| 0 | 1 | 1 | (3 hex) | = ±1 V |
| 1 | 0 | 0 | (4 hex) | = 0...5 V |
| 1 | 0 | 1 | (5 hex) | = ±5 V |
| 1 | 1 | 0 | (6 hex) | =0...10 V |
| 1 | 1 | 1 | (7 hex) | =±10 V |

**Note:** When using E984-258/265/275/285 PLCs the output ranges are selected using the Parma ... screen in Concept, not the 4x+4 register.

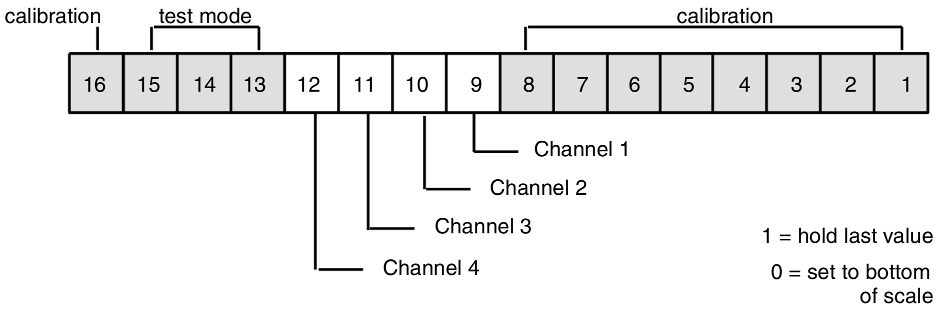
## Enabling Hold-Last-Value

Bits 9 through 12 of output register 40xxx + 5 control how the DAU 204 responds to the following fault conditions:

- Communications with the PLC is lost for more than 1 second.
- The PLC is in stopped mode or power is lost.

The following is an illustration of the Enable-Hold-Last-Value Register.

**Bits 9...12 of Output Register 40XXX = 5 (enable hold-last-value)**



> **Note:** When using E984-258/265/275/285 PLCs the hold-last-value is selected using the Parma ... screen in Concept.

For example, if channel 1 is configured for 4 ... 20 mA operation, and bit 9 of register 40xxx + 5 is set to 0 (bottom of scale), channel 1 will output 4 mA if communication with the PLC is lost. However, if bit 9 were set to 1 (hold last value), channel 1 would output the same signal (value) that was output when communication was lost.

## Controlling Output Signal Levels

Output registers 40xxx through 40xxx + 3 control the output signal levels on channels 1 through 4, respectively.

The table below shows how the data in these registers correspond to the output signal for each output range. Register values above 4095 are treated as 4095.

| A984-1xx, E984-24x/251/255 PLC Models | | | |
|---|---|---|---|
| Register Value (decimal) | Unipolar Voltage Output Signal | | |
| | 0 ... 1 V | 0 ... 5 V | 0 ... 10 V |
| 0 | 0 | 0 | 0 |
| 2047 | 0.5 | 2.5 | 5 |
| 4095 | 1 | 5 | 10 |
| | Bipolar Voltage Output Signal | | |
| | +/-1 V | +/-5 V | +/-10 V |
| 0 | -1 | -5 | -10 |
| 2047 | 0 | 0 | 0 |
| 4095 | 1 | 5 | 10 |
| | Current Output Signal | | |
| | 0 ... 20 mA | 4 ... 20 mA | |
| 0 | 0 | 4 | |
| 2047 | 10 | 12 | |
| 4095 | 20 | 20 | |

### ⚠ CAUTION

**Operational Hazard**

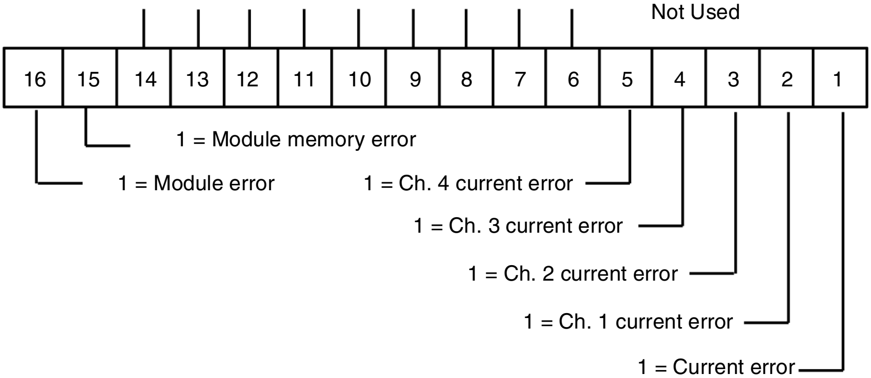
Before bringing field devices on-line, always ensure that you know the value in the registers that control each output channel so that the field devices do not begin operation without your understanding.

**Failure to follow this instruction can result in injury or equipment damage.**

## Monitoring the Module

Input register 30xxx can be used to monitor the DAU 204.

**Input Register 30XXX (module status)**



A current error indicates an open current loop (broken wire) or a high loop impedance (greater than 500 ohms). Check the field wiring. A module error indicates a fault within the module. Try restarting the module. If the fault continues, call Technical Support at 1-800-468-5342.

## DAU 204 Analog Output Module Custom Calibration

**Introduction**

This procedure is recommended for expert users only. All DAU 204 modules are carefully calibrated at the factory, so the procedure described below is needed **only** if you want to alter the module's calibration for a special application.

Depending on the accuracy desired, this procedure should take less than half an hour. To calibrate the DAU 204, the following materials are needed:

- Processor
- Rack
- Power supply
- Programming software (Modsoft) and computer
- Cable (preferably, shielded, twisted pair cable, such as Belden 9418)
- Multimeter with current measuring capability

## Calibrating the Module

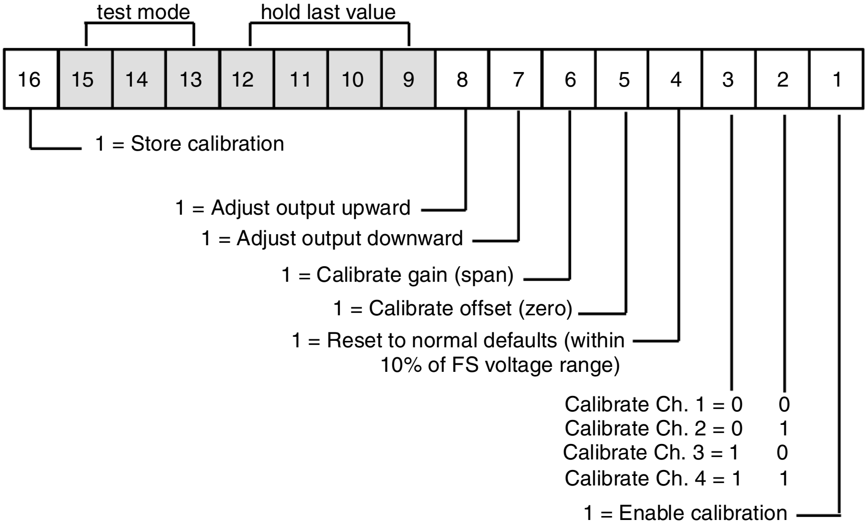
To calibrate the DAU 204 analog output module:

| Step | Action |
|---|---|
| 1 | Properly install and configure the module for the intended application See *DAU 204 Analog Output Module Installation, p. 381* and *Controlling Output Signal Levels, p. 393*. |
| 2 | Set the output data register for the channel you want to calibrate to 4095 decimal (for example, to calibrate channel 1, set output register 40xxx to 4095). |
| 3 | Using the multimeter, measure the output for the channel being calibrated. |
| 4 | Using output register 40xxx + 5 (defined in the figure below), adjust the output upward or downward. Refer to the channel gain table below for the op codes to use.<br>**Note:** When using E984-258/265/275/285 PLCs the channel calibration is selected using the Parma ... screen in Concept. |
| 5 | When the output equals the top of the desired range (for example, 20 mA for 4 ... 20 mA operation), set output register 40xxx + 5 to 0000 hex to stop the output movement. |
| 6 | Set the output data register for the channel you want to calibrate to 0 (for example, to calibrate channel 1, set output register 40xxx to 0). |
| 7 | Using output register 40xxx + 5, adjust the output upward or downward. Refer to the channel offset table below for the op codes to use. |
| 8 | When the output equals the bottom of the desired range (for example, 4 mA for 4 ... 20 mA operation), set output register 40xxx + 5 to 0000 hex to stop the output movement. |
| 9 | Repeat steps 2 through 8 until you've achieved the desire accuracy.<br>Repeat these steps for each channel, as desired.<br>To store the calibration in EEPROM, set output register 40xxx + 5 to 8011 hex. |

## Channel Calibration

The following is an illustration of the Channel calibration register.

**Bits 1...8 of Output Register 40XXX + 5**
**(channel calibration)**



**Code Tables**

The following table gives Op codes to adjust channel gain (span) upward or downward.

| | **Upward** | **Downward** |
|---|---|---|
| Channel 1 | 00A1 hexadecimal | 0061 hexadecimal |
| Channel 2 | 00A3 hexadecimal | 0063 hexadecimal |
| Channel 3 | 00A5 hexadecimal | 0065 hexadecimal |
| Channel 4 | 00A7 hexadecimal | 0067 hexadecimal |

The following table gives Op codes to adjust channel offset (zero) upward or downward.

| Op codes to adjust channel offset (zero) upward or downward | | |
|---|---|---|
| | Upward | Downward |
| Channel 1 | 0091 hexadecimal | 0051 hexadecimal |
| Channel 2 | 0093 hexadecimal | 0053 hexadecimal |
| Channel 3 | 0095 hexadecimal | 0055 hexadecimal |
| Channel 4 | 0097 hexadecimal | 0057 hexadecimal |

**Note:** When you replace the module, you will need to perform this procedure again.

To return a channel to an uncalibrated state (before factory calibration i.e. within 10 percent of full scale of voltage range), set output register 40xxx + 5 to the appropriate op code shown in the table below.

| Op codes to return channel to uncalibrated state | |
|---|---|
| Channel 1 | 0009 hexadecimal |
| Channel 2 | 000B hexadecimal |
| Channel 3 | 000D hexadecimal |
| Channel 4 | 000F hexadecimal |

## DAU 204 Analog Output Module Indicators

**LEDs**

The DAU 204 analog output module has three types of LEDs:

- Amber LED -- provides information about the health of the module
- Green LEDs -- provide information about the readiness of the module
- Red LEDs -- provide information about the integrity of each channel (in current mode only)

This chapter explains how to use these and other diagnostic tools to determine the status of the DAU 204 module, and to identify and solve problems if necessary.

**Amber LED**

The amber LED on the front of the module provides status information about the health of the module. A flashing amber LED indicates a fault in at least one of the following areas:

- Module Watchdog Circuit Fault
- Module Watchdog Circuit Fault at Startup
- Module RAM Failure at Startup
- Bus Interface Failure at Startup
- Module ROM Failure
- Module Processor Fault at Startup
- General Module Error

If the amber LED begins flashing, try restarting the module. If the flashing continues, call Technical Support at 1-800-468-5342.

**Green LEDs**

The green LED at the top of the module provides status information about the module's readiness. The remaining green LEDs provide status information about the activity on each channel.

After the module is powered up, the green LED at the top of the module should begin flashing. If not, check the power source and connections.

**Note:** The DAU 204 requires power from an external source (250 mA @ 24 Vdc) to operate. When an external source is NOT used the module pulls power from the internal bus gives a false green LED indication.

**⚠ WARNING**

**Operational Hazard**

Do not leave this module unpowered in the rack. This may affect the proper operation of the CPU and other I/O modules.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

Next, after the module has established communications with the PLC, the green LED at the top of the module should stop flashing and remain on. If not, ensure that the PLC has been powered up.

The remaining green LEDs should remain on or flash quickly as data is sent over each channel. If these green LEDs ever go off, check the power source and connections.

**Red LEDs**

The red LEDs provide status information about each channel's integrity in current mode only. A flashing or steady red LED indicates an open current loop (broken wire) or a high loop impedance (greater than 500 ohms ). Red LEDs do not function in voltage mode.

**Invalid Data**

If the module seems to be providing invalid output data:

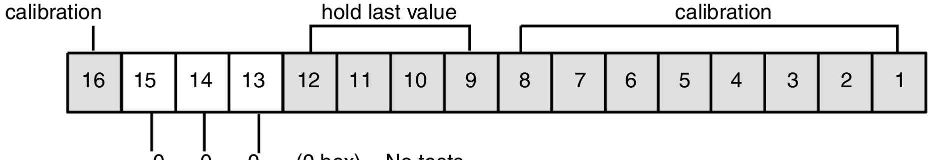
- Check wiring connections and integrity, DIP switch settings, and register settings.
- Verify the integrity of the field device.
- Make sure the signal cables are not placed on or near high-voltage (120 Vac or higher) cables. If the signal cables must cross high-voltage cables, ensure that the signal cables cross the high-voltage cables at right angles.

If electrical interference seems to be the problem, try placing the module as far as possible from power supplies and relay output modules. These products may generate electrical interference during operation. This interference would not affect the module but may induce noise on the channel wiring.

## Built-in Tests

The DAU 204 has built-in tests that are performed automatically when the module is powered up, but they can also be performed after the module is on-line by setting output register 40xxx +5 as shown in the built-in test register (below).

**Bits 13...15 of Output Register 40XXX + 5 (built-in tests)**



| | | | |
|---|---|---|---|
| 0 | 0 | 0 | (0 hex) = No tests |
| 1 | 0 | 1 | (5 hex) = Category 1 |
| 1 | 1 | 0 | (6 hex) = Category 2 (DAU 204 must be in ±10 V mode) |
| 1 | 1 | 1 | (7 hex) = Category 3 (DAU 204 must be in 4...20 mA mode) |

To stop the built-in tests, simply reset output register 40xxx + 5 to 0000 hexadecimal.

### ⚠ CAUTION

**Operational Hazard**

Before performing these tests, disconnect any field devices from the DAU 204. Failure to observe this precaution can cause unintended equipment operation.

**Failure to follow this instruction can result in injury or equipment damage.**

**Note:** When bits 13, 14, or 15 of the output register 40xxx + 5 are set to 1, the green LED flashes continuously until these bits are reset to 0. After resetting these bits to 0, the module should be restarted.

**Note:** When using E984-258/265/275/285 PLCs the built-in tests are selected using the Parma ... screen in Concept.

If the DAU 204 fails any of these tests (amber LED flashes), restart the module. If it continues to fail, call Technical Support at 1-800-468-5342.

## DAU 204 Analog Output Module Specifications

### Table of Specifications

The following table provides DAU 204 Specifications.

| | | |
|---|---|---|
| Module Topology | Number of Channels | 4 |
| | Number of Groups | 2 |
| | Points per Group | 2 |
| Operating Voltage Ranges | Bipolar | +/-1, +/-5, +/-10 Vdc |
| | Unipolar | 0 ... 1, 0 .. 5, 0 ... 10 Vdc |
| Operating Current Ranges | Unipolar | 0 ... 20, 4 ... 20 mA |
| Power Supply | External Supply | 250 mA @ 24 Vdc |
| | Internal Power Supply (via system bus) | less than 1 mA (TTL loading) |
| Required Loadable | SW-IODR-001 | |
| Isolation | Channel 1, 2 to Channel 3, 4 | 500 V @ 60 Hz |
| | Channel to Bus | 500 V @ 60 Hz |
| | Channel 1 to 2 and 3 to 4 | Not Isolated |
| Line/Load Impedance | Voltage Output | greater than or equal to 20,000 ohms |
| | Current Output | less than or equal to 500ohms, less than or equal to 50mH; No max. capacitance but can slew output |
| Resolution | 12 bit (0 ... 4095) | |
| Accuracy | +/-0.200 percent Full Scale Reading @ 25 degrees C | |
| Accuracy Drift w/ Temperature | Current Output | +/-0.002 percent FSR/ degrees C typical |
| | | +/-0.005 percent FSR/ degrees C maximum |
| | Voltage Output | +/-0.006 percent FSR/ degrees C typical |
| | | +/-0.0135 percent FSR/ degrees C maximum |
| Update Time | 5 ms per channel maximum | |
| Fault Detection | Open current loop (broken wire in current mode) | |
| MTBF | 100,000 hours, minimum, @ 30 degrees C, ground base fixed | |
| EMI Susceptance | 27 ... 500 MHz, 10 V/m | |

| | | |
|---|---|---|
| Electrostatic Discharge | 8 kV | |
| Fast Transient (IEC 801-4) | +/- 1.0 kV | |
| Surge Withstand | 2 kV (Transients, IEC 801-5) | |
| Operating Conditions | Temperature | 0 ... 60 degrees C<br>(32 ... 140 degrees F) |
| | Humidity | 95 percent RH noncondensing @ 60 degrees C |
| | Chemical Interactions | Can be damaged by strong alkaline (pH greater than 7) solutions |
| | Vibration | 10 ... 57 Hz @ 2 Gs |
| Storage Conditions | Temperature | -40 ... 85 degrees C<br>(-40 ... 185 degrees F) |
| | Free Fall | 1 m (approx. 39 in) |
| I/O Map | Register 3x/4x | 1 in/6 out<br>1 in/5 out for (E984-258/265/275/285 Only) |
| Material | Lexan (Enclosures and Bezels) | |
| Space Required | 1 A120 SMS rack slot | |
| Dimensions (WxHxD) | | 40.3 x 145.0 x 117.5 mm |
| | | 1.60 x 5.60 x 4.50 in |
| Weight, Maximum | | 453 g, |
| | | 1 lb. |
| Agency Approvals | UL 508; CUL; FM Class I, Div 2; and European Directive EMC 89/336/EEC (See *Requirements for CE Compliance, p. 857*) Standards | |

# Overview of DAU 208 Analog Output Module

# 28

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DAU 208 analog output module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DAU 208 Analog Output Module?

**Brief Product Description**

The DAU 208 is an eight-channel +/-10 V analog output module with opto-isolation. Digital-to-analog conversions are performed by a single converter, sequentially multiplexed to the eight output circuits. Outputs are short circuit-proof, and reset themselves after the short is removed.

The DAU 208 can be installed in any slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and peripheral connections on the front. The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided.

**⚠ WARNING**

**Operational Hazard**

The DAU 208 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

## DAU 208 Analog Output Module Conversion Ranges

**Introduction**

The PLC model determines the available ranges. Refer to the table below. The ranges for the A984-1xx/24x/251/255 PLC models are in *DAU 208 Analog Output Module Specifications, p. 416*.

**Conversion Ranges**

+/- 10 VDC for E984–258/265/275/285 PLC Models

| +/- 10 VDC for E984-258/265/275/285 PLC Models | | | |
|---|---|---|---|
| +/- 10 VDC | 12-bits | 15-bits + sign | Range |
| -10.24 ... | 0 | -32768 | Under-range |
| -10.005 | 47 | -32016 | |
| -10.00 | 48 | -32000 | Nominal range |
| 0 | 2048 | 0 | |
| +10.00 | 4048 | +32000 | |
| +10.005 ... | 4049 | +32016 | Overrange |
| +10.24 | 4095 | +32752 | |

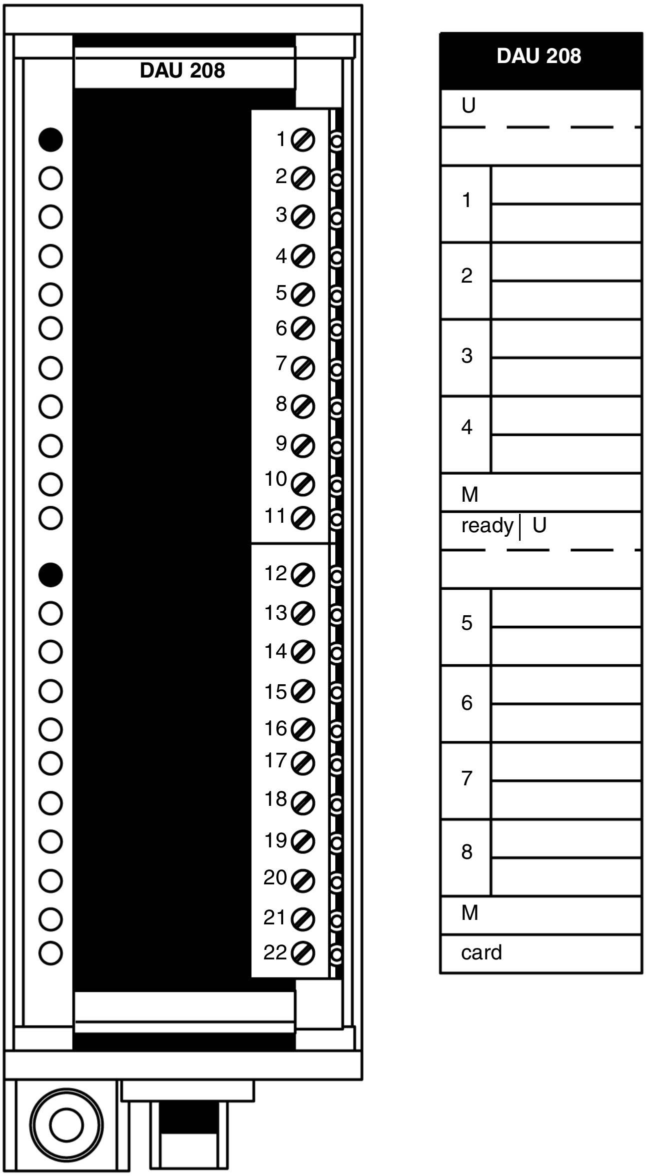
## DAU 208 Analog Output Module Physical Characteristics

**LEDs**

The DAU 208 has two green LEDs:

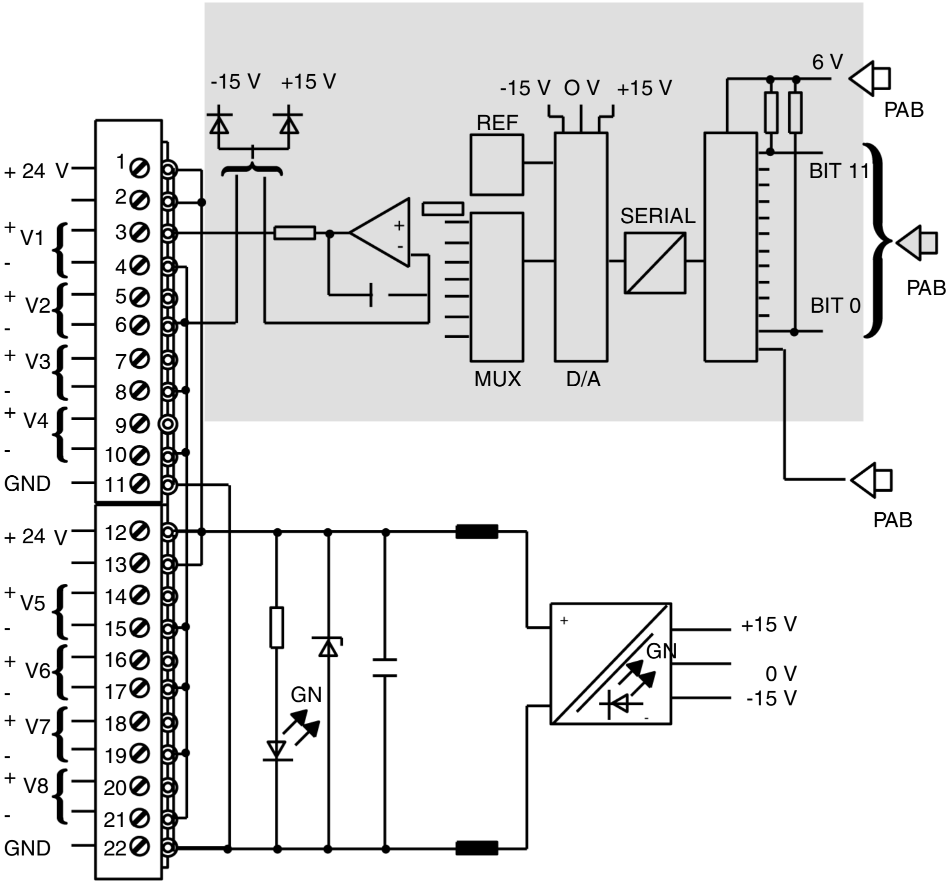
- Opposite terminal #1, indicating the presence of user-supplied 24 Vdc power (ON = power supplied; OFF = power off)
- Opposite terminal #12, indicating operation of the dc-dc converter that powers the D/A circuitry (ON = Ready; OFF =  Fault)

**Front View** A front view with DAU 208 label is provided below.



**Simplified Schematic**

The DAU 208 can be field wired to up to eight voltage output devices.



## DAU 208 Analog Output Module Configuration

**I/O Mapping**

The DAU 208 must be I/O Mapped as eight 4x output registers, and BIN must be set for data type.

**Cabling**

- Shielded, twisted pair cable (2 or 4 x 0.5 mm/channel) should be used; all channels can be connected with a common shielded cable.
- Connect shield to ground (GND) on one side with a short cable (less than 8 in.).
- Observe a minimum distance of 20 in between the module and power lines or other sources of electrical disturbance.

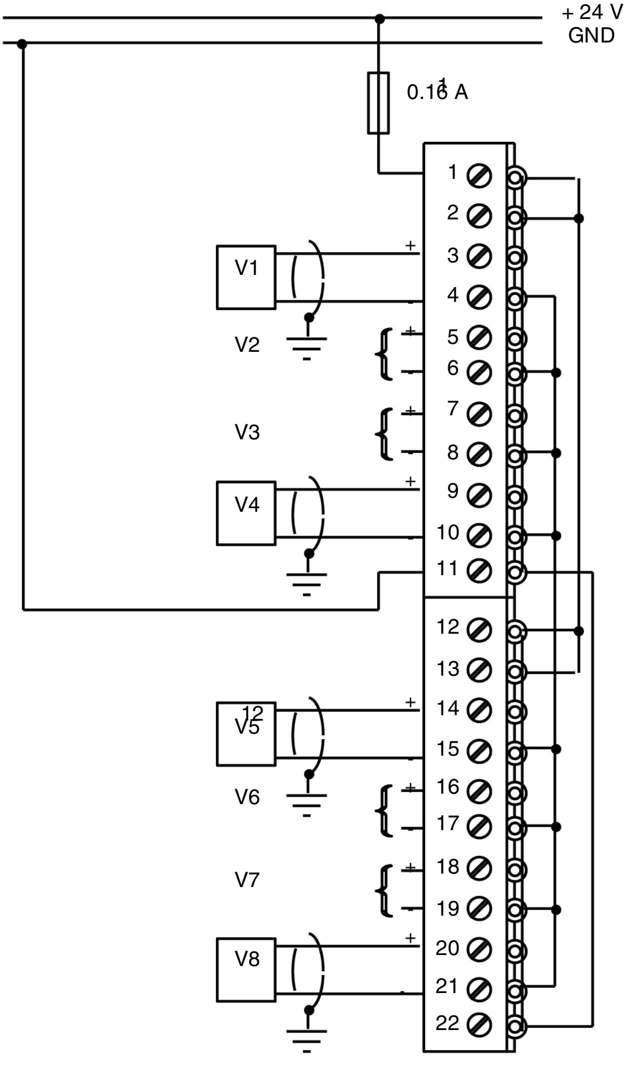
**Connection and Assignment of Output Addresses**

**Note:** Detailed Compact 984 cabling and installation instructions are found in the ***984—A120 Compact Programmable Controllers User Guide*** (890 USE 108 00 formerly GM-A984-PCS).

## DAU 208 Analog Output Module Field Wiring

**Wiring Diagram for DAU 208**

After conversion by the DAU 208, words 1 ... 8 are shown as analog values at their respective addresses 1 ... 8, as shown in the following illustration.



## DAU 208 Analog Output Module Calibration

### Introduction

⚠ **CAUTION**

**Calibration Caution**

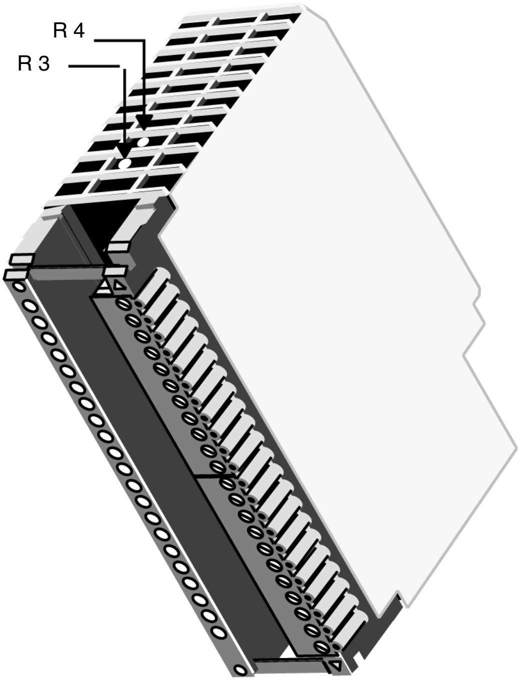
Modicon recommends that units requiring recalibration be returned to the factory, since inaccuracies could be due to faulty components. However, users who wish to perform their own calibration should use the following procedure.

**Failure to follow this instruction can result in injury or equipment damage.**

By adjusting the two potentiometers located on the top of the DAU 208 module, you can calibrate both the plus and minus ranges for the eight output channels.

## Location of DAU 208 Potentiometers

The following illustration shows the location of the potentiometers on the DAU 208.



In this procedure, R4 is used to calibrate the plus output voltage ranges, and R3 is used to calibrate the negative ranges and the zero point.  The third potentiometer mounted opposite R3 on a separate PCB is factory preset and should not be adjusted.  Its purpose is to establish voltage outputs of the DC-DC supply that powers the module's D/A converter.

Items required for calibration are:

- A 3.3 kW Precision Register
- A Voltmeter with appropriate scale and accuracy of 0.2 ... 0.5 PPM.

## Calibrating the Analog Output Channels

Take the following steps to calibrate the analog output channels.

| Step | Action |
|---|---|
| 1 | Connect the 3.3 k ohms Resistor across Channel 1. Connect the voltmeter across the 3.3 k ohms Resistor and load the Channel 1 register with 4048 decimal. Adjust R4 for a reading of +10 Vdc (+/- 0.5 mV) on the voltmeter. |
| 2 | Load the Channel 1 register with 48 decimal. Adjust R3 for a reading of -10 Vdc (+/- 0.5 mV) on the voltmeter. |
| 3 | Load the Channel 1 register with 2048 decimal. Adjust R3 for a reading of 0 Vdc (+/- 0.5 mV) on the voltmeter. |
| 4 | Move the resistor and voltmeter to the other channels and check outputs. Zero output points should be within +/- 2 mV, and +/-10 Vdc outputs within +/-7 mV. |
| 5 | When satisfied with the readings on all eight channels, drop a bead of sealing varnish on both potentiometers' adjusting screws to secure their settings. |

## DAU 208 Analog Output Module Specifications

### Table of Specifications

The following table contains a list of DAU 208 specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Out puts | 8 | |
| | Isolation | Channel-to-Bus | 700 Vdc |
| | | Channel-to-External Supply | 700 Vdc |
| | Voltage Output | +/-10 V, greater than 3.3 k ohms | |
| | Maximum Load Current | 3 mA | |
| | Max. Short Circuit Current | 20 mA | |
| Power Supply | External | 24Vdc, 120 mA maximum | |
| | Internally Provided Source from I/O bus | 5 Vdc, 30 mA maximum | |
| | Power Dissipation | 3 Ω | |
| Voltage Output Capabilities | Linear Measuring Range Conversion Values for the DAU208 A984-1xx, E984-24x/251/255 PLC Models Only | | |
| | Analog Value | Decimal Value | Comments |
| | -10.24 | 0 | |
| | -10.00 | 48 | |
| | -5.00 | 1048 | |
| | -1.00 | 1848 | |
| | -0.50 | 1948 | |
| | -0.10 | 2028 | |
| | -0.01 | 2046 | |
| | -0.005 | 2047 | Linear Range |
| | 0.00 | 2048 | |
| | +0.005 | 2049 | |
| | +0.01 | 2050 | |
| | +0.10 | 2068 | |
| | +0.50 | 2148 | |
| | +1.00 | 2248 | |
| | +5.00 | 3048 | |
| | +10.00 | 4048 | |
| | +10.24 | 4095 | |

| | | |
|---|---|---|
| A/D Conversion | Conversion Time for All Outputs | 1 ms maximum |
| | Resolution | 11 bits plus sign |
| | Overrange | +/-2.4% (maximum +/-10.24 V) |
| | Overall Error | +/-0.1% @ 0 ... 605 C |
| I/O Map | Register 1x/0x | 0 in/8 out |
| Dimensions | W x H x D | 40.3 x 145 x 117.5  mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 350 g (.77 lb.) |
| Agency Approvals | VDE 0160; UL 508; CSA 22.2 No.142 and FM Class I, Div 2 Standards | |

**Note:** If Power is removed from A984 or stopped, the outputs will go to a no output condition.

# DEA 202 InterBus S Interface Module

# 29

## At a Glance

**Introduction**

This information in this chapter describes the DEA 202 InterBus S Interface Module.

**What's in this Chapter?**

This chapter contains the following topics:

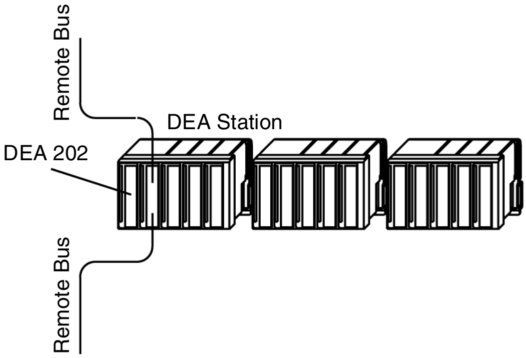
## DEA 202 Features and Functions

**Product Overview**

The DEA-202 enables A120 series I/O modules to connect to the remote bus in an INTERBUS configuration. For the INTERBUS master, the DEA module is a remote node that can address up to 18 I/O modules (288 I/Os) via the subracks AS- HDTA200, AS- HDTA 201 or AS- HDTA 202.

The DEA 202 comes with an integrated (non-isolated) power supply. It provides a 5 VDC supply at 1.6 A for the modules on the parallel I/O bus.

The following figure shows the DEA 202 INTERBUS topology.



**⚠ CAUTION**

**Addressing errors.**

The DEA 202 module may cause addressing errors in INTERBUS configurations of generation 4. For this reason the DEA 202 must not be used together with INTERBUS Controller Boards of generation 4.

**Failure to follow this instruction can result in injury or equipment damage.**

## Features

The following list identifies key features of the DEA 202.

- Coupling module with integrated power supply.
- With the exception of intelligent modules, all analog and discrete Compact I/O modules can be employed.
- The DEA 202 requires 1 word of the packet length for private data. Consequently, a maximum of 31 words remains available for use by the INTERBUS.
- DIP switch default adjustment: Disconnection behavior as well as status and control word processing.

## Functional Details

The module serves as the coupling element between the remote bus (CPU connection) and PAB (connection to the I/O modules).

The undervoltage monitoring signal from the primary and secondary voltages is evaluated internally by the module.

## Watchdog

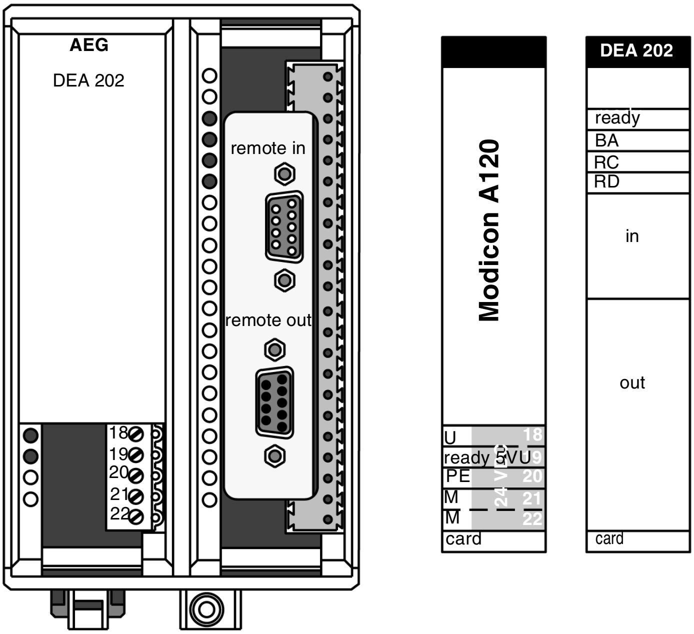
The watchdog is a self-monitoring feature of the DEA. It consists of a monoflop with a delay time of about 320 ms. The DEA firmware performs an interrupt triggered control of the monoflop. After successfully powering on, which includes a successful EPROM check and initialization, the monoflop is triggered during program execution.

The delay time of the monoflop cannot be changed. The green "ready" (watchdog) LED goes off if cycle times are greater than the monoflop’s delay time. This condition activates the disconnection behavior as determined by DIP switches S2 & S3.

## Module Faults

The DEA 202 collects messages from the associated modules and reports these to the master as module faults (refer to the "DEA 202 Status and Fault Messages" section of the *INTERBUS Quantum 140 NOA 611 00 User Manual* (P/N 840 USE 419 00).

The following figure shows the DEA 202 front view and label.



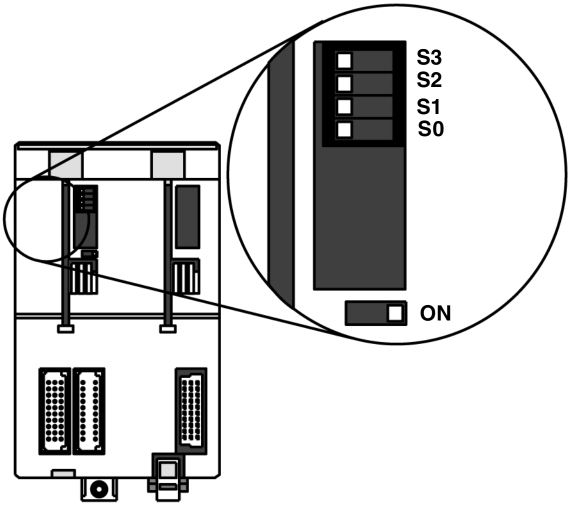
## Configuration of the DEA 202

### Overview

The following information describes how to configure the DEA 202.

### DIP Switch Location and Settings

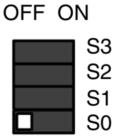
The following figure shows the location and settings for the DIP switch.



**Note:** For DEA 202 operation with the 140 NAO 611 00, all DIP switches (S0 ... S3) must be in the "OFF" position.

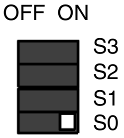
### Status Processing (S0)

The following figure shows the status processing switch settings.



Analog value processing with status and parameter*

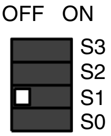
* As shipped



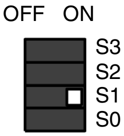
Analog value processing without status and parameter

## Control Word Processing (S1)

The following figure shows the control word processing switch settings.



DEA control word active.
Required setting for 140 NOA 611 00.
Output begins after bus initialization completion.*

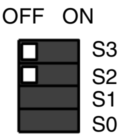


DEA control word inactive
Required setting for 140 NOA 611 10 and other
Output begins immediately after startup.

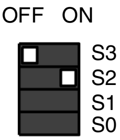
* Delivery status

## Disconnection Behavior (S2, S3)

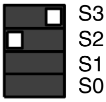
The following figure shows the disconnection behavior switches and settings.



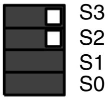
Master defaults are in effect (no defaults selected: All outputs are cutoff)*



Halt with value retention (outputs remain unchanged)



Forced cutoff of all outputs



Reserved for service specialists (Test bay setting)

* As shipped, required setting for operation with a 140 NOA 611 00.

**Note:** S0 and S1 settings are meaningless.

## Subrack Mounting Slot

The module is installed in DTA 200 primary subrack slot 1-1/1-2.

When installing the module, be sure to adhere to the installation steps that are included in the accompanying documentation: *Inter-Bus- -S Quantum 140 NOA 611 00 User Manual* (P/N 840 USE 419 00).

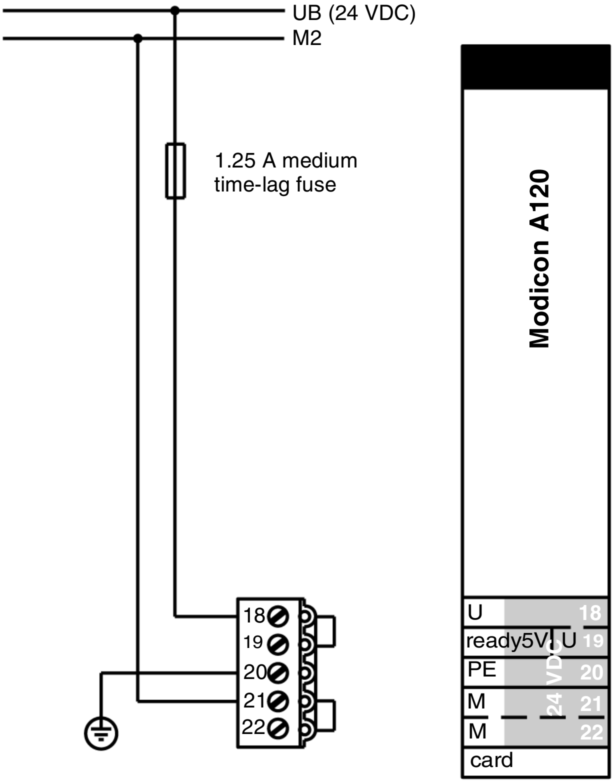
## Compatible A120 I/O Modules

The following table lists the A120 I/O modules that are compatible with the DEA 202 module.

| Module Type | Module Number |
|---|---|
| Discrete Input, 8 point | DEP 208, DEP 209, DEP 210 and DEP 211 |
| Discrete Input, 16 point | DEP 214, DEP 215, DEP 216, DEP 217, DEP 218, DEP 220, DEP 254, DEP 256, DEP 257, DEP 296, DEP 297 and DEO 216, |
| Discrete Output, 4/8 point | DAP 204, DAP 208, DAP 209, DAP 258 and DAP 210 |
| Discrete Output, 16 point | DAP 216, DAP 217, DAP 218 and DAO 216 |
| Discrete Input/Output | DAP 212, DAP 220, DAP 250, DAP 252, DAP 253 and DAP 292 |
| Analog Output | DAU 202, DAU 208 and DAU 252 |
| Analog Input | ADU 204, ADU 205, ADU 206, ADU 216*, ADU 210*, ADU 214* ADU 254 and ADU 256 |
| * Although these modules are not available in Concept, they can still be used with the DEA 202. | |

**Power Supply Connection**

The following figure shows a sample DEA 202 power supply connection. You enter the relevant power supply information in the label inlay.



## ⚠ CAUTION

**Improper connection danger.**

The module's integrated power supply is non-isolated. Improper connection (for example, absence of the M2 connection), can lead to module destruction.

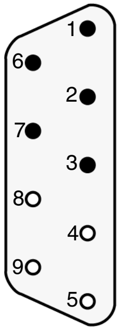
**Failure to follow this instruction can result in injury or equipment damage.**

Note that the noise immunity can be improved if by-pass capacitors are installed at the power supply module U and M terminals.

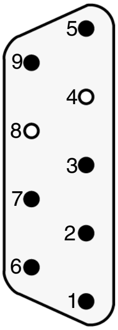
**InterBus-S Connection**

Set up the connection according to the "Remote Bus Node Wiring" section of the *InterBus-S 140 NOA 611 00 User Manual* (P/N 840 USE 419 00).

The following figure shows the remote bus port pin assignmentsas viewed from the solder side.



Sub-D9 “in” plug (top)



Sub-D9 “out” socket (bottom)

| Pin | Signal | Function |
|---|---|---|
| 1 | DO | Transmit data (+) |
| 2 | DI | Receive data (+) |
| 3 | GND | Signal ground |
| 5* | | (5 VDC Out) cannot be used externally |
| 6 | $\overline{DO}$ | Transmit data (-) |
| 7 | $\overline{DI}$ | Receive data (-) |
| 9* | RBST | Plug identifier |

*) Incoming remote bus = not used

● Pin present

○ No pin present

## DEA 202 LEDs

**LED Displays**

The following table describes the LED displays, which are located on the module front plate.

| No. | Label Inlay Identifier | Color | Function |
|---|---|---|---|
| 18 (left) | U | Green | 24 VDC supply present |
| 19 (left) | ready 5 V | Green | Module ready for service, 5 VDC output voltage present |
| 3 (right) | ready | Green | Coupler ready |
| 4 (right) | BA | Green | Transfer in progress |
| 5 (right) | RC | Green | "Remote bus check", remote bus input monitoring |
| 6 (right) | RD | Red | "Remote bus disabled", remote bus feed-through terminated (remote bus node diagnosis) |

## DEA 202 Specifications

**Specifications**

The following table lists specifications for the DEA 202 InterBus S Interface Module.

| **Assignment** | |
|---|---|
| System | TSX Compact (A120, 984) |
| Module area | Slot 1-1/1-2 of DTA 200 primary backplane |
| **I/O Map** | |
| Register 3x/4x | 0 in/ 0 out |
| **Power Supply** | |
| External input voltage | UB = 24 VDC, max. 0.85 A |
| Primary fusing | 1.25 A medium time-lag fuse |
| Power on current | 20 A, time constant = 1 ms |
| Tolerances, limiting values | 24VDC external power source, 22 ... 30VDC input, peak value= 33VDC |
| Reference potential M | M2 |
| Protective earth | PE |
| Secondary voltage | 5.15 VDC, max. 1.6 A, non-isolated |
| Buffering time | Typically 5 ms for 24 VDC |
| Overload protection | Through current limiting |
| **Data Interface** | |
| Field bus | Through a potential-free RS-485 interface (serial, symmetric) |
| INTERBUS Protocol chip | SUPI II (INTERBUS Generation 3) |
| **Processor** | |
| Processor type | Intel 80C152 / 12 MHz |
| Data memory | 32 KB RAM |
| Firmware | 32 KB EPROM |
| **Mechanical Design** | |
| Module | Standard double-size module |
| Format | 2 slots |
| Weight | Approx. 500 g |
| **Connections** | |
| Power supply | 5-pole screw/plug-in terminal block |
| Remote bus | Sub-D9 plug and Sub-D9 socket |
| Back plane | 2 plug connectors 1/3 C30M, 1 socket connector 1/3 R30F |

| **Environmental Characteristics** | |
|---|---|
| Regulations | VDE 0160, UL 508; CSA 22.2 No.142, European Directive on EMC 89/336/EEC, and Low Voltage Directive 79/23/EEC Standards. |
| Permissible ambient temperature | 0 ... +60 degrees C |
| Power dissipation | Typically 6 W |

# Overview of the DEO 216 Input Module

# 30

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEO 216 Input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEO 216 Input Module?

**Brief Product Description**

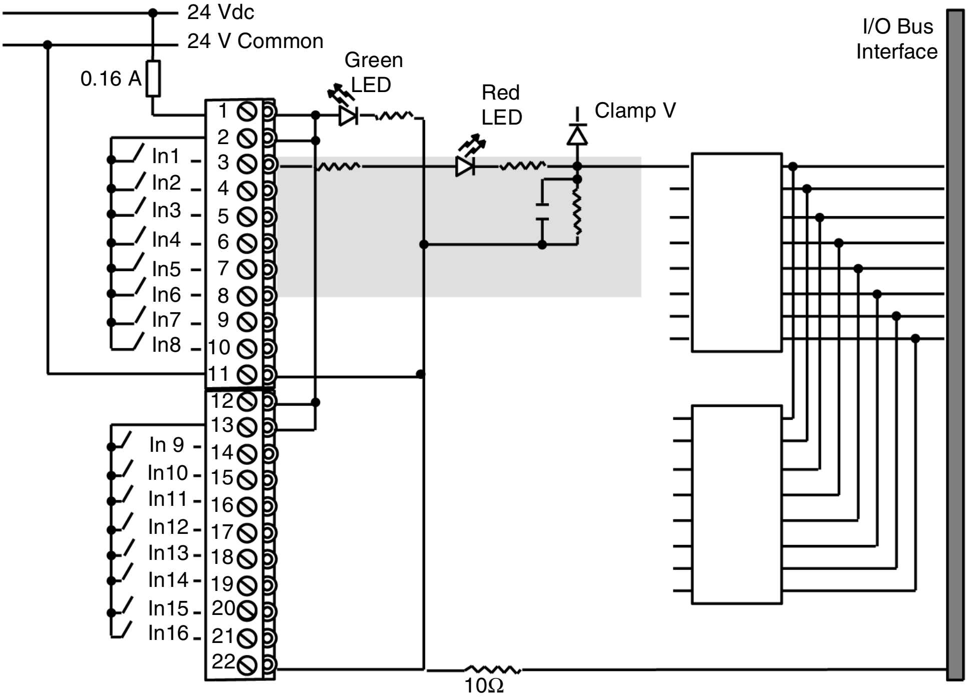
The DEO 216 is a 24 Vdc, 16 point discrete input module.

It senses input signals received from field sensing devices such as push-button, limit and proximity switches, or other 24 Vdc input sources and converts those signals into logic voltage levels that can be used by the controller. Signals are field wired in two groups, eight signals per group. DEO 216 inputs are not opto–isolated from the I/O bus.

**LEDs**

The DEO 216 module has one green LED, opposite terminal screw 1, which indicates when ON that power is available to the 16 inputs below it. The module also has 16 red LEDs, eight opposite terminal screws 3 ... 10 and eight opposite terminal screws 14 ... 21; when any one of these LEDs are ON, it indicates voltage present at the corresponding input.

The following figure is a wiring diagram and simplified schematic of the DEO 216 Input module.



## Specifications of the DEO 216 Input Module

### Specifications for the DEO 216

The following table shows the specifications.

| DEO216 Specifications | | |
|---|---|---|
| Module Topology | Number of Inputs | 16 |
| | Number of Groups | 1 |
| | Points/Group | 16 |
| | Isolation | Not isolated from the I/O bus |
| Power Supplies | External Source Requirement | 20 ... 30 Vdc for eight inputs |
| | Rated Signal Value | +24 Vdc |
| | Internally Provided Source | 5 V, < 15 mA from I/O bus |
| | Internal Power Dissipation | 2 W (typical) |
| Electrical Characteristics | ON State Signal Level | +12 ... 30 Vdc |
| | OFF State Signal Level | -2 ... +5 Vdc |
| | ON State Input Current | 7 mA @ 24 Vdc 8.5 mA @ 30 Vdc |
| | Response Time | 4 ms (typical) |
| | Operating Mode | True High |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |
| I/O Map | Discrete 1x/0x | 16 in/0 out |
| Dimensions | WxHxD | 40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 220 g (.5 lb) |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | |

# Overview of the DEP 208 Input Module

# 31

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEP 208 input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEP 208 Input Module?

**Brief Product Description**

The DEP 208 is a discrete input module with eight independent 230 Vac input circuits. It senses input signals from field sensing devices such as pushbuttons, limit or proximity switches, or other ac input sources and converts those signals into voltage signals that can be used by the PLC in a logic scan. Signals are field-wired in one group of eight inputs. Each input is opto-isolated from the I/O bus.

## DEP 208 Input Module LEDs

**LEDs**

The DEP 208 has nine LEDs. One green LED opposite terminal screw 1 indicates the presence of 5 V from the I/O bus. Eight red LEDs opposite terminal screws 3, 5, 7, 9, 14, 16, 18, and 20 indicate that voltage is present at inputs 1 ... 8, respectively.

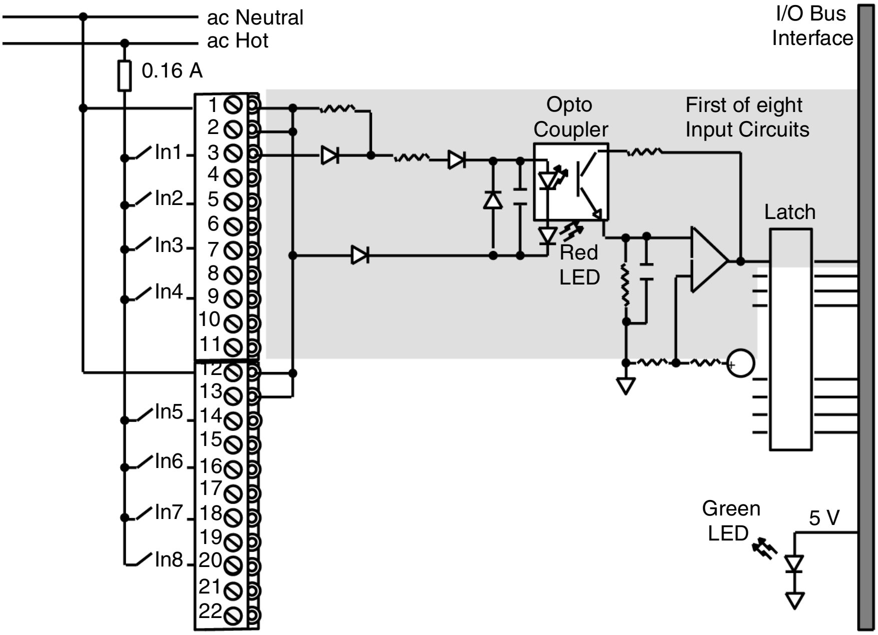
## DEP 208 Input Module Field Wiring

### Introduction

The DEP 208 is a discrete input module with eight independent 230 Vac input circuits. It senses input signals from field sensing devices such as pushbuttons, limit or proximity switches, or other ac input sources and converts those signals into voltage signals that can be used by the PLC in a logic scan. Signals are field-wired in one group of eight inputs. Each input is opto-isolated from the I/O bus.

### Wiring Diagram and Simplified Schematic for DEP 208

A wiring diagram and simplified schematic for the DEP 208 input module is provided below.



## Using the DEP 208 Input Module wilth Proximity Switches

**Introduction**

The leakage current of two-wire proximity switches may be as high as 3 mA. Since the OFF current rating of the DEP 208 is .5 mA per input, two-wire proximity switches may trigger false inputs in the module. If you plan to use the DEP 208 in a proximity switch application, consider the following recommendations to prevent false inputs from occurring.

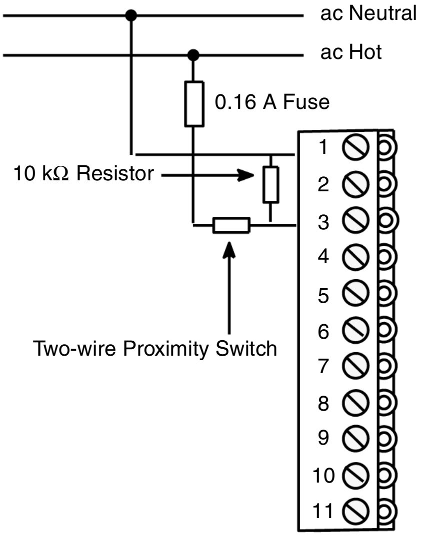
**Existing Installations**

To eliminate the possibility of false inputs, place a 10 kOhm resistor between neutral and each input terminal on the module to shunt off some of the current. See the diagram below.

**New Installations**

Keep the above current ratings in mind when selecting proximity switches. Three-wire proximity switches have leakage current levels below .5 mA, and are recommended in order to avoid the need for the 10 kOhm resistor.

The following diagram illustrates wiring the DEP 208 with a 10 kOhm Resistor.



## DEP 208 Input Module Specifications

**Table of Specifications for DEP 208**

The following table contains a list of DEP 208 input module specifications.

| | | |
|---|---|---|
| Module Topology | Number of Inputs | 8 |
| | Number of Groups | 1 |
| | Points/group | 8 |
| | Isolation | Optocoupler on each input point |
| Power Supplies | External Source Requirement | 230 Vac (+/- 15 percent), 47 ... 63 Hz |
| | Internally Provided Source | 5 V, less than 30 mA from the I/O bus |
| | Internal Power Dissipation | 2 W (typical) |
| Electrical Characteristics | Working Voltage Range | 195 ... 265 Vac |
| | ON Current Minimum | 1 mA/input |
| | OFF Current Maximum | 0.5 mA/input |
| | 0 to 230 V Response Time | 25 ms (typical) |
| | 230 to 0 V Response Time | 50 ms (typical) |
| | Operating Mode | True High |
| | Wire Size/Terminal | One wire: 14 AWG |
| | | Two wires: 20 AWG |
| I/O Map | Discrete 1x/ox | 8 in/0 out |
| Dimensions | WxHxD | 40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in) |
| | Weight | 220 g (.5 lb) |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | |

# Overview of the DEP 209 Input Module

# 32

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEP 209 input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEP 209 Input Module?

**Brief Product Description**

The DEP 209 is a discrete input module with eight independent 120 Vac input circuits. It senses input signals from field sensing devices such as pushbuttons, limit or proximity switches, or other ac input sources and converts those signals into voltage signals that can be used by the controller in a logic scan. Signals are field-wired in one group of eight inputs. Each input is opto-isolated from the I/O bus.

## DEP 209 Input Module LEDs

**LEDs**

The DEP 209 has nine LEDs. One green LED opposite terminal screw 1 indicates the presence of 5 V from the I/O bus. Eight red LEDs opposite terminal screws 3, 5, 7, 9, 14, 16, 18, and 20 indicate that voltage is present at inputs 1 ... 8, respectively.

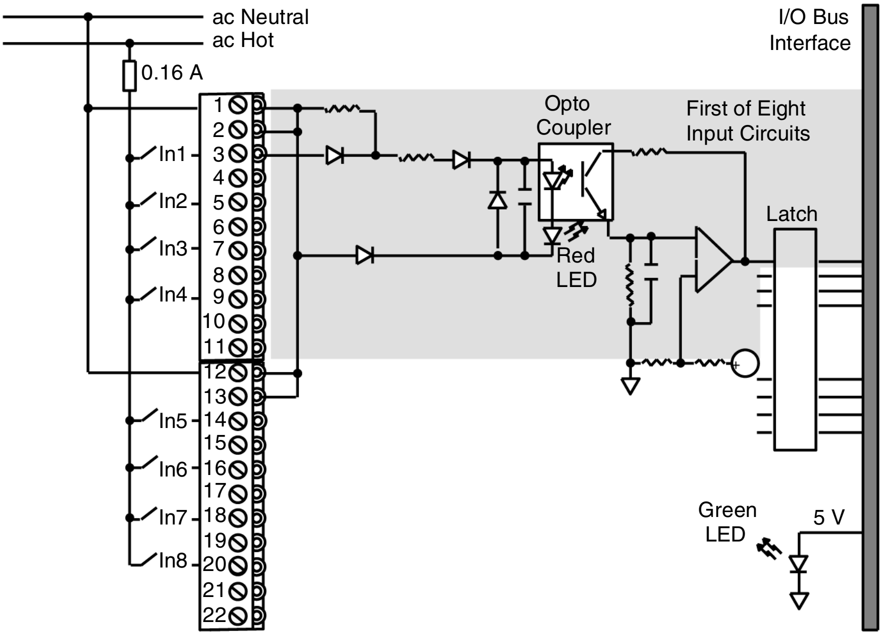
## DEP 209 Input Module Field Wiring

**Introduction**

The DEP 209 is a discrete input module with eight independent 120 Vac input circuits. It senses input signals from field sensing devices such as pushbuttons, limit or proximity switches, or other ac input sources and converts those signals into voltage signals that can be used by the controller in a logic scan. Signals are field-wired in one group of eight inputs. Each input is opto-isolated from the I/O bus.

**Wiring Diagram and Simplified Schematic for DEP 209**

A wiring diagram and simplified schematic for the DEP 209 input module is provided below.



## Using the DEP 209 Input Module with Proximity Switches

**Introduction**

The leakage current of two-wire proximity switches may be as high as 3 mA. Since the OFF current rating of the DEP 209 is .5mA/input, two-wire proximity switches may trigger false inputs in the module. If you plan to use the DEP 209 in a proximity switch application, consider the following recommendations to prevent false inputs from occurring.

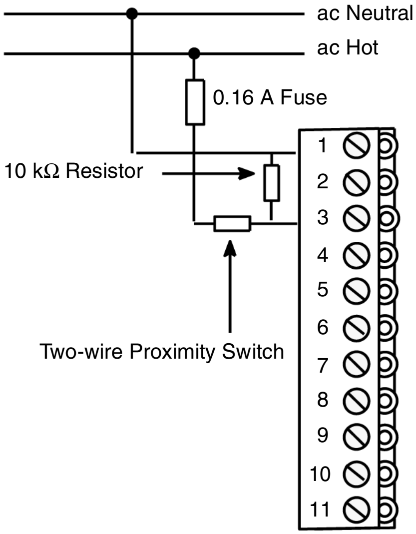
**Existing Installations**

To eliminate the possibility of false inputs, place a 10 kOhms resistor between neutral and each input terminal on the module to shunt some of the current.

**New Installations**

Keep the above current ratings in mind when selecting proximity switches. Three-wire proximity switches have leakage current levels below .5 mA and are recommended in order to avoid the need for the 10 kOhms resistor.

The following diagram illustrates wiring the DEP 209 with a 10 kOhm resistor.



## DEP 209 Input Module Specifications

### Table of Specifications

The following table contains a list of DEP 209 input module specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Inputs | | 8 |
| | Number of Groups | | 1 |
| | Points/group | | 8 |
| | Isolation | | Optocoupler on each input |
| Power Supplies | External Source Requirement | | 120 Vac (+/- 15 percent) |
| | | | 47 ... 63 Hz |
| | Internally Provided Source from I/O bus | | 5 V; less than 30 mA |
| | Internal Power Dissipation | | 2 W typical |
| Electrical Characteristics | Working Voltage Range | | 85 ... 138 Vac |
| | ON Current Minimum | | 1 mA/input |
| | OFF Current Maximum | | 0.5 mA/input |
| | Response Time | 0 to 230 V | 25 ms typical |
| | | 230 to 0 V | 50 ms typical |
| | Operating Mode | | True High |
| | Wire Size/terminal | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| I/O Map | Discrete 1x/0x | | 8 in/0 out |
| Dimensions | W x H x D | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| | Weight | | 220 g |
| | | | 0.5 lb |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | | |

# Overview of the DEP 210 Input Module

# 33

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEP 210 input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEP 210 Input Module?

**Brief Product Description**

The DEP 210 is a 115 Vac, eight-point input module with 1.8 kV isolation between inputs and the bus. The module senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other 115 Vac input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in one group of eight signals. Inputs are opto-isolated from the system bus.

**⚠ WARNING**

**Operational Hazard**

The DEP 210 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

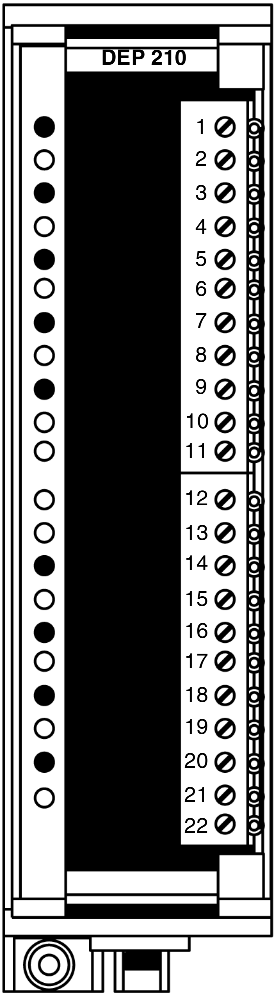
**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

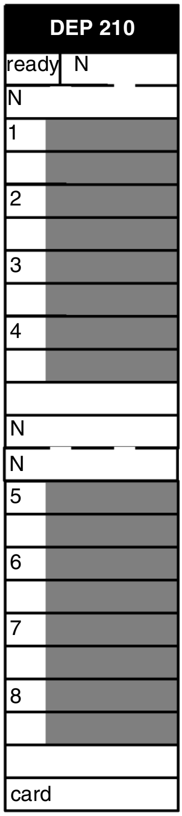
## DEP 210 Input Module LEDs

**LEDs**

The DEP 210 module has one green LED opposite terminal screw 1. When this LED is ON, it indicates the presence of working voltage from the PLC. The module also has eight red LEDs, opposite terminal screws 3, 5, 7, 9, 14, 16, 18, and 20. When any one of these LEDs is ON, it indicates voltage present at the corresponding input. Location of the LEDs is shown in the figure below.

A front view and fill-in labels of the DEP 210 is provided below.





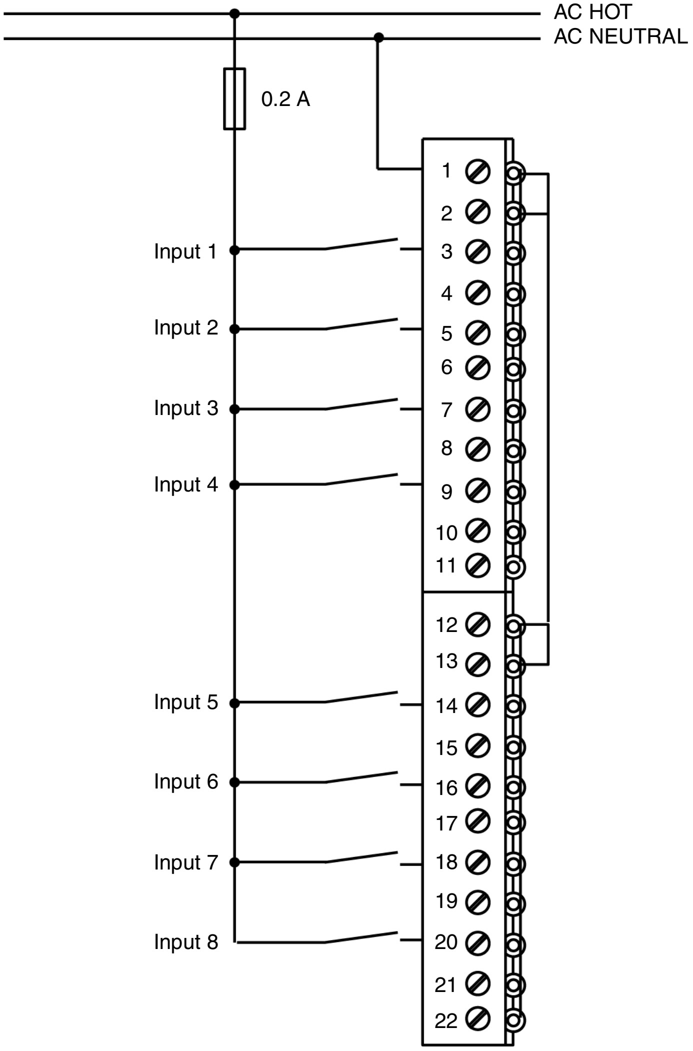
## DEP 210 Input Module Field Wiring

**Introduction**

The DEP 210 is a 115 Vac, eight-point input module with 1.8 kV isolation between inputs and the bus. The module senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other 115 Vac input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in one group of eight signals. Inputs are opto-isolated from the system bus.

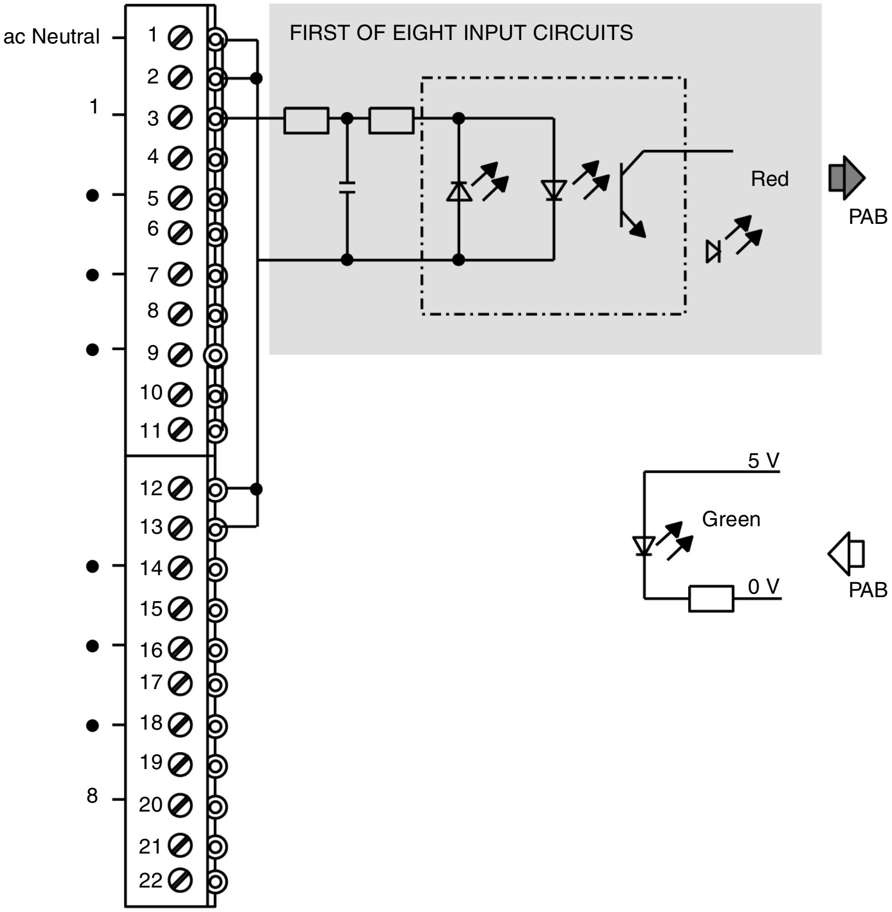
## Wiring Diagram for DEP 210

A sample wiring diagram for the DEP 210 input module is provided below.



**Simplified Schematic for DEP 210**

A simplified schematic for the DEP 210 input module is provided below.



## DEP 210 Input Module Specifications

### Table of Specifications for DEP 210

The following table contains a list of DEP 210 input module specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Inputs | | 8 |
| | Number of Groups | | 1 |
| | Points/group | | 8 |
| | Isolation | | Optocoupler on each input |
| | | | 1.8 kV field-to-bus |
| Power Supplies | External Source Requirement | | 115 Vac |
| | Rated Signal Value | | 115 Vac |
| | | | 47 ... 65 Hz |
| | Internally Provided Source from I/O bus | | 5 V |
| | | | 35 mA maximum |
| | Internal Power Dissipation | | 3 W typical |
| Electrical Characteristics | ON State Signal Level | | 80 ... 132 Vac |
| | OFF State Signal Level | | 0 ... 35 Vac |
| | ON State Input Current | | 15.5 mA/input @ 115 Vac |
| | | | 6 mA @ 80 V, 20 mA @ 132 V |
| | OFF State Input Current | | 3 mA maximum |
| | Response Time | ON | 10 ms typical |
| | | OFF | 40 ms typical |
| | Operating Mode | | True High |
| | Wire Size/ terminal | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| I/O Map | Discrete 1x/0x | | 8 in/0 out |
| Dimensions | W x H x D | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| | Weight | | 250 g |
| | | | 0.55 lb |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | | |

# Overview of the DEP 211 Input Module

# 34

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEP 211 input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEP 211 Input Module?

### Brief Product Description

**Note:** Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft.

The DEP 211 is a 115 Vac, eight-point isolated input module. The module senses input signals received from field devices such as pushbuttons, limit and proximity switches, or other 115 Vac sources and converts those signals into logic voltage levels that can be used by the controller. Signals are field wired in one group of eight signals. Inputs are isolated from the system bus and from one another.

**⚠ WARNING**

**Operational Hazard**

The DEP 211 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

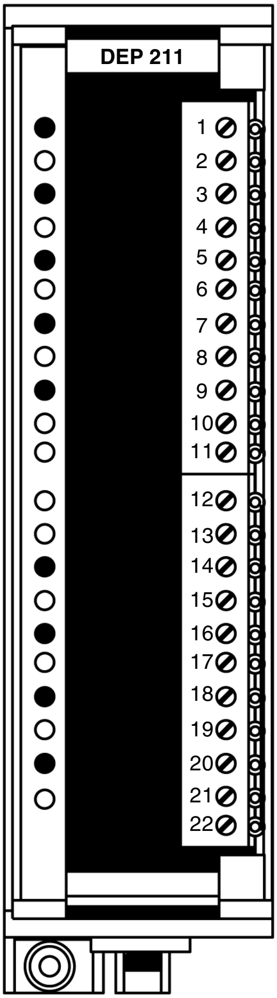
**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

## DEP 211 Input Module LEDs

**LEDs**

The DEP 211 module has one green LED opposite terminal screw 1. When this LED is ON, it indicates the presence of working voltage from the controller. The module also has 8 red LEDs, opposite terminal screws 3, 5, 7, 9, 14, 16, 18, and 20. When any one of these LEDs is ON, it indicates voltage present at the corresponding input. Location of the LEDs is shown in the figure below.

A front view of the DEP 211 is provided below.



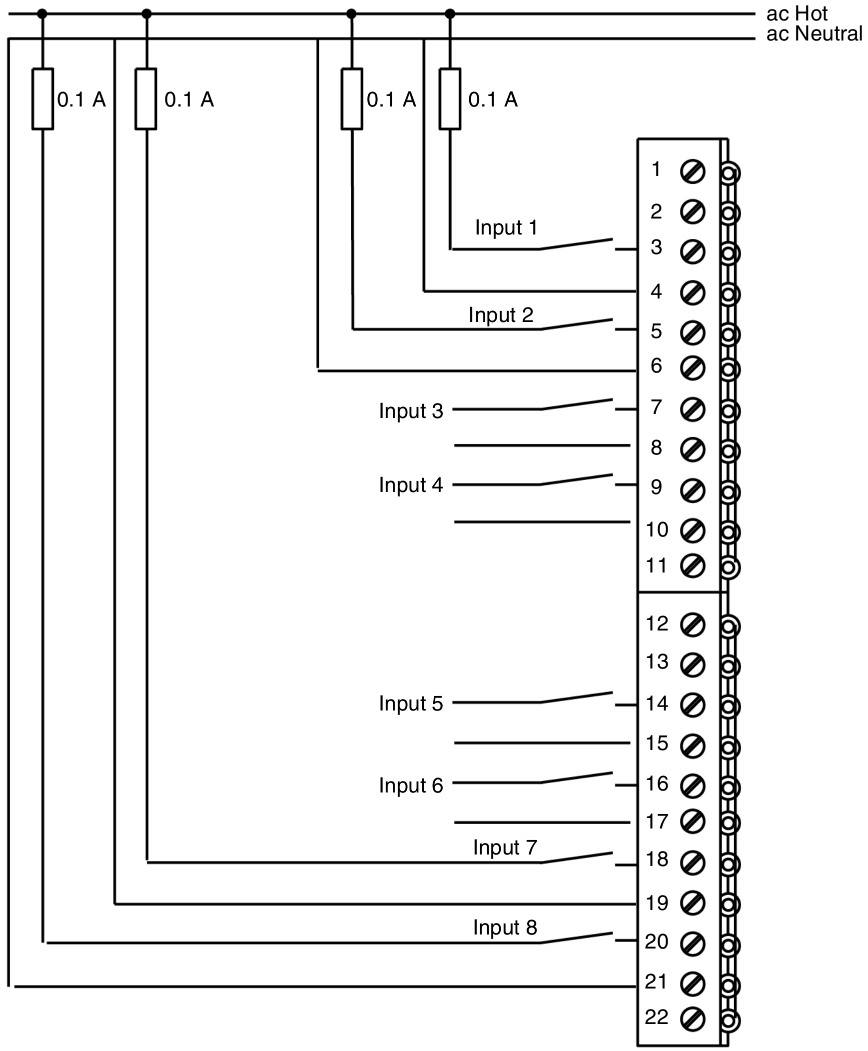
## DEP 211 Input Module Field Wiring

**Introduction**

The DEP 211 is a 115 Vac, eight-point isolated input module. The module senses input signals received from field devices such as pushbuttons, limit and proximity switches, or other 115 Vac sources and converts those signals into logic voltage levels that can be used by the controller. Signals are field wired in one group of eight signals. Inputs are isolated from the system bus and from one another.

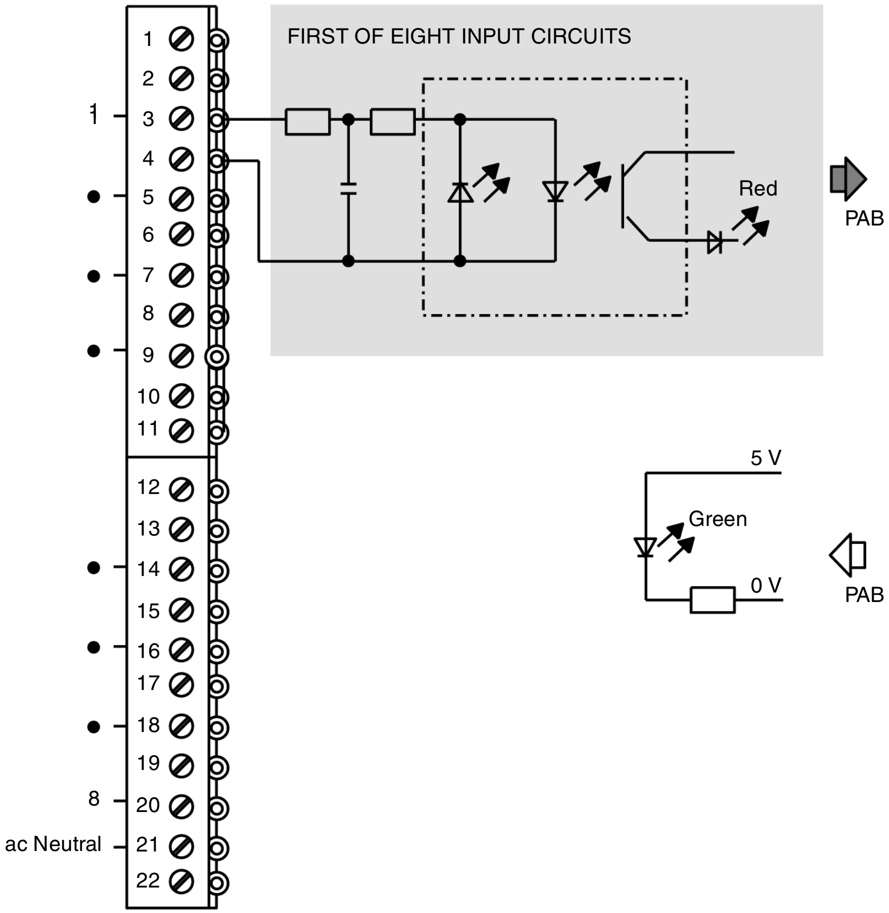
**Wiring Diagram for DEP 211**

A sample wiring diagram for the DEP 211 input module is provided below.



### Simplified Schematic for DEP 211

A simplified schematic for the DEP 211 input module is provided below.



# DEP 211 Input Module Specifications

### Table of Specifications for DEP 211

The following table contains a list of DEP 211 input module specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Inputs | | 8 |
| | Number of Groups | | 8 |
| | Points/group | | 1 |
| | Isolation | | Optocoupler on each input |
| | | | 1.8 kV between inputs |
| Power Supplies | External Source Requirement | | None |
| | Rated Signal Value | | 115 Vac, 47 ... 65 Hz |
| | Internally Provided Source from I/O bus | | 5 V |
| | | | 35 mA maximum |
| | Internal Power Dissipation | | 3 W typical |
| Electrical Characteristics | ON State Signal Level | | 80 ... 132 Vac |
| | OFF State Signal Level | | 0 ... 35 Vac |
| | ON State Input Current | | 15.5 mA/input @ 115 Vac |
| | | | 6 mA @ 80 V; 20 mA @ 132 V |
| | OFF State Input Current | | 3 mA maximum |
| | Response Time | ON | 10 ms typical |
| | | OFF | 40 ms typical |
| | Operating Mode | | True High |
| | Wire Size/ terminal | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| I/O Map | Discrete 1x/0x | | 8 in/0 out |
| Dimensions | W x H x D | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| | Weight | | 250 g |
| | | | 0.55 lb |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | | |

# Overview of the DEP 214/254 Input Module

# 35

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEP 214/254 input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEP 214/254 Input Module?

### Brief Product Description

**Note:** Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft.

The DEP 214/254 is a 12 ... 60 Vdc 16-point discrete input module. It senses levels provided by field devices such as pushbuttons, limit and proximity switches, or other dc input sources, and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals/group. Inputs are optically isolated from the system bus. The DEP 254 functions just like the DEP 214 except that the DEP 254 operates at extended temperature.

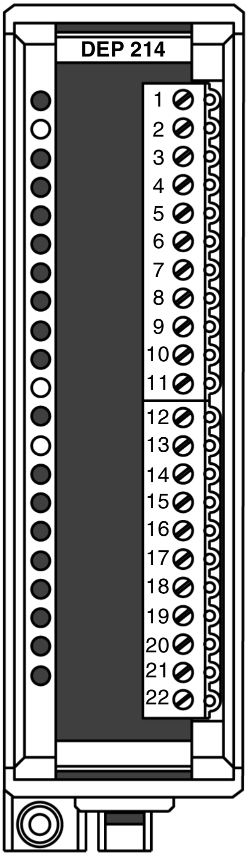
**Note:** DEP 254 model is available with conformal coating. The conformal coating model is DEP 254C and it meets Railway standard EN 50 155.

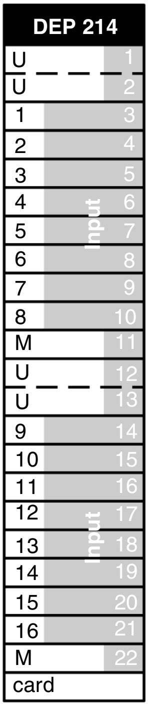
## DEP 214/254 Input Module LEDs

**LEDs**

The DEP 214/254 can be installed in any slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and peripheral connections on the front. The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided.

A front view with DEP 214 label is provided below.





| DEP 214 | |
|---|---|
| U | 1 |
| U | 2 |
| 1 | 3 |
| 2 | 4 |
| 3 | 5 |
| 4 | 6 |
| 5 Input | 7 |
| 6 | 8 |
| 7 | 9 |
| 8 | 10 |
| M | 11 |
| U | 12 |
| U | 13 |
| 9 | 14 |
| 10 | 15 |
| 11 | 16 |
| 12 | 17 |
| 13 Input | 18 |
| 14 | 19 |
| 15 | 20 |
| 16 | 21 |
| M | 22 |
| card | |

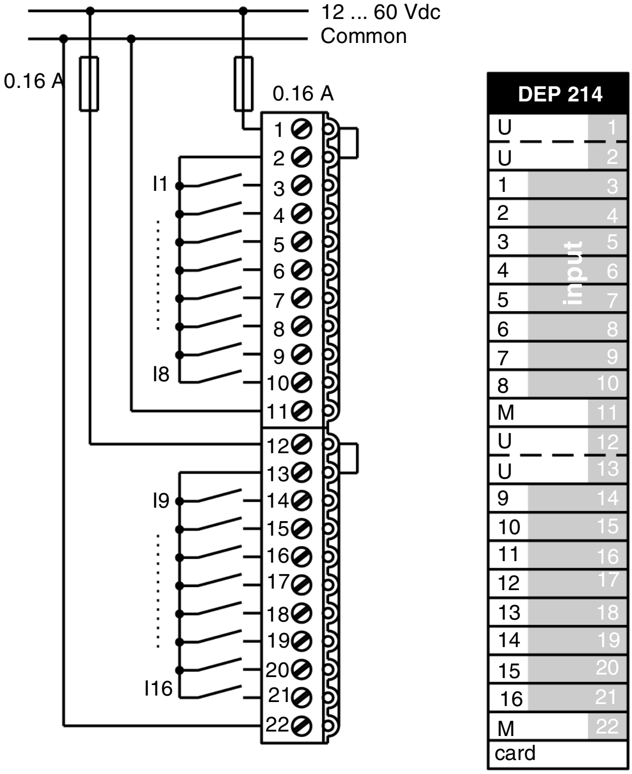
## DEP 214/254 Input Module Field Wiring

**Introduction**

The DEP 214/254 is a 12 ... 60 Vdc 16-point discrete input module. It senses levels provided by field devices such as pushbuttons, limit and proximity switches, or other dc input sources, and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals/group. Inputs are optically isolated from the system bus. The DEP 254 functions just like the DEP 214 except that the DEP 254 operates at extended temperature.

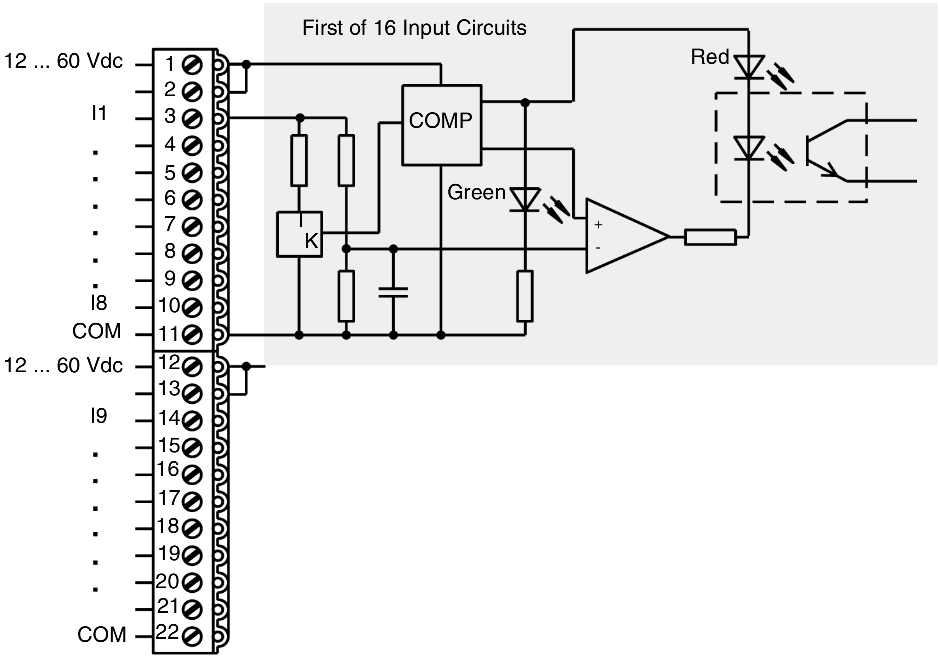
**Wiring Diagram for DEP 214/254**

A sample wiring diagram for the DEP 214/254 input module is provided below.



**Simplified Schematic for DEP 214/254**

A simplified schematic for the DEP 214/254 input module is provided below.



## DEP 214/254 Input Module Specifications

### Table of Specifications for DEP 214/254

The following table contains DEP 214/254 input specifications.

| | | |
|---|---|---|
| Module Topology | Number of Inputs | 16 |
| | Number of Groups | 2 |
| | Points/group | 8 |
| | Isolation | Optocoupler on each input |
| Required Loadable | SW-IODR-001 | |
| Power Supplies | External Source Requirement | 12 ... 60 Vdc for eight inputs |
| | Internally Provided Source from I/O bus | 5 V; 22 mA maximum |

The following table lists DEP 214/254 switching levels.

| Signal Input | 12 V | 24 V | 48 V | 60 V |
|---|---|---|---|---|
| Signal Level OFF | -0.6 ... +1.8 V | -3 ... +5 V | -6 ... +10 V | -3 ... +9 V |
| Signal Level ON | +9 ... +15 V | +11 ... +30 V | +33 ... +60 V | +45 ... +75V |
| Current OFF | -0.6 ... +1 mA | -1.7 ... +2.9 mA | -3.4 ... +2.5 mA | -1.7 ... + 2.5mA |
| Current ON | +5.1 ... +7.1 mA | +6.0 ... +7.1 mA | +2.0 ... +2.5 mA | +2.0 ... +2.5mA |
| Reference Current | less than or equal to 20 mA | less than or equal to 10 mA | less than or equal to 7 mA | less than or equal to 7 mA |

## DEP 214/254 Specifications (continued)

| | | | |
|---|---|---|---|
| | ON State Input Current | | 7 mA @ 24 Vdc |
| | | | 8.5 mA @ 30 Vdc |
| | Response Time | | 4 ms typical |
| | Operating Mode | | True High |
| | Wire Size/ terminal | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| Temperature | Ambient Operating | | 0 ... 60 degrees C for DEP214<br>-40 ... +70 degrees C for DEP254 |
| I/O Map | Discrete 1x/0x | | 16 in/0 out |
| Dimensions | W x H x D | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| | Weight | | 260 g |
| | | | 0.57 lb |
| Agency Approvals | DEP214: VDE 0160; UL 508; and CSA 22.2 No.142 Standards. | | |
| | DEP254C: Railway EN 50 155; EMC 89/336/EEC Standards. UL 508; CSA 22.2 No.142; FM Class I, Div 2 pending | | |

# Overview of the DEP 215 Input Module

# 36

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEP 215 input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEP 215 Input Module?

### Brief Product Description

**Note:** Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft.

The DEP 215 is a TTL, 16-point discrete input module. It senses levels provided by field devices such as pushbuttons, limit and proximity switches, or other TTL input sources, and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals/group. Inputs are opto-isolated from the system bus.

## DEP 215 Input Module LEDs

### LEDs

The DEP 215 module has two green LEDs, opposite terminal screws 1 and 12. When one of these LEDs is ON, it indicates that power is available to the group directly below it. The module also has 16 red LEDs, eight opposite terminal screws 3 ... 10 and eight opposite terminal screws 14 ... 21; when any one of these LEDs are ON, it indicates a -1 ... +2 Vdc level present at the corresponding input.

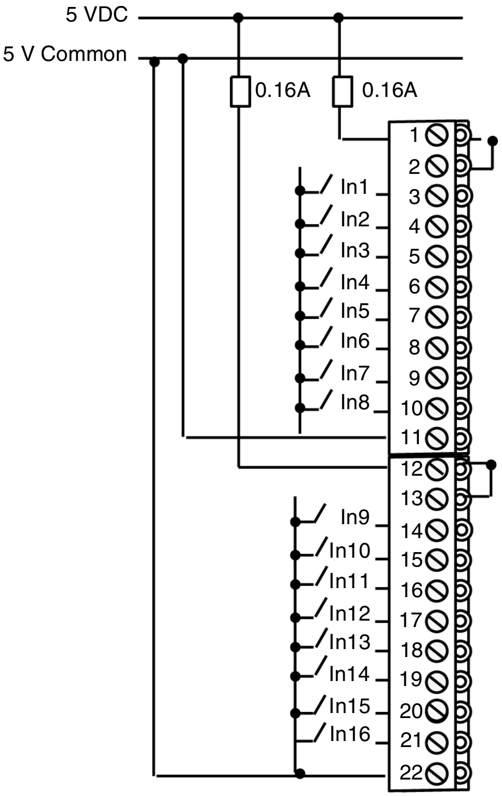
## DEP 215 Input Module Field Wiring

**Introduction**

The DEP 215 is a TTL, 16-point discrete input module. It senses levels provided by field devices such as pushbuttons, limit and proximity switches, or other TTL input sources, and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals/group. Inputs are opto-isolated from the system bus.

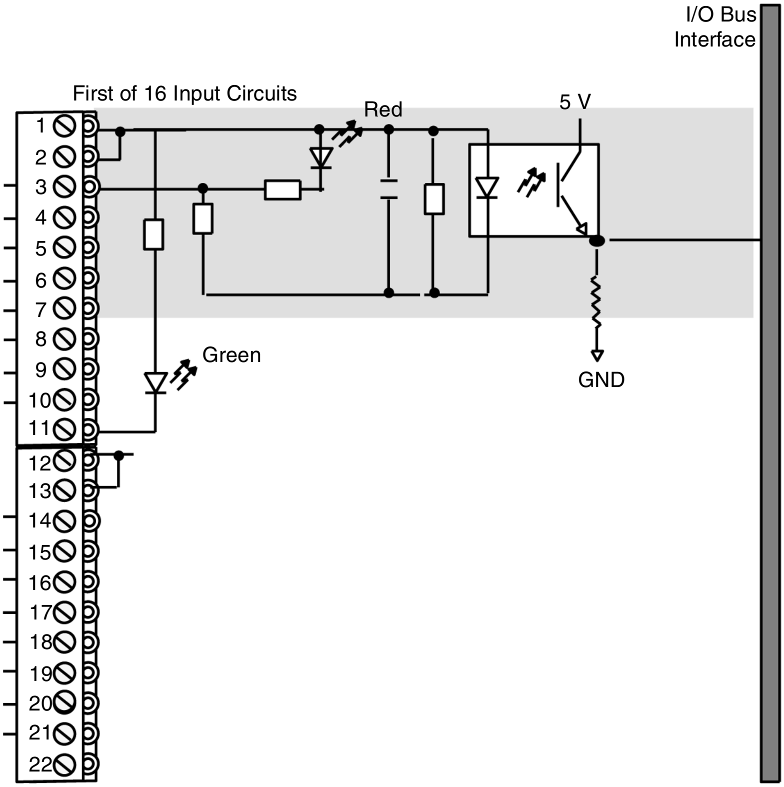
**Wiring Diagram for DEP 215**

A sample wiring diagram for the DEP 215 input module is provided below.



### Simplified Schematic for DEP 215

A simplified schematic for the DEP 215 input module is provided below.



## Unique True Low Characteristics of the DEP 215 Input Module

**Introduction**

This section is intended for DEP 215 16-point TTL input module users who have installed or are otherwise familiar with 200, 500 or 800 Series I/O TTL input modules.

**True Low Module**

These users should be aware that:

| Step | Action |
|---|---|
| 1 | The DEP 215 is a True Low module; therefore:<br>● a HIGH (4 ... 5.5 Vdc) input level to the DEP 215 is read as a logic zero (0) by the system PLC<br>● a low (-1 ... +2 Vdc) level is read as a logic 1 |
| 2 | Conversely, other I/O family TTL input modules are traditionally True High; therefore:<br>● +5 Vdc input levels to other I/O family TTL input modules are read as logic 1<br>● low or ground input levels are read as logic 0 |

## DEP 215 Input Module Layout

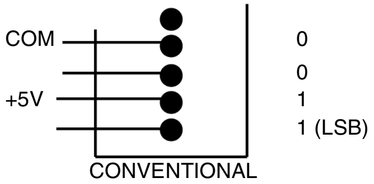
## CAUTION

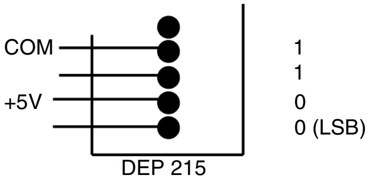
**Operational Hazard**

Traffic Copping the DEP 215 as BCD and using input devices associated with other series traditional True High modules will cause the controller's BCD conversion to produce unexpected results.

**Failure to follow this instruction can result in injury or equipment damage.**

For example, refer to the module input layout in the following illustration.





If the DEP 215 were substituted for an older series TTL input module in a system and I/O Mapped as BCD, the four bottom inputs would be interpreted as an invalid decimal 12 by the PLC. Since this interpretation is a number greater than 9, the internal conversion result would be zero. A conventional module's conversion value would be decimal 3. In this case, inverting all of the field device inputs to the DEP 215 or changing to a device with complementary outputs results in usable data.

## DEP 215 Input Module Specifications

### Table of Specifications for DEP 215

The following table contains DEP 215 input module specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Inputs | | 16 |
| | Number of Groups | | 2 |
| | Points/group | | 8 |
| | Isolation | | Optocoupler on each input |
| Required Loadable | SW-IODR-001 (See *Requirements for CE Compliance, p. 857*) | | |
| Power Supplies | External Source Requirement | | 5 Vdc for eight inputs |
| | Rated Signal Value | | Sinking device |
| | Internally Provided Source from I/O bus | | 5 V; 25 mA maximum |
| | Internal Power Dissipation | | 2 W typical |
| Electrical Characteristics | False Condition Signal Level | | 4 ... 5 Vdc |
| | True Condition Signal Level | | -1 ... +2 Vdc |
| | True Condition Input Current | | 3.5 mA @ 0 Vdc |
| | Response Time | | 1 ms typical |
| | Operating Mode | | True Low |
| | Wire Size/terminal | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| I/O Map | Discrete 1x/0x | | 16 in/0 out |
| Dimensions | W x H x D | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| | Weight | | 220 g |
| | | | 0.5 lb. |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | | |

# Overview of the DEP 216/256 Input Module

# 37

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEP 216/256 input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEP 216/256 Input Module?

**Brief Product Description**

The DEP 216/256 is a 24 Vdc, 16-point discrete input module. It senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other 24 Vdc input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals per group. Inputs are opto-isolated from the system bus. The DEP 256 functions just like the DEP 216 except that the DEP 256 operates at extended temperature.

**Note:** The DEP 256 model is available with conformal coating. The conformal coating model is DEP 256C and it meets Railway standard EN 50 155.

## DEP 216/256 Input Module LEDs

**LEDs**

The DEP 216/256 module has two green LEDs, opposite terminal screws 1 and 12. When one of these LEDs is ON, it indicates that power is available to the eight inputs directly below it. The module also has 16 red LEDs, eight opposite terminal screws 3 ... 10 and eight opposite terminal screws 14 ... 21; when any one of these LEDs are ON, it indicates voltage present at the corresponding input.

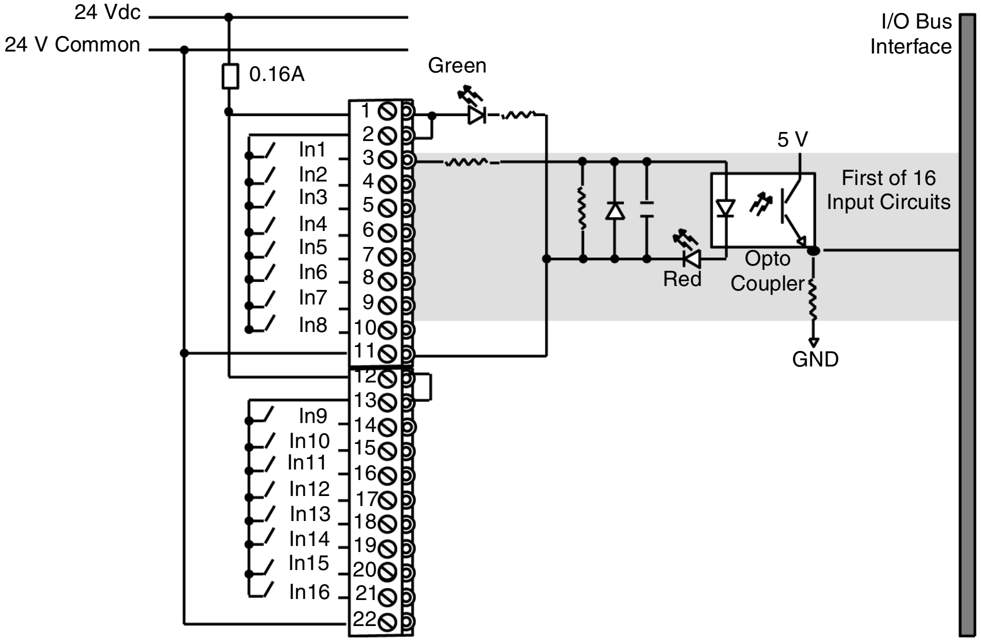
## DEP 216/256 Input Module Field Wiring

**Introduction**

The DEP 216/256 is a 24 Vdc, 16-point discrete input module. It senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other 24 Vdc input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals per group. Inputs are opto-isolated from the system bus. The DEP 256 functions just like the DEP 216 except that the DEP 256 operates at extended temperature.

**Simplified Schematic for DEP 216/256**

A simplified schematic for the DEP 216/256 input module is provided below.



## DEP 216/256 Input Module Specifications

**Table of Specifications for DEP 216/256**

The following table contains DEP 216/256 input module specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Inputs | | 16 |
| | Number of Groups | | 2 |
| | Points/group | | 8 |
| | Isolation | | Optocoupler on each input |
| Power Supplies | External Source Requirement | | 24 Vdc for eight inputs |
| | Rated Signal Value | | 24 Vdc +25 percent/-15 percent |
| | Internally Provided Source from I/O bus | | 5 V; 15 mA |
| | Internal Power Dissipation | | 2 W typical |
| Electrical Characteristics | ON State Signal Level | | 12 ... 30 Vdc |
| | OFF State Signal Level | | -2 ... +5 Vdc |
| | ON State Input Current | | 7 mA @ 24 Vdc |
| | | | 8.5 mA @ 30 Vdc |
| | Response Time | | 4 ms typical |
| | Operating Mode | | True High |
| | Wire Size/terminal | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| Environmental Characteristics | Operating Temperature | | 0 ... 60 degrees C for DEP216<br>-40 ... +70 degrees C for DEP256 |
| I/O Map | Discrete 1x/0x | | 16 in/0 out |
| Dimensions | W x H x D | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| | Weight | | 220 g |
| | | | 0.5 lb |
| Agency Approvals | DEP216: VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards. | | |
| | DEP256C: Railway standard EN 50 155; European Directive EMC 89/336/EEC. UL 508; CSA 22.2 No.142; and FM Class I, Div 2 pending. | | |

# Overview of the DEP 217 Input Module

# 38

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEP 217 input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEP 217 Input Module?

### Brief Product Description

**Note:** Some A120 I/O modules (DEP 211/214/215/217, DAP211/217, ADU204/211/214/216, DAU204, VIC2xx, and MOT20x) require a loadable (SW-IODR-001) for proper operation when using certain PLCs (A984-1xx, E984-24x/251/255) with Modsoft.

The DEP 217 is a 24 Vdc, 16-point discrete true low input module. It senses levels provided by field devices such as pushbuttons, limit and proximity switches, or other 24 Vdc input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals/group. Inputs are opto-isolated from the system bus.

**Note:** The DEP 217 is a true low module; therefore, a high (greater than or equal to external source minus 6Vdc) is read by the PLC as a logic 0. Conversely, a low (less than or equal to external source minus 12Vdc) is read by the PLC as a logic 1.

## DEP 217 Input Module LEDs

### LEDs

The DEP 217 module has two green LEDs, opposite terminal screws 1 and 12. When one of these LEDs is ON, it indicates that power is available to the group directly below it. The module also has 16 red LEDs, eight opposite terminal screws 3 ... 10 and eight opposite terminal screws 14 ... 21; when any one of these LEDs are ON, it indicates 3 external source minus 12 V at the corresponding input.

# DEP 217 Input Module Field Wiring

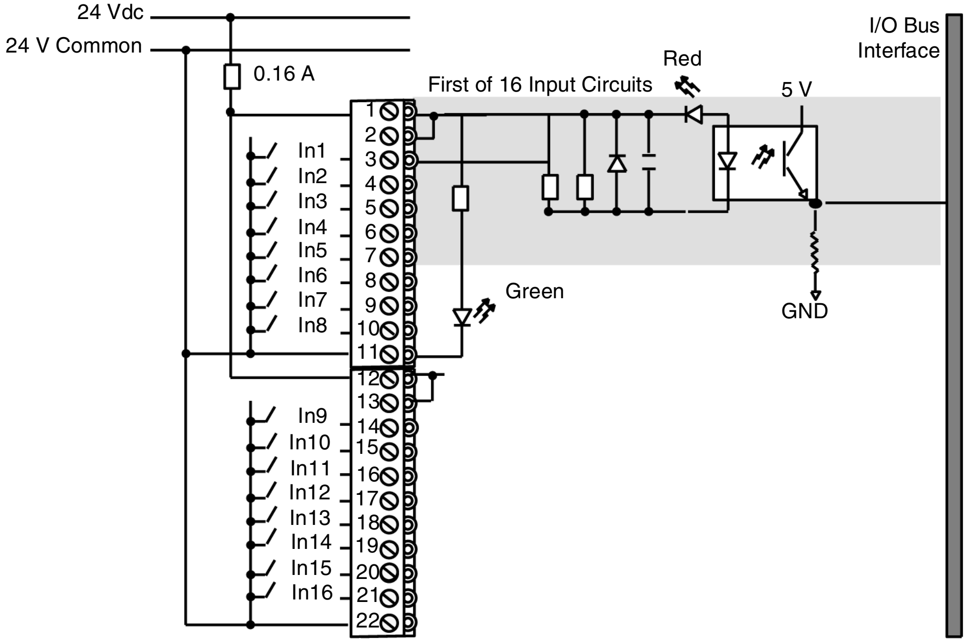
## Introduction

The DEP 217 is a 24 Vdc, 16-point discrete true low input module. It senses levels provided by field devices such as pushbuttons, limit and proximity switches, or other 24 Vdc input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals/group. Inputs are opto-isolated from the system bus.

**Note:** The DEP 217 is a true low module; therefore, a high (greater than or equal to external source minus 6Vdc) is read by the PLC as a logic 0. Conversely, a low (less than or equal to external source minus 12Vdc) is read by the PLC as a logic 1.

## Wiring Diagram and Simplified Schematic for DEP 217

A wiring diagram and simplified schematic for the DEP 217 input module is provided below.



## DEP 217 Input Module Specifications

### Table of Specifications for DEP 217

The following table contains DEP 217 input module specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Inputs | | 16 |
| | Number of Groups | | 2 |
| | Points/group | | 8 |
| | Isolation | | Optocoupler on each input |
| Required Loadable | SW-IODR-001 (See *Requirements for CE Compliance, p. 857*) | | |
| Power Supplies | External Source Requirement | | 24 Vdc for eight inputs |
| | Rated Signal Value | | Sinking device |
| | Internally Provided Source from I/O bus | | 5 V; 25 mA |
| | Internal Power Dissipation | | 3 W typical |
| Electrical Characteristics | False Condition Signal Level | | greater than or equal to external source minus 6 Vdc |
| | True Condition Signal Level | | less than or equal to external source minus 12 Vdc |
| | True Condition Input Current | | 7 mA @ 0 Vdc |
| | Response Time | | 4 ms typical |
| | Operating Mode | | True Low |
| | Wire Size/ terminal | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| I/O Map | Discrete 1x/0x | | 16 in/0 out |
| Dimensions | W x H x D | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| | Weight | | 220 g |
| | | | 0.5 lb. |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | | |

# Overview of the DEP 218 Input Module

# 39

## At a Glance

### Purpose

The purpose of this chapter is to describe the DEP 218 input module.

### What's in this Chapter?

This chapter contains the following topics:

## What is the DEP 218 Input Module?

### Brief Product Description

⚠ **WARNING**

**Operational Hazard**

The DEP 218 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

The DEP 218 is a 115 Vac, 16-point input module with 1.8kV isolation between field devices and the bus. It senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other 115 Vac input sources and converts those signals into logic voltage levels that can be used by the controller. Signals are field wired in two groups, eight signals/group. Inputs are opto-isolated from the system bus.

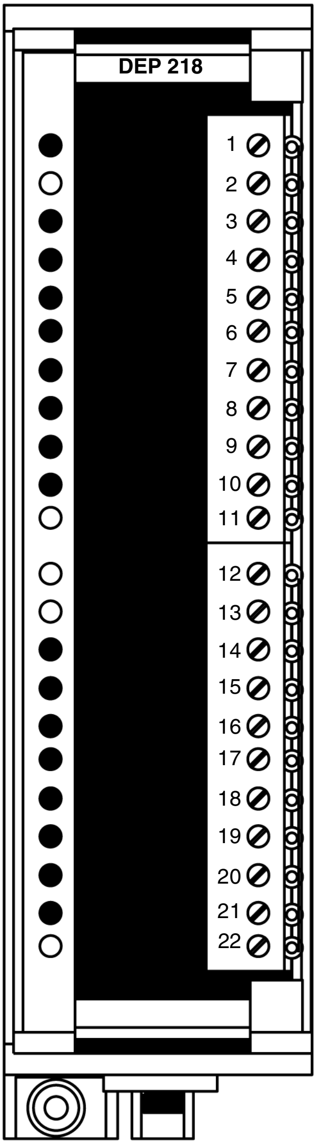
**Note:** The DEP 218 is designed for capacitive loads. Without any discharge bypass resistor. When using field devices with resistive loads you should use 120K 1/4 Watt resistors (approximately) across the input terminals of the DEP 218. This allows accurate switching of phase firing type solid state sensors by ensuring that the capacitor discharges within the sensor required 50 milliseconds. If your application permits, a DEP 210 may be substituted for the DEP 218. The DEP 210 has an internal input discharge circuit.

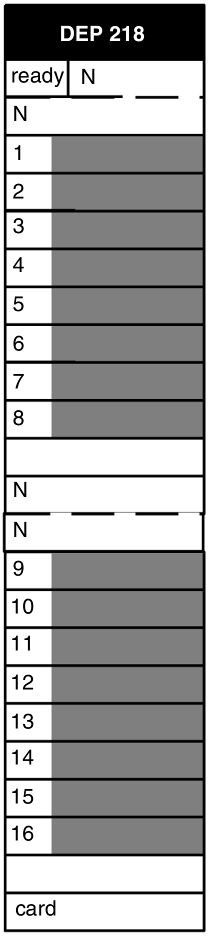
## DEP 218 Input Module LEDs

**LEDs**

The DEP 218 module has one green LED opposite terminal screw 1. When this LED is ON, it indicates the presence of working voltage from the power supply. The module also has 16 red LEDs, eight opposite terminal screws 3 ... 10 and eight opposite terminal screws 14 ... 21; when any one of these LEDs is ON, it indicates voltage present at the corresponding input.

A front view and fill-in labels of the DEP 218 module is provided below.

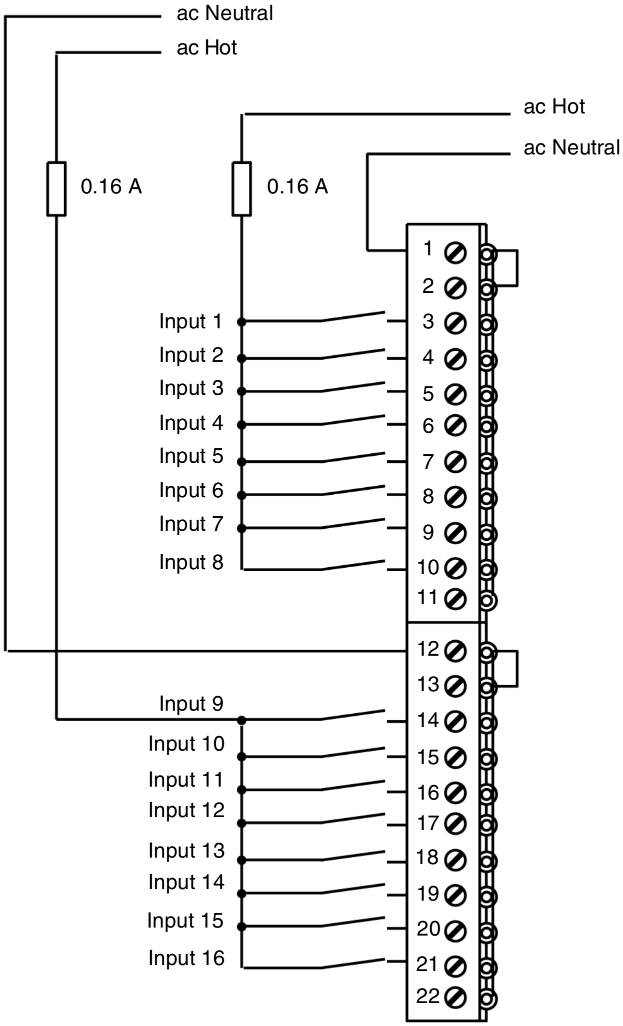




## DEP 218 Input Module Field Wiring

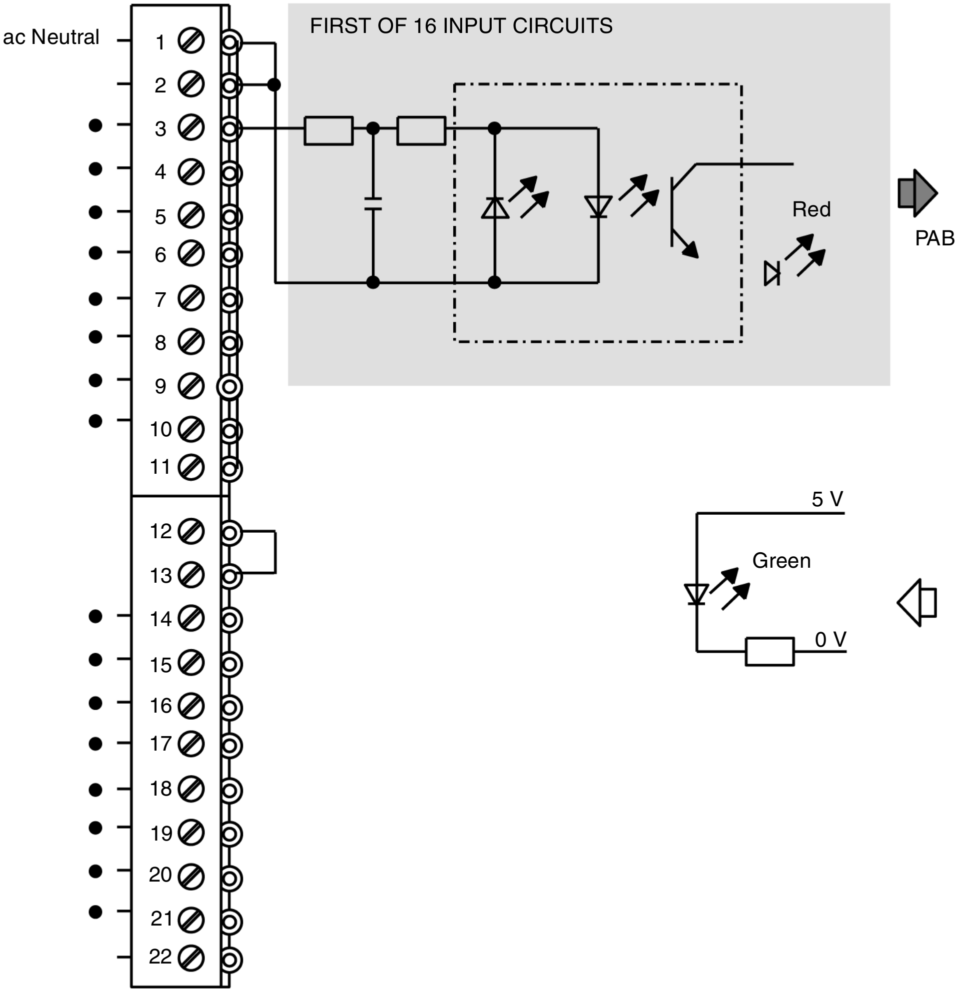
**Wiring Diagram for DEP 218**

A sample wiring diagram for the DEP 218 input module is provided below.



## Simplified Schematic for DEP 218

A simplified schematic for the DEP 218 input module is provided below.



# DEP 218 Input Module Specifications

**Table of Specifications for DEP 218**

The following table contains DEP 218 input module specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Inputs | | 16 |
| | Number of Groups | | 2 |
| | Points/group | | 8 |
| | Isolation | | Optocoupler on each input point, 1.8 kV field-to-bus |
| Power Supplies | External Source Requirement | | 115 Vac |
| | Rated Signal Value | | 115 Vac |
| | | | 47 ... 65 Hz |
| | Internally Provided Source from the I/O bus | | 5 V, less tghan 50 mA |
| | Internal Power Dissipation | | 3 W typical |
| Electrical Characteristics | ON State Signal Level | | 80 ... 132 Vac |
| | OFF State Signal Level | | 0 ... 35 Vac |
| | ON State Input Current | | 15.5 mA/input @ 115 Vac |
| | | | 6 mA @ 80 V, 20 mA @ 132 V |
| | OFF State Input Current | | 3 mA maximum |
| | Response Time | ON | 10 ms typical |
| | | OFF | 40 ms typical |
| | Operating Mode | | True High |
| | Wire Size/ terminal | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| I/O Map | Discrete 1x/0x | | 16 in/0 out |
| Dimensions | W x H x D | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| | Weight | | 300 g |
| | | | 0.66 lb |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | | |

# Overview of the DEP 220 Input Module

# 40

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEP 220 input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEP 220 Input Module?

**Brief Product Description**

The DEP 220 is a 24 Vdc +25 percent/-15 percent, 16-point discrete input module similar to the DEP 216 module, with a much faster response time (0.5 ms). It senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other 24 Vdc input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals per group. Inputs are opt-isolated from the system bus.

**⚠ CAUTION**

**Operational Hazard**

Modicon recommends using two separate power sources with the DEP 220-one for outputs and one for inputs-in order to avoid electrical switching noise.

**Failure to follow this instruction can result in injury or equipment damage.**

**Note:** Inputs do not work if output supply is disconnected.

## DEP 220 Input Module LEDs

**LEDs**

The DEP 220 module has two green LEDs, opposite terminal screws 1 and 12. When one of these LEDs is ON, it indicates that power available to the eight inputs directly below it. The module also has 16 red LEDs, eight opposite terminal screws 3 ... 10 and eight opposite terminal screws 14 ... 21; when any one of these LEDs are ON, it indicates voltage present at the corresponding input.

## DEP 220 Input Module Field Wiring

**Introduction**

The DEP 220 is a 24 Vdc +25 percent/-15 percent, 16-point discrete input module similar to the DEP 216 module, with a much faster response time (0.5 ms). It senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other 24 Vdc input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals per group. Inputs are opto-isolated from the system bus.

⚠ **CAUTION**

**Operational Hazard**

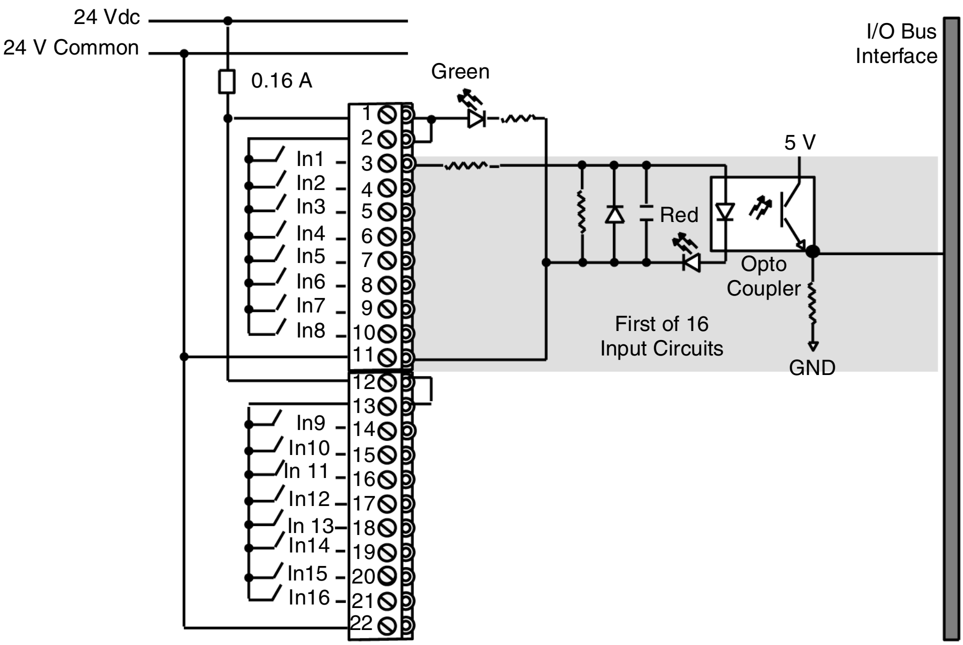
Modicon recommends using two separate power sources with the DEP 220-one for outputs and one for inputs-in order to avoid electrical switching noise.

**Failure to follow this instruction can result in injury or equipment damage.**

**Note:** Inputs do not work if output supply is disconnected.

## Wiring Diagram and Simplified Schematic

A sample wiring diagram and simplified schematic for the DEP 220 input module is provided below.



## DEP 220 Input Module Specifications

### Table of Specifications

The following table contains DEP 220 input module specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Inputs | | 16 |
| | Number of Groups | | 2 |
| | Points/group | | 8 |
| | Isolation | | Optocoupler on each input |
| Power Supplies | External Source Requirement | | 20 ... 30 Vdc for eight inputs |
| | Rated Signal Value | | +24 Vdc |
| | Internally Provided Source from the I/O bus | | 5 V; less than 25 mA |
| | Internal Power Dissipation | | 2 W typical |
| Electrical Characteristics | ON State Signal Level | | 12 ... 30 Vdc |
| | OFF State Signal Level | | -2 ... +5 Vdc |
| | ON State Input Current | | 7 mA @ 24 Vdc |
| | | | 8.5 mA @ 30 Vdc |
| | Response Time | | 0.5 ms typical |
| | Operating Mode | | True High |
| | Wire Size/ terminal | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| I/O Map | Discrete 1x/0x | | 16 in/0 out |
| Dimensions | W x H x D | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| | Weight | | 220 g |
| | | | 0.5 lb |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | | |

# Overview of the DEP 257 Input Module

# 41

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEP 257 input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEP 257 Input Module?

**Brief Product Description**

The DEP 257 is an extended temperature( -40 ... +705 C), 110 Vdc 40%, 16-point discrete input module. The full operational range of this module is 66 ... 154 Vdc. It senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other dc input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals per group. Inputs are opto-isolated from the system bus.

**Note:** The DEP 257 model is available with conformal coating. The conformal coating model is DEP 257C.

## DEP 257 Input Module LEDs

**LEDs**

The DEP 257 module has two amber LEDs, opposite terminal screws 1 and 12. When one of these LEDs is ON, it indicates that power is available to the eight inputs directly below it. The module also has 16 red LEDs, eight opposite terminal screws 3 ... 10 and eight opposite terminal screws 14 ... 21; when any one of these LEDs are ON, it indicates voltage present at the corresponding input.

**⚠ CAUTION**

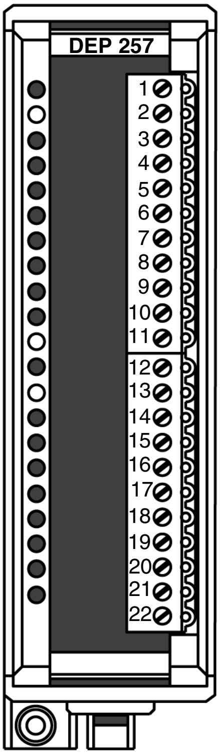
**Operational Hazard**

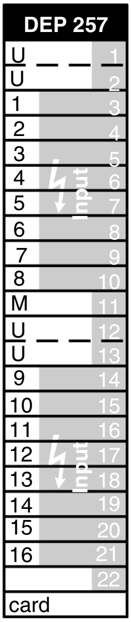
Use of SIM 011 with DEP 257 is not allowed.

**Failure to follow this instruction can result in injury or equipment damage.**

**Note:** To I/O Map the DEP 257 module in Modsoft you must select DEP 216. Both modules share a host driver and have similar characteristics.

A front view with DEP 257 label is provided below.





## DEP 257 Input Module Field Wiring

**Introduction**

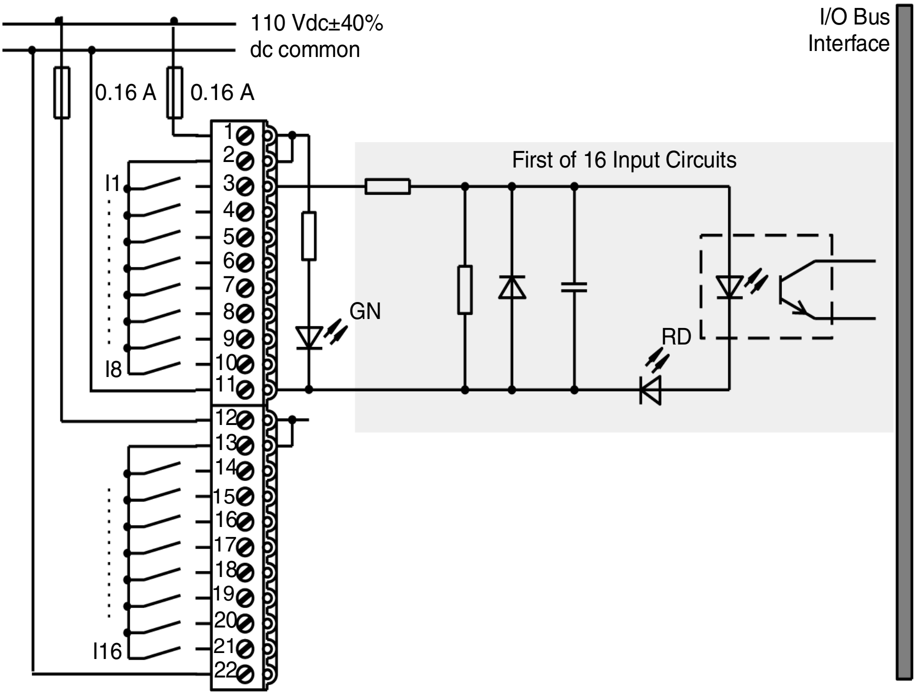
The DEP 257 is an extended temperature( -40 ... +70 degrees C), 110 Vdc +/-40 percent, 16-point discrete input module. The full operational range of this module is 66 ... 154 Vdc. It senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other dc input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals per group. Inputs are opto-isolated from the system bus.

**Note:** The DEP 257 model is available with conformal coating. The conformal coating model is DEP 257C.

**Wiring Diagram and Simplified Schematic**

A wiring diagram and simplified schematic for the DEP 257 input module is provided below.

0.16 A



## DEP 257 Input Module Specifications

### Table of Specifications

The following table contains DEP 257 input module specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Inputs | | 16 |
| | Number of Groups | | 2 |
| | Points/group | | 8 |
| | Isolation | | Optocoupler on each input |
| Power Supplies | External Source Requirement | | 110 Vdc +/-40 percent for each group of eight inputs |
| | External Power | | 40 mA all points on |
| | Rated Signal Value | | 66 ... 154 Vdc |
| | Internally Provided Source from I/O bus | | 5 Vdc @ 25 mA |
| | Internal Power Dissipation | | 3 W typical |
| Electrical Characteristics | ON State Signal Level | | 55 ... 170 Vdc |
| | OFF State Signal Level | | -2 ... +10 Vdc |
| | ON State Input Current | | 2.2 mA @ 110 Vdc |
| | Response Time | | 6 ms typical |
| | Sensor Supply | | 110 Vdc +/-40 percent for each group of 8 inputs each residual ripple max 20 percent |
| | Wire Size/ terminal | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| I/O Map | Discrete 1x/0x | | 16 in/0 out |
| Environmental | Extended Operating Temperature Range | | -40 ... +70 degrees C |
| Dimensions | W x H x D | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| | Weight | | 220 g |
| | | | 0.5 lb |
| Agency Approvals | DEP257: UL 508; cUL; CSA 22.2 No. 142; and European Directive EMC 89/336/EEC Standards | | |
| | DEP257C: Railway standard EN 50 155; UL 508; cUL; CSA 22.2 No. 142; and European Directive EMC 89/336/EEC Standards | | |

# Overview of the DEP 296 Input Module

# 42

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEP 296 input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEP 296 Input Module?

**Brief Product Description**

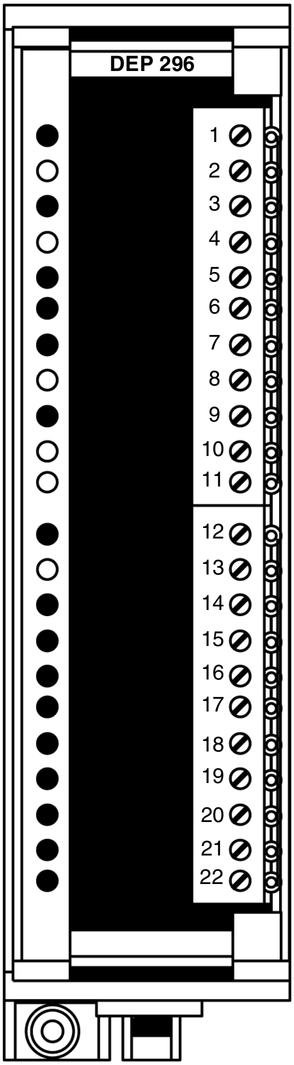
The DEP 296 is a 60 Vdc, 16-point isolated input module. It senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other 60 Vdc input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals/group. Inputs are opto-isolated from the system bus.

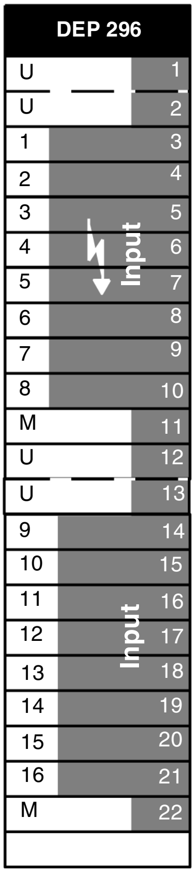
## DEP 296 Input Module LEDs

**LEDs**

The DEP 296 module has two green LEDs, opposite terminal screws 1 and 12. When one of these LEDs is ON, it indicates that power is available to the eight inputs directly below it. The module also has 16 red LEDs, eight opposite terminal screws 3 ... 10 and eight opposite terminal screws 14 ... 21; when any one of these LEDs are ON, it indicates voltage present at the corresponding input.

A front view with DEP 296 label is provided below.





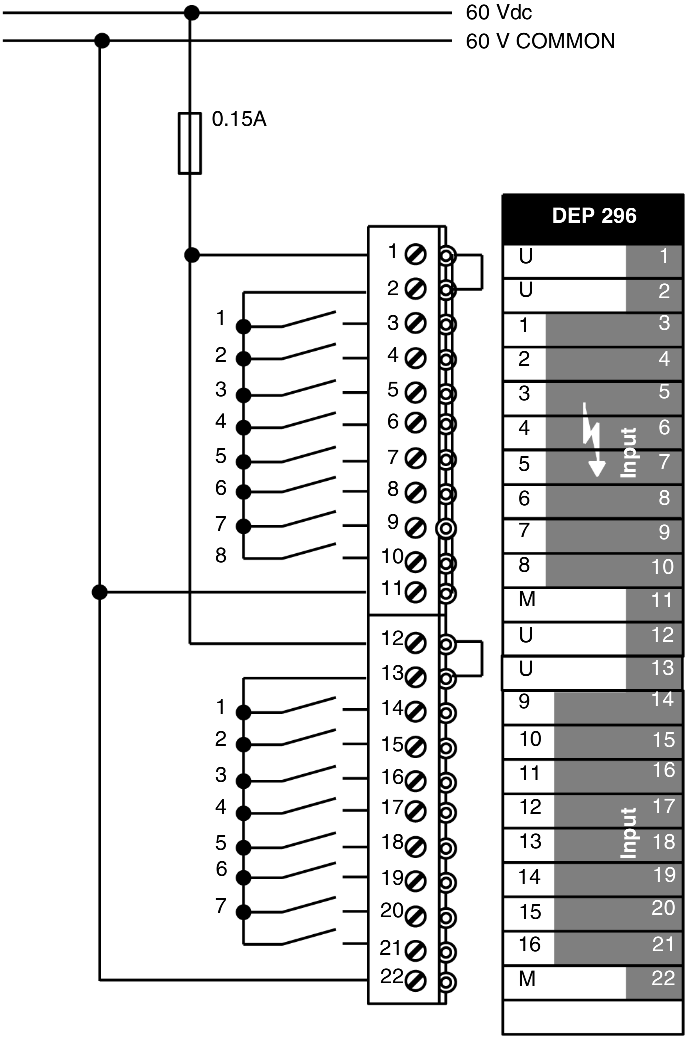
| DEP 296 | |
|---|---|
| U | 1 |
| U | 2 |
| 1 | 3 |
| 2 | 4 |
| 3 | 5 |
| 4 | 6 |
| 5 | 7 |
| 6 | 8 |
| 7 | 9 |
| 8 | 10 |
| M | 11 |
| U | 12 |
| U | 13 |
| 9 | 14 |
| 10 | 15 |
| 11 | 16 |
| 12 | 17 |
| 13 | 18 |
| 14 | 19 |
| 15 | 20 |
| 16 | 21 |
| M | 22 |

## DEP 296 Input Module Field Wiring

**Introduction**

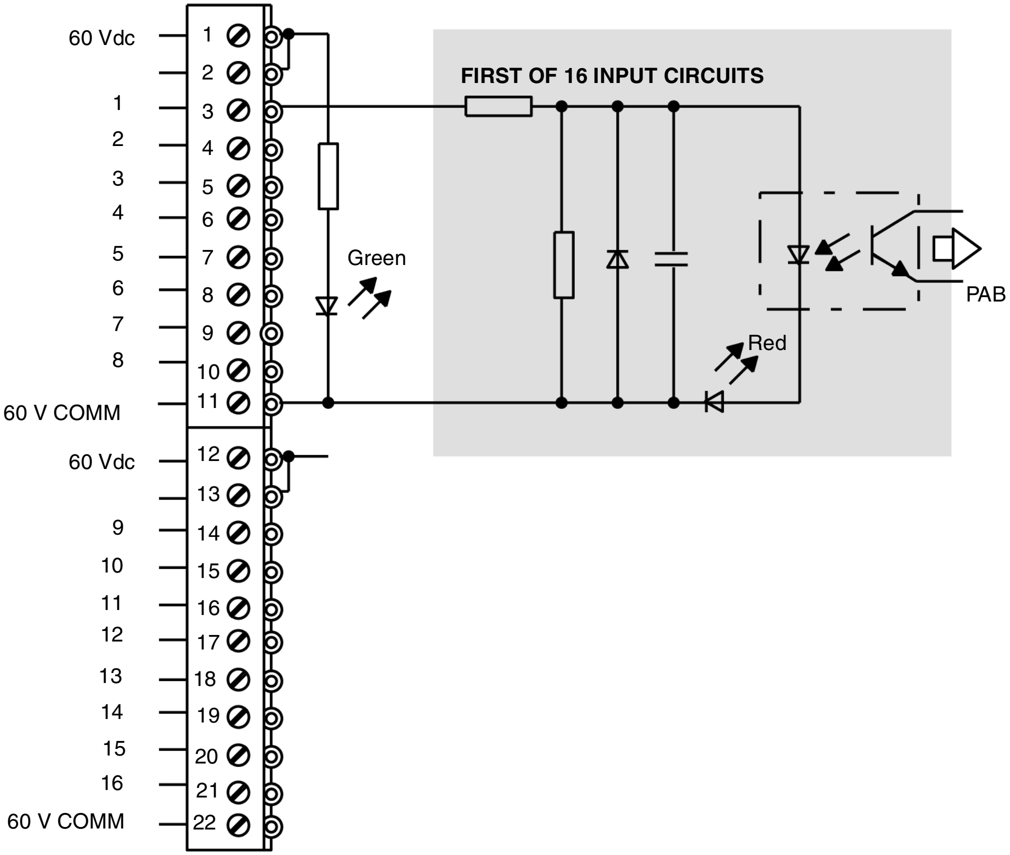
The DEP 296 is a 60 Vdc, 16-point isolated input module. It senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other 60 Vdc input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals/group. Inputs are opto-isolated from the system bus.

**Wiring Diagram** A wiring diagram for the DEP 296 input module is provided below.



**Simplified Schematic**

A simplified schematic for the DEP 296 input module is provided below.



## DEP 296 Input Module Specifications

**Table of Specifications**

The following table contains DEP 296 input module specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Inputs | | 16 |
| | Number of Groups | | 2 |
| | Points/group | | 8 |
| | Isolation | | Optocoupler on each in put |
| Power Supplies | External Source Requirement | | 60 Vdc |
| | | | 125 mA |
| | Internally Provided Source from I/O bus | | 5 V |
| | | | 25 mA maximum |
| | Internal Power Dissipation | | 4 W typical |
| Input Characteristics | Rated Signal Value | | +60 Vdc |
| | ON State Signal Level | | 35 ... 70 Vdc |
| | OFF State Signal Level | | -4 ... +13 Vdc |
| | ON State Input Current | | 7 mA @ 60 Vdc |
| | Response Time | | 4 ms typical |
| | Operating Mode | | True High |
| | Wire Size/terminal | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| I/O Map | Discrete 1x/0x | | 16 in/0 out |
| Dimensions | W x H x D | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| | Weight | | 220 g |
| | | | 0.5 lb |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | | |

# Overview of the DEP 297 Input Module

# 43

## At a Glance

**Purpose**

The purpose of this chapter is to describe the DEP 297 input module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the DEP 297 Input Module?

**Brief Product Description**

The DEP 297 is a 48 Vdc, 16-point isolated input module. It senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other 48 Vdc input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals/group. Inputs are opto-isolated from the system bus.

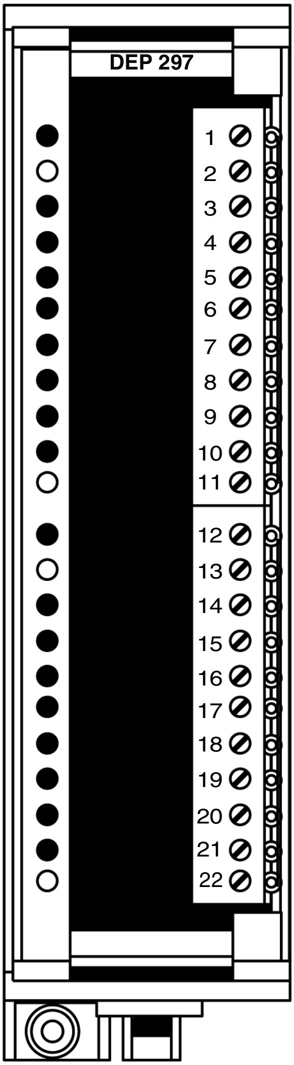
**Note:** To I/O Map the DEP 297 module in Modsoft you must select DEP 216. Both modules share a host driver and have similar characteristics.

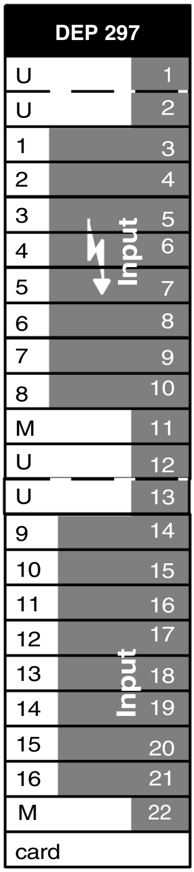
## DEP 297 Input Module LEDs

**LEDs**

The DEP 297 module has two green LEDs, opposite terminal screws 1 and 12. When one of these LEDs is ON, it indicates that power is available to the eight inputs directly below it. The module also has 16 red LEDs, eight opposite terminal screws 3 ... 10 and eight opposite terminal screws 14 ... 21. When any one of these LEDs is ON, it indicates voltage present at the corresponding input.

A front view with DEP 297 label is provided below.





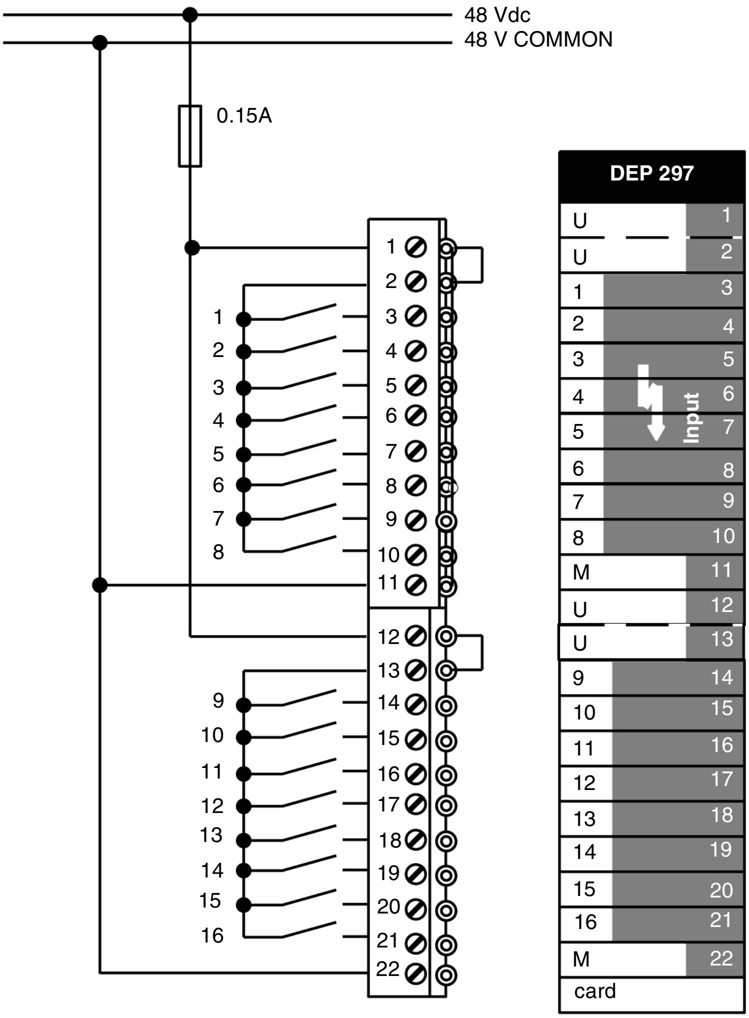
## DEP 297 Input Module Field Wiring

**Introduction**

The DEP 297 is a 48 Vdc, 16-point isolated input module. It senses input signals received from field sensing devices such as pushbuttons, limit and proximity switches, or other 48 Vdc input sources and converts those signals into logic voltage levels that can be used by the PLC. Signals are field wired in two groups, eight signals/group. Inputs are opto-isolated from the system bus.

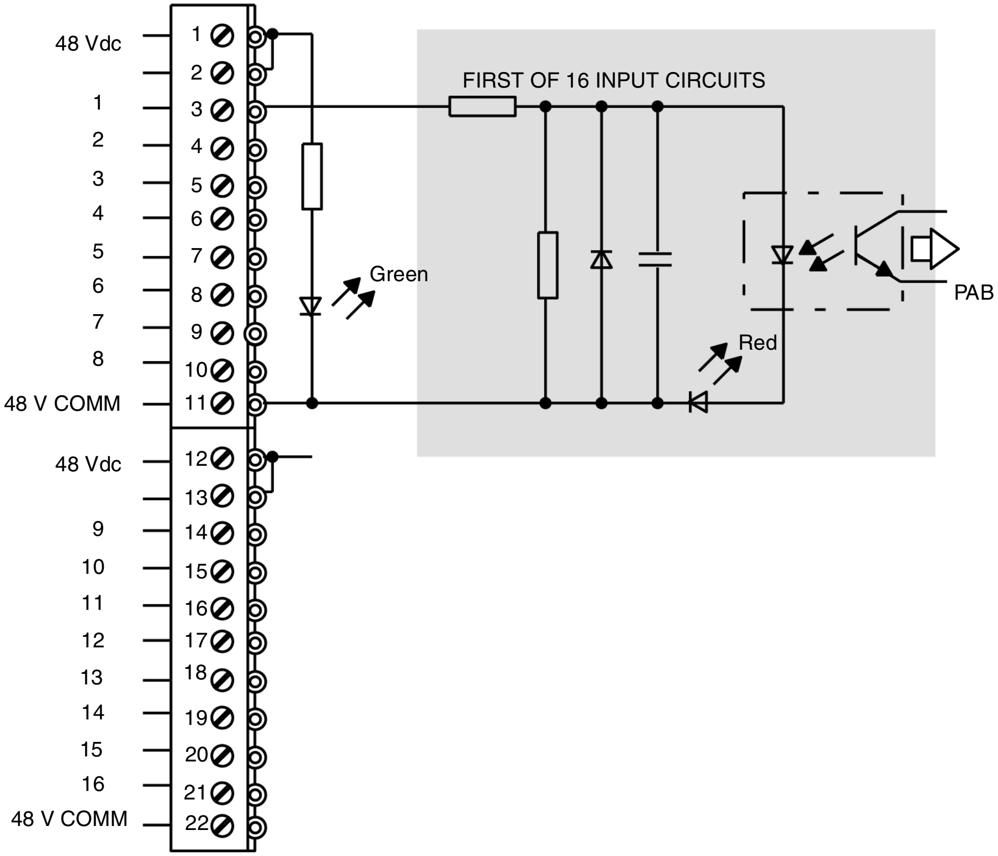
**Note:** To I/O Map the DEP 297 module in Modsoft you must select DEP 216. Both modules share a host driver and have similar characteristics.

**Wiring Diagram** A wiring diagram for the DEP 297 input module is provided below.



**Simplified Schematic**

A simplified schematic for the DEP 297 input module is provided below.



## DEP297 Input Module Specifications

### Table of Specifications

The following table contains DEP 297 input module specifications.

| | | | |
|---|---|---|---|
| Module Topology | Number of Inputs | | 16 |
| | Number of Groups | | 2 |
| | Points/group | | 8 |
| | Isolation | | Optocoupler on each input |
| Power Supplies | External Source Requirement | | 48 Vdc |
| | | | 125 mA |
| | Internally Provided Source from I/O bus | | 5 V |
| | | | 25 mA maximum |
| | Internal Power Dissipation | | 3 W typical |
| Input Characteristics | Rated Signal Value | | +48 Vdc |
| | ON State Signal Level | | 29 ... 56 Vdc |
| | OFF State Signal Level | | -3 ... +10 Vdc |
| | ON State Input Current | | 7 mA @ 48 Vdc |
| | Response Time | | 4 ms typical |
| | Operating Mode | | True High |
| | Wire Size/terminal | One wire | 14 AWG |
| | | Two wires | 20 AWG |
| I/O Map | Discrete 1x/0x | | 16 in/0 out |
| Dimensions | W x H x D | | 40.3 x 145 x 117.5 mm |
| | | | 1.6 x 5.6 x 4.5 in |
| | Weight | | 220 g |
| | | | 0.5 lb |
| Agency Approvals | VDE 0160; UL 508; and CSA 22.2 No.142 Standards | | |

# Overview of the FRQ 204/254 Frequency Module

# 44

## At a Glance

**Purpose**

The purpose of this chapter is to describe the FRQ 204/254 Frequency Module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the FRQ 204/254 Frequency Module?

**Brief Product Description**

The FRQ-204/254 serves the purpose of frequency and speed measurement for the Compact PLCs and has the following features:

- 4Frequency inputs for counting pulse voltages 5 VDC (TTL) or 24 VDC, Counting frequency up to 1 kHz (1 x up to 50 kHz)
- 4fixed assigned semiconductor outputs 24 VDC, 0.5 A for Limit monitoring with:
  - Short–circuit and overload protection
  - Switch–off with value saving
  - Group indication of the overload/ short–circuit switch–off
  - Group short–circuit signal
  - Hardware reset for the acknowledgment of the overload
- 4process inputs 24 VDC for free use
- several LED indicators for function tracking and monitoring

**Note:** The FRQ 254 functions just like the FRQ 204 except that the FRQ 254 operates at extended temperature.

The FRQ-204/254 can be inserted on any I/O slot in the subracks AS-HDTA-200, AS-HDTA-201 and AS-HDTA-202.

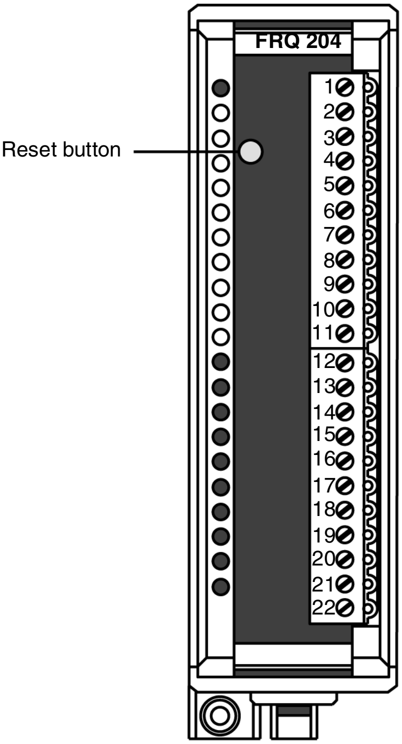
The power supply is obtained:

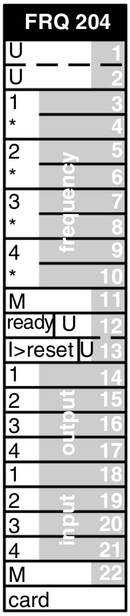
- Internally with 5 VDC via the I/O bus
- Externally with 24 VDC for 24 V counter inputs, outputs and enable inputs
- If required, an addition externally with 5 VDC with 5 V input pulses.

## Physical Characteristics of the FRQ 204/254 Frequency Module

**Illustration**

The module a has bus connection on the rear and peripheral connection via screw/ plug–in terminals on the front. One of the enclosed fill–in labels is inserted in the detachable cover of the subrack near the viewing field for the LED indicators. System relevant data should be entered in the provided fields (e.g. signal names).





## Operating Modes of the FRQ 204/254 Frequency Module

**FRQ 204/254 Operating Modes**

The module comprises 4 independent hardware counters for the following operating modes:

- Frequency measurement <20 Hz, <1 kHz, <50 kHz
- Speed measurement <1 200 rev/min., <60 000 rev/min., <65 520 rev/min.

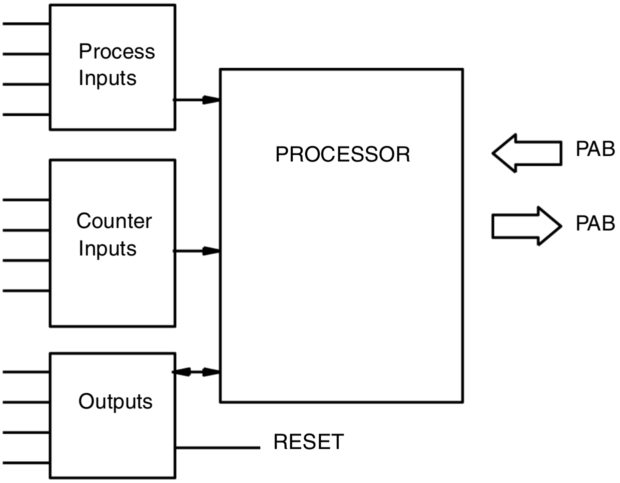
The above mentioned operating modes and the required parameters should be defined in the parameters dialog screen of the panel software.

This module is a I/O bus node with isolation to the process peripherals.

In case of overload or short–circuit the corresponding output is switched off. The yellow LED indicates the overload. The reset button provides the acknowledgement. The outputs can be operated only when 24 V supply is available. When the module is inserted with voltage supply on (24 V and 5 V supply), all the outputs take 0 V position. The 4 discrete inputs (Input 1 ... 4 with LEDs) are available as free process inputs for your use. There is no functional assignment to the counter.

**FRQ 204/254 Block Diagram**

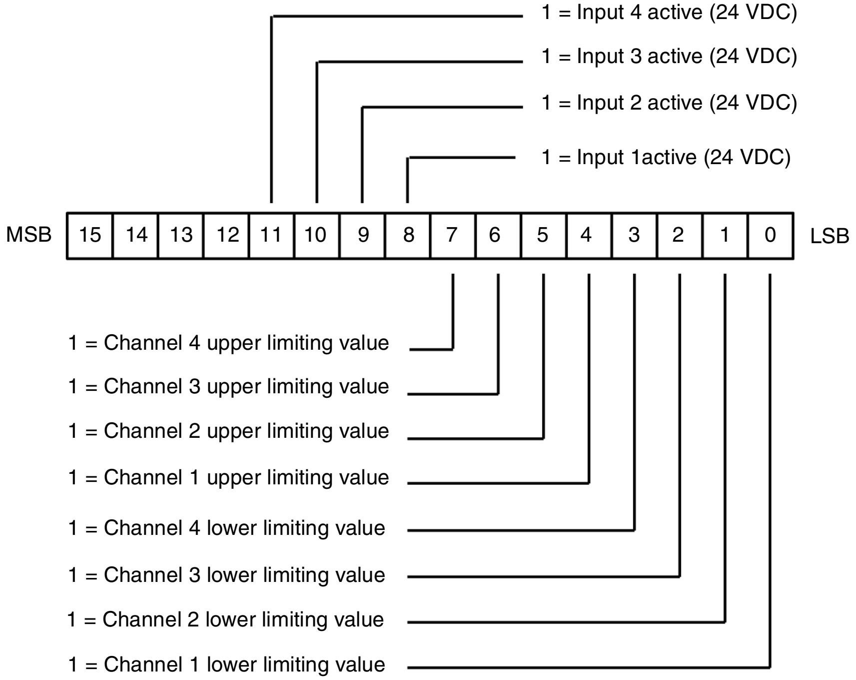
The following diagram describes the architecture of the FRQ 204/205 frequency module.



# Configuration of the FRQ 204/254 Frequency Module

**I/O Mapping**

This modules uses 5 3x input registers as detailed here.

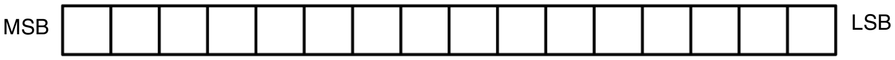


Bits 12 ... 15 are not used

**Note:** Bits 4 ... 7 are high when the value is >= the upper limit. Bits 0 ... 3 are high when the value is <= the lower limit.

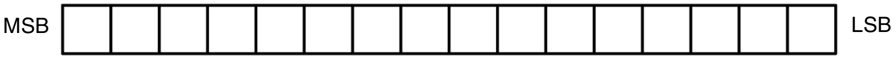
The 3x register is shown below.

3x-register 2 (frequency/revolution data)



...
...
...

3x-register 5 (frequency/revolution data)



**I/O Node Number**

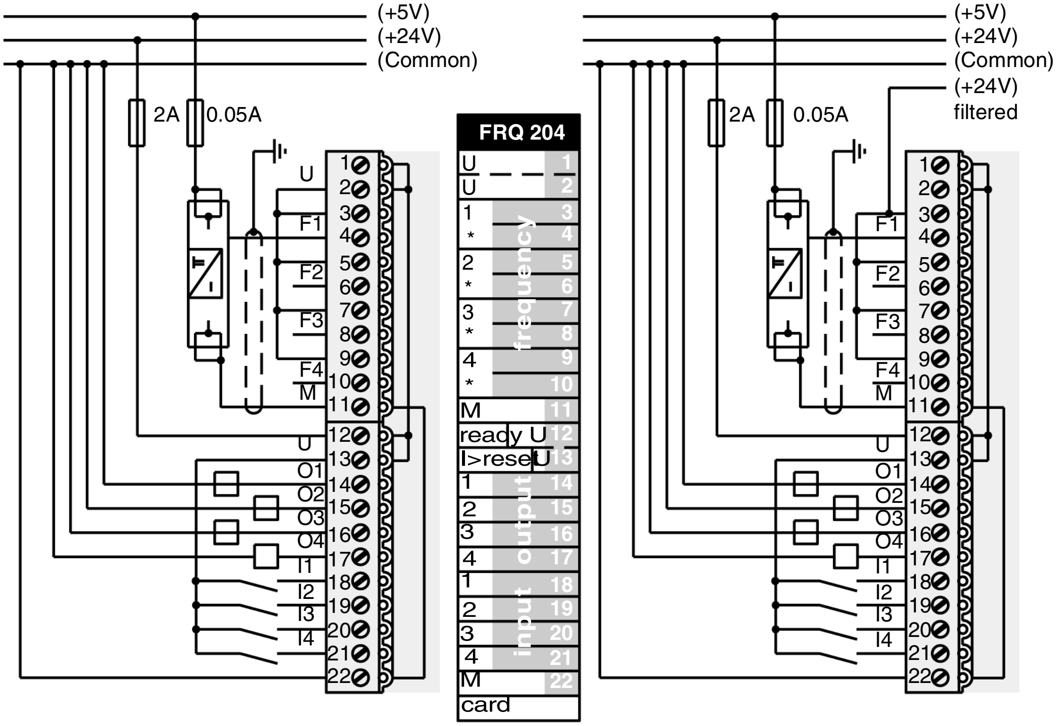
Select the I/O slot number via the I/O map configuration and set the addressing of the 3x registers to be used.

**Wiring**

- For the counter input connection please use shielded cables, e.g. JE–LiYCY 2 x 2 x 0.5 mm**2** (P/N E–Nr. 424 234 035). All counter inputs can be combined together in one common shielded cable, e.g. LiYrdf(Cgv)Y 5 x 2 x 0.5 mm**2** (P/N E–No. 424 238 059)
- The maximum cable length is 100 m
- The shield should be connected on one side with a short cable (<20 cm) to earth ground. The cable shield should be grounded on both sides when higher noise levels are present.
- The cable should not be combined together with supply lines or similar sources of electrical interference. Distance >0.5 m.

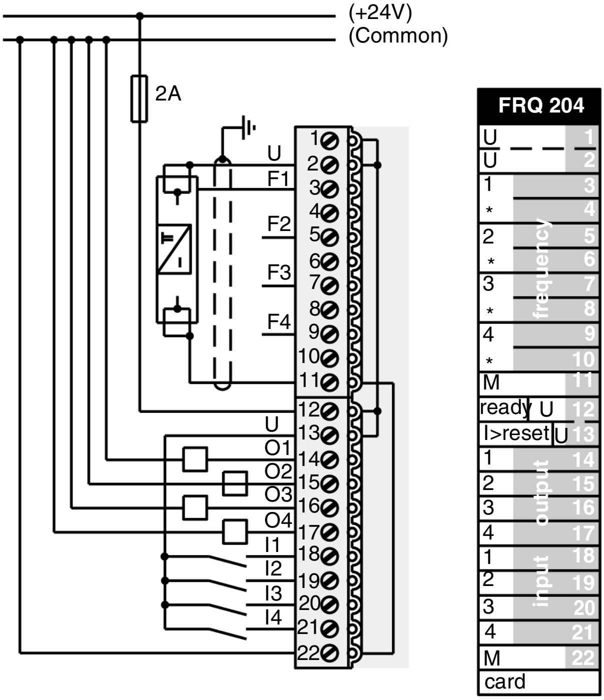
## Connection and Signal Address Assignment

The figure below illustrates a connection example for counter input F1 with 5 V input pulses (left) for systems with higher noise level (right).



**Note:** The example shows a 5 V pulse generator that requires a supply voltage of 24 VDC. Supply it from terminal 1.

The following figure illustrates a connection example for counter input F1 with 24 V input pulses.



> **Note:** The counter input F1 (TTL) is for the connection of 5 V sensor (max. 50 kHz).

# Operation and LED Displays of the FRQ 204/254 Frequency Module

**Operation and LEDs**

The module comes with the following LED indicators:

| Color and Name | Use | LED on | LED off |
|---|---|---|---|
| 1 x green "U" | supply LED for 24 V counter inputs, outputs and process inputs: | supply is available | supply is not available |
| 1 x green "ready" | LED for function | Firmware initialization is completed, PAB interface enabled (backplane communication) | Module is not ready for operation |
| 1 x yellow "(reset)" | LED for overload or short–circuit of the outputs | short–circuit or overload on one or more outputs | faultless operation |
| 4 x red "output 1 ... 4" | LEDs for outputs | outputs have "1" signal | outputs have "0" signal |
| 4 x red "input 1 ... 4" | LEDs for free process inputs | signal on input | signal on input |

The red LED indicators show the level of voltage of input or output signal (1 or 0). Thus, the red LED goes on when the voltage level is high (1).

Reset button:

- switches off the stored overload indication
- removes the reclosing lockout of the switched off (overloaded) outputs, when the overload is no longer present
- switches the group short circuit signal again to 0.

## Specifications of the FRQ 204/254 Frequency Module

### FRQ 204/254 Power Supply

The following table describes the power supply.

| | | |
|---|---|---|
| External Power Supply For: | 24 Vdc, ca. 1.1 A | Counter Inputs |
| | | Process Inputs |
| | | Outputs |
| | 5 Vdc, 20 mA | Counter Inputs |
| Internal Power Source via I/O bus | Maximum | 5 V, 100 mA |
| | Typical | 75 mA |
| Power Loss | Typical | 1.3 W |

### FRQ 204/254 I/O Map

The following table describes the I/O map.

| | |
|---|---|
| Register 3x/4x | 5 in / 0 out |

## FRQ 204/254 Frequency Inputs

The following table describes the frequency inputs.

| | | |
|---|---|---|
| Quantity | | 4 for input pulses with 5 Vdc (TTL) or 24 Vdc |
| Type of Networking | | potential free (optical coupler) against I/O bus |
| Signal Level at 5 V (TTL) | ON signal | >= 2.3 V |
| | OFF signal | 0 ... 1 V |
| | Input Current | <= 2.5 mA each at 0 V (current sink) |
| Signal Level at 24 V (TTL) | ON Signal | 12 ... 30 V |
| | OFF signal | -2 ... +5 V |
| | Input Current | <= 6 mA each at 30 V (current source) |
| Signal Level at 24 V (TTL) | ON signal | 12 ... 30 V |
| | OFF signal | -2 ... +5 V |
| Input Current (current source) | | < 6 mA each at 30 V |
| Minimum Pulse Width | | 0.35 ms |
| Pulse Duty Factor | | 7:13 ... 1:1 ... 13:7, (13:7 = 65% : 35%) |
| Counting range | | 0 ... 32,767 |
| Counting Frequency | | 1 kHz maximum (Input 1 with 5 V pulses 50 kHz maximum) |
| Accuracy (Time = 5) at: | | |
| 5 Hz | 0.5% | Operating mode < 20 Hz |
| 20 Hz | 2% | |
| 25 Hz | 4% | Operating mode < 1 Hz |
| 100 Hz | 1% | |
| 1 kHz | 0.1% | |
| 5 ... 50 kHz | 0.05% | Operating mode < 50 kHz |
| Accuracy (Time =1) | | ca. 10 times lower (use only for fast approximate measurements) |

## FRQ 204/254 Process Inputs

The following table describes the process inputs.

| | | |
|---|---|---|
| Quantity | | 4 |
| Type of Networking | | potential free (optical coupler) against I/O bus |
| Rated Signal Value | | 24 V |
| Signal Level | HIGH Signal | 12 ... 30 V |
| | LOW signal | -2 ... +5 V |
| Input Current | | 7 mA @ 24 V, 8.5 mA at 30 V |
| Input Delay | | 4 ms |

## FRQ 204/254 Semiconductor Outputs

The following table describes the semiconductor outputs.

| | |
|---|---|
| Quantity | 4 |
| Technique | with short–circuit and overload protection, Switch–off with value saving Group indication of the overload/ short–circuit switch–off Group short–circuit signal via I/O map status word, Hardware reset for the overload acknowledgement |
| Type of Networking | potential free (optical coupler) against I/O bus |
| Consumer Connection | Between output and reference potential M1 |
| Working Voltage U | $U_S$ = 24 Vdc |
| Signal Logic | Positive Logic |
| Signal Output Level | 1 signal U = $U_S$ - 0 ... 2 V |
| | 0 signal 0 ... +2 V, < 1 mA |
| Load Current/Output | 500 mA maximum (Current source) |
| Starting Current for Incandescent Lamp | Iein = 10 x IN, max. 5 W |
| Load Current for All Outputs | 1 A maximum (due to 50% simultaneity factor) |
| Operating Delay | < 1 ms |
| Circuit with Inductive Loads | Clamping diode (suppressor diode) locally (parallel to the operating coil), **absolutely necessary** when contact elements are present in the output lines or the lines to the peripherals are very long. |
| Switching Cycles | 1000 / h (0.28 / s) with inductive load and max. permissible current per output 100 / s with ohmic load 8 / s with 1.2 W lamp load |

## FRQ 204/254 Physical Characteristics

The following table describes the physical characteristics.

| | |
|---|---|
| Module | Standard Size Case |
| Format | 1 Slot |
| Weight | 300 g |

## FRQ 204/254 Type of Connection

The following table describes the connection type.

| | |
|---|---|
| Process | 2 Pluggable 11 Pole Screw/Plug-in Terminals |
| I/O Bus (Internal) | 1/3 C30M |

## FRQ 204/254 Maximum Cable Lengths

The following table describes the maximum cable lengths.

| | |
|---|---|
| Counter Inputs | max 100 m shielded (longer cables on request) |
| Outputs and Enable Inputs | max. 400 m unshielded<br>max 1000 m shielded |

## FRQ 204/254 Environmental Characteristics

The following table describes the environmental characteristics.

| | |
|---|---|
| Operating Temperature | 0 ... 60 C for FRQ204<br>-40 ... +70 C for FRQ254 |

## FRQ 204/254 Agency Approvals

The following table describes the agency approvals.

| |
|---|
| VDE 0160, UL 508; CSA 22.2 No.142, European Directive on EMC 89/336/EEC, and Low Voltage Directive 79/23/EEC Standards |

# Overview of MOT 20X Motion Modules

# 45

## At a Glance

**Purpose**

The purpose of this chapter is to describe the MOT 20X Motion modules.

⚠ **WARNING**

**Compatibility warning**

The MOT 20X module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

**Note:** The following A120 I/O modules require a loadable (SW--IODR--001) for proper operation when using certain PLCs (A984--1xx, E984--24x/251/255) with Modsoft:
- DEP 211/214/215/217
- DAP211/217
- ADU204/211/214/216
- DAU204
- VIC2xx
- MOT20x

**What's in this Chapter?**

This chapter contains the following topics:

## What are the MOT 20X Modules?

**Brief Description**

The MOT 20x modules include the MOT 201 single-width I/O module (encoder only) and the MOT 202 double-width module (resolver and encoder). They are designed to provide single-axis motion control to the 984-A120 Series PLCs.

The MOT 20x motion modules are designed to control a single axis of motion using advanced digital brushless motion control. This capability provides optimal control by eliminating potentiometer adjustments and analog velocity loops. These MOT modules are designed to operate with an A Series Compact 984 PLC-i.e., a Compact A984-120, -130, -131, -141, or -145.

**Note:** The MOT 20X modules are designed to serve a variety of applications with great accuracy and speed, however certain applications might be outside their scope. Please consult Modicon for applications information if you intend to use the module specifically for precise velocity control.

The primary feedback used by the DNP servo system is position information from either a resolver or an encoder mounted to the motor. Velocity information is derived from the position information, rather than being received from a velocity transducer. This leads to some inaccuracies when using the DNP servo as a velocity controller. Small speed irregularities may result, particularly at slower speeds.

**Related Publications**

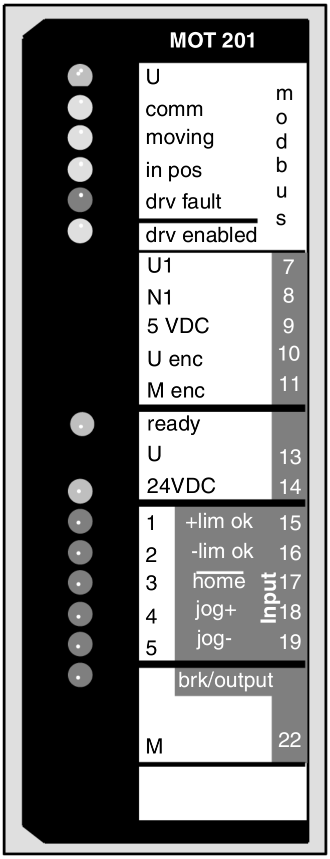
The following publications contain detailed information on the MOT 20X modules:

- Single-Axis Software System (SASS) Motion User Guide (GM-MOTN-001)
- Modicon Motion Development Software (MMDS) User Guide (GM-MMDS-002)

## Overview of the MOT 201 Motion Module

**Brief Description** The MOT 201 is an encoder-only module contained in a single-width housing. It works with dc motors that use Cyberline drives and other types of dc and brushless drives from Gettys and other manufacturers. The module contains I/O to interface to the drive and the machine, including drive enable, drive fault, and a variety of user-configurable signals. The MOT 201 is not capable of commutating brushless motors.

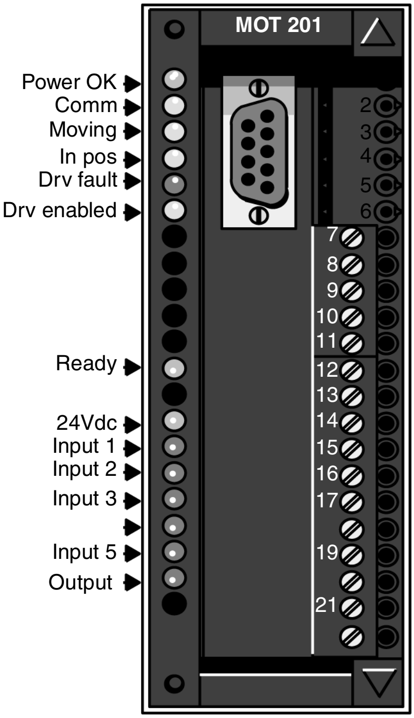
A front view of the MOT 201 Motion module is provided below.



**LEDs**

Fourteen LEDs are visible on the front panel to indicate various functions and conditions.

Refer to the following diagram and table for the indicator positions, nomenclature and a brief explanation of their functions.



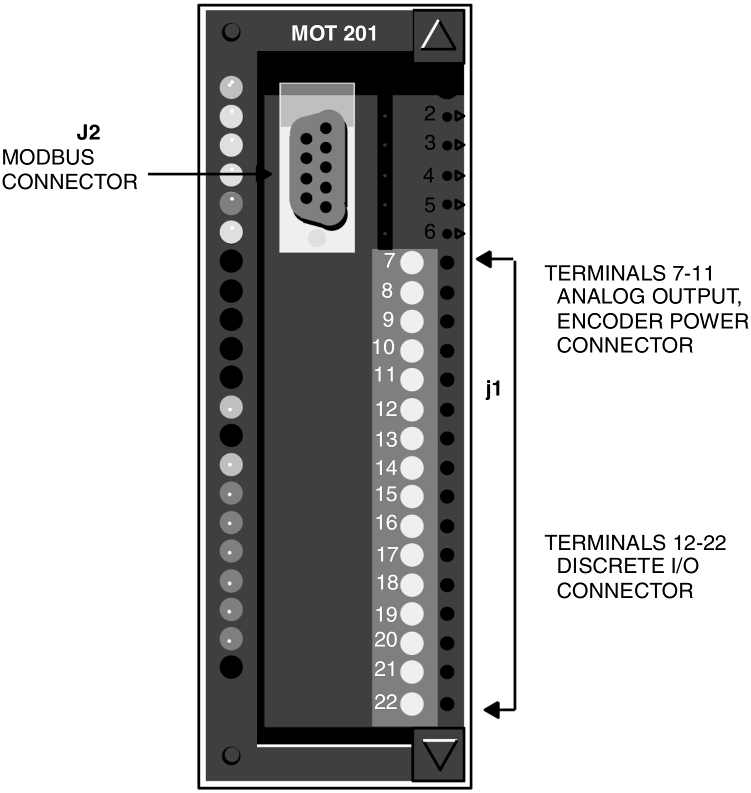
The following table describes the meaning of each front panel indicator.

| | | |
|---|---|---|
| U (POWER OK) | Green | Backplane power is present |
| Comm (MODBUS) | Amber | Blinking = RS-232 serial port communication link active |
| Moving | Amber | MOT is still commanding new positions for the motor |
| In pos | Amber | Difference between the target position and the actual motor position less than In Position Band parameter value |
| Drv fault (DRIVE FAULT) | Red | A fault condition exists in the drive controlled by the MOT |
| Drv enabled (DRIVE ENABLED) | Amber | Drive enable signal to the drive is active |

| | | |
|---|---|---|
| Ready (MODULE OK) | Green | MOT is operational. When not ON, a failure of the module has been detected. When blinking once every 3 s, module is in kernel mode and the executive must be downloaded |
| 24Vdc | Green | 24 Vdc for the I/O is present |
| Input 1 (+LIMIT OK) | Red | Motor has not reached the maximum limit for clockwise motion, or user-configured input 1 is active |
| Input 2 (- LIMIT OK) | Red | Motor has not reached the maximum limit for counterclockwise motion, or user-configured input 2 is active |
| Input 3 (HOME LIMIT) | Red | Motor is not at the Home switch, or user-configured input 3 is active |
| Input 4 (JOG +) | Red | Jog + switch or user-configured input 4 is active |
| Input 5 (JOG -) | Red | Jog - switch or the user-configured input 5 is active |
| Output 1 (BRAKE) | Red | Brake control is active(brake released), or user-configured output 1 is active |

**Connectors**

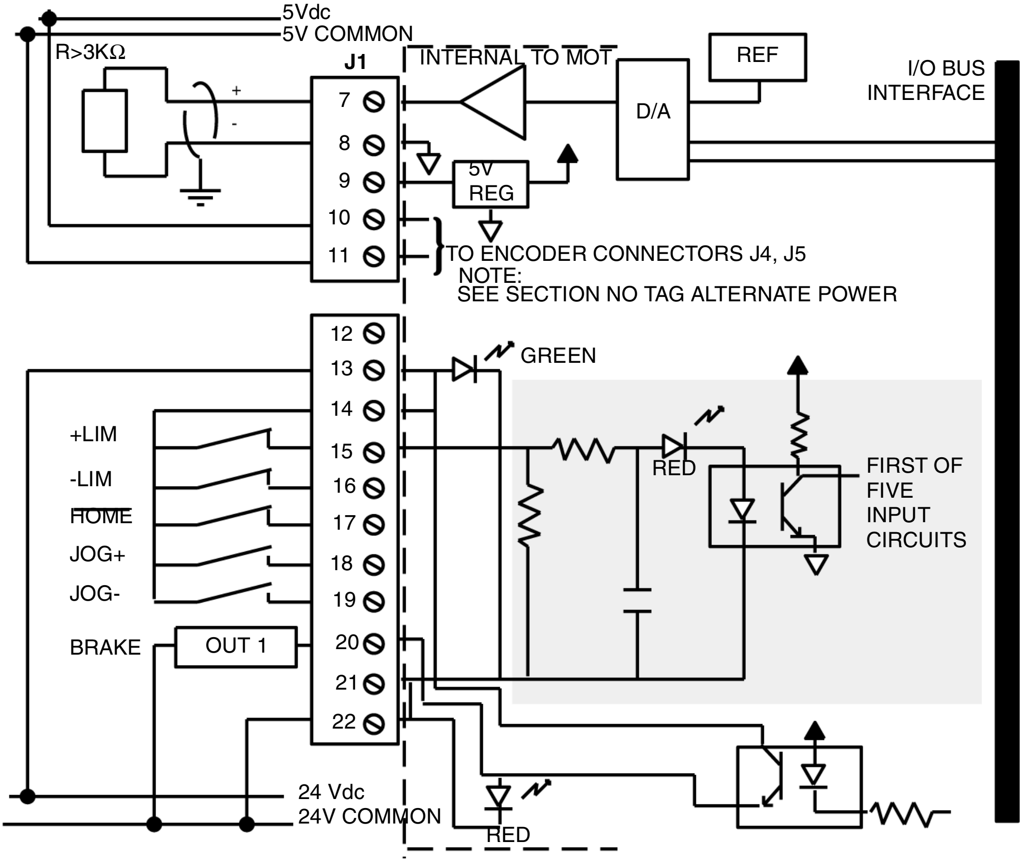
The MOT 201 has five connectors, J1 ... J5. The J1 and J2 connectors are located on the front of the module.



The J2 connector is a standard 9-pin, D-shell RS-232 serial port. Its operating mode and communications parameters are set via a DIP switch on the back of the unit (discussed later in this chapter).

**MOT 201 J1 Connector**

The J1 connector is a 22-terminal screw I/O connector, as shown in the Discrete I/O, Analog Output, and Encoder Power wiring diagram below.



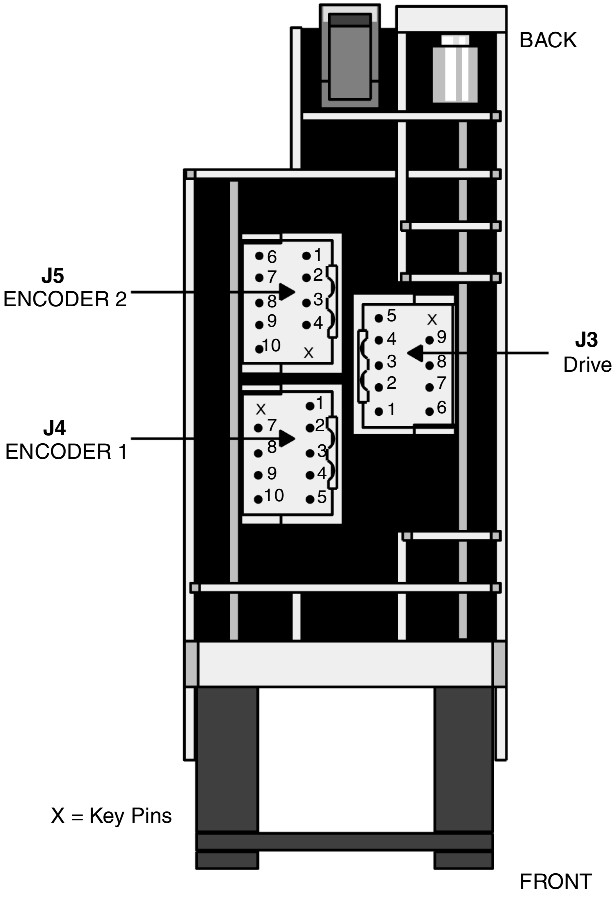
J1 discrete connections are listed in the following table.

| Pin # | Function | Pin # | Function |
|---|---|---|---|
| 1 ... 6 | Not Used | 15 | +Travel limit/Aux in 1 |
| 7 | Analog output | 16 | -Travel limit/Aux in 2 |
| 8 | Analog output return | 17 | Home/Aux in 3 |
| 9 | +5 Vdc | 18 | Jog+/Aux in 4 |
| 10 | Encoder Power | 19 | Jog-/Aux in 5 |
| 11 | Encoder power return | 20 | Aux 1 output/Brake |
| 12 | Not Used | 21 | 24 Vdc common |

| | | | |
|---|---|---|---|
| 13 | 24 Vdc power | 22 | 24Vdc common |
| 14 | 24 Vdc power | | |

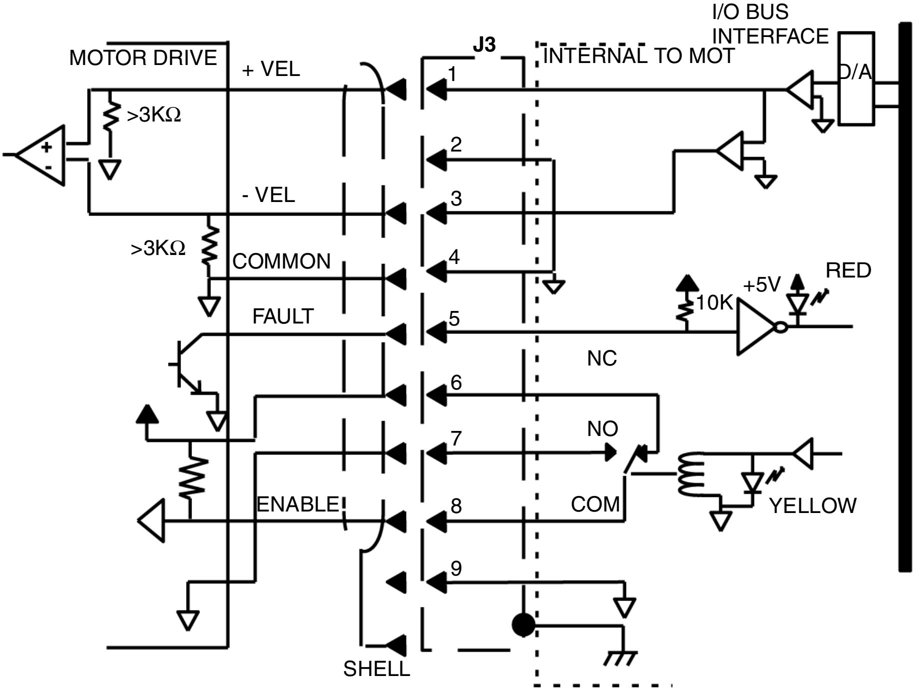
## MOT 201 Bottom Connectors

The J3, J4 and J5 connectors are located on the bottom of the module.



## MOT 201 J3 Connector

J3 is a 10-pin motor drive connector.

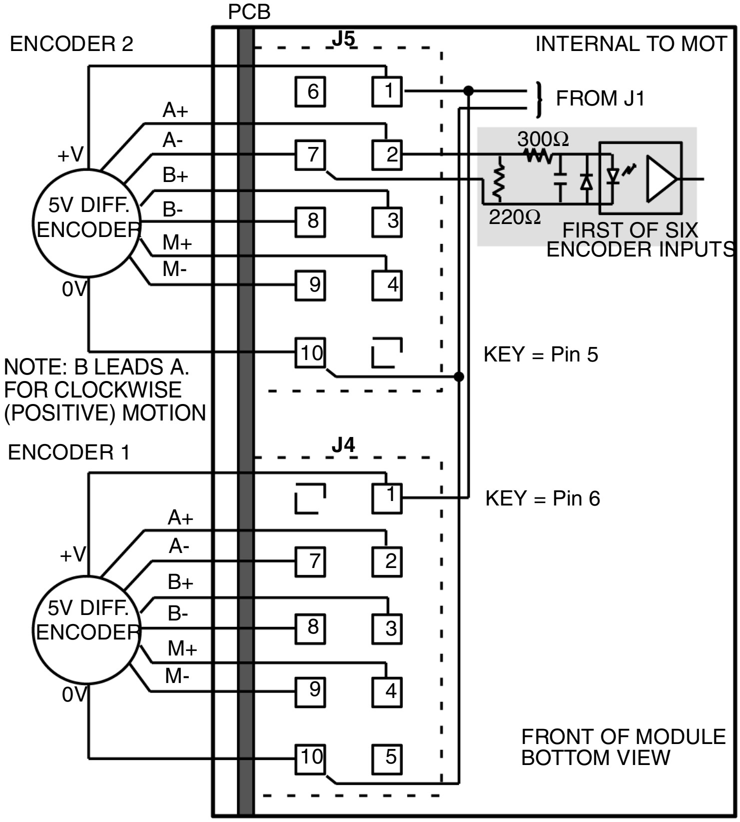


J3 drive connections are listed in the following table.

| Pin # | Function | W922 Cable Color |
|---|---|---|
| 1 | +Velocity command | Black |
| 2 | Common | White |
| 3 | -Velocity command | Blue |
| 4 | Common | Orange |
| 5 | Drive fault input | Yellow |
| 6 | Drive enable contact (N.C.) | Red |
| 7 | Drive enable contact (N.O.) | Brown |
| 8 | Drive enable common | Green |
| 9 | Common | Purple |
| 10 | Key | Gray |

## MOT 201 J4 and J5 Connectors

J4 and J5 are 10-pin encoder feedback connections. The pins on these two connectors have nearly identical functionality (pins 5 and 6 are different).



J4 and J5 encoder feedback connections are listed in the following table.

| Pin # | Function |
|---|---|
| 1 | Encoder power |
| 2 | + Phase A |
| 3 | + Phase B |
| 4 | + Mark |
| 5 | Key (J5) |
| 6 | Key (J4) |
| 7 | - Phase A |
| 8 | - Phase B |
| 9 | - Mark |

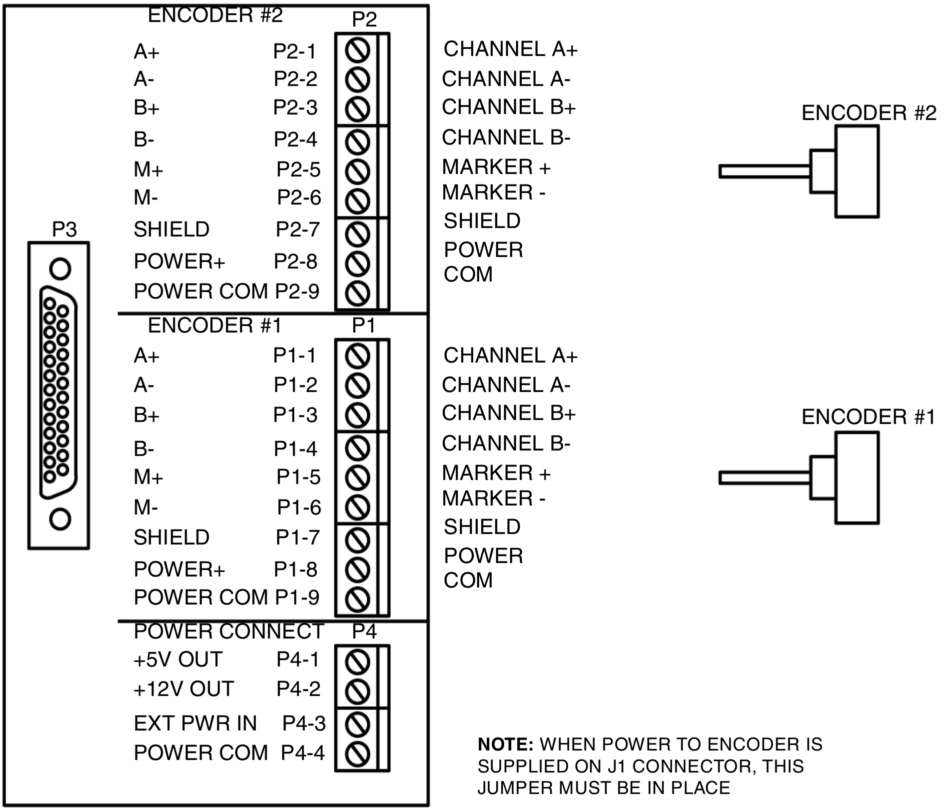
| | |
|---|---|
| 10 | Encoder Power return |

### The Encoder Feedback Interface

The MOT 201 accepts feedback from one or two +5 V differential encoders. You may pick between the following two connection options:

- Option 1 uses an AS-W922-008 or AS-W922-015 generic cable, which is terminated at one end and unterminated at the other to plug into either encoder connector on your module
- Option 2 connects to the encoders through a cable and an optional AS-BR85-110 Breakout module.

An AS-W923 encoder breakout cable has a male DB25 connector at one end; the other end has two connectors to attach to the module's two encoder connectors.



**NOTE:** WHEN POWER TO ENCODER IS SUPPLIED ON J1 CONNECTOR, THIS JUMPER MUST BE IN PLACE

## Encoder Connection Options

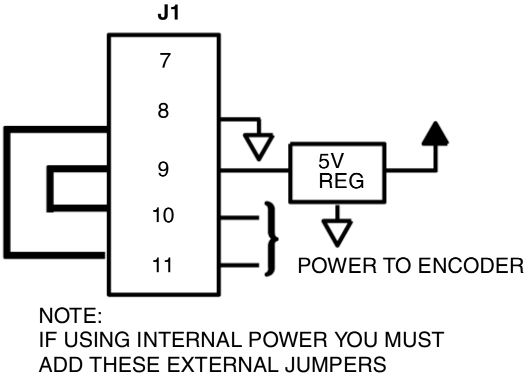
Cables and breakout modules are listed in the following table.

| Part Number | Use | Cable Description |
|---|---|---|
| AS-W921-XXX | Drive | Cyberline1000 to 10-position AMP Shielded MT Connector (008, 015) |
| AS-W922-XXX | Generic | 10-pin AMP Shielded MT Connector to Wires (008, 015) |
| AS-W923-XXX | Encoder Break out | Two 10-pin AMP Shielded MT Connectors to DB25 Connector (Y Cable) (003, 006) |
| AS-W955-XXX | Modbus | DB9 to DB25 (012, 025) |
| AS-W956-XXX | Modbus | DB9 to DB9 (012, 025) |
| AS-BR85-110 | Breakout Module | For use with AS-W923 cable |
| XXX stands for the cable length. | | |

The breakout module is a DIN rail-mountable terminal block PCB assembly and accommodates discrete wiring from the encoder(s). It has a female DB25 connector for the cable attachment and the terminals are clearly marked with the appropriate encoder connections.

**Note:** When configuring feedback devices, remember that Channel 1 is not used by the MOT 201. Encoder 1 (J4) = Channel 2, and encoder 2 (J5) = Channel 3.

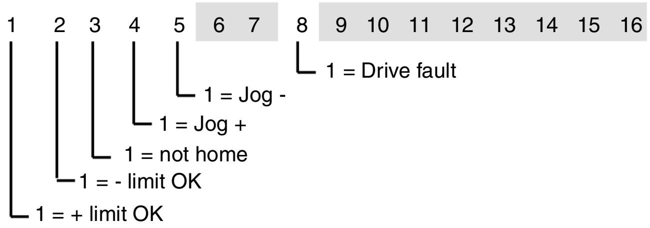
An external power supply is typically used with an encoder (see illustration below). However, when total encoder power (for one or two encoders) requires no more than 75 mA of power, you may use 5 Vdc power from the Compact 984 and thus eliminate the need for the external power supply.



## Discrete I/O

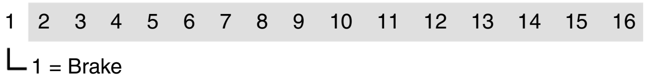
The MOT 201 contains five discrete inputs and one discrete output. The inputs can be used as either user-defined discrete inputs or as predefined inputs. The discrete output as well as the inputs are controlled by the I/O command set.

The register bit assignments are shown in the following diagram.



**Note:** Module inputs 1 (+ Limit OK), 2 (- Limit OK) and 3 (NOT HOME) default to 1 (predefined) at power-up while inputs 4 (Jog +) and 5 (Jog -) default to 0 (discrete). Output 1 default condition is user-defined.

Discrete output bit definitions are shown in the following diagram.



Refer to the Single-Axis Software (SASS) Motion User Guide (GM-MOTN-001), for details on configuring the I/O.

## Analog Output

A +/- 10 V analog output is supplied via connector J1 on the front of the module. This output is configured by you via the analog output setup command; it is available for diagnostic purposes, or it can be placed under user program control.

## The Motor Drive Interface

The interface to the motor drive from the MOT 201 consists of several digital and analog I/O signals:

- A drive enable signal
- A drive fault signal
- Velocity or current command signals

A form C relay is provided to enable the drive. A true high drive fault signal is accepted from the drive that must be held at ground to indicate a non-fault condition.

A differential +/- 10 V analog signal is provided to control a dc drive. This signal can be software configured to be a velocity or current command. Connection for the motor drive is made to the module through the J3 connector.

Two AS-W922 cables are available. They are terminated to plug into your module at one end and unterminated at the other end.

**Note:** Servo motor thermal overload switches should always be monitored to prevent equipment damage. The MOT 201 does not have a dedicated input for this function. Either a MOT 201 input or some other system input should be used in your system design to monitor this condition.

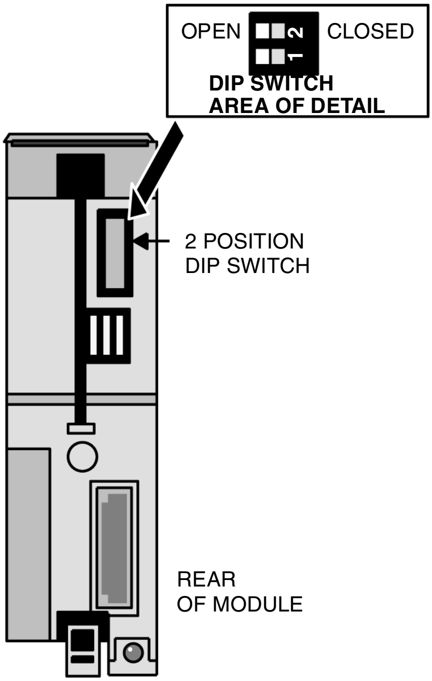
## The DIP Switch

The MOT 201 has an RS-232 serial port to connect the module to an IBM PC (or compatible) running the Modicon Motion Development Software (MMDS). A two-position DIP switch is located on the rear panel of the module. SW1 is used to specify the module's operating mode (984 or MMDS control). SW2 is used to specify the communication characteristics of the Modbus port upon power-up.

The MOT 201 DIP switch settings are listed in the following table.

| DIP Switch | Position | Function |
|---|---|---|
| SW1 | Left/Open (factory set) | Compact 984 Controlled |
| | Right/Closed | MMDS Controlled |
| SW2 | Left/Open (factory set) | Programmed baud |
| | Right/Closed | Modbus Default |

The MOT 201 DIP switch locations are shown in the following illustration.



### Setting the Operating Mode with SW1

The SW1 setting determines which device can write to the MOT 201. The setting is read at power-up and selects either the MMDS or the Compact 984 to control the operation of the module. This mode selection is a safety feature that prevents you from accidentally issuing commands to the module using MMDS while it is being controlled by the Compact 984.

The control priority (SW1) is as follows:

1. When only MMDS is attached to the module, it has write privilege regardless of the setting on SW1.
2. When only the Compact 984 is communicating via Traffic Cop to the module, it has write privilege regardless of the setting of SW1.
3. When the Compact 984 has issued the local lockout command, it has write privileges regardless of the setting of SW1 and whether or not MMDS is attached.
4. When the local lockout command is not issued and both the Compact 984 and MMDS are communicating to the module, the setting of SW1 controls which device has write privilege.

**Note:** Either device may read (i.e. a GET command) at any time. However, reading the error log (a system command) is not allowed without write privilege because the log is lost once it is read. Refer to Single-Axis Software System (SASS) Motion User Guide (GM-MOTN-001) for details.

### Setting the Modbus Communication Characteristics (SW2)

Switch#2 controls the Modbus communication characteristics. When the module is powered up, SW2 is read. When the switch is closed then the default characteristics are used. When the switch is open then the communication characteristics last saved in the module are used.

Once communication characteristics are initialized, they may be changed at any time under software control only if SW2 is in the open position. Refer to Single-Axis Software System (SASS) Motion User Guide (GM-MOTN-001) for details.

When SW2 is closed, the Modbus port default characteristics are as follows:

- 1 start bit
- 7 data bits
- 1 stop bit
- Even parity checking
- 9600 baud rate

## Modbus Connections

The 9-pin serial modbus connections are listed in the following table.

| Signal | Computer Pin | MOT Pin | Signal | Function |
|---|---|---|---|---|
| | 1NC | 1NC | | Shield |
| TXD | 2 | 3 | RXD | Serial data |
| RXD | 3 | 2 | TXD | Serial data |
| GND | 5 | 5 | GND | Ground |
| DTR | 4 | 6 | DSR | Control line |
| DSR | 6 | 4 | DTR | Control line |
| RTS | *7 | / 7* | RTS | Control line |
| CTS | *8 / | 8* | CTS | Control line |
| | 9NC | 9NC | +5 V | Future Use |
| * These pins are jumpered (7 & 8) on both. | | | | |

**CAUTION**

**Ensure 5 V power is correct for the application.**

Pin 9 supplies 5 V of power (75 mA). Make sure this is the correct pin for your application before wiring.

**Failure to follow this instruction can result in injury or equipment damage.**

The 25-pin serial modbus connections are listed in the following table.Modbus Connections for 25-Pin Serial.

| Signal | MOT Pin | Computer Pin | Signal | Function |
|---|---|---|---|---|
| | 1NC | 1NC | | Shield |
| TXD | 2 | 2 | RXD | Serial data |
| RXD | 3 | 3 | TXD | Serial data |
| GND | 5 | 7 | GND | Ground |
| DTR | 4 | 6 | DSR | Control line |
| DSR | 6 | 20 | DTR | Control line |
| RTS | *7 | / 4* | RTS | Control line |
| CTS | *8 / | 5* | CTS | Control line |
| +5 V | 9NC | 9NC | +5 Vdc | Future Use |
| * These pins are jumpered, (7&8 on MOT, 4&5 on computer). | | | | |

## Overview of the MOT 202 Motion Module

**Brief Description**

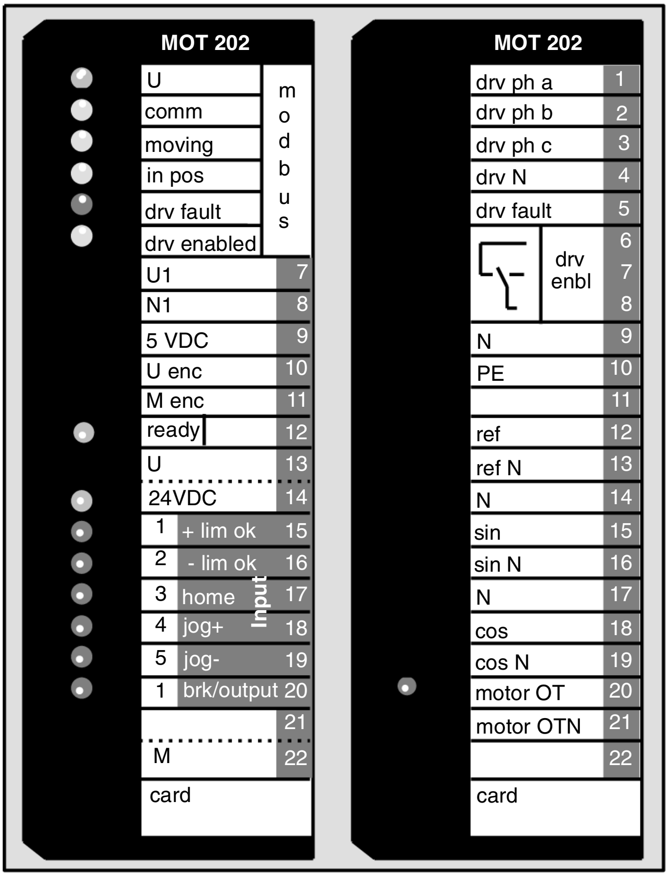
The MOT 202 is a resolver and encoder designed to interface directly to the Modicon Cyberline CL1000 series and M100 series of brushless servo amplifiers and brushless motors in addition to all the MOT 202 capabilities. Control of the MOT 202 can be:

- Through the backplane of the A120 Series I/O system bus interface
- Through the Modbus interface
- By internally stored user programs

The MOT 202 is a double-size module that requires two contiguous slots in an A120 I/O backplane.

**Note:** The MOT 202 does not fit in the last two (rightmost) slots of a DTA 200 or DTA 201 backplane.

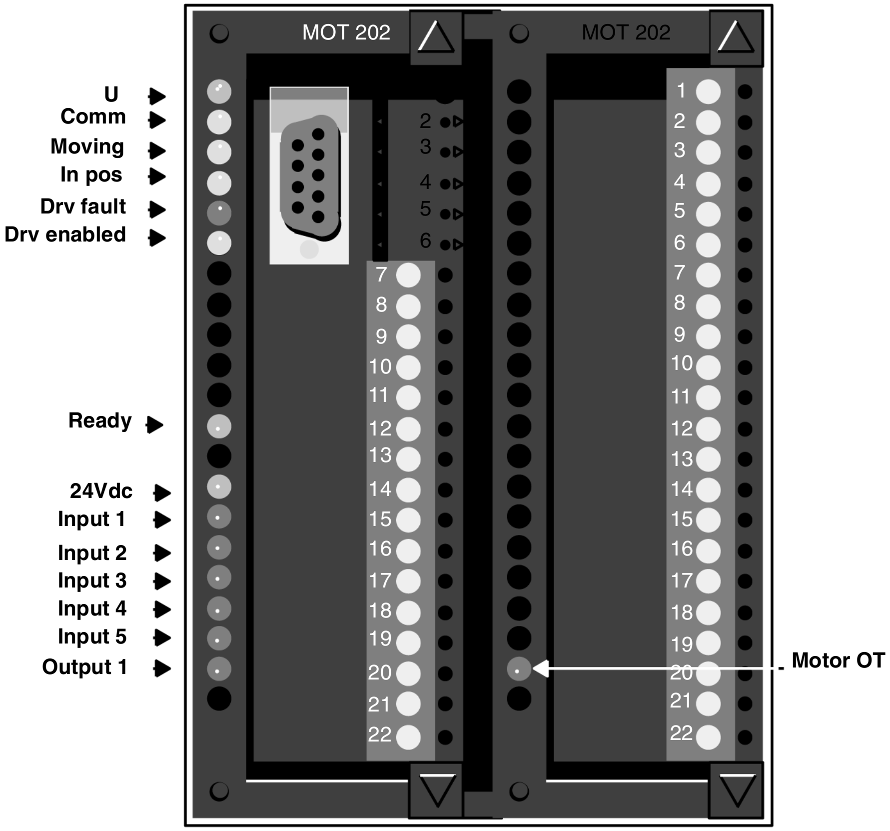
A front view of the MOT 202 Motion module is provided below.



## LEDs

Fifteen LEDs are visible on the front panel to indicate various functions and conditions.

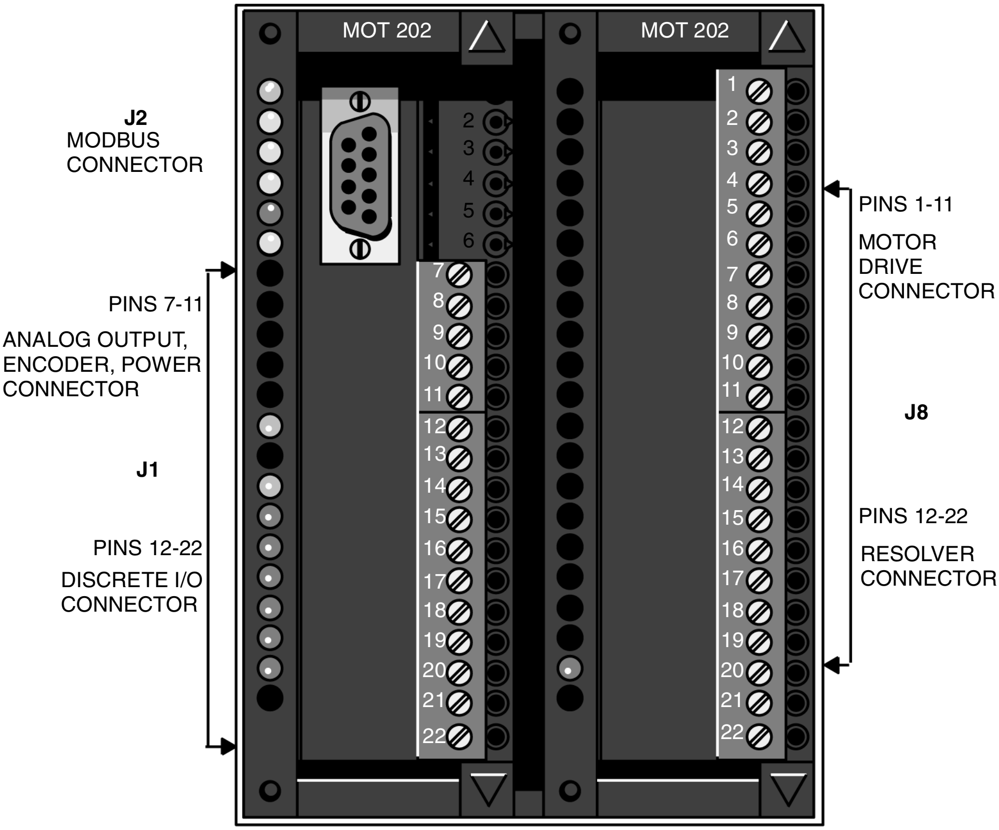
Refer to the following diagram and table for the indicator positions, nomenclature and a brief explanation of their functions.



| Indicator | Color | Meaning |
|---|---|---|
| U (POWER OK) | Green | Backplane power is present |
| Comm (MODBUS) | Amber | Blinking = RS-232 serial port communication link active |
| Moving | Amber | MOT is still commanding new positions for the motor |
| In pos | Amber | Difference between the target position and the actual motor position less than In Position Band parameter value |

| | | |
|---|---|---|
| Drv fault (DRIVE FAULT) | Red | A fault condition exists in the drive controlled by the MOT |
| Drv enabled (DRIVE ENABLED) | Amber | Drive enable signal to the drive is active |
| Ready (MODULE OK) | Green | MOT is operational. When not ON, a failure of the module has been detected. When blinking once every 3 s, module is in kernel mode and the executive must be downloaded |
| 24Vdc | Green | 24 Vdc for the I/O is present |
| Input 1 (+LIMIT OK) | Red | Motor has not reached the maximum limit for clockwise motion, or user-configured input 1 is active |
| Input 2 (- LIMIT OK) | Red | Motor has not reached the maximum limit for counterclockwise motion, or user-configured input 2 is active |
| Input 3 (HOME LIMIT) | Red | Motor is not at the Home switch, or user-configured input 3 is active |
| Input 4 (JOG +) | Red | Jog + switch or user-configured input 4 is active |
| Input 5 (JOG -) | Red | Jog - switch or the user-configured input 5 is active |
| Output 1 (BRAKE) | Red | Brake control is active(brake released), or user-configured output 1 is active |
| Motor O.T. | Red | Motor over temperature condition |

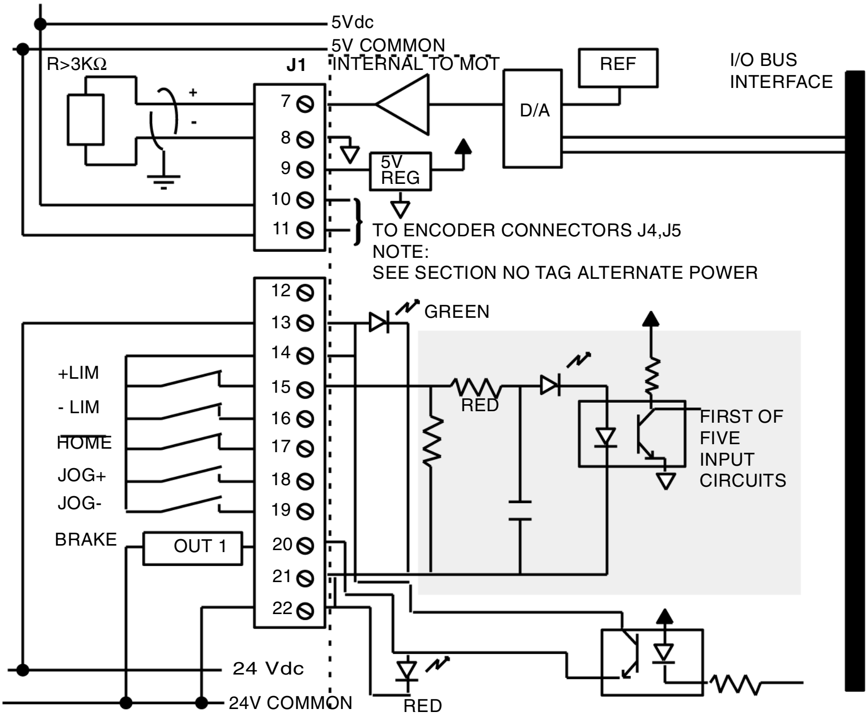
**Connectors** The MOT 202 has 7 connectors (J1, J2, and J8 on the front of module) (J4, J5, J6, and J7 on the bottom of module).



The J2 connector is a standard 9-pin, D-shell RS-232 serial port. Its operating mode and communications parameters are set via a DIP switch on the back of the unit (discussed later in this chapter).

## MOT 202 J1 Connector

The J1 connector is a 22-screw terminal I/O connector, as shown in the Discrete I/O, Analog Output, and Encoder Power wiring diagram below.

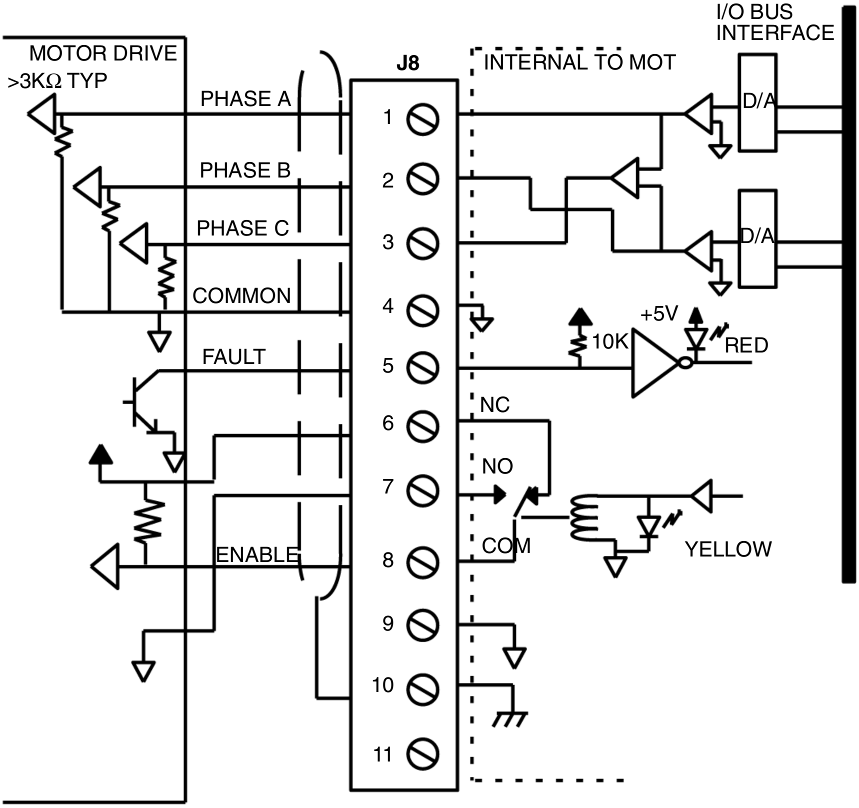


J1 discrete connections are listed in the following table.

| Pin # | Function | Pin # | Function |
|---|---|---|---|
| 1 ... 6 | Not Used | 15 | +Travel limit/Aux in1 |
| 7 | Analog output | 16 | -Travel limit/Aux in 2 |
| 8 | Analog output return | 17 | Home/Aux in 3 |
| 9 | +5 Vdc | 18 | Jog+/Aux in 4 |
| 10 | Encoder Power | 19 | Jog-/Aux in 5 |
| 11 | Encoder power return | 20 | Aux 1 output/Brake |
| 12 | Not Used | 21 | 24 Vdc common |
| 13 | 24 Vdc power | 22 | 24Vdc common |
| 14 | 24 Vdc power | | |

## MOT 202 J8 Connector

J8 is a 22-screw terminal connector that may be for the motor drive and resolver wiring. The top half of J8 (terminals 1 ... 11) is for motor wiring.



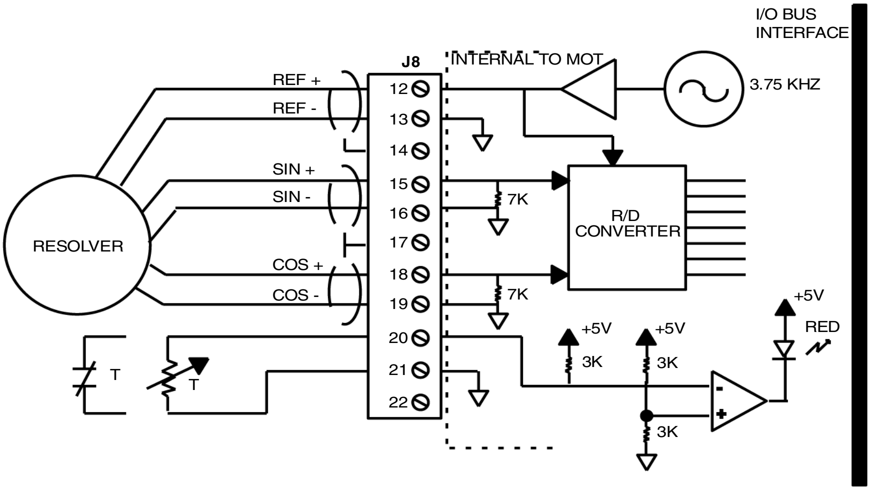
J8 drive connections are listed in the following table.

| Pin # | Function | W922 Cable Color |
|---|---|---|
| 1 | +Velocity command | Black |
| 2 | Common | White |
| 3 | -Velocity command | Blue |
| 4 | Common | Orange |
| 5 | Drive fault input | Yellow |
| 6 | Drive enable contact (N.C.) | Red |
| 7 | Drive enable contact (N.O.) | Brown |
| 8 | Drive enable common | Green |
| 9 | Common | Purple |
| 10 | Key | Gray |

**Note:** The J6 connector on the bottom of the module performs the same motor wiring function. If you are using an AS-W922 cable for motor drive wiring, use the J6 connector. If not, you can choose between J8 or J6.

## Bottom Half J8 Connector

The bottom half of J8 (terminals 12 ... 22) is for resolver wiring.

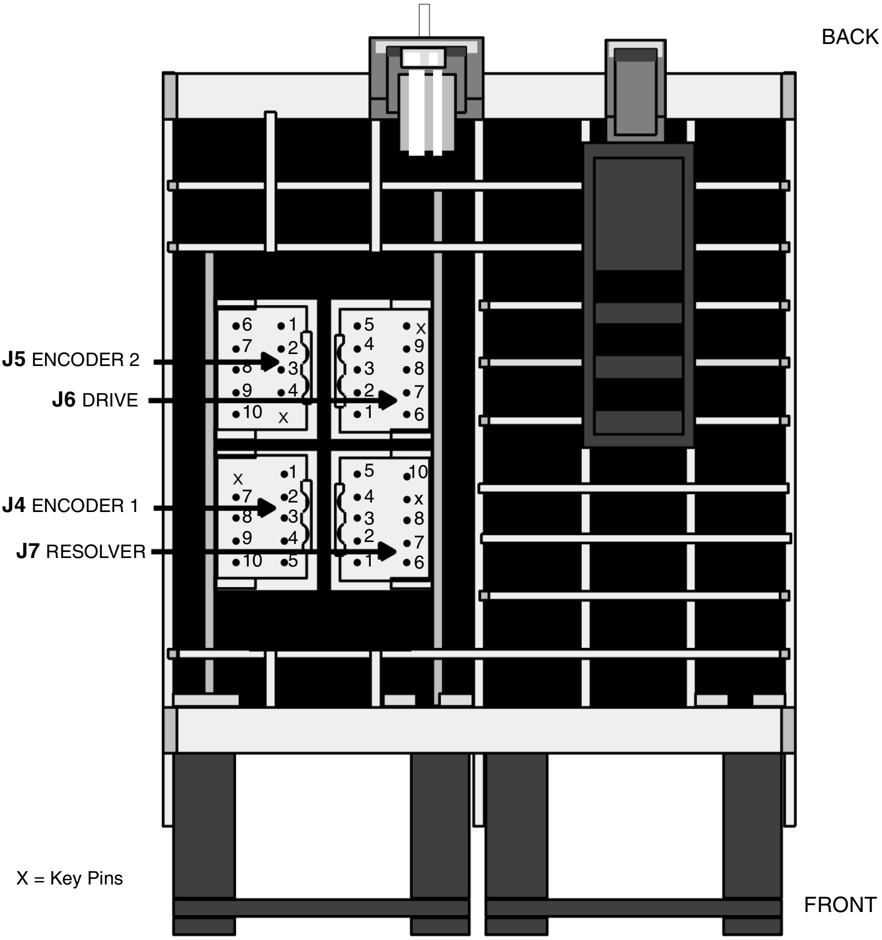


| J8 Pin # | J7 Pin # | Function |
|---|---|---|
| 12 | 2 | Reference output high |
| 13 | 7 | Reference output low |
| 14 | 4 | Shield |
| 15 | 3 | Sine input high |
| 16 | 8 | Sine input low |
| 17 | | Shield |
| 18 | 5 | Cosine input high |
| 19 | 10 | Cosine input low |
| 20 | 1 | Motor O.T. input high |
| 21 | 6 | Motor O.T. input low |
| | 9 | Not Used |

## MOT 202 Bottom Connectors

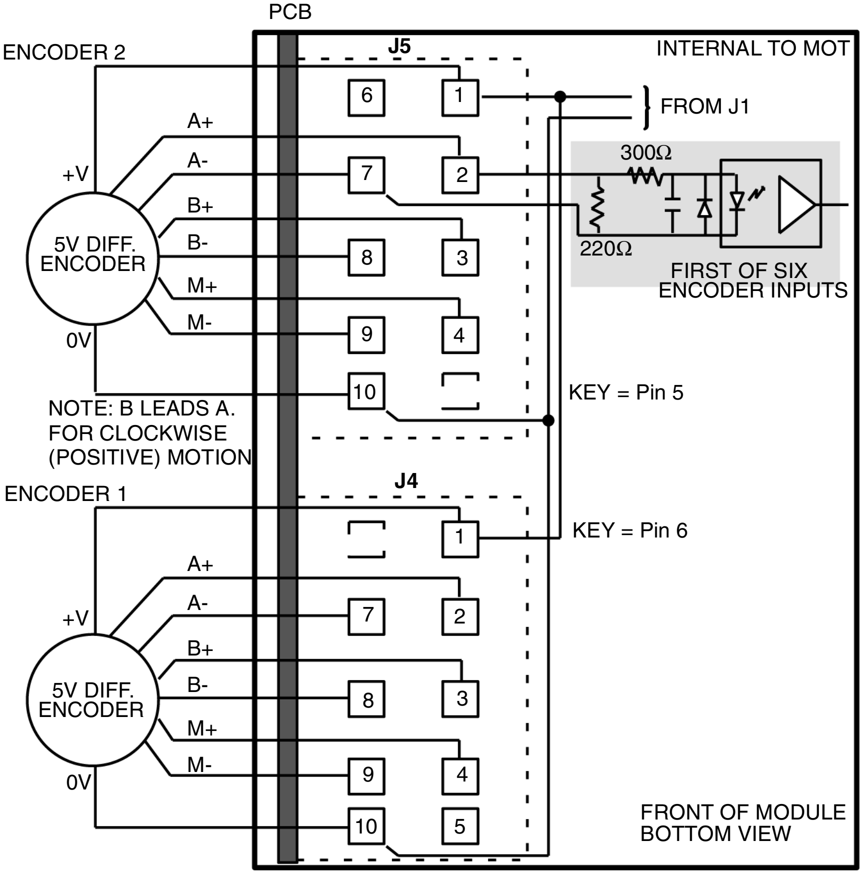
**Note:** The J7 connector on the bottom of the module performs the same resolver wiring function as terminals 12 ... 22 on J8. If you are using an AS-W922 cable for resolver wiring, use the J7 connector. If not, you can choose between J8 or J7.

The J4 ... J7 connectors are located on the bottom of the module.



**MOT 202 J5 Connectors**

J4 and J5 are 10-pin encoder feedback connections. The pins on these two connectors have nearly identical functionality (pins 5 and 6 are different).



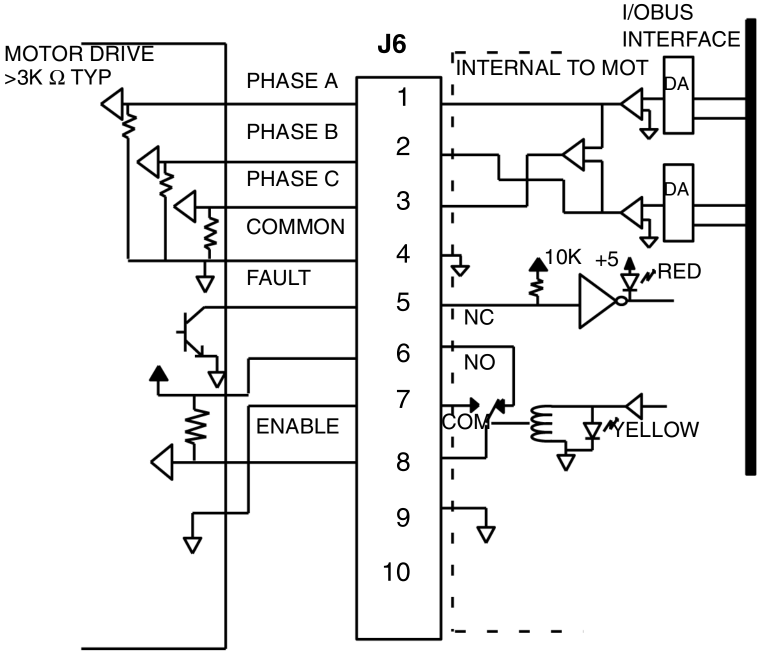
J4 and J5 encoder feedback connections are listed in the following table.

| Pin # | Function |
|---|---|
| 1 | Encoder power |
| 2 | + Phase A |
| 3 | + Phase B |
| 4 | + Mark |
| 5 | Key (J5) |
| 6 | Key (J4) |
| 7 | - Phase A |
| 8 | - Phase B |

| | |
|---|---|
| 9 | - Mark |
| 10 | Encoder Power return |

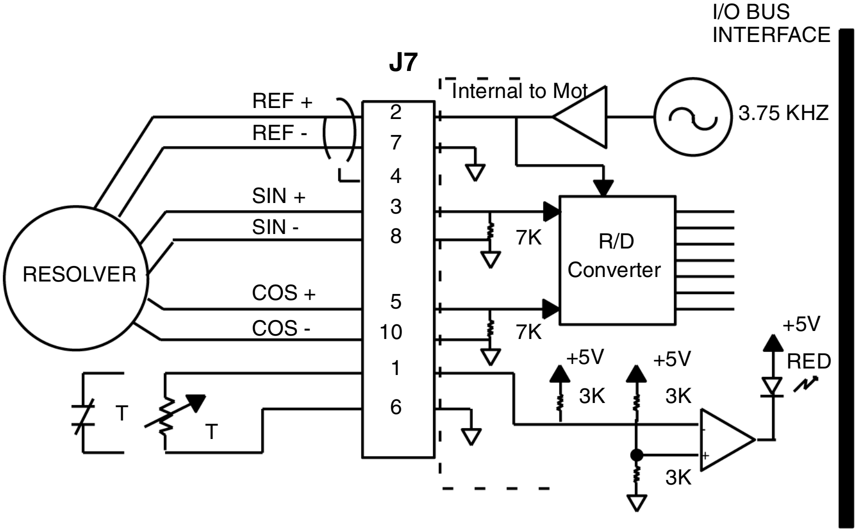
## MOT 202 J6 and J7 Connectors

J6 is a 10-pin connector that may be for the motor drive wiring.



**Note:** The first 11 terminal screws of the J8 connector on the front of the module perform the same motor wiring function. If you are using an AS-W922 cable for motor drive wiring, use the J6 connector. If not, you can choose between J8 or J6.

J7 is a 10-pin connector that may be used for resolver wiring:



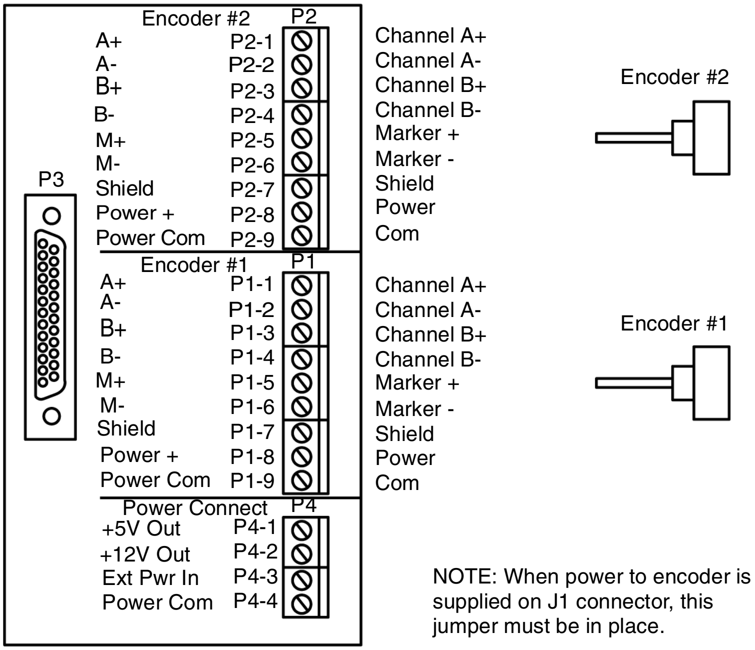
**Note:** The J7 performs the same resolver wiring function as terminals 12 ... 22 of the J8 connector on the front of the module. If you are using an AS-W922 cable for resolver wiring, use the J7 connector. If not, you can choose between J8 or J7.

## The Encoder Feedback Interface

The MOT 202 accepts feedback from one or two +5 V differential encoders. You may pick between the following two connection options:

- Option 1 uses an AS-W922-008 or AS-W922-015 generic cable, which is terminated at one end and unterminated at the other to plug into either encoder connector on your module
- Option 2 connects to the encoders through a cable and an optional AS-BR85-110 Breakout module.

An AS-W923 encoder breakout cable has a male DB25 connector at one end; the other end has two connectors to attach to the module's two encoder connectors.



NOTE: When power to encoder is supplied on J1 connector, this jumper must be in place.

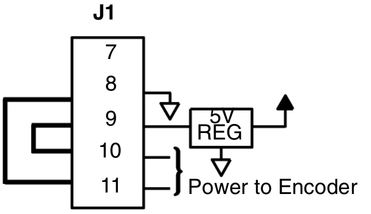
Cables and breakout modules are listed in the following table.

| Part Number | Use | Cable Description |
|---|---|---|
| 100-338-XXX | Drive | Cyberline1000 to Discrete Wires (008, 015) |
| AS-W921-XXX | Drive | Cyberline1000 to 10-position AMP Shielded MT Connector (008, 015) |
| AS-W922-XXX | Generic | 10-pin AMP Shielded MT Connector to Wires (008, 015) |

| | | |
|---|---|---|
| AS-W923-XXX | Encoder Breakout | Two 10-pin AMP Shielded MT Connectors to DB25 Connector (Y Cable) (003, 006) |
| AS-W955-XXX | Modbus | DB9 to DB25 (012, 025) |
| AS-W956-XXX | Modbus | DB9 to DB (012, 025) |
| AS-BR85-110 | Breakout Module | For use with AS-W923 cable |
| XXX stands for the cable length. | | |

The breakout module is a DIN rail-mountable terminal block PCB assembly and accommodates discrete wiring from the encoder(s). It has a female DB25 connector for the cable attachment and the terminals are clearly marked with the appropriate encoder connections.

An external power supply is typically used with an encoder (see illustration below). However, when total encoder power (for one or two encoders) requires no more than 75 mA of power, you may use 5 Vdc power from the Compact 984 and thus eliminate the need for the external power supply.

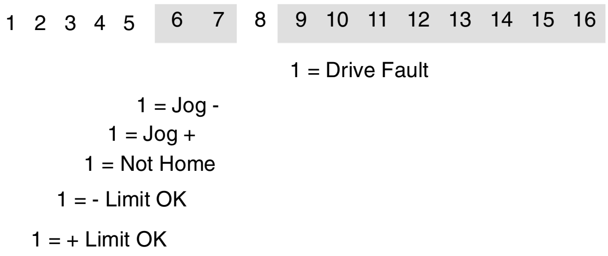


NOTE:
IF USING INTERNAL POWER YOU MUST
ADD THESE EXTERNAL JUMPERS.

**Discrete I/O**

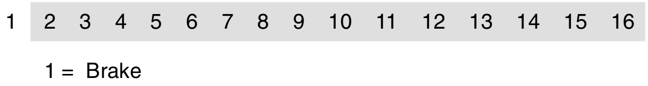
The MOT 202 contains five discrete inputs and one discrete output. The inputs can be used as either user-defined discrete inputs or as predefined inputs. The discrete output as well as the inputs are controlled by the I/O command set.

The register bit assignments are shown in the following diagram.



**Note:** Module inputs 1 (+ Limit OK), 2 (- Limit OK) and 3 (NOT HOME) default to 1 (predefined) at power-up while inputs 4 (Jog +) and 5 (Jog -) default to 0 (discrete).

Discrete output bit definitions are shown in the following diagram.



Refer to the Single-Axis Software (SASS) Motion User Guide (GM-MOTN-001), for details on configuring the I/O.

**Analog Output**

A +/- 10 V analog output is supplied via connector J1 on the front of the module. This output is configured by you via the analog output setup command; it is available for diagnostic purposes, or it can be placed under user program control.

## The Motor Drive Interface

The interface to the motor drive from the MOT 202 consists of several digital and analog I/O signals:

- A drive enable signal
- A drive fault signal
- Three-phase current commands

A form C relay is provided to enable the drive. A true high drive fault signal is accepted from the drive that must be held at ground to indicate a non-fault condition.

Three +10 V analog current commands are provided to control a three-phase brushless ac motor. For dc drives, only two of the three phases (phase A and phase C) are used. Connection for the motor drive may be made to the module through the connector on the bottom of the module (J6) or to the discrete wiring points on the front (J8) of the module.

Two AS-W922 cables are available. They are terminated to plug into your module at one end and unterminated at the other end.

## Resolver Feedback/ Thermal Interface

The MOT 202 may use a resolver to provide feedback for the position, velocity and commutation of the motor. A resolver is essentially a rotary brushless transformer that provides absolute position information to the MOT. The MOT calculates an absolute position from the continuous signal of the resolver.

The MOT provides a reference output to drive transmit mode resolvers. The drive signal is a 3.75 kHz, self-compensating sine wave. The amplitude of the reference is adjusted by the module (if necessary) at power-up to get returned signal strengths of approximately 2 Vrms at the sine and cosine inputs of the module.

Connection for resolver feedback may be made to the module through the connector on the bottom of the module (use cable AS-W922-XXX) or to the discrete wiring points on the front of the module.

**Note:** If the cable length between MOT and the resolver is more than 100 ft, please consult with Modicon.

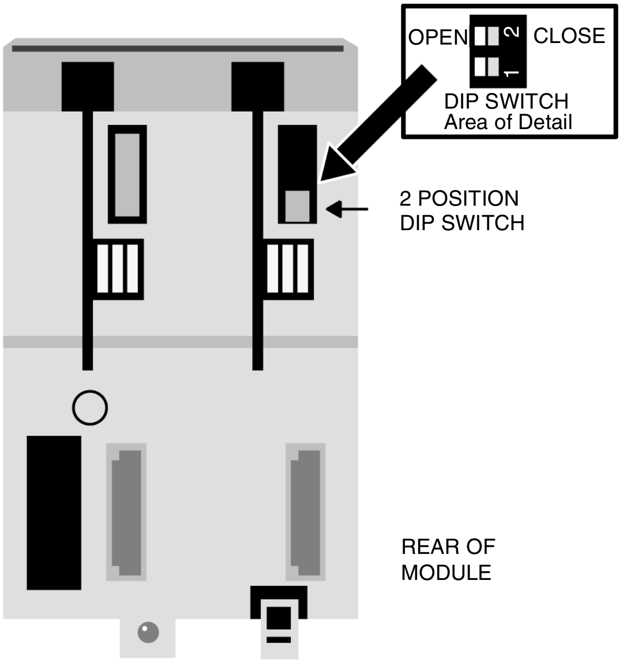
The module can also monitor motor temperature by means of a thermistor or thermostatic switch. The two-wire input recognizes a high impedance (greater than 3072 or open switch) as an over temperature condition. When the input is not used it must be shorted. The over-temperature fault is reported to MMDS or the Compact 984 as a drive fault. The over-temperature fault may be distinguished from a normal drive fault by observing the associated indicator on the front of the module.

**DIP Switches**

One two-position DIP switch is located on the rear panel of the module. SW1 determines the module's mode of operation (984 or MMDS control). SW2 determines the communication characteristics of the Modbus port upon power up of the module.

| DIP Switch | Position | Function |
|---|---|---|
| SW1 | Left/Open (factory set) | Compact 984 Controlled |
| SW1 | Right/Closed | MMDS Controlled |
| SW2 | Left/Open (factory set) | Programmed baud |
|  | Right/Closed | Modbus Default |

The MOT 202 DIP switch locations are shown in the following illustration.



## Setting the Operating Mode with SW1

The SW1 setting determines which device can write to the MOT 202. The setting is read at power-up and selects either the MMDS or the Compact 984 to control the operation of the module. This mode selection is a safety feature that prevents you from accidentally issuing commands to the module using MMDS while it is being controlled by the Compact 984.

The control priority (SW1) is as follows:

1. When only MMDS is attached to the module, it has write privilege regardless of the setting on SW1.
2. When only the Compact 984 is communicating via Traffic Cop to the module, it has write privilege regardless of the setting of SW1.
3. When the Compact 984 has issued the local lockout command, it has write privileges regardless of the setting of SW1 and whether or not MMDS is attached.
4. When the local lockout command is not issued and both the Compact 984 and MMDS are communicating to the module, the setting of SW1 controls which device has write privilege.

**Note:** Either device may read (i.e. a GET command) at any time. However, reading the error log (a system command) is not allowed without write privilege because the log is lost once it is read. Refer to Single-Axis Software System (SASS) Motion User Guide (GM-MOTN-001) for details.

## Setting the Modbus Communication Characteristics (SW2)

Switch#2 controls the Modbus communication characteristics. When the module is powered up, SW2 is read. When the switch is closed then the default characteristics are used. When the switch is open then the communication characteristics last saved in the module are used.

Once communication characteristics are initialized, they may be changed at any time under software control only if SW2 is in the open position. Refer to Single-Axis Software System (SASS) Motion User Guide (GM-MOTN-001) for details.

When SW2 is closed, the Modbus port default characteristics are as follows:

- 1 start bit
- 7 data bits
- 1 stop bit
- Even parity checking
- 9600 baud rate

The 9-pin serial modbus connections are listed in the following table.

| Signal | Computer Pin | MOT Pin | Signal | Function |
|---|---|---|---|---|
| | 1NC | 1NC | | Shield |
| TXD | 2 | 3 | RXD | Serial data |
| RXD | 3 | 2 | TXD | Serial data |
| GND | 5 | 5 | GND | Ground |
| DTR | 4 | 6 | DSR | Control line |
| DSR | 6 | 4 | DTR | Control line |
| RTS | *7 | / 7* | RTS | Control line |
| CTS | *8 / | 8* | CTS | Control line |
| | 9NC | 9NC | +5 V | Future Use |
| * These pins are jumpered (7 & 8) on both. | | | | |

**CAUTION**

**Ensure 5 V power is correct for the application.**

Pin 9 supplies 5 V of power (75 mA). Make sure this is the correct pin for your application before wiring.

**Failure to follow this instruction can result in injury or equipment damage.**

The 25-pin serial modbus connections are listed in the following table.Modbus Connections for 25-Pin Serial

| Signal | MOT Pin | Computer Pin | Signal | Function |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| | 1NC | 1NC | | Shield |
| TXD | 2 | 2 | RXD | Serial data |
| RXD | 3 | 3 | TXD | Serial data |
| GND | 5 | 7 | GND | Ground |
| DTR | 4 | 6 | DSR | Control line |
| DSR | 6 | 20 | DTR | Control line |
| RTS | *7 | / 4* | RTS | Control line |
| CTS | *8 / | 5* | CTS | Control line |
| +5 V | 9NC | 9NC | +5 Vdc | Future Use |
| * These pins are jumpered, (7&8 on MOT, 4&5 on computer). | | | | |

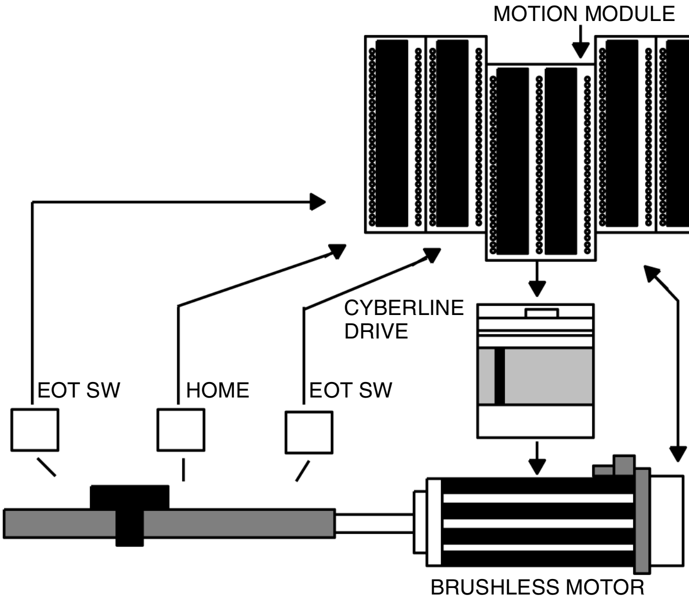
# MOT 20X Module System Information

## +EOT and -EOT Limits

The +EOT and -EOT normally closed limit switches indicate the Ends Of Travel so the MOT can stop the motor to avoid damage.

| ⚠ | **DANGER** |
|---|---|
| | **Mis-wiring Danger**<br>When wiring, ensure that moving positive moves you towards the +, and negative motion moves you towards the -EOT.<br>**Failure to follow this instruction will result in death or serious injury.** |

The following diagram illustrates a typical MOT 20X installation.



If either of these inputs becomes 0 volts (open in the line), the MOT will generate a fatal error.

**Note:** If you reach the limit switches, the MOT disables the drive and stops the motor. Otherwise system safety may be compromised.

The MOT also has software programmable end-of-travel limits to provide over-travel protection. These programmable limits stop the drive and signal a non-fatal error.

The end-of-travel limit switches provide backups for the software limits. The priority should be as follows:

Use software limits as the primary end-of-travel limit. Allow tolerance so you read the software limits before striking the limit switches.

**Note:** If you don't set the zero position properly, the software end-of-travel limits won't be where expected.

The hardware limit switches should be set outside the software limit switches. This ensures a safe system shut down and thus prevents any over shooting that may result in mechanical damage.

You may use mechanical stops to limit motion and act as a fail-safe stop. These back up the software and hardware limit switches. Plan these as you do your mechanical design.

### Home Limit

By using a home limit switch, the MOT can send the machine to its home position. The machine is considered at home when it satisfies two conditions:

- Home limit switch open-this gives the approximate home position
- Encoder or resolver at zero position

**Note:** In order to ensure that your motor establishes the same home position each time, always home in the same direction. This approach gives you a reliable and consistent homing system. It is not completely dependent on a critical switch setting.

Home works properly even if the machine holds the home switch open for several feedback revolutions. The MOT always finds the same zero. How it chooses the resolver (or encoder) zero depends on its approach. Home is the first feedback zero in the direction of the Home after the switch is open.

### Flash Memory

The MOT comes with a flash EEPROM that allows storage of application programs and configuration parameters, such as servo parameters, speed limits, etc. It will also accept firmware updates as firmware enhancements become available.

## Communications Protocol

Communications with the MOT is through six pairs of 4x and 3x registers (I/O mapped to the MOT), using a very rigid format. The first register sent is always the control register and the second register is always the command register. The first register returned is always the current status of the MOT, while the second register returned is always an echo of the command register. All remaining registers, data register 1... 4, are reserved for data and are used as necessary. For additional information refer to Single-Axis Software System (SASS) Motion User Guide (GM-MOTN-001).

**Note:** For I/O Map information refer to the 984-A120 Compact Programmable Controllers User Guide (890 USE 108 00).

## On-line/Off-line Development (MMDS)

The Modicon Motion Development Software (MMDS Ver. # 3.00 or higher) is an on-line/off-line software package which runs on a user-supplied IBM PC or compatible computer. [MMDS is purchased separately.] MMDS lets you connect the computer with the MOT (through an RS-232 serial interface) to set parameters, check module diagnostics, and exercise the motor during initial system setup. It also lets you write motion programs and download them to the Compact 984 to be used with the MRTM loadable function block, or you can download into the MOT directly.

## System Pre-Check

Do this before you apply power to the MOT system:

| Step | Action |
|---|---|
| 1 | Check all wiring-compare your wiring to the previous wiring diagrams |
| 2 | Make sure the dc power is within the range specified for the MOT. |
| 3 | Inspect the motors and loads-Are the motors securely mounted? Is it safe to run the motors? If not, remove keys from motor shafts to disconnect the motors from their mechanical loads. |
| 4 | Be sure the Compact 984 is stopped-This prevents an accidental local lockout command issued from the Compact 984 which cannot be changed by the MMDS. The MMDS is not capable of changing this setting. |

## Releasing the MOT

The only way to release the MOT is to issue the release lockout command from the Compact 984. If a Set or Motion Command is issued while the Modbus is locked out (Compact 984 command), the MOT will reject the command and set a fault bit true.

## MOT 20X Motion Module Specifications

### Table of Specifications

The following table describes MOT 20X Motion Module Specifications

### Module Topology, Required Loadable

The following section describes Module Topology and Required Loadable Specifications.

| | | |
|---|---|---|
| Module Topology | Number of Discrete Inputs | 5 |
| | Number of Discrete Outputs | 1 |
| | Number of Analog Outputs | 1 |
| Required Loadable | SW-IODR-001 | |

### Power Supplies, DIN Rail Grounding

The following section describes Power Supplies and DIN Rail Grounding Specifications.

| | | | |
|---|---|---|---|
| Power Supplies | I/O system bus 5 Vdc | MOT 201 | 300 mA |
| | | MOT 202 | 600 mA |
| DIN Rail Grounding | < 0.1 Ω | | |

## Input/Outputs, Drive Interface

The following section describes Input/Outputs and Drive Interface Specifications.

| | | | |
|---|---|---|---|
| Input/Outputs | Digital | Optically Isolated | to 500 Vdc |
| | | Output drive capability | 150 mA (using customer supplied 20 ... 28 Vdc, true high) |
| | | Input impedance | 3.5 K Ω (ON @ 15 Vdc minimum, OFF @ 5 Vdc maximum, true high) |
| | Analog | Drive capability | +/- 10 Vdc, 3 mA |
| | | Resolution | 12 bits |
| | | Accuracy | +/- 100 mVdc (without offsets) |
| | | | +/- 50 mVdc (with offset) |
| Drive Interface | Drive fault input | | True high, pulled up internally |
| | Drive enable relay | | form C contacts, 30 Vdc @ 0.5 A resistive |
| | dc motors (201/202) | Command signal | +/- 10 Vdc @ 3 mA differential |
| | | Current or velocity command | Software selectable |
| | | Phasing | Positive voltage for CW motion |
| | ac motors (202 only) | Three phase current | +/- 10 Vdc @ 3 mA |
| | | Command signal | Summing to 0 +/- 0.1 Vdc |

### Communications, Resolver Feedback

The following section describes Communications and Resolver Feedback Specifications.

| | | | |
|---|---|---|---|
| Communications | Modbus | | 1 RS-232 serial port interface |
| | Baud rate | | 300 ... 9600, 9600 default, set by software (for ASCII only) |
| | 5 Vdc supply | | 75 mA maximum |
| Resolver Feedback | Resolver reference drive | | 3.75 +/- 0.05 kHz; 2 +/- 1.0 Vrms |
| | | | 100 mA RMS drive capability |
| | | | 200 mW maximum |
| | Resolver sine/cosine inputs | | 7 K Ω impedance |
| | Resolver resolution | 14 bits | to 1350 RPM |
| | | 12 bits | to 6000 RPM |
| | | with standard transmit style resolver | +/- 10 min of arc typical |
| | System accuracy | | 16 bits to 300 RPM |
| | | | +/- 15 min of arc maximum |
| | System Repeatability | | +/- 3 min of arc |
| | Cable length | | Consult Customer Service if over 100 ft |

## Encoder Feedback

The following section describes Encoder Feedback Specifications.

| | | |
|---|---|---|
| Encoder Feedback | Differential signal | 2 V minimum |
| | Phase | B leads A for CW motion |
| | Input impedance | 145 Ω nominal |
| | Maximum encoder frequency | 500 kHz square wave |
| | | 350 ns minimum time be tween edges from phase A and B |
| | Encoder feedback loss | Detected on phase A and B differential signals. Loss of marker signal is not to be detected; results in failure to home the system |
| | Resolution | 4 times encoder line count |
| | Marker | Positive pulse for proper homing |
| | Power for encoder from Compact 984 | 5 V nominal |
| | | 4.4 V minimum |
| | | 75 mA maximum |
| | Power for encoder from external power supply | depends on encoder requirements |
| | Cable length | Consult Customer Service if over 300 ft |

## Motion, Thermistor Resistance

The following section describes Motion and Thermistor Resistance Specifications.

| | | |
|---|---|---|
| Motion | Absolute positioning range | 32 bit resolution, convertible to in, mm, or any other user-definable unit |
| | Speed range | 0 ... 6000 RPM |
| Thermistor Resistance (202 only) | Cold Resistance | 1 K Ω maximum |
| | Hot Resistance | 5 K Ω maximum |

### I/O Map, Dimensions

The following section describes I/O Map and Dimensions Specifications.

| | | | |
|---|---|---|---|
| I/O Map | Register 3x/4x | | 6 in/6 out |
| Dimensions | MOT201 | (W x H x D) | 40.3 x 145 x 117.5 mm |
| | | | 1.6x 5.6x 4.5 in |
| | MOT 202 | (W x H x D) | 86.3 x 145 x 117.5 mm |
| | | | 3.4 x 5.6 x 4.5 in |
| | MOT 201 | Weight | 0.36 kg |
| | | | 0.8 lb |
| | MOT 202 | Weight | 0.61 kg |
| | | | 1.35 lb |
| | Number of slots | MOT 201 | 1 |
| | | MOT 202 | 2 |
| | Breakout Module | | 7.6 x 13.5 x 11.4 mm |
| | | | 3.0 x 5.31 x 4.5 in* |

## Agency Approvals, Environmental Characteristics

The following section describes Agency Approvals and Environmental Specifications.

| | | | |
|---|---|---|---|
| Agency Approvals | MOT 201 | VDE 0160; UL 508; and CSA C22.2 No.142; and European Directive EMC 89/336/EEC Standards | |
| | MOT 202 | VDE 0160; UL 508; and CSA C22.2 No.142 Standards | |
| Environmental Characteristics | Temperature | Operating | 0 ... 60 degrees C |
| | | Storage | -40 ... +85 degrees C |
| | Humidity | Operating | 93 percent Rh at 60 degrees C, noncondensing |
| | | Storage | |
| | Vibration | 0.075 mm displacement amplitude | 10 ... 57 Hz |
| | | 1 g | 57 ... 150 Hz |

**Note:** The double-width MOT 202 module does not fit in the last two (rightmost) slots in the DTA 200 and DTA 201 backplanes. Select alternate slots in the backplane when mounting the MOT 202.

# Overview of the VIC/VRC/CTR 2XX Counter Input Module

# 46

## At a Glance

**Purpose**

The purpose of this chapter is to describe the VIC/VRC/CTR 2XX Counter Input Module.

**What's in this Chapter?**

This chapter contains the following topics:

## What is the VIC/VRC/CTR 2XX Counter Input Module?

### Brief Description

**Note:** The BVIC-200, 205, 212, and 224 modules are now referred to as BVRC-200, BCTR-205, 212 and 224 respectively. The VRC200 is designed for use as a Variable Reluctance Counter to be used with AC signals. The Counter modules (CTR205/212/224) are designed for counting DC input signals at 5, 12 or 24 volts DC. The VRC and CTR modules are functionally the same as the original VIC modules except that they are powered off the 984's power supply instead of an external supply. The VRC and CTR models numbers also tie in the modules' applications more closely with their name.

The VRC/CTR series of counter input modules allows you to directly connect up to four high speed pulse or four VRC inputs (flowmeters, positive displacement meters, ac waveforms, etc.) to a single module. The module uses input metering Device K Factor information, and can modify this value to compensate for wear or application abnormalities.

The four VRC/CTR modules operate identically; each supports a different voltage input level.

| | |
|---|---|
| VRC-200 | VRC inputs (.025 to 36 Vac Peak typical) |
| CTR-205 | 5 Vdc |
| CTR-212 | 12 Vdc |
| CTR-224 | 24 Vdc |

## VIC/CRC/CTR 2XX Counter Input Module LEDs

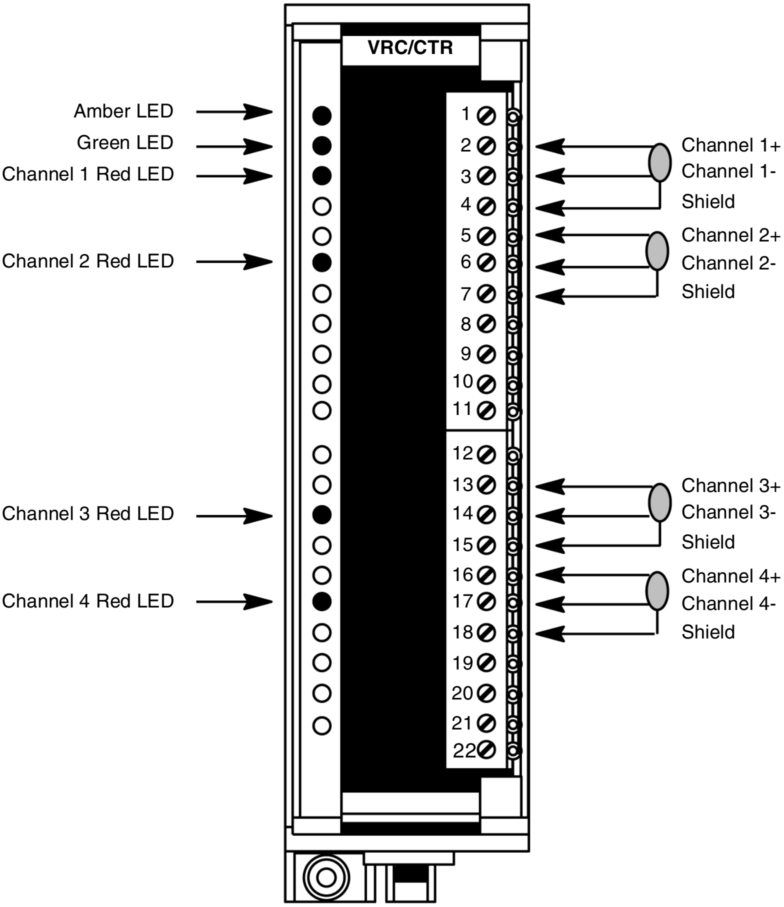
**Introduction**

The front of the VRC/CTR module has LED indicators that provide operational status, and incoming pulse annunciation.

| | |
|---|---|
| Amber | Module powered-up and passed power-up diagnostics |
| Green | Module is configured |
| Red | Input data present |

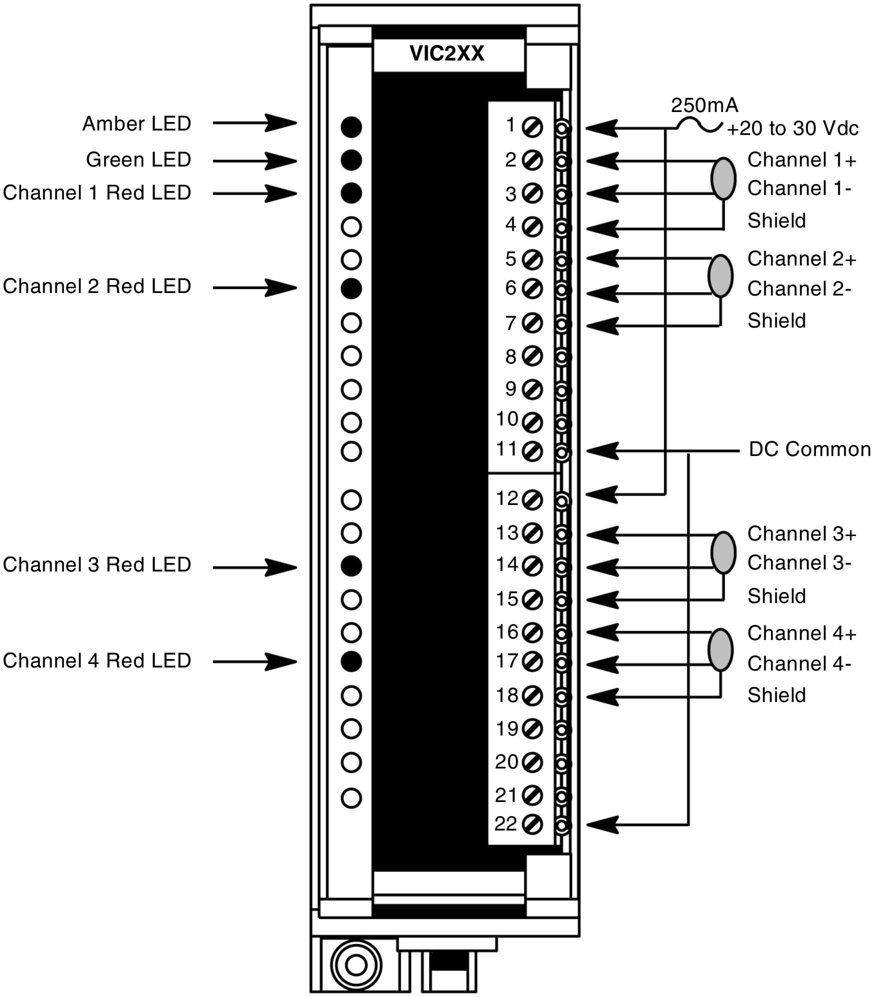
## LED Locations and Wiring of the VRC/CTR Module

The following diagram illustrates the LED locations and wiring of the VRC/CTR module.



## LED Locations and Wiring of the VIC200, 205, 212, and 212 Modules

The following diagram illustrates the LED locations and wiring ONLY of the VIC200, 205, 212, and 212 modules.



## Installation of the VRC/CTR 2XX Module

**Overview**

Installing Installing the VRC/CTR 2XX modules consists of:

- Field wiring the module for the application selected
- Configuring the module to fit its application

## VIC/CRC/CTR 2XX Counter Input Module Field Wiring

**Introduction**

The VRC/CTR module is capable of detecting extremely low voltage signals. It is very important that you minimize the amount of electrical interference that the module is exposed to. Also, exercise caution with low signal level wiring (turbine meters, pulse transducers etc.). Do not mix signal and power wiring, and ensure that signal wires cross power wiring at 90° angles.

Cables connecting field devices to the VRC/CTR module should be limited to 100 ft (30.6 m) or less. Specifications for the cable should be equal to or exceed those of Belden #8760. Grounding of the shield and instrument wires should occur only at the VRC/CTR module end of the cable. Wiring to the incoming power terminals should be protected by a field-mounted, slow blow fuse rated at 250 mA.

## VIC/CRC/CTR 2XX Counter Input Module Configuration for 16-bit Compact Controllers

**Output Registers**

The VRC/CTR 2XX uses three 4x output registers and three 3x input registers, I/O mapped as BIN data type.

| Output Register | Function |
|---|---|
| 4x | Factor Data Word |
| 4x + 1 | Control Word 1 |
| 4x + 2 | Control Word 2 |

**Factor Data Word**

This register is used to send into the module K or Meter factor data for each of the four input channels. Control Words 1 and 2 are used to load this factor data into the module.

**K Factor Valid Data**

Valid K factor values are integer numbers in the range 1 ... 65,535. K factor values are typically located on the meter housing, and should be entered exactly as seen on the housing. If you want data to be counted as engineering units, this is where the value would be entered.

Factor data values loaded into each channel inform the module how many pulses to count before incrementing an on-board counter for each input channel. If a value is loaded into the K factor location, the module will provide information to the PLC based on each channel's K factor.

If a channel's K factor is zero (0), the module will provide raw or unit counts to the PLC. To change this value, simply enter a new K factor value into the factor register and sets the respective bit in output register #2 (bits 13, 14, 15, or 16, respectively, for input channels 1, 2, 3, or 4).

## Meter Factor Valid Data

Meter factor values are used to apply a corrective offset or calibration value against a K factor. This feature allows a meter's K factor value to be modified in the field. This is helpful because a meter or field device's characteristics may change as it wears or accumulates material that affects its accuracy.

Typical data used for meter factors are numbers from 0.0001 ... 1.9999, where 1.0000 means no error exists and no correction has been made. To load a Meter factor value, you must enter a five-digit number between 00001 ... 19999 into output register 1 and set the appropriate bit in output register 3 (control word 2). Do not enter a decimal point, since the module assumes a decimal point between the fourth and fifth digits (the meter factor value has an implied decimal to the right of the most significant digit.).

This number is multiplied into the K factor value, with the result being used to form the C factor. Therefore, if you want to calculate the C factor manually,

C factor = (K x M)/10,000

The module as shipped from the factory defaults to a Meter factor of 10000 (unity gain). To change a Meter factor value, simply place the new value into the factor register and set the respective bit in output register 3, bits 1, 2, 3, or 4.

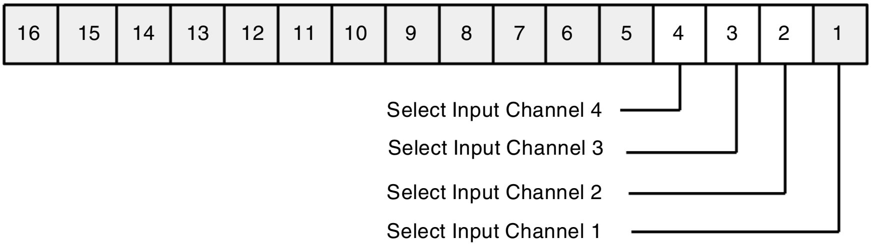
## Control Word #1 (4x + 1)

This register is used to:

- Select the input to be read
- Clear input channel data
- Suspend an input channel's counting and hold its value
- Load input channel K factor data

### Input Channel Select (Control Word 1, bits 1 ... 4)

The following graphic shows the input channel select.

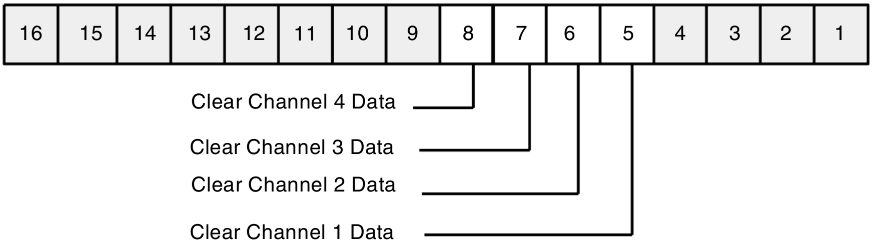


Only one of these bits may be ON at any time. If more than one of these bits is ON, only one channel will be displayed in the input data register. The order of Priority for determining which channel is displayed when multiple bits are ON is 1, 2, 3, and 4.

**Note:** If auto sequence is enabled, these bits are ignored.

### Clear Channel Data (Control Word 1, bits 5 ... 8)

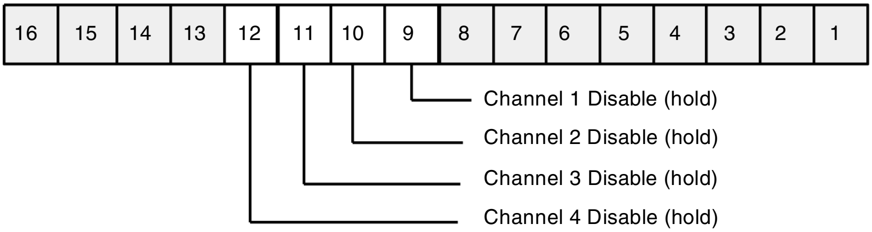
The following graphic shows the clear channel data.



To clear a specific channel's count data, set the appropriate bit to ON (1). If a bit is set ON, that channel's data will be reset and held to zero.

## Channel Hold (Control Word 1, bits 9 ... 12)

The following graphic shows the channel hold.



To suspend counting and HOLD a channel at a value, set the appropriate bit ON (1). The VRC/CTR will suspend counting that channel and hold the value until the bit is released (0), at which time the channel will again monitor the incoming pulses.

### ⚠ CAUTION

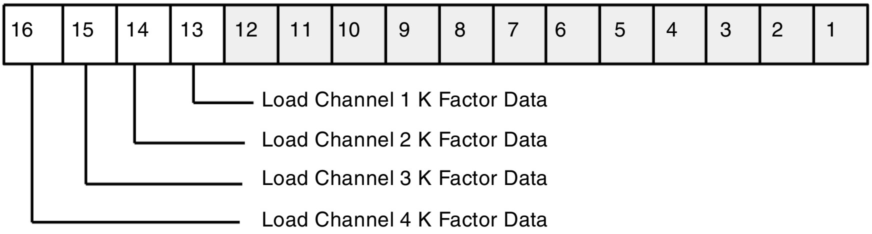
**Response speed.**

The Channel Hold feature is not intended for immediate or instantaneous control. The ability or speed with which the VRC/CTR module is capable of holding a value depends on a number of factors: PLC scan time, incoming pulse speed, module activity, and the status of other channels. All of these factors may influence how fast the VRC/CTR module can respond to a HOLD request from the PLC.

**Failure to follow this instruction can result in injury or equipment damage.**

## Load K Factor Data (Control Word 1, bits 13 ... 16)

The four bits shown below are used to load K factor data into the VRC/CTR module.



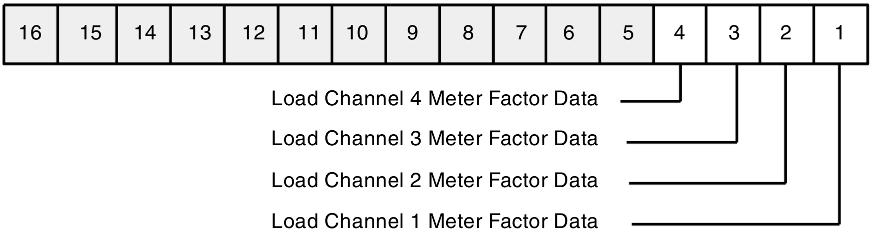
### Control Word 2 (4x + 2)

This register is used to:

- Load input channel meter factor data
- Select the channel input data to be accumulated (counts or input frequency)
- Invoke automatic channel sequencing
- Select the factor (K, Meter, or C) to be displayed
- Select raw input frequency display

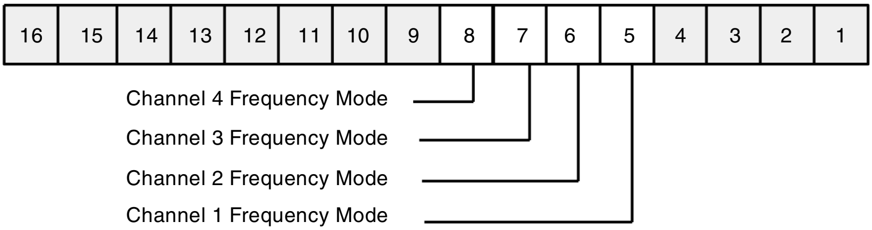
### LOAD METER FACTOR DATA (Control Word 2, bits 1 ... 4)

These four bits load the meter factor data into the VRC/CTR module.



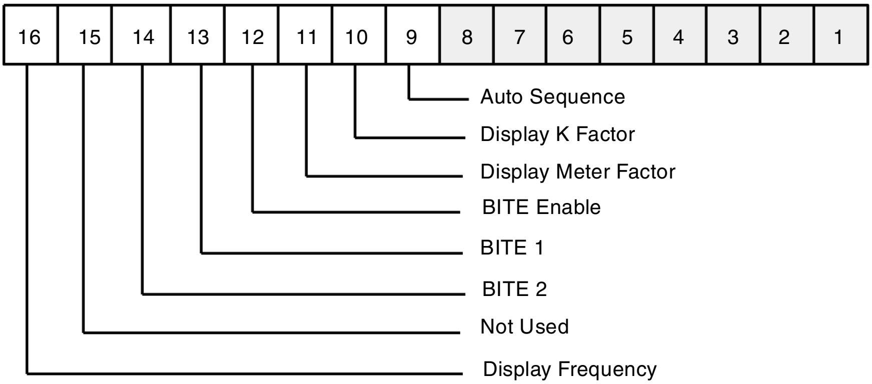
### Frequency Mode (Control Word 2, bits 5 ... 8)

The module can display, accumulate, or totalize incoming counts, or it can display the data in rate or frequency. Setting bits 5 ... 8 to a 1 causes data frequency to be displayed.



**Auto Scan (Control Word 2, bits 9 ... 16)**

The VRC/CTR module has the ability to auto scan its input channels. This feature allows you to easily integrate the VRC/CTR module into the Compact 984 PLC system with minimal ladder programming.



**Bit 9—Auto Sequence**

By setting bit 9 ON (1), the module sequentially displays each of the four input channels to register 3**x**. The VRC/CTR module will sequence through each of the four channels on a **1**/**2** s time base (2 s total update of all four channels).

**Note:** This bit will override the manual channel select bits (output word 2, bits 1 ... 4).

**Bit 10—Display K Factor**

By setting bit 10 ON (1), the module displays the K factor data for the enabled channel in input word 2. If this bit is OFF (0) and the display Meter factor bit is OFF, the module displays the calculated factor value (C Factor) for each channel in input word 2.

**Bit 11—Display Meter Factor**

By setting bit 11 ON (1), the module displays the Meter factor data for the enabled channel in input word 2. If this bit is OFF (0) and the display K factor bit is OFF, the module displays the calculated factor value (C Factor) for each channel in input word 2.

**Bits 12 ... 14—BITE (Built–in Test Enable)**

Refer to *Troubleshooting, p. 607* for BITE test information. Set these bits to 0 for normal information. Set to 1 for diagnostic test.

**Note:** Bit 15 of control word 2 is unused.

**Bits 12 ... 14—Display Frequency**

It may be desirable to see the raw frequency being delivered to one of the respective input channels. If bit 16 is set ON (1) and the module is in the rate mode, the data input register 1 will reflect raw frequency (Hz) being read at the respective input channel. The scaled rate and counting will continue in the background.

**Input Registers**

The read field consists of three 3**x** words that provide data or status information to the Compact 984 processor.

| Input Register | Function |
|---|---|
| 3*x* | READ DATA |
| 3*x + 1* | Factor Value |
| 3*x + 2* | Status Word |

**Input Data (3x)**

Count data for all four channels is displayed in this register. Data may be displayed on demand (manually) or can be sequentially (automatically) displayed by the VRC/CTR module.

**Factor Value (3x +1)**

Register 2 is used to display K, Meter, or the C Factor values used by each channel of the VRC/CTR module. This register provides a means of verifying that the factor value loaded into each channel of the VRC/CTR module is correct. You must monitor the active channel bits to accurately determine each channel's data at any given moment in time.

**C Factor Data**

C Factor (Calculated Factor) is the result of the K factor being multiplied by the Meter factor and then being divided by 10,000 prior to being displayed to the PLC. Meter factor default is 10000 (unity) and K factor default is 0. When K and Meter factors are in their default state, the C factor will equal the raw frequency delivered to the VRC/CTR module by the flow meter.

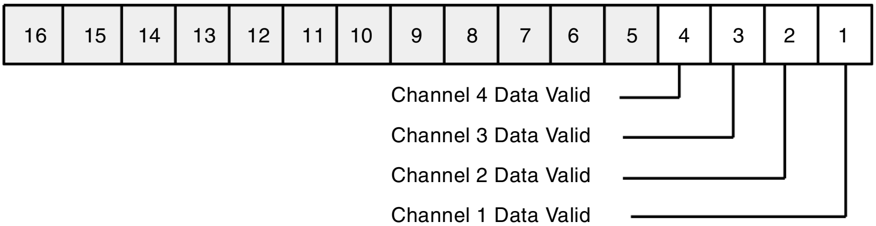
**Status Word (3x + 2)**

This register is used to indicate:

- When an input channel data is valid
- When a channel count has rolled over
- Excessive signal input frequency to a channel
- Whether auto sequencing is selected
- Module hardware failure

## Active Channel Status (Status Word, bits 1 ... 4)

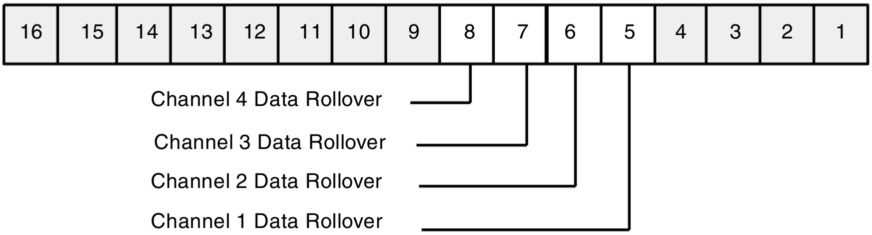
Whenever one of these bits is ON (1), the data in the READ DATA word is valid.



**Note:** There will only be one bit on at any time.

## Channel Rollover (Status Word, bits 5 ... 8)

The following figure shows the channel roll over bit settings.



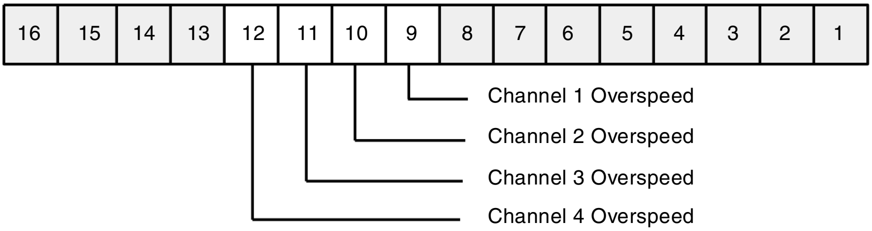
Whenever any of these bits is ON (1), it indicates that the module has incremented the data past the 32,768 count mark for that respective channel. When any of the individual channels (1 ... 4) is at 32,767 and one more pulse is detected, the module will set the appropriate rollover bit ON (1) and clear the accumulated data (00000) for that channel.

Any pulses that are detected after the rollover bit is set will continue to accumulate for that channel starting at (00000). After the rollover bit is set and the count continues, once the count reaches 16,384, the rollover bit will be reset to zero.

The module resets each respective rollover bit to zero (0) whenever the count in a specific channel increments from 16,383 to 16,384.

## Channel Overspeed (Status Word, bits 9 ... 12)

The following figure shows the Channel Overspeed bits.



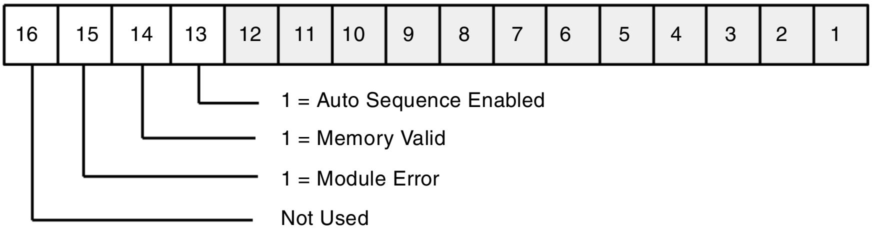
If the module detects pulses that are faster than 12.5 kHz, the module will inform the ladder program by setting individual bits that correspond to each of the four input channels. When the overspeed flag is on, the counter is disabled.

If any of these bits is set ON (1), the data for that channel may be invalid. These bits are only set when the pulse stream exceeds 12.5 kHz. If the signal temporarily exceeds 12.5 kHz, the bit will be set ON only during that period. If the signal returns within the design specification, the bit will turn off. If the module is used in an application that may exceed 12.5 kHz, these bits should be monitored by the ladder logic program.

**Note:** Overspeed detection was designed to guard against input devices exceeding 10 kHz. The overspeed bits apply to all VRC input modes of the VIC-200, and to the counter input function of the 205, 212, or 224. If the module is configured for dc pulse applications (CTR-205, –212 or –224), the overspeed bits will function as stated above, but the frequency data being read in input register 3x will remain valid until 25 kHz.

## Status Word, bits 13 ... 16

The following figure shows the Auto Sequence Mode bits.



All channels are read by the PLC in sequence, every 2 s.

**Bit 14—Memory Valid**

If bit 14 is detected in an OFF (0) state, the module's data or configuration is in question. If this is the case, you may either initiate a self–test, power cycle the module, or replace the module.

**Bit 15—Module Error**

Bit 15 is set (1) when a hardware failure is detected within the module. If this bit is set, the module must be power cycled. If the bit does not clear after a power cycle, the module should be replaced.

**Note:** Bit #16 is not used.

## Troubleshooting

**Amber LED**

Module Status is determined when the PLC goes into run mode. The table below illustrates possible module conditions.

| LED Status | Description |
|---|---|
| Steady ON | Module Ready (operational) |
| 1 blink | Module Watchdog Fault |
| 2 blinks | Module Watchdog Fault at Startup |
| 3 blinks | Module RAM memory failure at Startup |
| 4 blinks | Bus interface failure at Startup |
| 5 blinks | Module ROM memory failure |
| 6 blinks | Module processor Startup Fault |
| 7 blinks | General Module error |

When the module detects these conditions, the amber LED blinks the appropriate number of times. After each sequence of pulses, the LED pauses (each pause is a new starting point).

**Green LED**

When the PLC goes into run mode communication is established with the module. The green LED is on when communication has been established properly. The green LED remains off when communication is not established.

**Red LED**

Each of the four red LEDs illuminates when data is detected. The LEDs for each of the four channels operate as follows:

| LED Status | Description |
|---|---|
| Steady OFF | No incoming signal |
| Blinking | Incoming signal detected, < 40 Hz |
| Steady ON | Incoming signal detected, > 40 Hz |

**Establishing Communication**

If the LEDs on the front of the module are showing, then the module is communicating with the PLC processor.

| | |
|---|---|
| Amber | ON |
| Green | ON |
| Red | Blinking or ON |

## Steps after Establishing Communication

Refer to table below for steps after establishing communication:

| Step | Action |
|---|---|
| 1 | Monitor the status of READ Word 3 bits 13 ... 16 to determine what channel the module is displaying. |
| 2 | Check the front of the module to determine if the appropriate channel's red LED is pulsing or ON. |
| 3 | If the above conditions are true, check to make sure the Clear Channel bit (Write Word 2, bits 8 ... 11) for the appropriate channel is not set. |
| 4 | Check that Hold Count bit (Write Word 2, bits 5 ... 8) for the appropriate channel is not set. |
| 5 | If these bits are OFF, check to make sure that the module's self–test feature is not enabled (Write Word 3, bit 15 ON). |

## Invalid Data

The module is capable of measuring frequencies up to 25 kHz, and counting pulses up to 12.5kHz. The counter input mode stops counting inputs if the overspeed bits are set. This occurs at input frequencies over 12.5kHz.

If the incoming cable must pass high voltage cables, make sure the signal cable passes the high voltage cable at 90. If electrical interference is being considered, attempt to locate the VRC/CTR module as far away as possible from the P120 power supply and relay output modules. These products may generate electrical interference during operation. This does not affect the VRC/CTR module but may induce pulses on incoming channel wiring.

If the channel is configured for dc operation, the module is capable of counting up to 25 kHz. If the incoming signal is within specifications and data is still not correct, check that the data values loaded into each channel's K and Meter factor values are correct. The K and Meter factor values are used to scale incoming signals for display purposes. These values are monitored in Read word 2 and are displayed whenever a channel is enabled and either bit 7 or 6 of Write word 3 are ON.

## Overspeed VRC Inputs (Flowmeters, Variable Inputs, etc.)

The module is capable of detecting when incoming signals are exceeding the design limits of each channel. The module will detect when incoming signals exceed 12.5kHz and set one of four bits (Read word 3, bits 5 ... 8) for PLC use. These bits operate independently (i.e., if a channel exceeds 12.5 kHz, the remaining channels are not affected). If overspeed is detected, the respective channel will continue to operate, but the data is not guaranteed. If the incoming signal returns to less than 12.5 kHz, the overspeed bit will turn OFF.

**Overspeed Pulsed Inputs (Square Wave)**

Each channel on the module is capable of being configured for dc operation on the VIC-205, 212, and 224 modules. When configured for dc operation, in the frequency input mode, each channel is capable of measuring frequencies up to 25kHz. In the frequency input mode the overspeed bits turn on at 12.5kHz, but the data is valid up to 25kHz.

When configured for the counter input mode, the count value stops counting when the overspeed bits are turned on. The counter mode continues to count up to a pulse rate of 12.5kHz.

**Overspeed Built–in Test Enable (BITE)**

The VRC/CTR module has built–in diagnostics that can be enabled to check the module's control electronics. These tests are automatically run each time the module is powered up but can also be run after the module is on–line. By selecting one of three test sequences and then setting this bit ON, the module enters a self–test mode.

To terminate the self-test mode, reset the BITE Enable bit (0). Bits 13 and 14 determine the type of test that will be executed. Available tests and a brief explanation of what they accomplish are shown in the truth table below.

Truth Table for BITE Tests

| Bit 14 | Bit 13 | Bit 12 | Description |
|---|---|---|---|
| OFF | OFF | OFF | Test disabled |
| OFF | ON | ON | Tests VRC/CTR Microprocessor, RAM, ROM, Ready and Run LEDs, 24 Vdc |
| ON | OFF | ON | Tests EEPROM, Bus Interface, Internal timers, VRC electronics, Pulse indication, Frequency, and Software products |
| ON | ON | ON | Overspeed and LED Indicators (requires external input from a calibrated signal generator) |

**Note:** The two bits select the category of test in binary. If the BITE enable bit is ON, the module remains in self–test until the BITE enable bit is turned off. The enable bit and the category bits are currently only read once on entry to the BITE procedure. If you turn the bit OFF, the module will return to on line soon after the applicable test is completed. Allow 100 ms minimum for each test.

Currently, the red LED illuminates steady and the green LED flashes if the test is completed successfully. If a failure is detected, the error bit will illuminate and the red LED will blink.

## VIC/CRC/CTR 2XX Counter Input Module Specifications

### Table of Specifications

The following table contains a list of VIC/CRC/CTR 2XX counter input module specifications.

| **VIC/VRC/CTR 2XX High Speed Input Specifications** |
|---|

### Electrical Specifications

The following section describes Electrical Specifications.

| | | | |
|---|---|---|---|
| Electrical | Inputs/module | | 4 |
| | Isolation | | 30 Vdc |
| | Supply Voltage for BVIC 2xx ONLY (24 Vdc power supply) | | 24 Vdc, +/-2.4Vdc |
| | Signal Voltage Range | VIC/VRC-200 (VRC inputs) | .025 ... 36 Vac Peak typical |
| | | VIC/CTR-205 | 5 Vdc, +/-.5Vdc |
| | | | Low <= 0.800, High >= 2.000 Vdc typical @ source Z < 10 ohms |
| | | VIC/CTR-212 | 12 Vdc, +/-1.2Vdc |
| | | | Low <= .65 1.920,High >= 4.800 Vdc typical @ source Z < 10 ohms |
| | | VIC/CTR-224 | 24 Vdc, +/-2.4Vdc |
| | | | Logic Low < 3.840, Log ic High > 9.600 Vdc typical @ source Z < 10 W |

### Frequency Specifications

The following section describes Frequency Specifications.

| | | |
|---|---|---|
| Frequency | VIC/VRC Inputs | 0 ... 10.0 kHz |
| | VIC/VRC/CTR Vdc Inputs- Counter Mode | 0 ... 10.0 kHz |
| | VIC/VRC/CTR Vdc Inputs- Frequency Mode | 0 ... 25.0 kHz |
| | VIC/VRC/CTR Pulse Width | 20 micros minimum |
| | VIC/VRC/CTR Overspeed | 12.5 kHz detection |

## Data Formats, Required Loadable

The following section describes Data Format and Required Loadable Specifications.

| | | | |
|---|---|---|---|
| Data Formats | Accumulated, Scaled Accumulated, Rate (Hz) Scaled Rate | | |
| | Accuracy | VIC/ CTR-205, 212, 224 | +/- 1 count over full range |
| | | VIC/VRC-200 | +/- 0.1 percent of full scale, +/- 1 count |
| Required Loadable | SW-IODR-001 (See Appendix B, file SVI.DAT) | | |

## Power Required, DIN Rail Grounding

The following section Power Required and DIN Rail Grounding Specifications.

| | | |
|---|---|---|
| Power Required | VRC/CTR External Power Source | None Required |
| | VRC/CTR Internal Power Source from the backplane | 275 mA @ 5 Vdc maxi mum |
| | VIC External Power Source, Regulated or Unregulated | 20 ... 30VVdc |
| | VIC External Power Source, Typical | 70mA @ 24VVdc |
| | VIC Internal Power Source from the backplane | None Required |
| DIN Rail Grounding | < 0.1Ohms | |

## Environment, I/O Map

The following section describes Environment and I/O Map Specifications.

| | | | |
|---|---|---|---|
| Environment | Temperature | Operational | 0 ... 60 degrees C |
| | | | 32 ... 140 degrees F |
| | | Storage | -40 ... +85 degrees C |
| | | | -40 ... +185 degrees F |
| | Humidity | | 0 ... 95 percent @ 60 degrees C, noncondensing |
| I/O Map | Register 3x/4x | | 3 in/3 out |

## Dimensions and Agency Approvals

The following section describes Dimensions and Agency Approvals

| | | |
|---|---|---|
| Dimensions | W x H x D | 40.6 x 142.2 x 114.3 mm |
| | | 1.6 x 5.6 x 4.5 in |
| | Weight | 300 g |
| | | 0.70 lb |
| | Power Connections | 60/75 copper (Cu) |
| | Torque on set screws | 0.5 in/lb |
| Agency Approvals | VDE 0160; UL 508; CSA 22.2 No.142; FM Class I, Div 2 and European Directive EMC 89/336/EEC Standards | |

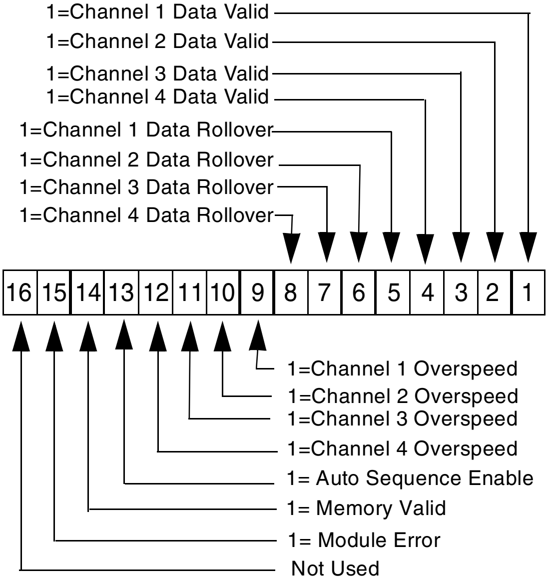
## VIC/CRC/CTR 2XX Counter Input Module for Compact 32-bit Controllers

**I/O Map Register**

In I/O map these modules are configured with nine 3x registers and one 4x register The 3x register assignements are as follows:

- 3x - Register 1: Input Status Word 3
- 3x - Register 2: Channel 1 Read Data
- 3x - Register 3: Channel 1 Factor Value
- 3x - Register 4: Channel 2 Read Data
- 3x - Register 5: Channel 2 Factor Value
- 3x - Register 6: Channel 3 Read Data
- 3x - Register 7: Channel 3 Factor Value
- 3x - Register 8 : Channel 4 Read Data
- 3x - Register 9 : Channel 4 Factor Value

3x Register 1 Input Status Word Bit Assigment

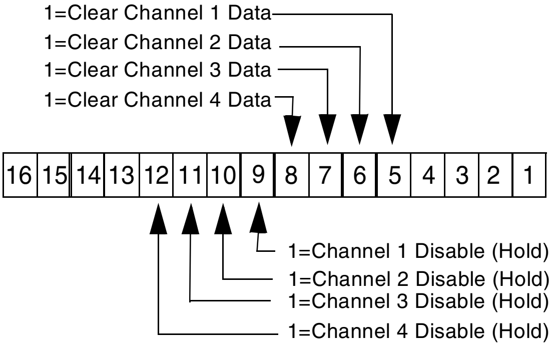


Factor value registers the display either K or M factor as selected in the I/O map parameter screen. The value entered in the parameter screen for the associated channel will be displayed

Real data registers display either count or frequency as selected on the I/O map parameter screen.

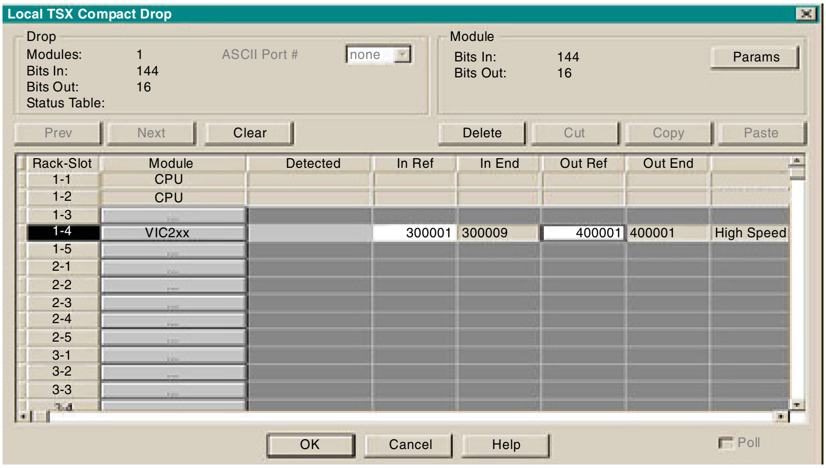
## Control Word

4X Register Control Word



## I/O Map Parameter Screen

There is a parameter screen for these modules where the K- Factor, Meter-Factor, Mode and common parameters for the module are entered. The following screen capture illustrates this:



Local TSX Compact Drop

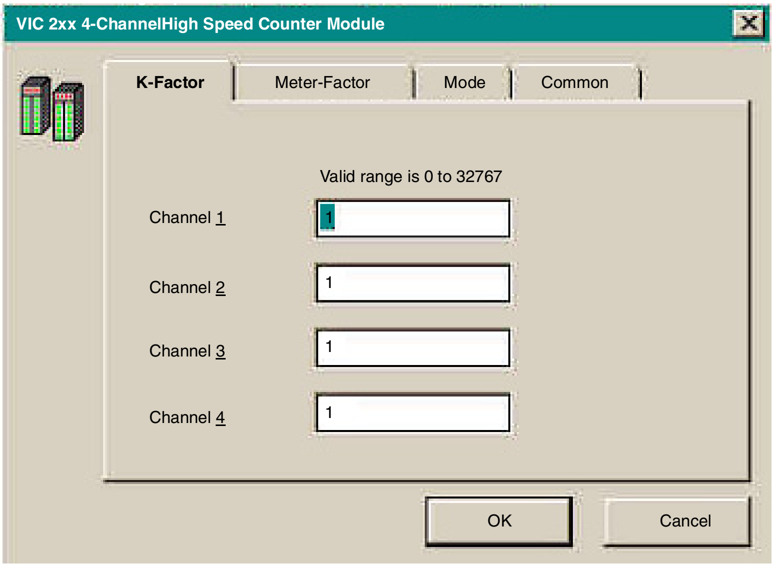
Drop
Modules: 1
ASCII Port # none
Bits In: 144
Bits Out: 16
Status Table:

Module
Bits In: 144
Bits Out: 16

| Rack-Slot | Module | Detected | In Ref | In End | Out Ref | Out End | |
|---|---|---|---|---|---|---|---|
| 1-1 | CPU | | | | | | |
| 1-2 | CPU | | | | | | |
| 1-3 | | | | | | | |
| 1-4 | VIC2xx | | 300001 | 300009 | 400001 | 400001 | High Speed |
| 1-5 | | | | | | | |
| 2-1 | | | | | | | |
| 2-2 | | | | | | | |
| 2-3 | | | | | | | |
| 2-4 | | | | | | | |
| 2-5 | | | | | | | |
| 3-1 | | | | | | | |
| 3-2 | | | | | | | |
| 3-3 | | | | | | | |

## Input Screen for K-Factor

Enter the K-Factor for each channel:



VIC 2xx 4-ChannelHigh Speed Counter Module

Valid range is 0 to 32767

Channel 1: 1

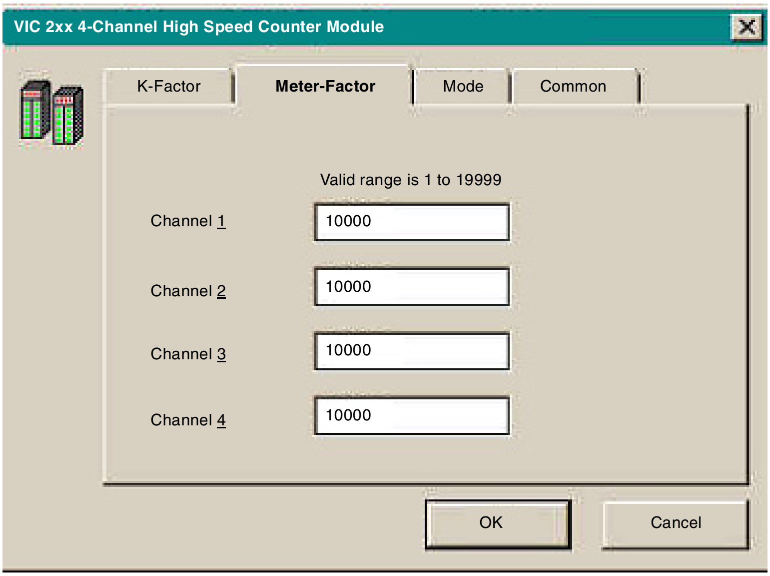
Channel 2: 1

Channel 3: 1

Channel 4: 1

## Input Sceen for Meter- Factor

Enter the Meter-Factor for each channel:



VIC 2xx 4-Channel High Speed Counter Module

Valid range is 1 to 19999

Channel 1: 10000

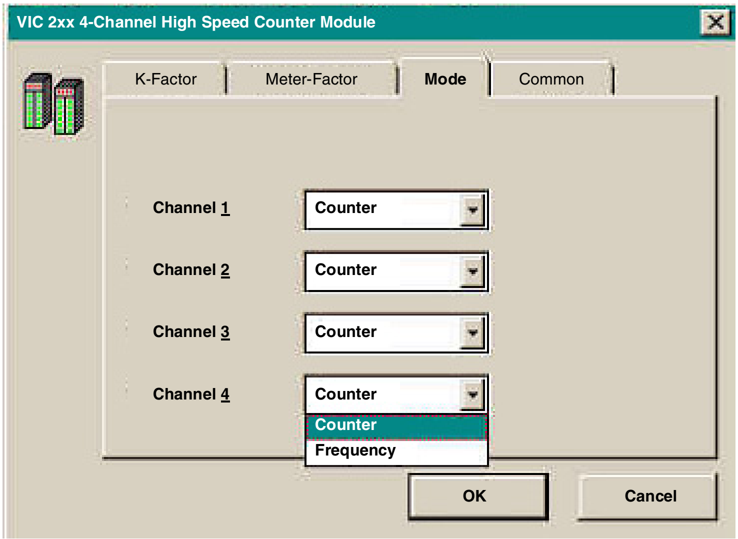
Channel 2: 10000

Channel 3: 10000

Channel 4: 10000

## Input Screen Module Mode

For each channel, select either Counter or  Frequency in the Real Data register:



Channel 1: Counter

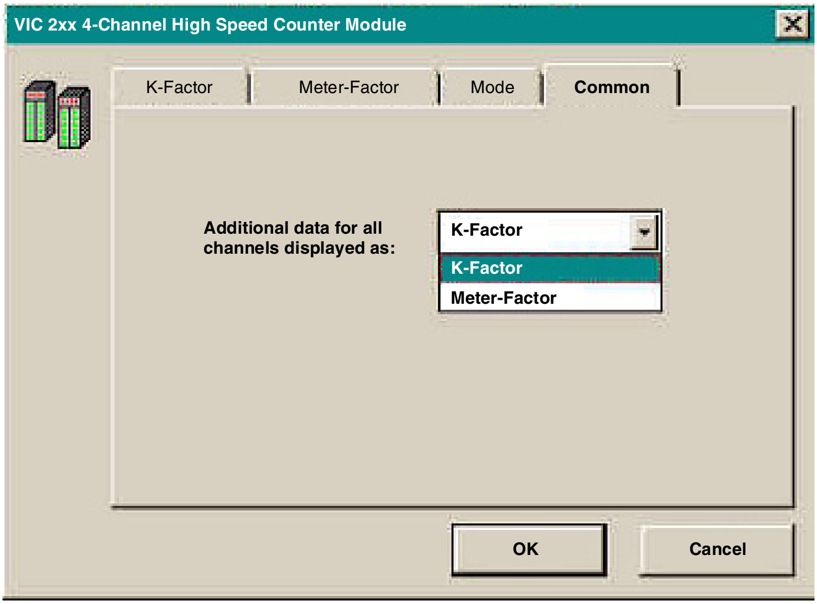
Channel 2: Counter

Channel 3: Counter

Channel 4: Counter

## Input Screen for Module Common Parameters

Select to display either K or M factor in the Factor Data registers This selection applies to a four channels:



Additional data for all channels displayed as: K-Factor

# Overview of the ZAE 201 Counter/Positioner Module

# 47

## At a Glance

**Purpose**

The purpose of this chapter is to describe the ZAE 201 Counter/Positioner Module.

**What's in this Chapter?**

This chapter contains the following sections:

# 47.1 Overview of the ZAE 201 Counter/Positioner Module

## At a Glance

**Purpose**

This section provides an overview of the ZAE 201 Counter/Positioner Module.

**What's in this Section?**

This section contains the following topics:

## What is the ZAE 201 Counter/Positioner Module?

**Brief Product Description**

The ZAE 201 is a dual-function, user-configurable module that can operate as either a high speed counter or to monitor a simple one–axis positioning application. The ZAE 201 has two output relays, the operation of which are specified when the module is parameterized for either counting or positioning functions. Operational power for the module is 24 Vdc, and position/count signals may be passed to the module as either 5 V (RS422 compatible) or 24 V inputs.

In the counter mode, the unit acts as a high speed counter. Counting is started and stopped by activating and deactivating the count gate input. When counting (count gate activated), two output relays operate based on setup parameters passed to the unit prior to activating the count gate.

In the positioning mode, the unit monitors a single–axis motion. This is accomplished by providing quadrature encoder inputs to the ZAE201. When a motion request is received, the unit will control the state of two output relays based on the current position relative to the commanded position. During motion, the state of two relay outputs are maintained such that speed can be controlled as the target position is approached. The specific operation of these relays is determined by setup parameters passed to the ZAE 201. Direction of motion and absolute speed are determined by other devices controlled through user logic.

## LED Indicator Displays of the ZAE 201 Counter/Positioner Module

**LED Indicators**

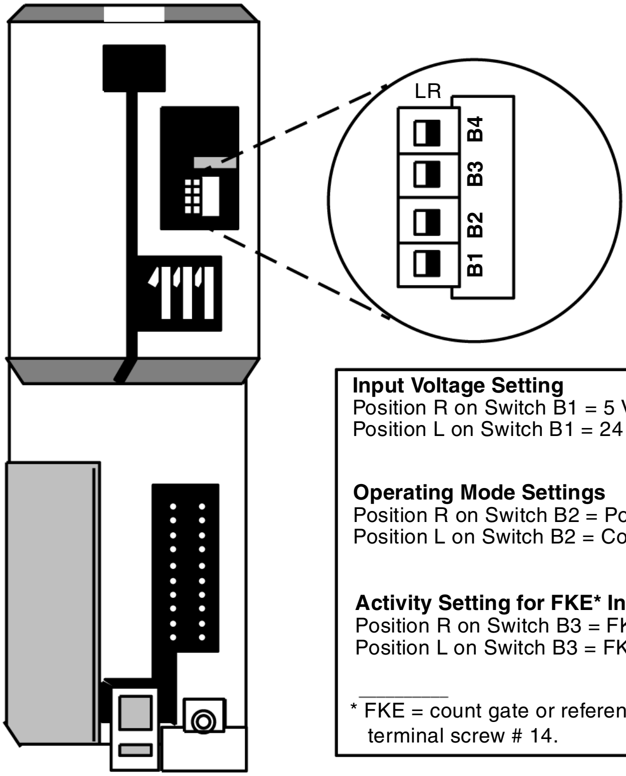
The ZAE 201 has seven LED indicators displayed on the front panel:

- The green LED opposite terminal screw 1 goes ON to indicate the presence of the 24 V supply voltage
- The amber LED opposite terminal screw 2 may be used as an encoder power monitor if you are using 24 V input signals; if you remove the jumper between terminal screws 1 and 2 and add a wire from the encoder supply, the LED will go ON to indicate a loss of power from the field device. Do not remove the jumper or use this LED with 5 V input signals.
- The green LED opposite terminal screw 12 is the READY LED; its meaning is mode dependent. It goes ON in the positioner mode when the module has been completely parameterized and the reference point trip has been performed. It goes ON in the counter mode when the module has been completely parameterized.
- The amber LED opposite terminal screw 13 is the RUN LED; its meaning is mode dependent. It goes ON in the positioner mode when a motion command is being executed. It goes ON in the counter mode when the module is parameterized and the counter gate is open.
- The red LED opposite terminal screw 14 goes ON to indicate an FKE input active condition.
- The two red LEDs opposite terminal screws 16 and 18 indicate the current condition of relays 1 and 2, respectively. When an LED is ON, its respective relay is closed; when an LED is OFF, its relay is open.

# Choosing Operating Mode and Input Voltage Level for the ZAE 201 Counter/Positioner Module

## Switch Location and Settings

The choices of operating mode and input voltage are set via DIP switches on the back of the module. The module can operate in only one mode and at only one input voltage at a time.



**Input Voltage Setting**
Position R on Switch B1 = 5 V inputs
Position L on Switch B1 = 24 V inputs

**Operating Mode Settings**
Position R on Switch B2 = Position sensing mode
Position L on Switch B2 = Counter mode

**Activity Setting for FKE* Input**
Position R on Switch B3 = FKE* input active LOW
Position L on Switch B3 = FKE* input active HIGH

---

* FKE = count gate or reference trip input, field wired at terminal screw # 14.

## Operating States of the ZAE 201 Counter/Positioner Module

### Operating States

After a ZAE 201 module has been installed, its two output relays must be parameterized for counting or positioning functions. When the Compact-984 Controller is started and begins solving user logic, the ZAE 201 comes up in an initialized but nonfunctional state called NET IN. In order to bring the module into a READY state where it can function, information must be sent to the module identifying how the two relays are to be used and how the FKE input is to be interpreted. The process of sending this information to the module is called **parameterization**, and the specific parameters are dependent upon the module's operating mode.

At the beginning of each scan, the ZAE 201 places the latest status and counter or positioning data in its input data block. The controller uses this information to determine the next command for the module. Commands are stated in the output data block. If no new command is appropriate based on the current information in the input data block, the command byte in the output data block is set to 0.

The ZAE 201's maximum count cannot exceed 8,388,607.

Typically, the command register in the output data block should be cleared at the start of a scan, allowing the user logic to define a new command as required. The command is passed to the module at the end–of–scan. Commands may be given only when the ZAE 201 is not busy, and a command must be consistent with the current state of the module. If either of these conditions is not met, an error will be returned in the input data block.

The ZAE 201 can be reset to a NET IN state at any time. New information can then be passed to the module, thereby redefining the operating parameters before returning to the READY state.

## Representing the ZAE 201 Data Blocks in the I/O Map

**Overview**

The ZAE 201 is described in the Compact-984 I/O Map as a three-register bidirectional module. Three consecutive 3**x** input registers are used to store the three words in the input data block, and three consecutive 4**x** output registers are used to store the three words in the output data block.

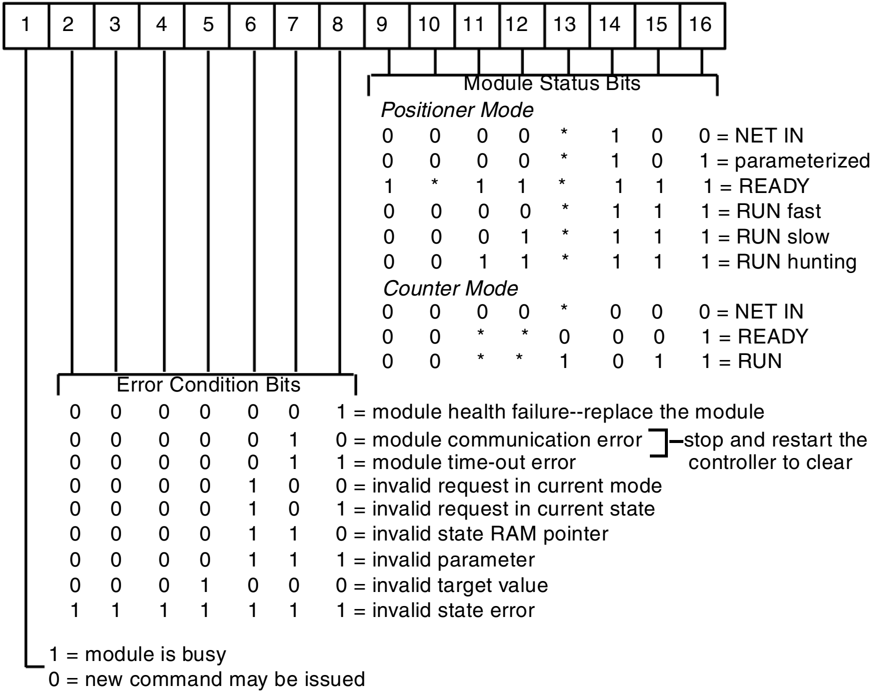
## Format of the Input Data Block

**The first word in the (3x**) input data block contains input data necessary for user logic to efficiently control the ZAE 201; it comprises three parts:

- A one–bit module busy flag
- A set of seven error condition bits
- A set of eight mode–specific module status bits

The following diagram shows the first word in the input data block.

First Word in the Data Input Block



*Positioner Mode*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | * | 1 | 0 | 0 = NET IN |
| 0 | 0 | 0 | 0 | * | 1 | 0 | 1 = parameterized |
| 1 | * | 1 | 1 | * | 1 | 1 | 1 = READY |
| 0 | 0 | 0 | 0 | * | 1 | 1 | 1 = RUN fast |
| 0 | 0 | 0 | 1 | * | 1 | 1 | 1 = RUN slow |
| 0 | 0 | 1 | 1 | * | 1 | 1 | 1 = RUN hunting |

*Counter Mode*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | * | 0 | 0 | 0 = NET IN |
| 0 | 0 | * | * | 0 | 0 | 0 | 1 = READY |
| 0 | 0 | * | * | 1 | 0 | 1 | 1 = RUN |

Error Condition Bits

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 1 = module health failure--replace the module | |
| 0 | 0 | 0 | 0 | 0 | 1 | 0 = module communication error | –stop and restart the controller to clear |
| 0 | 0 | 0 | 0 | 0 | 1 | 1 = module time-out error | |
| 0 | 0 | 0 | 0 | 1 | 0 | 0 = invalid request in current mode | |
| 0 | 0 | 0 | 0 | 1 | 0 | 1 = invalid request in current state | |
| 0 | 0 | 0 | 0 | 1 | 1 | 0 = invalid state RAM pointer | |
| 0 | 0 | 0 | 0 | 1 | 1 | 1 = invalid parameter | |
| 0 | 0 | 0 | 1 | 0 | 0 | 0 = invalid target value | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 = invalid state error | |

1 = module is busy
0 = new command may be issued

---

* indicates that the bit value may be either 1 or 0 when the module is in this state.

The second and third words in the input data block contain the latest count or position value, depending on the operating mode of the module. The second word contains the high order position or count, and the third word contains the low order.

The following is an explanation of bits 10 ... 13 in the above illustration:

| | |
|---|---|
| Bit 10 | In position mode, a 1 in this bit indicates whether the motion is within the specified target range |
| Bit 11 | The state of relay 2 at terminal 18 |
| Bit 12 | The state of relay 1 at terminal 16 |
| Bit 13 | The state of FKE input at terminal 14 |

**Note:** When in position mode the counts are 4 times those counts when in counter mode.

## Format of the Output Data Block

**The first 4x** word in the output data block passes commands to the ZAE 201 module. It uses its low byte (bits 9 ... 16) to indicate the command type; the high byte (bits 1 ... 8) is not used. The command types and their output data block implementations are mode dependent.

The following table is an output data block representation of counter/positioner commands:

| Operating Mode | Command | Hex Value | Low Byte Bit Values |
|---|---|---|---|
| Counter | parameterize | 01 | 0 0 0 0 0 0 0 1 |
| | reset | 02 | 0 0 0 0 0 0 1 0 |
| | clear current count | 03 | 0 0 0 0 0 0 1 1 |
| Positioner | parameterize | 01 | 0 0 0 0 0 0 0 1 |
| | reset | 02 | 0 0 0 0 0 0 1 0 |
| | run reference | 04 | 0 0 0 0 0 1 0 0 |
| | run reference + | 05 | 0 0 0 0 0 1 0 1 |
| | go to target | 06 | 0 0 0 0 0 1 1 0 |

These commands initiate a process to be carried out by the module and causes the module to change state, sometimes permanently and sometimes temporarily.

The second and third words in the output data block are command dependent. Sometimes they are used to pass needed information to the ZAE 201; other times they may not be used at all. Some commands require more information than can be stored in two words, and in these cases the second word is used as a pointer into state RAM where the requisite number of registers is accessed.

# 47.2 Using the ZAE 201 Counter/Positioner Module as a High-Speed Counter

## At a Glance

**Purpose**

This section provides an overview of the using the ZAE 201 Counter/Positioner Module as a high-speed counter.

**What's in this Section?**

This section contains the following topics:

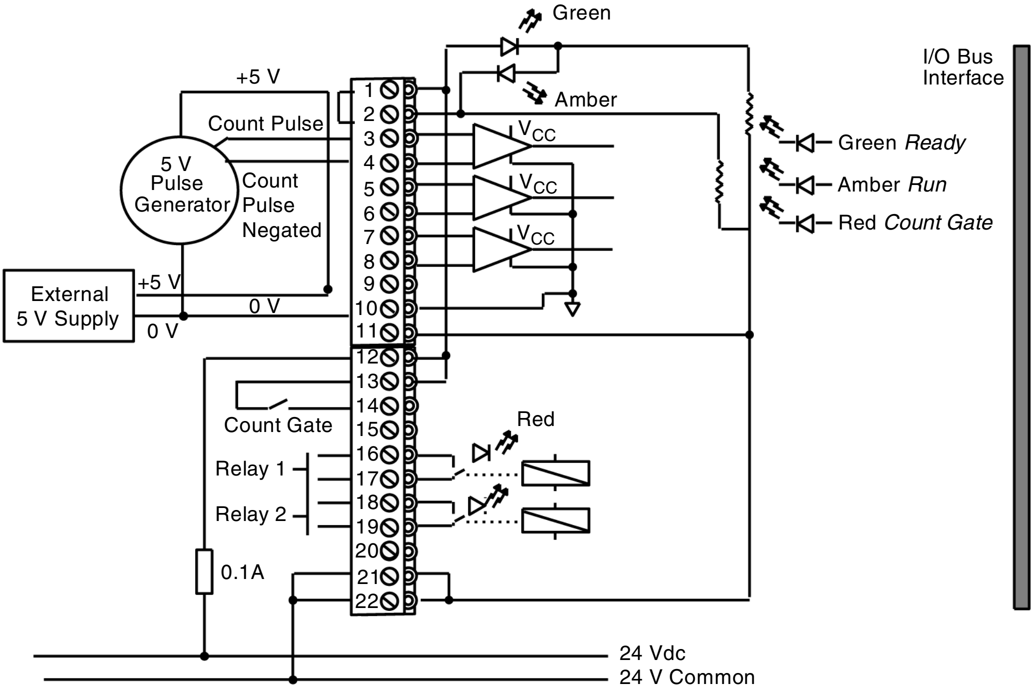
## Field Wiring the ZAE 201 for Counting Applications

### Field Wiring for Counting Applications

The ZAE 201 module can be field wired for counting applications in three different ways—for 5 V inputs and for 24 V inputs with or without the power monitor jumpered between terminals 1 and 2.

### Wiring for Counting with 5 V Inputs

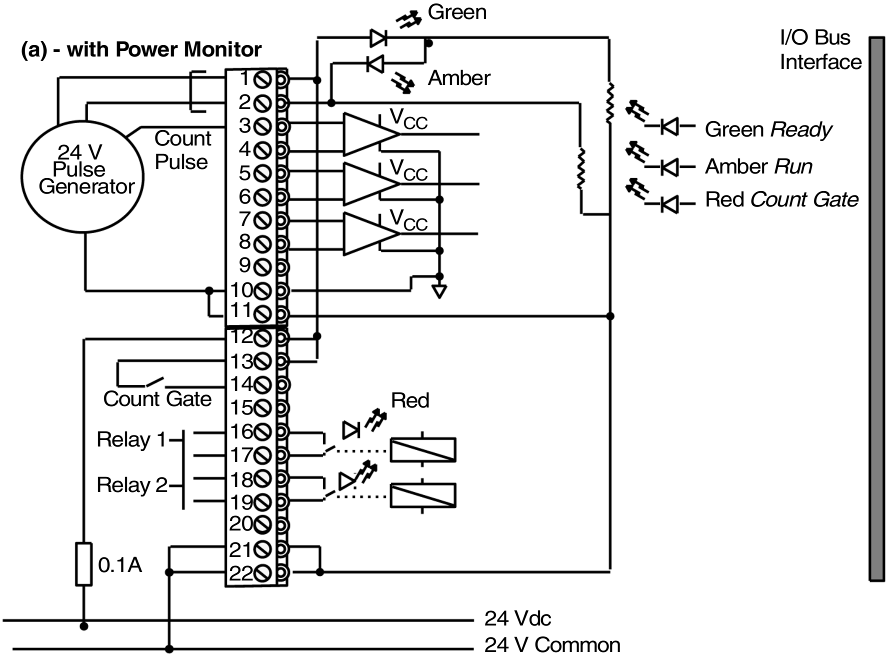
The ZAE 201 can be field wired for counting with 5 V inputs as shown below.



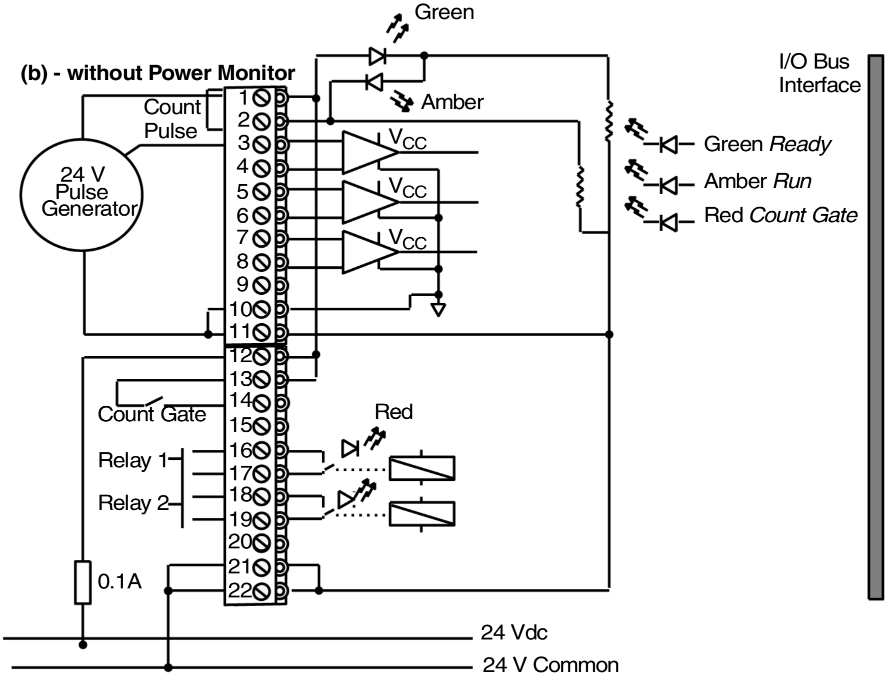
## Wiring for Counting with 24 V Inputs

The ZAE 201 can be field wired for counting with 24 V inputs, with or without the power monitor jumpered between terminals 1 and 2 as shown below.

**(a) - with Power Monitor**



**(b) - without Power Monitor**



### Facts About Field Wiring for Counting Applications

**Note:** When the jumper between terminals 1 and 2 is removed and when both terminals are field wired, as they are in panel (a) of the previous figure, the amber LED opposite terminal 2 can be used as a power monitor for 24 V input signals. In all other cases, the jumper should be left installed, thus preventing the LED from turning on.

For 24 V operations, a pulse source for the count is field wired to terminal screw 3. For 5 V operations, a differential input is required; pulse source and pulse source must be field wired to terminal screws 3 and 4, respectively. This source is a series of pulses generated by the events being counted.

The counter gate is field wired to terminal screw 14. This gate is used to control the counting operation. When the module is in the READY state and the count gate goes active, the current count held in the data input block is set to 0 and the module starts accumulating a new count.

The two relays that will receive your counter control logic are wired at terminal screws 16 and 18. Counter control logic is very application specific. For example, relay 1 at terminal screw 16 might be connected to an indicator light that is programmed to turn ON when a specified count is reached; at the same time, relay 2 at terminal screw 18 might be used to modify some aspect of the operation being counted when some other count is reached.

## Switch Settings for Using the ZAE 201 as a High-Speed Counter

### Procedure for Setting Switches

To set a ZAE 201 module up as a high speed counter:

| Step | Action |
|---|---|
| 1 | Place DIP switch B2 on the back of the module in the left (L) position. |
| 2 | Use DIP switch B1 to specify the desired input voltage at the count pulse inputs. |
| 3 | Use DIP switch B3 to specify whether the counter gate activity will be HIGH or LOW. |

## Overview of ZAE 201 Counter Mode Commands and States

### Parameterization

When the ZAE 201 has been installed as a counter module and the Compact-984 Controller has been powered up, the ZAE 201 comes up in a NET IN state. In the NET IN state, the module is able to accumulate pulse counts and store current count information in the second and third word of the input data block. The ZAE 201 must be given a set of counter mode parameters before the count gate and relays can operate.

Two parameters—P1 and P2—must be passed to the module. These two parameters are the count values at which relay 1 and relay 2, respectively, are to be either opened or closed. A third bit of information must also be passed to the module defining how the relays are to operate when the count is equal to P1 or P2.

### READY and RUN States

Once the module has been parameterized, it goes into a READY state, where it is prepared for normal counting functionality controlled by the counter gate input. When the counter gate is active, the module is in the RUN state where it proceeds with its counting operation.

When the counter gate is not active, the module switches to the READY state where it stops counting and maintains the count that it has accumulated. Activating and deactivating the counter gate switches the module from READY to RUN and back.

### RESET

If you need to change the operating parameters without stopping the controller, you can put the module back into a NET IN state at any time by issuing a RESET command.

### Single Count and Multiple Count Operations

The relays can operate in either single or multiple count operations.An example of a single count operation might be using the P1 parameter is set to define when relay 1 opens—when the specified count is reached, the relay opens and the count continues.

An example of a multiple count operation might be a relay scheduled to open at a defined count and close when the count reaches 1.25 times the defined count. This operation will continue to open at every multiple of the defined parameter and close at every quarter multiple of that parameter.

## ZAE 201Counter Mode Commands

### Counter Mode Commands

There are three commands that can be used in the counter mode—parameterize, clear current count, and reset. These commands are implemented in the three-word output data block specified in the I/O Map for the ZAE 201.As described in the following table, not all commands are acceptable at all times to the module:

| State | parameterize | clear current counter | reset |
|---|---|---|---|
| NET IN | allowed | allowed | allowed |
| READY | not allowed | allowed* | allowed |
| RUN | not allowed | not allowed | allowed |

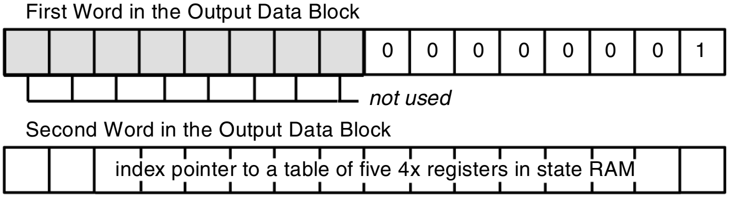
*** Allowed, but has no effect if the module has entered RUN state since being parameterized.**

If a command is issued during a state that does not allow that command, an error is reported in the first word of the input data block.

### Counter Mode Parameterize Command

The parameterize command implements the first two words in the output data block.

**Output Data Block Format: parameterize Command in Counter Mode**

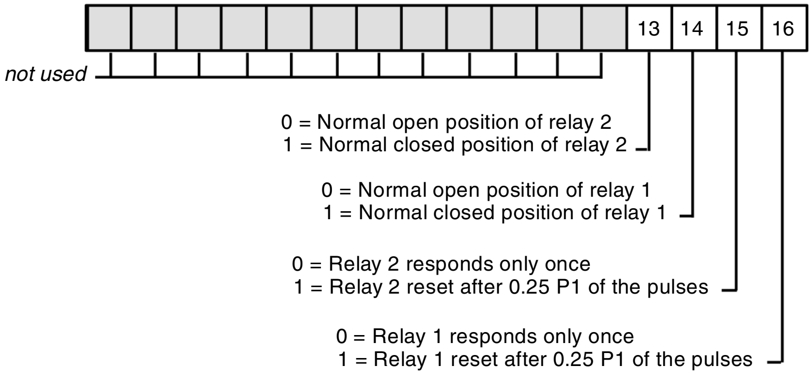


Third Word in the Output Data Block *Not Used*

The second word contains an index into a table of five 4**x** registers in the controller's state RAM. These five registers contain the information necessary to parameterize the module.

The first register in the 4**x** table contains information that defines how the relays will be set and how they will react when the count is met:

The following diagram illustrates how the relays will be set and how they will react when the count is met.



Any values that might appear in bits 1 ... 12 of the register are ignored.

The second and third registers in the 4**x** table contain a hexadecimal representation of P1, the count value controlling relay 1. The value of P1 < 8,388,607. The second register contains the high order part of the hex value, and the third register contains the low order part of the hex value.

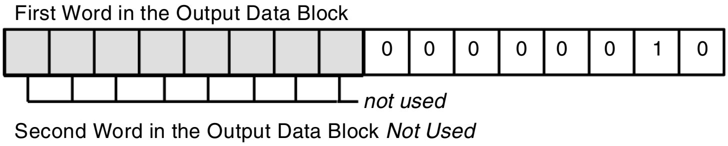
The fourth and fifth registers in the 4**x** table contain a hexadecimal representation of P2, the count value controlling relay 2. The value of P2 < 8,388,607. The fourth register contains the high order part of the hex value, and the fifth register contains the low order part of the hex value.

If an error occurs during the issue of the **parameterize** command, the appropriate code will be returned in the first word of the input data block.

## Counter Mode reset Command

The reset command implements only the first word in the output data block.

**Output Data Block Format: reset Command in Counter mode**

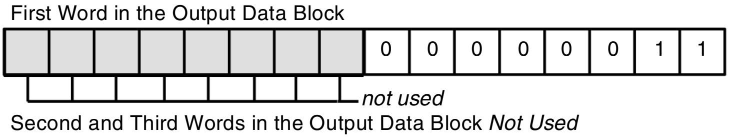


There are no errors associated with this command. If the module is in a RUN or READY state when the reset command is issued, the module will be put into a NET IN state. If the module is already in NET IN when the command is issued, nothing will happen.

## Counter Mode clear current count Command

The clear current count command implements only the first word in the output data block, as shown in the graphic below.

**Output Data Block Format: clear current count Command in Counter Mode**



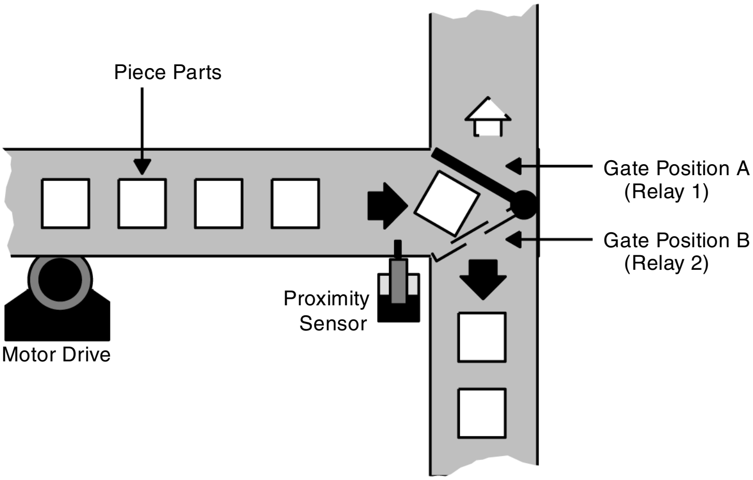
The only potential error associated with this command will be flagged if you issue it while the module is in RUN mode.

## Example: Using the ZAE 201 as a High-Speed Counter

**Overview**

This system carries piece parts along a motor-driven conveyor line. The line continues to a diverting mechanism that sends parts to either the right (R) or left (L) into separate bins. The ZAE 201 Counter will enable the system to be controlled such that the gate will switch positions after every 4,000 pieces.

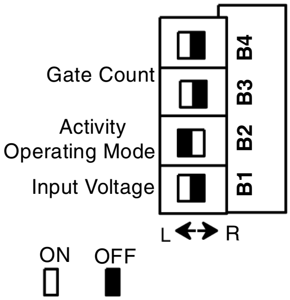
The following diagram illustrates a conveyer system application example.



**Counter Example DIP Switch Settings**

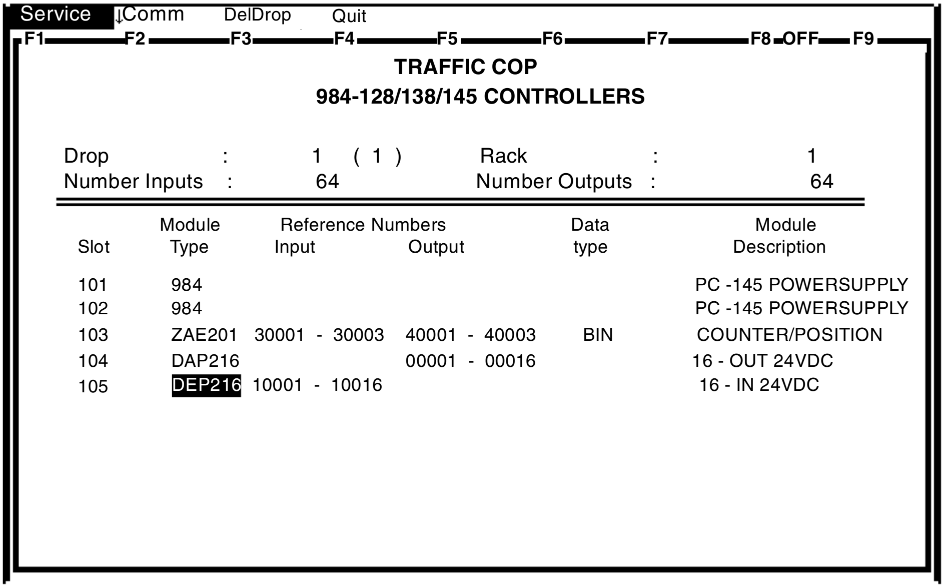
Set the DIP switches on the back of the module for COUNTER mode, 5 V input voltage, and LOW activity on the count gate.

The following diagram illustrates this procedure.



## Counter Example Traffic Cop Settings

Traffic cop the drop to support the system with the ZAE 201 high speed counter, a DAP 216 discrete output module, and a DEP 216 discrete input module:



```
                         TRAFFIC COP
                 984-128/138/145 CONTROLLERS

Drop           :      1  ( 1 )      Rack            :          1
Number Inputs  :      64            Number Outputs  :          64

          Module      Reference Numbers           Data        Module
  Slot    Type      Input            Output       type        Description

  101     984                                                 PC -145 POWERSUPPLY
  102     984                                                 PC -145 POWERSUPPLY
  103     ZAE201  30001 - 30003   40001 - 40003    BIN        COUNTER/POSITION
  104     DAP216                  00001 - 00016               16 - OUT 24VDC
  105     DEP216  10001 - 10016                               16 - IN 24VDC
```

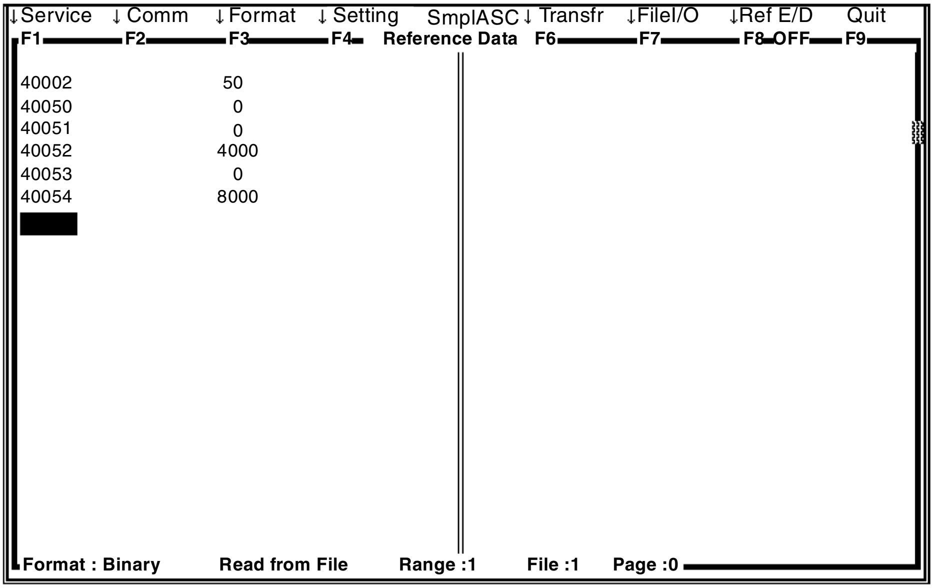
## Counter Example Coil Use

The following coils will be implemented in the example counting operation:

| Usage | Coil | Function |
|---|---|---|
| External (DAP 216) | 00001 | Control coil for gate position A (at DAP 216 terminal screw 3) |
| | 00002 | Control coil for gate position B (at DAP 216 terminal screw 4) |
| | 00007 | Control coil for the count gate, the FKE input (at terminal screw 14) |
| Internal | 00017 | Logic solve coil—when ON, ladder logic is being solved |
| External (DEP 216) | 10009 | State of Relay 1 output from ZAE 201 |
| External (DEP 216) | 10011 | State of Relay 2 output from ZAE 201 |

**Counter Example Parameterization**

Go to the reference editor by pressing <ALT><F2>, and edit register values to parameterize the ZAE 201 high speed counter:



```
40002          50
40050           0
40051           0
40052        4000
40053           0
40054        8000
```

```
Format : Binary      Read from File      Range :1      File :1      Page :0
```

Set register 40002 to a decimal value of 50; this indicates a pointer to a block of five 4**x** registers starting at 40050. (Do not set values in register 40001 manually—this will be done by the user logic.)

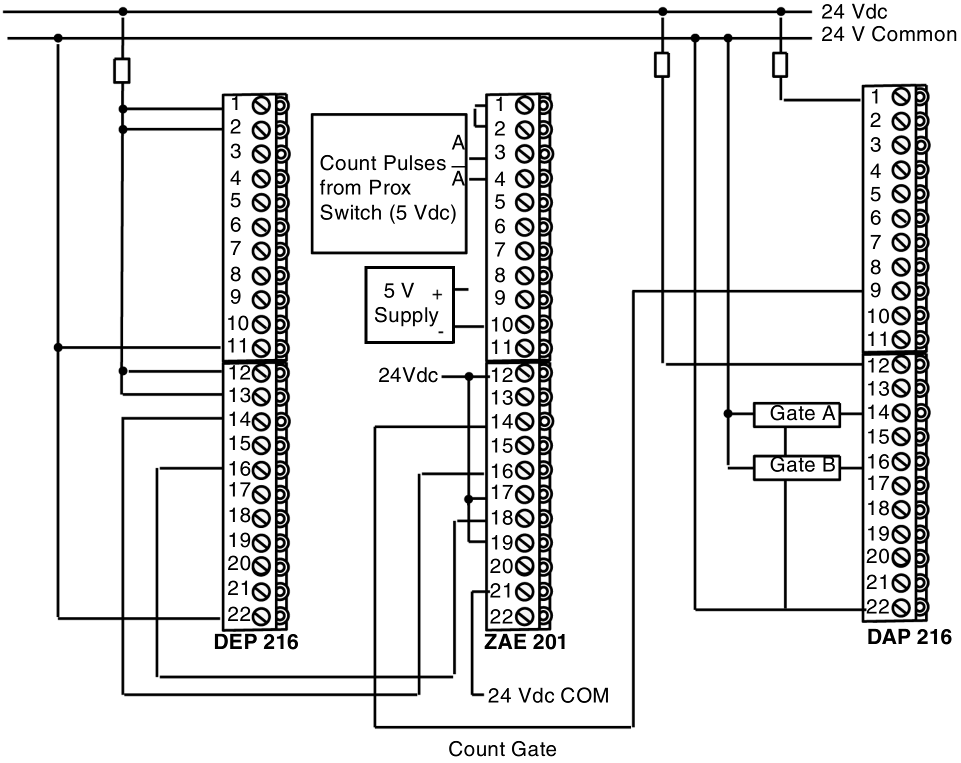
The values you set in the table registers indicate:

- Relays 1 and 2 are normally open and provide one–shot responses, since the four least significant bits in register 40050 are all set to 0
- The high order word value for relay 1, as expressed in register 40051, is 0
- The low order word value for relay 1, as expressed in register 40052, is 4,000 (FA0 in hex)
- The high order word value for relay 2, as expressed in register 40053, is 0
- The low order word value for relay 2, as expressed in register 40054, is 8,000 (1F40 in hex)

These parameterizing values will cause Relays 1 and 2 to close at the count values of 4000 and 8000, respectively.

## Counter Example Field Wiring Diagram

The discrete modules will be used to control the mechanics of the switching gate. Field wire the three A120 I/O modules like this:



# 47.3 Using the ZAE 201 Counter/Positioner Module as a Positioning Controller

## At a Glance

**Purpose**

This section provides an overview of the using the ZAE 201 Counter/Positioner Module as a positioning controller.

The ZAE 201 does not **control** speed, but provides relay outputs that indicate when speed should be changed. The actual control of speed must be provided by the user (ladder or hardware) logic—the module itself does not control the speed. Similarly, the ZAE 201 does not control direction; this is also a function of user-defined logic (ladder or hardware).

**What's in this Section?**

This section contains the following topics:

## Field Wiring for ZAE 201 Positioning Applications

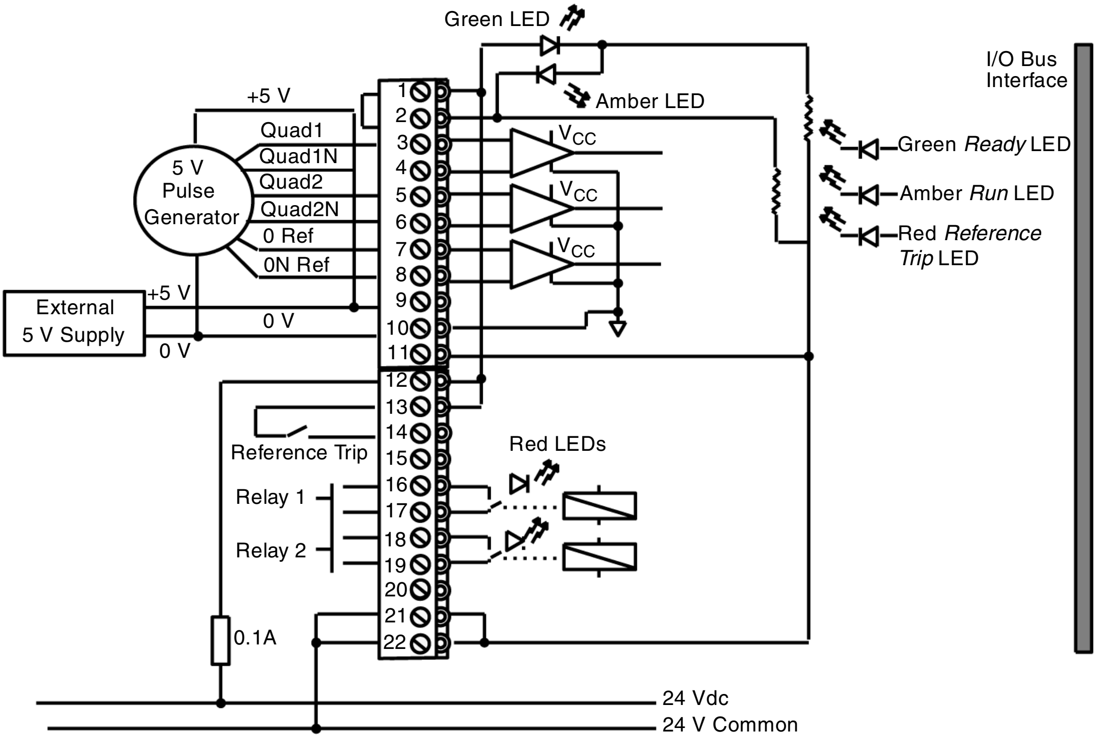
### Field Wiring for Positioning Applications

The ZAE 201 module can be field wired for positioning applications in three different ways—for 24 V inputs with or without the power monitor jumpered between terminals 1 and 2, and for 5 V inputs.

**Note:** When the jumper between terminals 1 and 2 is removed and when both terminals are field wired, as they are in Figure 18 (a), the amber LED opposite terminal 2 can be used as a power monitor for 24 V input signals. In all other cases, the jumper should be left installed.

## Wiring a ZAE 201 Module for Positioning with 5 V Inputs

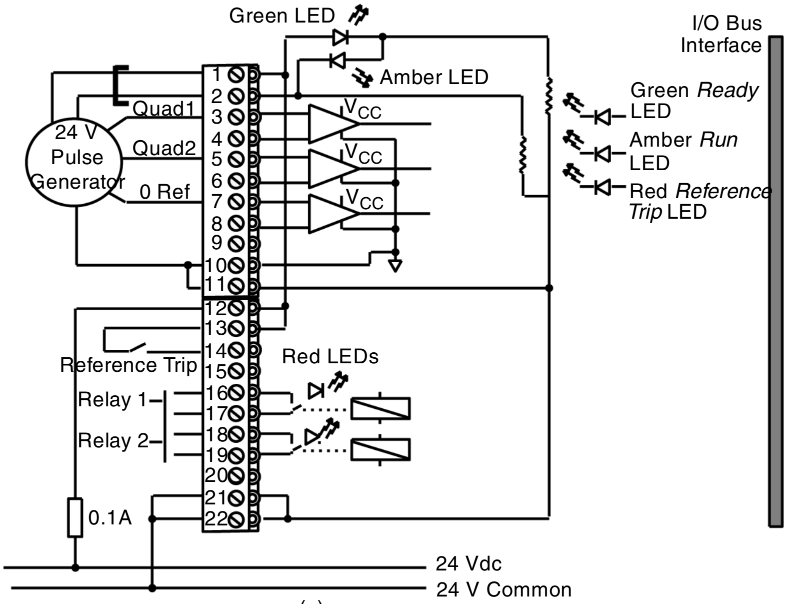
The ZAE 201 can be field wired for positioning applications with 5 V inputs as shown here.



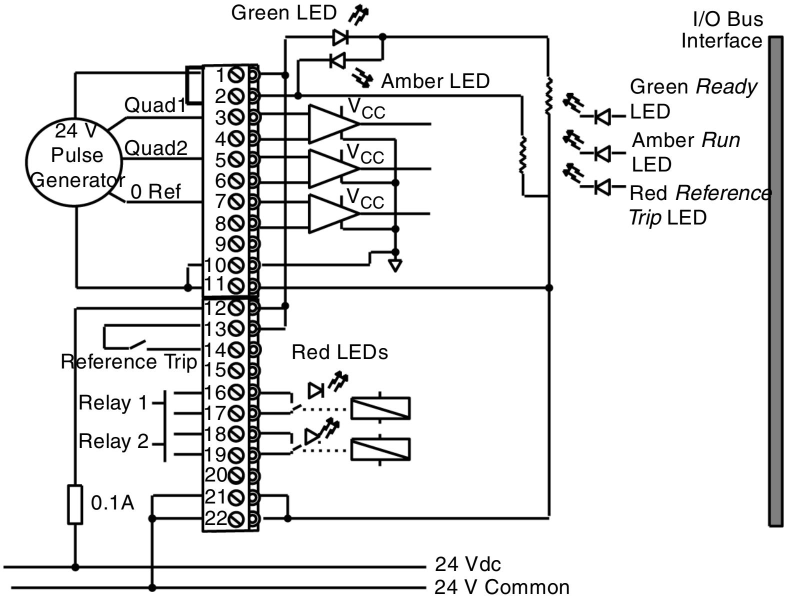
The direction of motion and speed are user defined. The ZAE 201 provides relay outputs that indicate when speed should be changed.

### Wiring a ZAE 201 Module for Positioning with 24 V Inputs

The ZAE 201 can be field wired for positioning applications with monitoring as shown in (a), and without (b).


Green LED
I/O Bus Interface
Amber LED
Green *Ready* LED
Amber *Run* LED
Red *Reference Trip* LED
24 V Pulse Generator
Quad1
Quad2
0 Ref
$V_{CC}$
$V_{CC}$
$V_{CC}$
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
Reference Trip
Red LEDs
Relay 1
Relay 2
0.1A
24 Vdc
24 V Common

(a)


Green LED
I/O Bus Interface
Amber LED
Green *Ready* LED
Amber *Run* LED
Red *Reference Trip* LED
24 V Pulse Generator
Quad1
Quad2
0 Ref
$V_{CC}$
$V_{CC}$
$V_{CC}$
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
Reference Trip
Red LEDs
Relay 1
Relay 2
0.1A
24 Vdc
24 V Common

(b)

## Position Control

For 24 V operations, a ZAE 201 positioning module requires three input signals from an incremental encoder to maintain absolute position—two quadrature pulse inputs connected at terminal screws 3 and 5 provide position and direction, and a third signal connected at terminal screw 7 provides a single pulse on every rotation of the encoder.

For 5 V operations, differential inputs are required; a ZAE 201 positioning module must be wired at six terminal screws:

- **Quad pulse 1** and **quad pulse 1** at terminal screws 3 and 4, respectively
- **Quad pulse 2** and **quad pulse 2** at terminal screws 5 and 6, respectively
- The **0 reference** and **0 reference** at terminal screws 7 and 8, respectively

The pulse signal combined with the reference trip input at terminal screw 14 define 0 for the linear travel route being controlled by the module.

The **reference trip input** is derived from the output of some type of proximity sensor placed at a position defined as 0. On command, the object under control is passed by the proximity switch. By logically ANDing the rotational pulse from the encoder with the signal from the proximity switch, you define 0 and maintain the position value of 0 within the module.

Position control is handled by user-defined discrete logic that controls a drive motor based on information provided by the Compact-984 Controller. Relays 1 and 2 on the ZAE 201 module control motor speed in the following manner, depending on whether the **parameterize** command has been set for overlapping mode or alternating mode pulse reception:

### Overlapping Mode

- Both relays ON — fast speed
- Relay 1 OFF and relay 2 ON — slow speed
- Both relays OFF — stop drive motor

### Alternating Mode

- Relay 1 ON and relay 2 OFF — fast speed
- Relay 1 OFF and relay 2 ON — slow speed
- Both relays OFF — stop drive motor

Motor direction must be controlled by other logic, typically by a discrete output module or ladder logic that drives a D/A converter—e.g., a DAU 202.

## Switch Settings for Using the ZAE 201 as a Positioning Controller

### Switch Settings

To set a ZAE 201 module up as a one-axis positioning controller, place DIP switch B2 on the back of the module in the right (R) position, use DIP switch B1 to specify the desired input voltage at the encoder inputs, and use DIP switch B3 to specify whether the reference trip activity will be HIGH or LOW.

The ZAE 201's maximum allowable positions are limited to a range between -8,388,607 and +8,388,607.

**Note:** The ZAE 201 does not control speed, but provides relay outputs that indicate when speed should be changed. The actual control of speed must be provided by the user (ladder or hardware) logic-the module itself does not control the speed. Similarly, the ZAE 201 does not control direction; this is also a function of user-defined logic (ladder or hardware).

## Overview of ZAE 201 Positioning Mode Commands and States

### Parameterization

When the ZAE 201 has been installed as a positioning module and the Compact-984 Controller has been powered up, the ZAE 201 comes up in a NET IN state. In the NET IN state, the module is unable to conduct any position control operations. It must be given a set of positioner mode parameters before it becomes a functioning module.

The process involves the setting of three positioning parameters—P1, P2, and P3—which describe how the two relays will manage motor speed as the target position is approached, These parameters are unsigned numbers that refer to three different distances from the target position.

For example, in overlapping mode, P1, P2, and P3 are values that must be defined based on the dynamics of the operation being controlled. When the distance from the target position reaches the value defined as P1, relay 1 is opened and the drive motor speed begins to be reduced. When the distance from the target position reaches the value defined as P2, relay 2 is opened and the drive motor is turned OFF; when the motor is turned OFF, the operation coasts to a stop. P3 defines an acceptable region on either side of the target position where you plan to stop the system.

Two additional bits of information must be passed to the module during the parameterization process. The first specifies the relay operation as a function of P1 and P2; the other specifies the speed at which the reference point will be approached.

### Running a Reference Point

After the ZAE 201 has been parameterized for positioning mode, the module is not yet able to perform motion control until it has undergone a procedure called **running a reference point**. This procedure defines the 0-point on the axis of travel. It requires the issuing of the **run reference point** command in the output data block in order to drive the system toward the 0-position (defined by a proximity sensor) and set the position value in the module to 0 when that point is reached.

The direction of motion is totally user-controlled.

### The READY State

After you have completed running a reference point, the ZAE 201 module enters the READY state for positioning operations. At this point, motion control can be enacted by simply requesting that the module drive the system to a particular coordinate.

### RESET

If you need to change the operating parameters, you can put the module back into a NET IN state at any time by issuing a **reset** command.

## The ZAE 201 Positioning Mode Commands

### Overview

As shown in the following table, there are five commands that can be used in the positioning mode—**parameterize**, **reset**, **run reference point**, **run reference point +**, and **go to target**. These commands are implemented in the three-word output data block specified in the I/O Map for the ZAE 201. Before ordering encoders, ensure they comply with the A, B, and Z pulses shown in the Specifications section.

Not all commands are acceptable at all times to the module:

The following table summarizes command and state compatibilities in positioner mode.

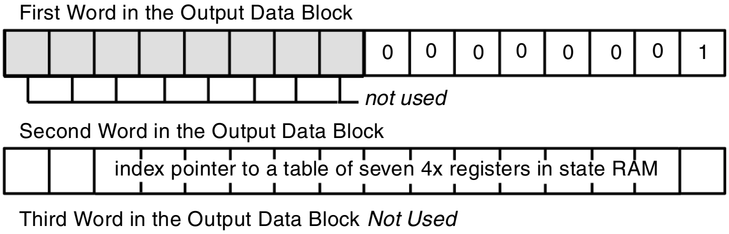
| State | parameterize | reset | run ref | run ref + | go to target |
|---|---|---|---|---|---|
| NET IN | allowed | allowed | not allowed | not allowed | not allowed |
| PARAM | not allowed | allowed | allowed | not allowed | not allowed |
| READY | not allowed | allowed | not allowed | allowed | allowed |
| RUN FAST | not allowed | allowed* | not allowed | not allowed | not allowed |
| RUN SLOW | not allowed | allowed* | not allowed | not allowed | not allowed |
| RUN HUNT | not allowed | allowed* | not allowed | not allowed | not allowed |
| * Allowed but can cause current motion to stop by opening both relays. | | | | | |

If a command is issued during a state that does not allow that command, an error is reported in the first word of the input data block.

### Positioning Mode parameterize Command

The **parameterize** command implements the first two words in the output data block:

Output Data Block Format: parameterize Command in Positioner Mode

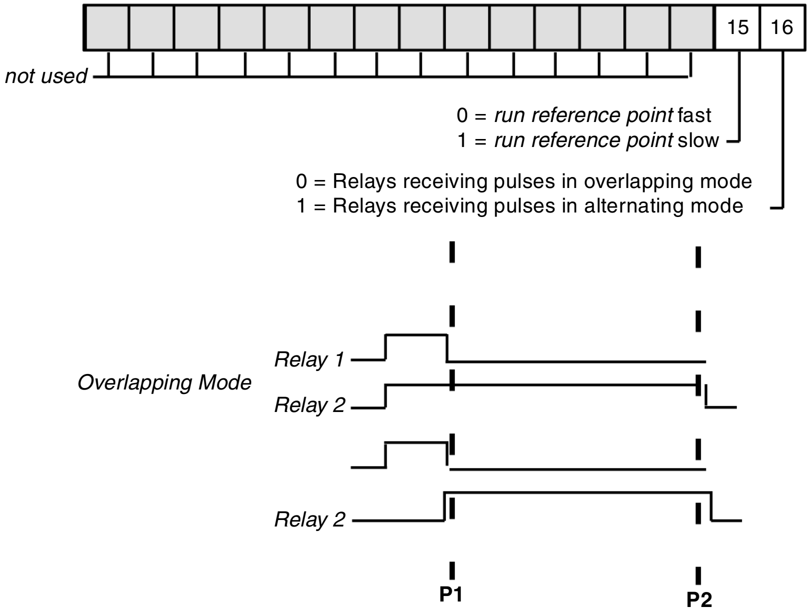


The second word contains an index into a table of seven 4**x** registers in the controller's state RAM. These seven registers contain the information necessary to parameterize the module.

## 4[x] Table

The first register in the 4**x** table contains information that defines the operation of the relays during motion to a target position and the speed at which a **run reference point** is executed.

The following diagram illustrates this procedure.



Any values that might appear in bits 1 ... 14 of the register are ignored.

The second and third registers in the 4**x** table contain a hexadecimal number that defines P1—the distance from the target position at which the motor speed should slow down. The value of P1 < 8,288,607. The second register contains the high order part of the hex value; the third register contains the low order part of the hex value.

The fourth and fifth registers in the 4**x** table contain a hexadecimal number that defines P2—the distance from the target position at which the motor should turn OFF. The value of P2 < 8,288,606. The fourth register contains the high order part of the hex value; the fifth register contains the low order part of the hex value.

The sixth and seventh registers in the 4**x** table contain a hexadecimal number that defines P3—the distance from the target position that is deemed within acceptable tolerance of the desired position. The value of P3 < 8,288,605. The sixth register contains the high order part of the hex value; the seventh register contains the low order part of the hex value.

## Positioning Mode Motion Completion

**CAUTION**

**Possible need to reset.**

If the motion never achieves the target tolerance, the ZAE 201 will never report the motion completed—no further motion commands can be given without resetting the module.

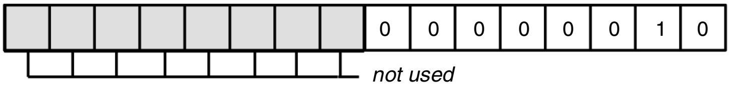
**Failure to follow this instruction can result in injury or equipment damage.**

## Positioning Mode reset Command

The **reset** command implements only the first word in the output data block:

**Output Data Block Format: *reset* Command in Positioner Mode**

First Word in the Output Data Block



Second and Third Words in the Output Data Block *Not Used*

There are no errors associated with this command. If the module is in a RUN or READY state when the **reset** command is issued, the module will be put into a NET IN state. If the module is already in NET IN when the command is issued, nothing will happen.

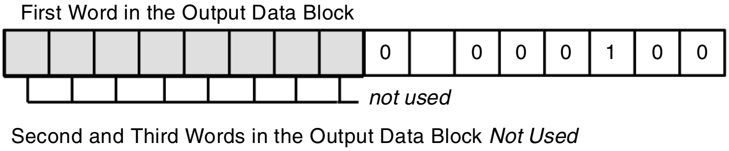
**Note:** The reset can be used as an emergency stop for any motion.

## Positioning Mode run reference point Command

The **run reference point** command is used to define a 0-point along the range of motion available to the system being controlled. The system is driven in the direction of a 0-point that has been predefined by a proximity sensor before issuing the command. When the system reaches the 0-point, the module defines its 0 reference location as this point.

The **run reference point** command implements only the first word in the output data block:

**Output Data Block Format: *run reference point* Command in Positioner Mode**

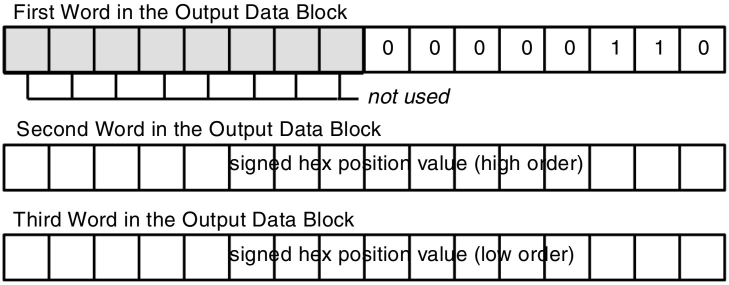


This command must be issued as part of the parameterization process and is valid only when the module is in a parameterized but not READY state.

## Positioning Mode go to target Command

The **go to target** command is the major motion command used in the positioning mode; it implements all three words in the output data block:

**Output Data Block Format: *go to target* Command in Positioner Mode**



When you issue the **go to target** command, you tell the ZAE 201 module to drive the system under control to a position specified by a hexadecimal number entered in the second and third words of the output data block. The value of that hex number is in the range -8,388,608 ... +8,388,607. The direction of motion may be positive or negative; anticipated direction must be specified in user logic and transmitted to the position control logic during the same cycle that the **go to target** command is issued.When a **go to target** command is received, bit 1 in the first word of the input data block is set to 1; the bit remains set until the target is reached and the READY state is reached. No further motion commands are permitted while the busy bit is set.

The **go to target** command is valid only while the ZAE 201 is in the READY state.

## Positioning Mode run reference point + Command

The **run reference point +** command implements all three words in the output data block:

**Output Data Block Format:** ***run reference point*** **+ Command in Positioner Mode**

First Word in the Output Data Block

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |

Second Word in the Output Data Block

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | signed hex position value (high order) | | | | | | | | | | |

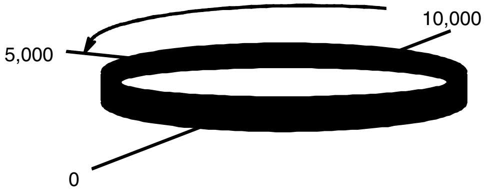
Third Word in the Output Data Block

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | signed hex position value (low order) | | | | | | | | | | |

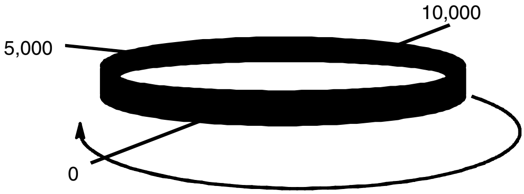
When you issue the **run reference point +** command, you tell the ZAE 201 module to drive the system under control in a positive direction to a position specified by a hexadecimal number entered in the second and third words of the output data block. The value of that hex number is in the range -8,388,608 ... +8,388,607. In order for this command to be satisfied, the system under control must be driven **through** the 0 reference point.

The **run reference point +** command is designed specifically for systems that continually return to the 0 reference point when driven in a positive direction—e.g., a continuous belt-driven machine. In this type of system, where all positions are defined as positive offsets of the predefined 0-point, the command may be used as an alternative to the **go to target** command for sending the system a target. If, for example, you want to move a system currently located at position 10,000 to target position 5,000, you may proceed to the target in either the positive or negative direction:

- To proceed in the negative direction, issue the **go to target** command to target position 5,000:



- To proceed in the positive direction, issue the **run reference point +** command to target position 5,000:



In the second case, the **run reference point +** command moves the system forward to the 0 reference point, resets the count to 0, then continues system movement positively to target position 5,000.

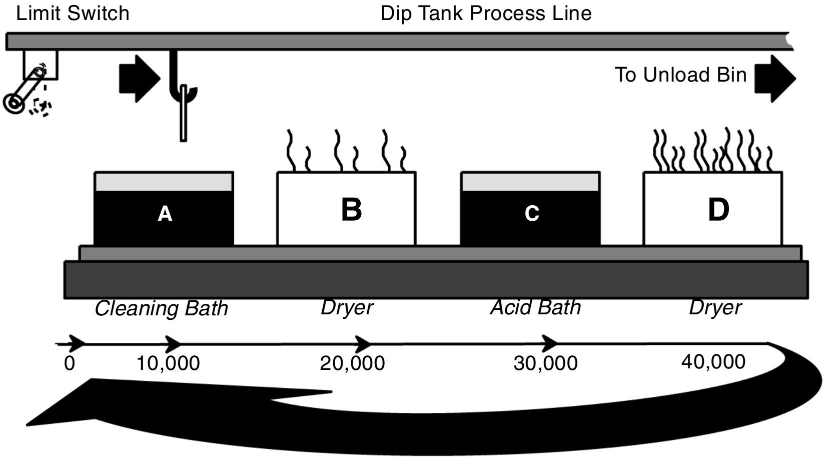
When a **run reference point +** command is received, bit 1 in the first word of the input data block is set to 1; the bit remains set until the target is reached and the READY state is reached. No further motion commands are permitted while the busy bit is set.

The **run reference point +** command is valid only while the ZAE 201 is in the READY state.

## Example: Using the ZAE 201 Module as a Positioner

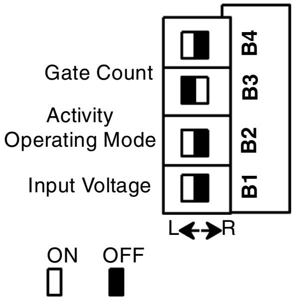
**Positioning Example**

The ZAE 201 module is used to control horizontal positioning in the following example. The system is a process line where printed circuit boards are dipped into a series of four tanks. In the positioning mode, the ZAE 201 carry the PCBs along the process line, position them over each of the four stations, and move them to the unload position at the end of the line. The example treats only the horizontal movement portion of the application; it does not treat vertical dipping motions.



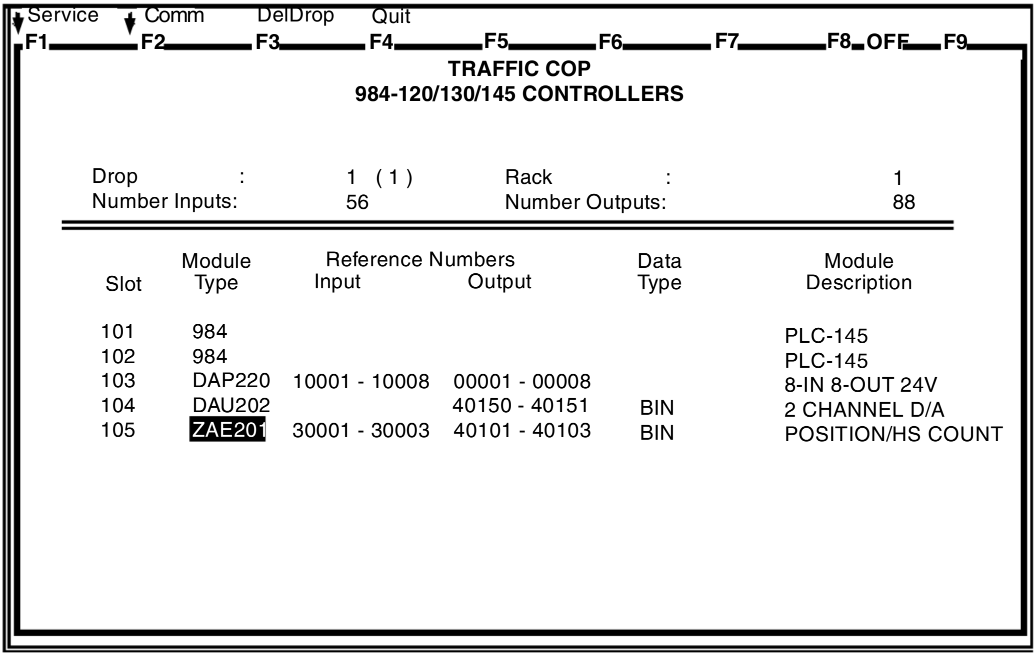
**Positioner Example DIP Switch Settings**

Set the DIP switches on the back of the module for POSITION mode, 5 Vdc input voltage, and HIGH activity on the count gate:



### Positioner Example Traffic Cop Settings

Traffic cop the drop to support the system with the ZAE 201 positioning module with a DAU 202 analog output module and a DAP 220 24 Vdc combo I/O module:



**TRAFFIC COP**

**984-120/130/145 CONTROLLERS**

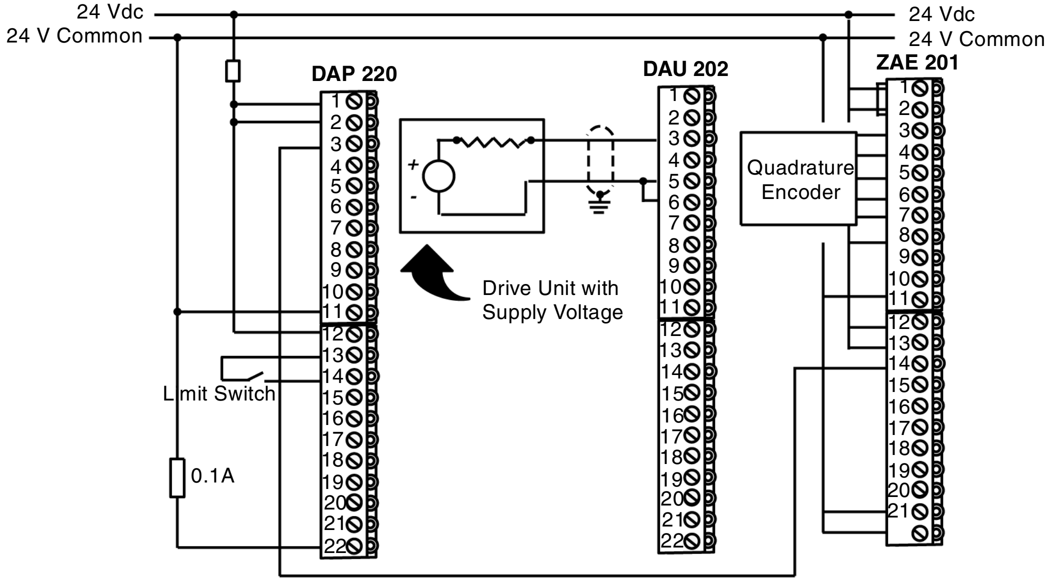
Drop : 1 ( 1 ) Rack : 1

Number Inputs: 56 Number Outputs: 88

| | Module | Reference Numbers | | Data | Module |
|---|---|---|---|---|---|
| Slot | Type | Input | Output | Type | Description |
| 101 | 984 | | | | PLC-145 |
| 102 | 984 | | | | PLC-145 |
| 103 | DAP220 | 10001 - 10008 | 00001 - 00008 | | 8-IN 8-OUT 24V |
| 104 | DAU202 | | 40150 - 40151 | BIN | 2 CHANNEL D/A |
| 105 | ZAE201 | 30001 - 30003 | 40101 - 40103 | BIN | POSITION/HS COUNT |

## Positioner Example Field Wiring Diagram

Field wire the two A120 I/O modules like this:



## Positioning Example Ladder Logic

The following ladder logic program automatically parameterizes the module upon power-up and then repeatedly directs the motion:

- Relays 1 and 2 are normally open and provide one-shot responses, since the four least significant bits in register 40120 are all set to 0
- The high order byte value for P1—the distance from the target location at which the motor drive will begin to slow the process—is expressed in register 40121 as 0
- The low order byte value for P1 is expressed in register 40122 as 1,000
- The high order byte value for P2—the distance from the target location at which the motor drive will stop—is expressed in register 40123 as 0
- The low order byte value for P2 is expressed in register 40124 as 500
- The high order byte value for P3—the acceptable distance from the target location—is expressed in register 40125 as 0
- The low order byte value for P3 is expressed in register 40126 as 250

## Positioning Example State RAM Values

The following values, initialized in State RAM, will enable the positioning example to operate using the logic, traffic cop, and module connections as described in the following tables.

## Data Blocks

### Parameterize Data Blocks

| | | |
|---|---|---|
| 40120 | 0 | Parameterize Data |
| 40121 | 0 | P1 Value |
| 40122 | 1000 Decimal | |
| 40123 | 0 | P2 Value |
| 40124 | 500 Decimal | |
| 40125 | 0 | P3 Value |
| 40126 | 250 Decimal | |

### Motion Direction Data Block

| | | |
|---|---|---|
| 40130 | 32 | These registers, when moved to call group 00001 - 00016, set Coil 10 or 11, specifying the direction of motion. |
| 40131 | 32 | |
| 40132 | 32 | |
| 40133 | 32 | |
| 40134 | 32 | |
| 40135 | 64 | |
| 40099 | 0 | Pointer to table of direction bits |
| 40140 | 0 | Pointer to table of motion commands |
| 40100 | 1 | Command data for parameterized command, pointing to a table starting with register 40120. This command will be active at the end of the first scan. |
| 40101 | 120 | |
| 40102 | 0 | |

## Motor Speed, Direction, Motion Commands

Motor Speed And Direction Values

| | | |
|---|---|---|
| 40160 | 4096 (+10 V) | One of these values is moved to register 40150, which is I/O mapped to the DAU 202. The output of the DAU 202 will control the motor speed and direction. NOTE: The specific values used here are application-dependent. |
| 40161 | 3072 (+5 V) | |
| 40162 | 2048 0 | |
| 40163 | 1024 (-5 V) | |
| 40164 | 0 (-10 V) | |

Motion Command Table

| | | |
|---|---|---|
| 40200 | 4 | Run reference point command data |
| 40201 | 0 | |
| 40202 | 0 | |
| 40203 | 6 | Move to position 10,000 command data |
| 40204 | 0 | |
| 40205 | 2710 Hex | |
| 40206 | 6 | |
| 40207 | 0 | 20,000 |
| 40208 | 4E20 Hex | |
| 40209 | 6 | |
| 40210 | 0 | 30,000 |
| 40211 | 7530 Hex | |
| 40212 | 6 | |
| 40213 | 0 | 40,000 |
| 40214 | 9C40 Hex | |
| 40215 | 6 | |
| 40216 | 0 | 0 |
| 40217 | 0 | |

## Positioning Example Network Diagrams

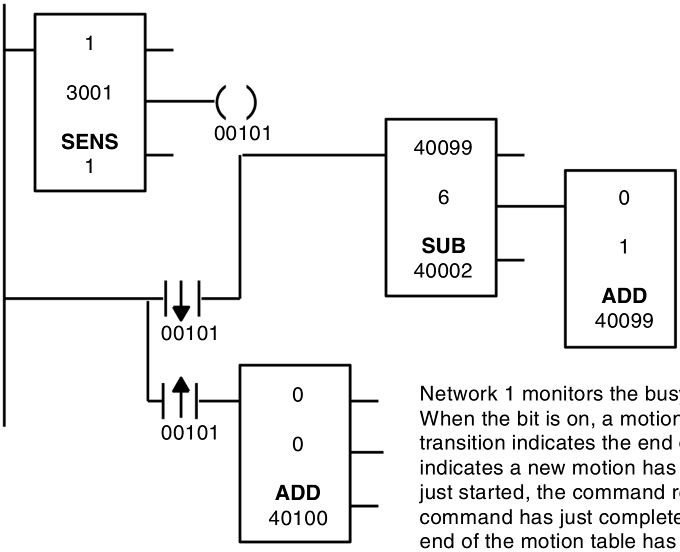
In the example shown here, the HOME proximity switch is simulated by disabling Coil 00001 and momentarily forcing it ON and then OFF, while the Run Reference Point command is being executed. This toggles the FKE input to the ZAE 201 via the DAP 220.

---

### Networks 1 and 2

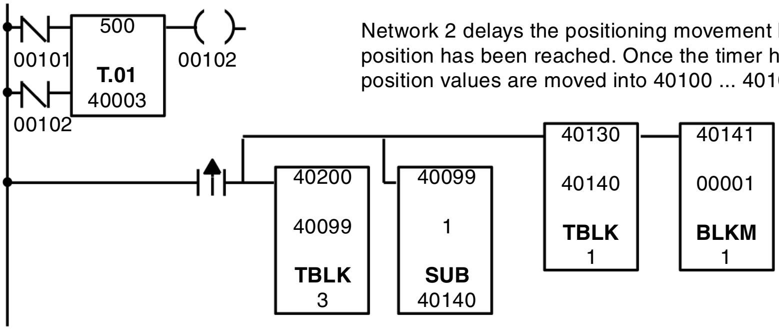
The following diagram describes Networks 1 and 2.

NETWORK 1



Network 1 monitors the busy bit in status Register 30001. When the bit is on, a motion is in progress. A negative transition indicates the end of a motion; a positive transition indicates a new motion has started. If a new motion has just started, the command register is cleared. If the motion command has just completed, a check is made to see if the end of the motion table has been reached (40099 = 6); if so, the pointer to the motion table is reset to 1.

NETWORK 2

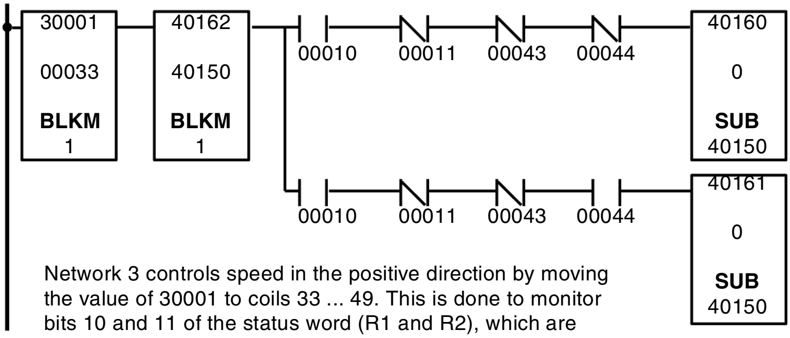


Network 2 delays the positioning movement by 5 s after each new position has been reached. Once the timer has timed out, the new position values are moved into 40100 ... 40102.

Also in this network, position pointer 40099 and direction pointer 40140 are incremented by 1 as part of the TBLK function block.

**Networks 3 and 4** The following diagram describes Networks 3 and 4.

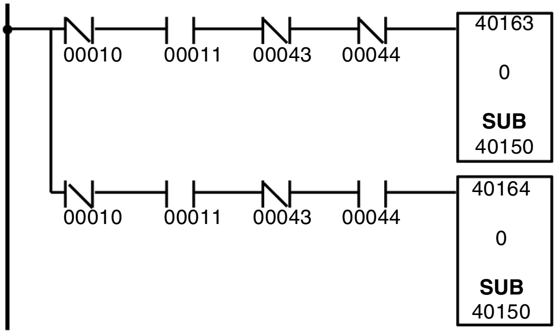
NETWORK 3



Network 3 controls speed in the positive direction by moving the value of 30001 to coils 33 ... 49. This is done to monitor bits 10 and 11 of the status word (R1 and R2), which are placed in coils 43 and 44. When P1 and P2 are reached, the system will change speeds appropriately (normal speed to slow speed, then slow speed to stop). Coils 10 and 11 define the direction of motion.

The BLKM of registers 40162 ... 40150 assumes no motion will occur. Subsequent logic sets up the appropriate speed.

NETWORK 4



Network 4 is similar to Network 3, but controls speed in the negative direction.

# 47.4 Specifications of the ZAE 201 Counter/Positioner Module

## Specifications of the ZAE 201 Counter/Positioner Module

**Purpose**

The purpose of this section is to list technical specifications of the module.

**ZAE 201 Counter/ Positioner Specifications**

Module Topology

| | |
|---|---|
| Number of Relay Outputs | 2 |
| Operating Modes | Switch-selectable counter/positioner |

Power Supplies

| | |
|---|---|
| External Power Source (for all operating modes) | 24 Vdc, 30 mA |
| Internal Power Source from I/O Bus | 5 V, 100 mA maximum |

Electrical Characteristics

| | | |
|---|---|---|
| Working Voltage Range of Relays | | 24 ... 60 Vdc |
| | | 24 ... 250 Vac |
| Contact Current (maximum) | Load Currents @ 230 Vac | 2 A continuous resistive |
| | | 4 A instantaneous resistive |
| | | 1 A continuous (Cos Φ = 0.5) |
| | Load Currents @ 24 Vdc | 2 A continuous resistive |
| | | 4 A instantaneous resistive |
| | | 1 A continuous (L/R* = 30 ms) |
| Wetting Current | | 5 mA (relay outs) |
| Contact Delay Time | | ~10 ms |

| | | |
|---|---|---|
| Protective Circuitry | | 68 Ω + 15 nF in parallel with the contact<br>Consumes ~1 mA |
| Maximum Wire Length | from 24 V Pulse Generator | 20 m |
| | | 65 ft |
| | from 5 V Pulse Generator | 50 m |
| | | 163 ft |
| * L = Load Inductance in H    R = Load Resistance in Ω | | |

### Input Characteristics

| | | |
|---|---|---|
| 5 V Input Selection | Differential RS-422 | 12 V peak-to-peak maximum |
| | | 400 mV peak-to-peak minimum |
| 24 V Input Selection | for 1 signal | 12 ... 30 V |
| | for 0 signal | -2 ... +5 V |
| Maximum Count Frequency | for 5 V input | 500 kHz |
| | for 24 V input | 50 kHz |
| PNP Encoder Quadrature type | | Two-track plus marker signal |
| Count Gate/Reference Trip | | 1 = 12 Vdc (min) |
| | | 0 = 5 Vdc (max) |
| Encoder Pulse Alignment | | See diagram below. |
| Duration | | > 10 ms |
| Rise Time | | N/A |

## Relay Contact Service Life

| | | |
|---|---|---|
| Mechanical Switching Cycles | | 20,000,000 |
| Electric Switching Cycles (Resistive Load) | @ 230 Vac/0.2 A | 10,000,000 |
| | @ 230 Vac/0.5 A | 7,000,000 |
| | @ 30 Vdc/2 A, clamping diode | 8,000,000 (typical) |
| | @ 60 Vdc/1 A with clamping diode | 1,000,000 typical |
| | | 3,000,000 maximum |
| | | 3000 cycles/hr maximum |
| Electric Switching Cycles (Inductive Load, Cos Φ = 0.5) | @ 230 Vac/ 0.5 A | 5,000,000 |

## I/O Map

| | |
|---|---|
| Register 3x/4x | 3 in/3 out |

## Dimensions

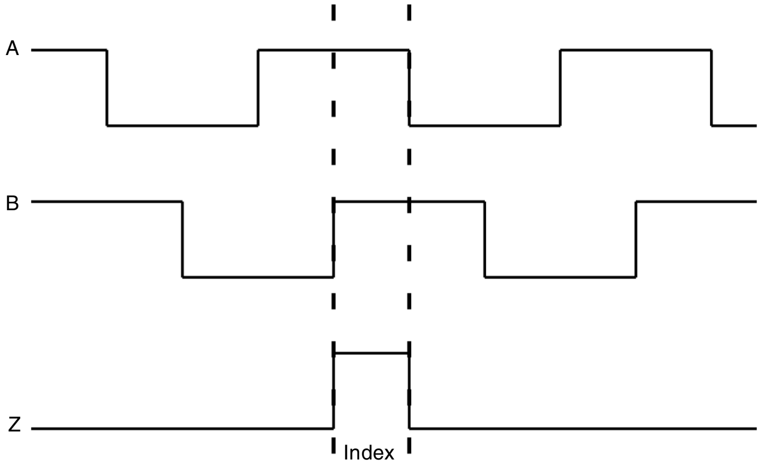
| | |
|---|---|
| W x H x D | 40.3 x 145 x 117.5 mm |
| | 1.6 x 5.6 x 4.5 in |
| Weight | 300 g |
| | 0.7 lb |

## Agency Approvals

| |
|---|
| VDE 0160; UL 508; CSA 22.2 No.142; and FM Class I, Div 2 Standards |

## Pulse Alignment of Encoders Used with the ZAE 201 Module

Encoders used with the ZAE 201 module should be ordered with the alignment of A, B and Z pulses as shown below.



Encoders used with the ZAE-201 module should be ordered with the alignment of A, B + Z pulses as shown above.

# Overview of the ZAE 204 High-Speed Counter Module

# 48

## At a Glance

**Purpose**

The purpose of this chapter is to describe the ZAE 204 High-Speed Counter Module.

⚠ **WARNING**

**Compatibility**

The ZAE 204 module will only operate properly when used with an A984, E984, or Micro 512/612 controller.

**Failure to follow this instruction can result in death, serious injury, or equipment damage.**

**What's in this Chapter?**

This chapter contains the following topics:

## What is the ZAE 204 High-Speed Counter Module?

**Brief Product Overview**

The ZAE 204 is a high speed counter module with the following characteristics:

- Four counter inputs for counting 5 Vdc (TTL) and 24 Vdc pulses; a counting range of 5 decades; and a counting frequency of up to 1 kHz (channel 1 can operate up to 10 kHz)
- Four 24 Vdc count enable inputs
- Four 24 Vdc semiconductor output switches, 0.5 A each, with short circuit/ overload protection and hardware reset

Power required by the module is:

- 5 Vdc via the internal I/O bus
- 24 Vdc external supply for 24 V counting inputs, outputs, and enable inputs

The ZAE 204 can be installed in any slot in the A120 subracks (DTA 200, 201, and 202). The module has bus contacts at the rear and field connections on the front. The blank label, which fits in the module cover, can be filled in with relevant information (signal values, etc.) in the spaces provided. Refer to *ZAE 204 Diagram, p. 667* below.

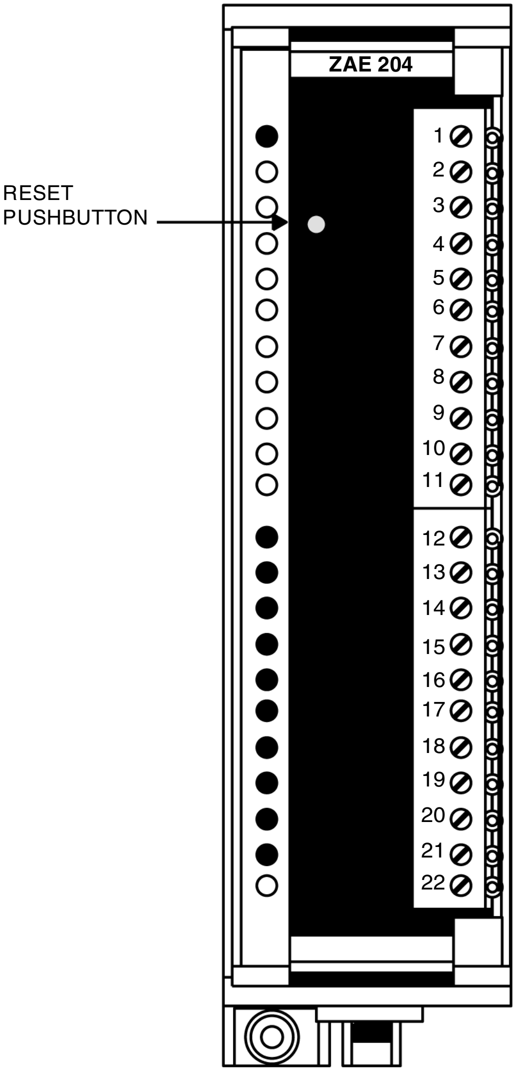
The ZAE 204 is made up of 4 independent counters for the following modes:

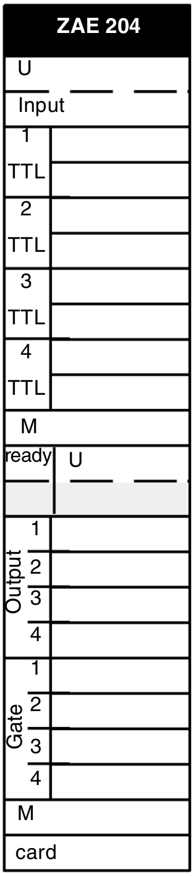
- Event counter
- Repeat counter
- Differential counter

The above operating modes and the parameters required for them are preset by the user program. See *Operation of the ZAE 204 Module, p. 684* for a description of these modes.

**ZAE 204 Diagram**

Any output that is overloaded or short-circuited is switched OFF, and is indicated by the amber fault LED (see next section (see *Operating and Display Elements of the ZAE 204 High-Speed Counter Module, p. 668*)). Correction is made by use of the RESET button as shown in the front view and label diagram below.





# Operating and Display Elements of the ZAE 204 High-Speed Counter Module

**ZAE 204 LEDs**

The ZAE 204 has eleven LEDs on the front of the module. From top to bottom, they are:

| **Color** | **Type** | **Function** |
|---|---|---|
| Green | Power | External 24 Vdc—when lit, power ON; when off, power OFF |
| Green | Ready | When lit, indicates firmware initialization is complete and module is ready for service; when off, indicates start-up functions are not complete and module is not yet ready.<br>**Note**: The PLC must be running for this LED to illuminate. |
| Amber | Fault | Indicates the presence of an overload or short-circuit at one or several output points. When lit, indicates an overload or short circuit; when off, no faults detected. |
| Red | Output 1 ... 4 | Located opposite terminal screws 14 ... 17. When lit, these LEDs indicate that the outputs are ON. |
| Red | Gate 1 ...4 | Located opposite terminal screws 18 ... 21. When lit, these LEDs indicate that the enable inputs (function gate) have a high signal level voltage applied to them. |

The RESET button is used to restore the operation of an output switch after the overload condition has been removed.

## Configuration of the ZAE 204 High-Speed Counter Module

### ZAE 204 Configuration Overview

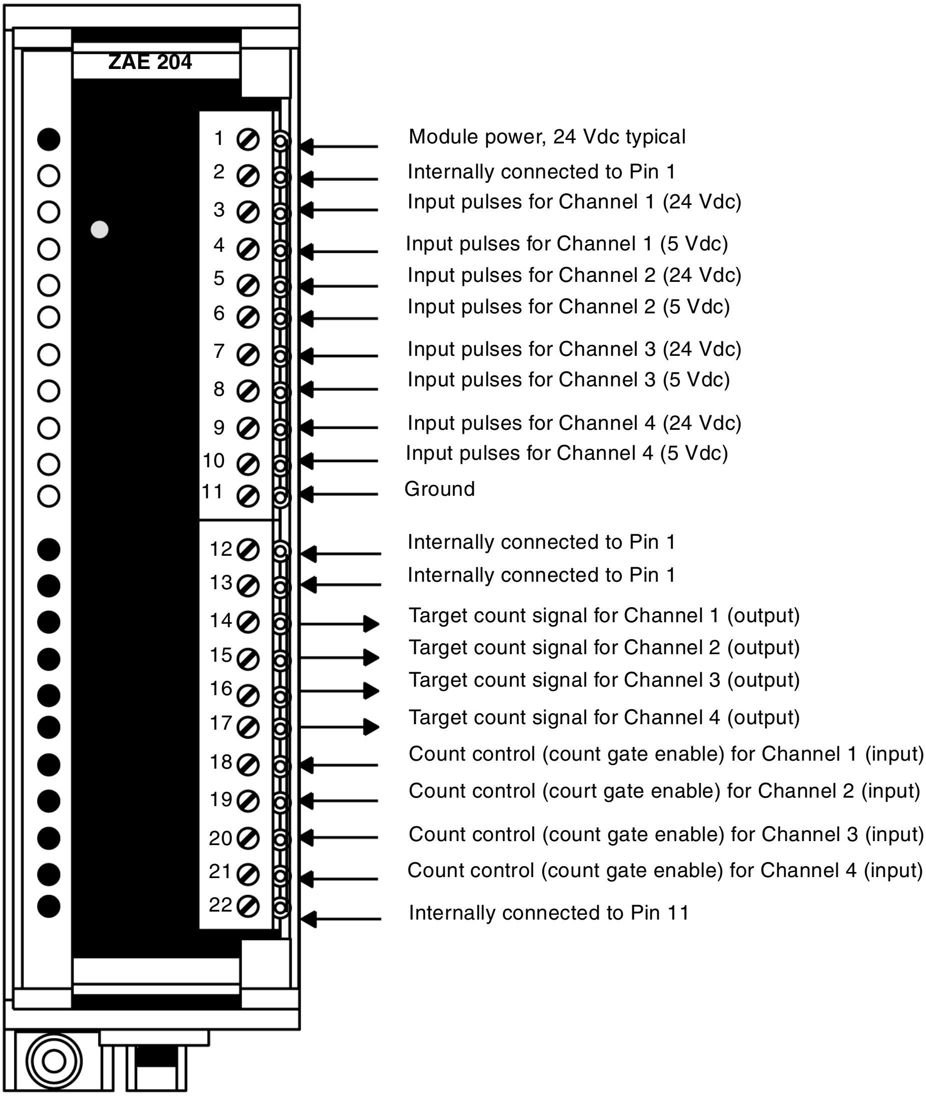
The ZAE2 04 contains four independent 16–bit 1 kHz counters. In addition, channel 1 can be programmed to accept up to 10 kHz inputs. The ZAE 204 has several modes of operation. It can operate as four independent up or down counters, either one time or repetitively. Alternatively, channels 1 and 2 and/or channels 3 and 4 can operate together as differential counters. In this mode, a single count value is maintained for channel pairs.

For the channel 1, 2 pair, input pulses at the channel 1 field connector cause this count value to increase, and input pulses at channel 2 cause the count value to decrease. The differential count value for the channel 1, 2 pair are returned to the location normally associated with channel 1. The channel 3, 4 pair works in a similar manner.

An output is provided for each channel (pins 14 ... 17) to signal when the accumulated count at a particular channel has reached its programmed target, counted up to or counted down from 0. An input signal (pins 18 ... 21) is provided for each channel to enable the counting operation. The accumulation of counts on any channel can be controlled through the state of the enable input to the appropriate pin.

## ZAE 204 Field Side Connections

The module must be traffic copped as six 3**x** input registers and one 4**x** output register, as shown in the following field side connections diagram.



**ZAE 204 Cabling**

- Shielded, twisted pair cable (2 or 4 x 0.5 mm/channel) should be used. All channels can be connected with a common shielded cable. The maximum cable length is 100 m.
- Connect shield to ground (GND) on one side with a short cable (< 8 in).
- Observe a minimum distance of 20 in between the module and power lines or other sources of electrical disturbance.

## Example Field Connections and Signal Addresses for the ZAE 204 Module

**Field Connection Diagrams**

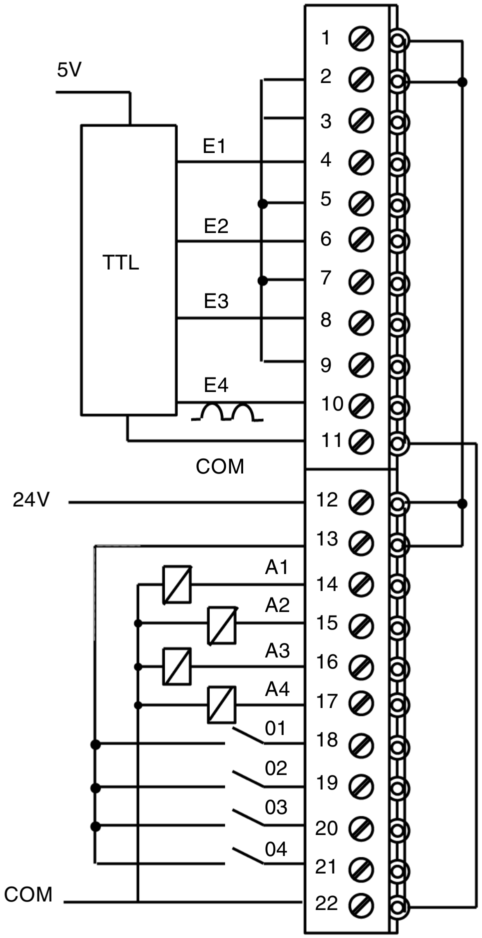
Three examples of ZAE 204 connections are provided:

- 5 V inputs (see *5 V Inputs Connection Example, p. 673*);
- 5 V inputs on a noisy system (see *5 V Inputs, High Interference Connection Example, p. 674*);
- 24 V inputs (see *24 V Inputs Connection Example, p. 675*).

**Note:** Detailed Compact 984 cabling and installation instructions are found in the 984-A120 Compact Programmable Controllers User Guide (GM-A984-PCS).

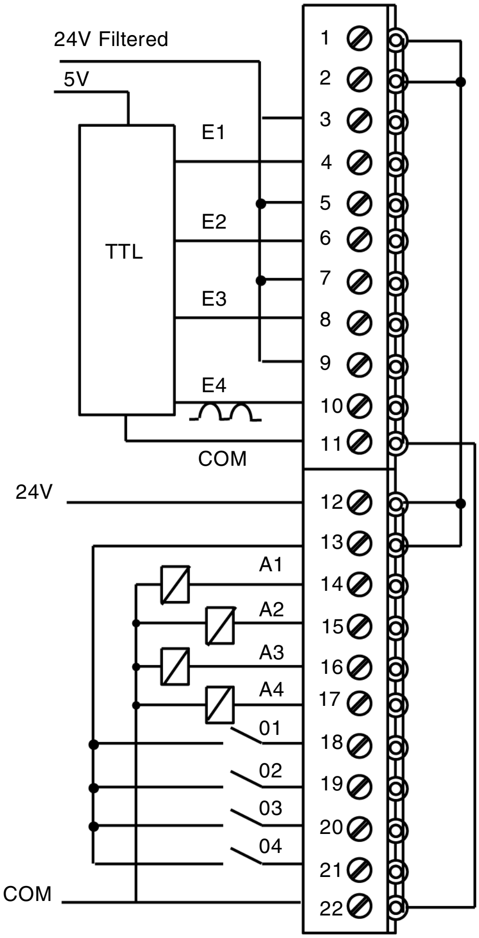
## 5 V Inputs Connection Example

Example connections for 5 V inputs are shown below.



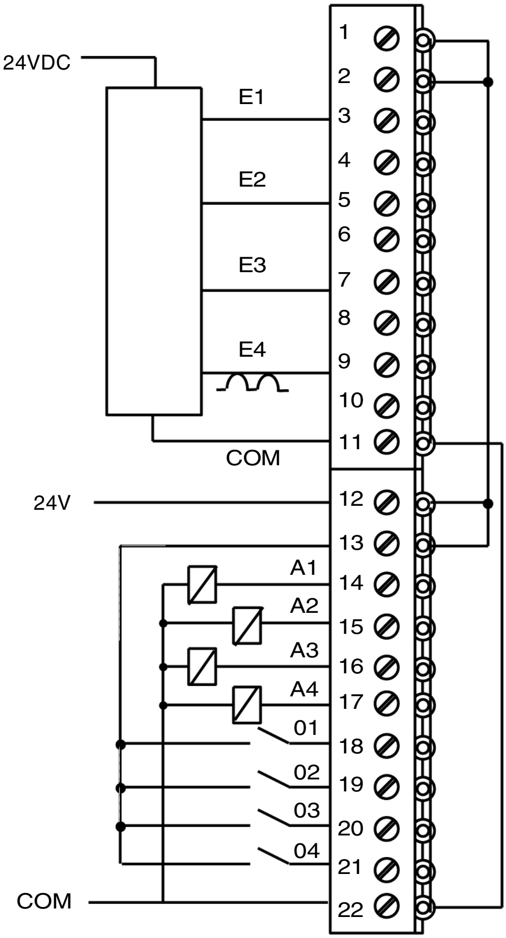
## 5 V Inputs, High Interference Connection Example

Example connections for 5 V inputs, on a system with a high interference level, are shown below.



## 24 V Inputs Connection Example

Example connections for 24 V inputs are shown below.

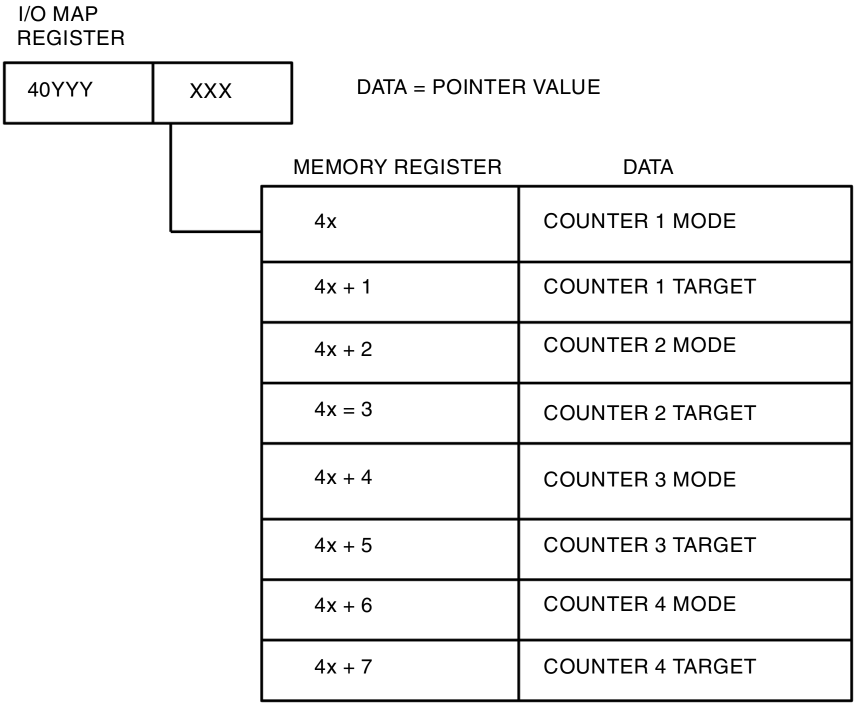


## Output Register Formats of the ZAE 204 Module

**Overview**

The ZAE 204 is traffic copped for set up through a single 4YYYY word (BIN register). The content of this word is interpreted as a pointer to the first of eight 4**x** registers that contain the programmable operating parameters for each of the four counter channels.

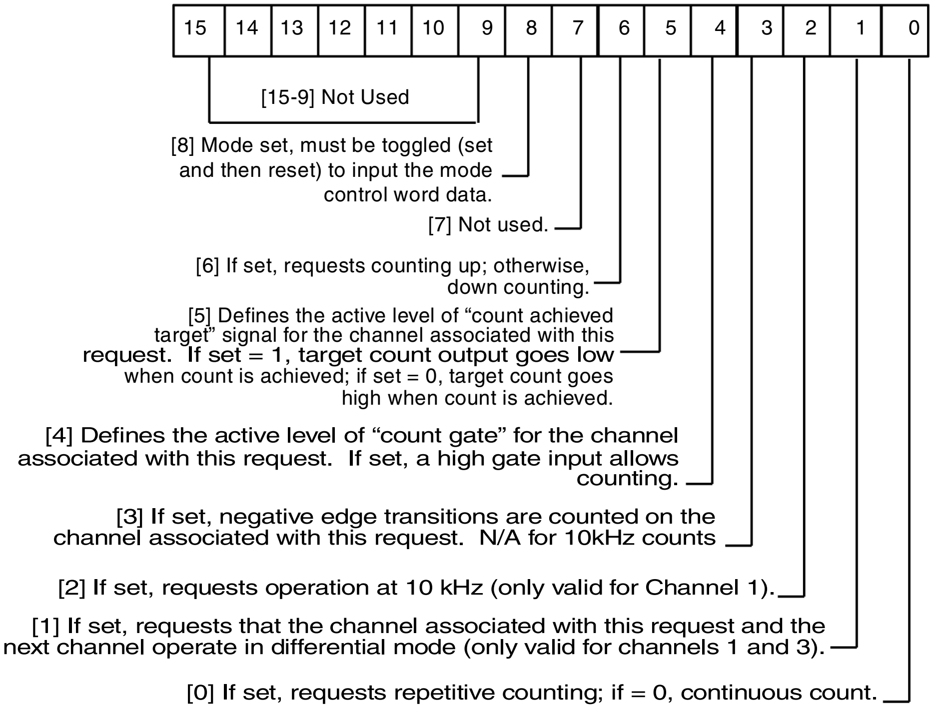
The format, of the eight words pointed to, appears in the following graphic, which shows the output register format for the ZAE 204 module.



| MEMORY REGISTER | DATA |
|---|---|
| 4x | COUNTER 1 MODE |
| 4x + 1 | COUNTER 1 TARGET |
| 4x + 2 | COUNTER 2 MODE |
| 4x = 3 | COUNTER 2 TARGET |
| 4x + 4 | COUNTER 3 MODE |
| 4x + 5 | COUNTER 3 TARGET |
| 4x + 6 | COUNTER 4 MODE |
| 4x + 7 | COUNTER 4 TARGET |

The following figure shows the bits in the ZAE 204 mode control word and their meanings.

**MODE CONTROL WORD**



[15-9] Not Used

[8] Mode set, must be toggled (set and then reset) to input the mode control word data.

[7] Not used.

[6] If set, requests counting up; otherwise, down counting.

[5] Defines the active level of "count achieved target" signal for the channel associated with this request. If set = 1, target count output goes low when count is achieved; if set = 0, target count goes high when count is achieved.

[4] Defines the active level of "count gate" for the channel associated with this request. If set, a high gate input allows counting.

[3] If set, negative edge transitions are counted on the channel associated with this request. N/A for 10kHz counts

[2] If set, requests operation at 10 kHz (only valid for Channel 1).

[1] If set, requests that the channel associated with this request and the next channel operate in differential mode (only valid for channels 1 and 3).

[0] If set, requests repetitive counting; if = 0, continuous count.

The target value is used in several ways. When up counting, the target value is the count at which the target value output for a channel will be on. When down counting, the target value is the value from which the counter counts down to zero. See *Operating and Display Elements of the ZAE 204 High-Speed Counter Module, p. 668* for a more complete description.

## Caution

### ⚠ CAUTION

**Chance of Incorrect Health Status Indication**

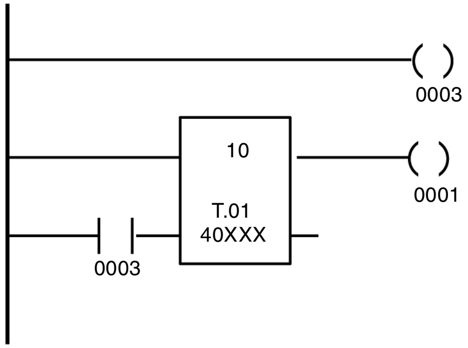
Caution:Modicon 984 PLCs assert IORST, the I/O bus reset, when in STOP mode. This signal halts operation of the ZAE 204 internal microprocessor by forcing it to a reset condition. When I/O Mapping as required in STOP mode, the module will be indicated unhealthy by an asterisk in the I/O module display, and the module description will incorrectly read, "B8 ". This does not affect I/O Mapping, which may proceed as usual. When using a STAT block, module health is properly indicated when Executive Prom Combination #1003 or greater is installed in the 984. Parameters will have to be loaded (or reloaded) after going into RUN from STOP mode, and that 3**x** register data will be zeroed when going from STOP to RUN. Refer to the next figure (see *ZAE 204 RUN/STOP Mode, p. 679*).

**Failure to follow this instruction can result in injury or equipment damage.**

## ZAE 204 RUN/ STOP Mode

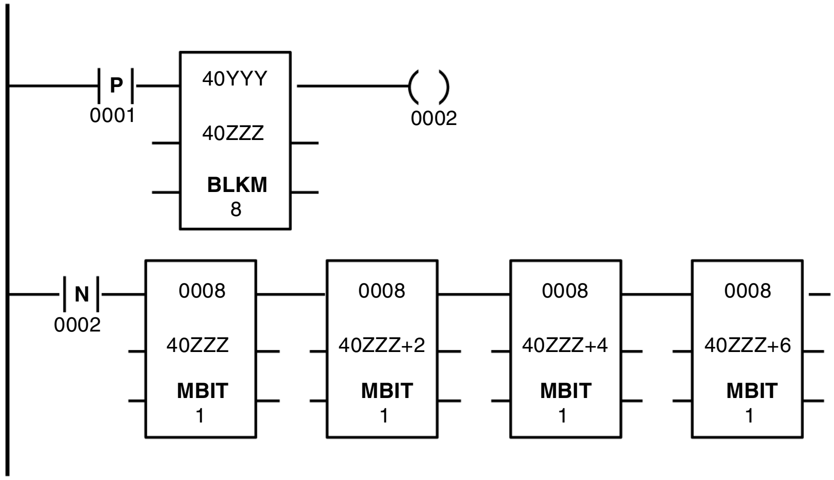
To ensure that the ZAE 204 parameters are loaded after the PLC is set to RUN from STOP mode, the ZAE 204 RUN/STOP mode user logic, shown below, may be used..

NETWORK #1 / SEGMENT #1



|  |  |
|---|---|
| 40YYY | CTR 1 Mode |
| 40YYY + 1 | CTR 1 Target |
| 40YYY + 2 | CTR 2 Mode |
| 40YYY + 3 | CTR 2 Target |
| 40YYY + 4 | CTR 3 Mode |
| 40YYY + 5 | CTR 3 Target |
| 40YYY + 6 | CTR 4 Mode |
| 40YYY + 7 | CTR 4 Target |

NETWORK #2 / SEGMENT #1



### Operation of Networks in the RUN/STOP Mode User Logic Diagram

On the first scan, the timer in Network 1 is set to zero. The next scan starts the timer, set for 100 ms. When it times out, the output comes on and will activate the BLKM through the positive transition contact referenced to Coil 1. The values of the 8 fixed 40YYY registers are block moved into 8 40ZZZ registers, which is a table pointed to by the contents of the I/O mapped output register. These registers contain the mode and target data for the module. The mode registers in the 40YYY table must have bit 8 set to 1, as required, to load the parameters into the ZAE 204. On the following scan after the BLKM is solved, coil 2 goes OFF. Power is then passed through the negative transitional to the MBIT blocks, which set bit 8 to zero in each mode control register in the 40ZZZ table. When this is done, the module is ready to accept counts from external pulse generators.

## Input Register Formats of the ZAE 204 Module

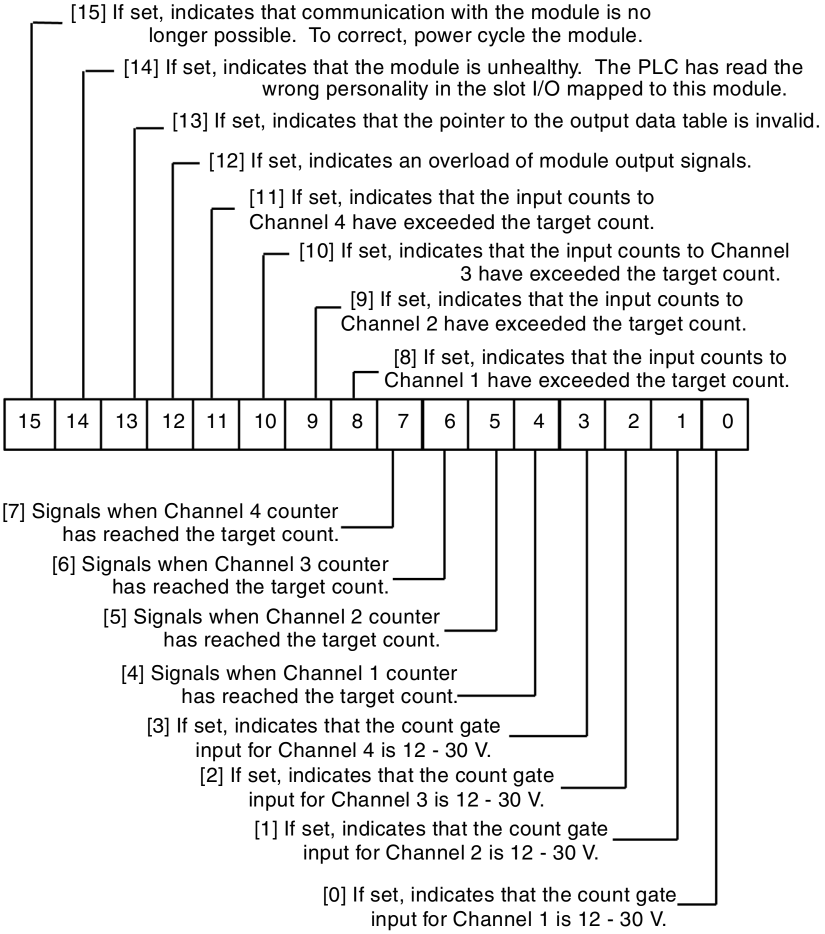
**Overview**

As described in the following table, the module is I/O mapped to input through six 3**x** words (BIN registers). The first two of the input words contain global and channel–specific status information. The last four input words contain the count associated with each of the four channels.

| I/O Map Registers | Description |
|---|---|
| 3x | Module status information |
| 3**x** + 1 | Mode–request errors for each channel |
| 3**x** + 2 | Current count for channel 1 |
| 3**x** + 3 | Current count for channel 2 |
| 3**x** + 4 | Current count for channel 3 |
| 3**x** + 5 | Current count for channel 4 |

The following figure shows the meanings of the bits in the ZAE 204 RUN/STOP first input word..

FIRST INPUT WORD



[15] If set, indicates that communication with the module is no longer possible. To correct, power cycle the module.

[14] If set, indicates that the module is unhealthy. The PLC has read the wrong personality in the slot I/O mapped to this module.

[13] If set, indicates that the pointer to the output data table is invalid.

[12] If set, indicates an overload of module output signals.

[11] If set, indicates that the input counts to Channel 4 have exceeded the target count.

[10] If set, indicates that the input counts to Channel 3 have exceeded the target count.

[9] If set, indicates that the input counts to Channel 2 have exceeded the target count.

[8] If set, indicates that the input counts to Channel 1 have exceeded the target count.

[7] Signals when Channel 4 counter has reached the target count.

[6] Signals when Channel 3 counter has reached the target count.

[5] Signals when Channel 2 counter has reached the target count.

[4] Signals when Channel 1 counter has reached the target count.

[3] If set, indicates that the count gate input for Channel 4 is 12 - 30 V.

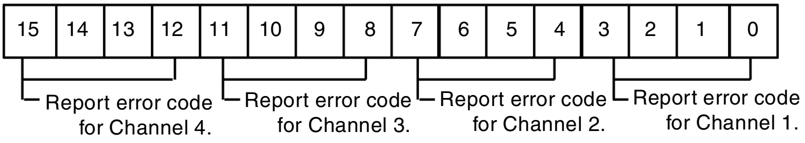
[2] If set, indicates that the count gate input for Channel 3 is 12 - 30 V.

[1] If set, indicates that the count gate input for Channel 2 is 12 - 30 V.

[0] If set, indicates that the count gate input for Channel 1 is 12 - 30 V.

The format for the second input word is:

SECOND INPUT WORD



Report error code for Channel 4.

Report error code for Channel 3.

Report error code for Channel 2.

Report error code for Channel 1.

Each nibble of the second word contains a single digit identifying the type of error found while trying to program the module with the user instruction provided for that channel. The meaning of the error codes is as follows:

| Error Code | Meaning |
|---|---|
| 0 | No error |
| 1 | Differential and 10kHz operation requested on channel 1 |
| 2 | Differential and repetitive mode requested on channels 1 or 3 |
| 3 | 10 kHz operation requested on channels 2, 3, or 4 |
| 4 | Mode change requested on channels 2 or 4 while channels 1 or 3 (respectively) are set to differential operation |
| 5 | Differential operation requested on channels 2 or 4 |
| 6 | An invalid target value has been specified |

## Operation of the ZAE 204 Module

### Overview

The operation of the ZAE 204 is controlled through the 4**x** register output table (see *Output Register Formats of the ZAE 204 Module, p. 676*. To control the operation of the module through user logic, the logic must be designed to set up the desired operating mode and then toggle the mode change bit (bit 8) in the mode control word for a particular channel for one scan.

If the bit is not cleared after one scan, the driver will continually attempt to change modes and reset the module (and count) based on the selected mode, thus not allowing the module to operate. Having set the desired mode of operation, the actual counting begins when the active level of the count gate for a channel based on bit 4 of the control word is asserted on the input terminal for the channel (pins 18 ... 21).

An LED is associated with each of the count gate terminals (described previously) that will illuminate when the count gate has 24 V applied. If the count gate is deasserted, the counting is temporarily suspended until it is once again asserted.

When a count operation is completed (count equals target or 0), the status bit in the first input word for that channel (bits 4 ... 7) is set. In addition, the signal on the output pin for the channel (pin 14 ... 17) is asserted to a level based in the state of bit 5 of the control word for the channel. An LED is associated with the output pin (described previously) that will illuminate. The ZAE 204 will continue to accumulate counts even though the count target has been reached. If this occurs it will be indicated by one of bits 8 ... 11 being set in the first input word depending on the particular channel.

The actual operation of the module depends on the mode of operation chosen. The operating mode is chosen by the state of bits 0 ... 7 of the mode control word. However, all combinations of these bits are not allowed. Invalid combinations are sensed and reported in the second input word. The following describes the operation in each of the allowed modes.

### One–time Operation

This is the default operation obtained by clearing all mode bits (0 ... 7) of the control word. In this mode, the module will count up or down (see bit 6 of the control word) once, and when the target value or 0 is reached, the input status and discrete outputs will reflect this. The module will continue to accumulate counts after this occurs. The counting process can be restarted by deasserting and reasserting the count gate input for the channel in question. In this mode, the maximum target value allowed is 32767.

### Repetitive Operation

This mode is activated by setting bit 0 of the control word for the channel in question. This mode is similar to one-time operation except that the count process restarts when the target value is reached. The target achieved signal in the status input, the output discrete, and the LED are asserted and remain so for 25% of the next count cycle, or 20 ms minimum. In this mode, the maximum target value allowed is 32767.

### Differential Counter

This mode applies to channels 1 and 3 only and is activated by setting bit 1 in the control word. If differential mode is selected for channel 1, channels 1 and 2 operate together, and the accumulated count value is reported in the channel 1 input counter ( 3**x** + 2). In this mode, the pulses input to the channel 1 input increment the count, while those input to channel 2 decrement the count. This mode is only available to be programmed in channels 1 or 3. When differential mode is selected for Channel 3, Channels 3 and 4 operate together.

The accumulated count value is reported in the Channel 3 input counter (3**x** + 4). Any attempt to use this mode in channels 2 or 4 will result in an error. Additionally, if a mode change to channel 2 or 4 is requested while channels 1 or 3 respectively are set to differential mode, an error will be reported. Selection of up or down counting (bit 6 of the control word) has no effect in this mode. The counting range is from -32767 ... +32768.

### 10 kHz Count In Channel 1

The default operation of the module is to accept input pulses at a maximum of 1 kHz. For channel 1 only, an option is available to accept up to 10 kHz pulses. This option is chosen by setting bit 2 of the control word for channel 1 to a 1. Choosing this option for any other channel will result in an error. Differential mode is not allowed. Only the 5 V input can be used, and only negative edge transitions are counted.

**Note:** If set to one–time operation, the counter associated with channel 1 will not continue to accumulate counts after target is reached.

## Specifications of the ZAE 204 High-Speed Counting Module

### ZAE 204 Module Topology

The following table describes the module topology.

| | |
|---|---|
| Number of Counting Inputs | 4 |
| Number of 24 Vdc Outputs | 4 |
| Number of Enable Inputs | 4 |
| Operating Mode | High Speed Counter |
| Isolation | Opto–coupler on each field point |

### ZAE 204 Power Supplies

Power supply details:

| | | |
|---|---|---|
| External Power Source Load | 24 Vdc | Count Inputs, 25 mA maximum |
| | | Gate Inputs, 30 mA maximum |
| | | Outputs, 1 A maximum |
| | 5 Vdc | Count Inputs, 10 mA maximum |
| Internal Power Source Load from I/O bus | maximum | 5 V, 100 mA |
| | typical | 75 mA |

## ZAE 204 Counter Inputs

Counter input details

| | | |
|---|---|---|
| Quantity | | 4 for input pulses with 5 Vdc (TTL) or 24 Vdc |
| Signal Level at 5 V (TTL) | ON signal | >= 2.3 V |
| | OFF signal | 0 ... 1 V |
| Input Current | | <= 2.5 mA each at 0 V (current sink) |
| Signal Level at 24 V (TTL) | ON signal | 12 ... 30 V |
| | OFF signal | -2 ... +5 V |
| Input Current (current source) | | < 6 mA each at 30 V |
| Minimum 0 Pulse Width | | 0.35 ms |
| Allowable Mark-space Ratio | | 65/35 percent maximum |
| Counting range | | 0 ... 32,767 or -32,768 ... 0 ... +32,767, depending on operating mode |
| Counting Frequency | | 1 kHz maximum |
| | | Input 1 with 5 V pulses 10 kHz maximum |

## ZAE 204 Enable Inputs (Gate)

Enable input details:

| | | |
|---|---|---|
| Quantity | | 4 |
| Rated Signal Value | | 24 V |
| Signal Level | HIGH Signal | 12 ... 30 V |
| | LOW signal | -2 ... +5 V |
| Input Current | | 7 mA @ 24 V |
| Input Delay (contact bounce suppression) | | 4 ms |
| Input Rise Time | | N/A |

## ZAE 204 Semiconductor Outputs

Semiconductor output details:

| | |
|---|---|
| Quantity | 4 |
| Working Voltage V | $U_S$ = 24 Vdc |
| Signal Language | True High |
| Signal Output Level | ON $V_S$ = 0 ... + 2 V |
| | OFF 0 ... 2 V, < 1 mA |
| | $U_S$ = 20 ... 30 Vdc |
| Load Current/Output | 500 mA maximum |
| Load Current for All Outputs | 1 A maximum |
| Switching Delay | < 1 ms |
| Power Dissipation | 1.25 W |
| Inrush Current for Lamps | 5 W maximum |

## ZAE 204 Operating Frequency

Operating fequency details:

| | | |
|---|---|---|
| Resistive Load | | 100/s |
| Inductive Load @ 500 mA | | 1000/hr |
| Bulb Load | @ 1.2 W | 8/s |
| | @ 5 W | 1000/hr |

## ZAE 204 I/O Map

Register detail:

| | |
|---|---|
| Registers 3x/4x | 6 in/1 out |

## Dimensions

Dimensions details:

| | | |
|---|---|---|
| W x H x D | mm | 40.3 x 145 x 117.5 |
| | in | 1.6 x 5.6 x 4.5 |
| Weight | g | 300 |
| | lb | 0.7 |

## ZAE 204 Agency Approvals

Agency Approval details:

| |
|---|
| VDE 0160; UL 508; CSA 22.2 No. 142 and FM Class I, Div 2 Standards. |

# Appendices

## At a Glance

**Purpose**

The following chapters contain material related to A120 I/O modules.

**What's in this Appendix?**

The appendix contains the following chapters:

# IEC Wiring Diagrams for A120 I/O Modules

# A

## At a Glance

**Introduction**

This chapter provides IEC-compliant wiring diagrams for the A120 Series I/O modules.

**What's in this Chapter?**

This chapter contains the following topics:

# IEC Nomenclature Legend

**Legend**

The following table describes the IEC nomenclature used in the IEC wiring diagrams.

| Nomenclature | Description |
|---|---|
| U | Voltage |
| I | Current |
| M | Common |
| PE | Ground |
| L | 230Vac or hot |
| US | 24Vdc |
| UB | Supply voltage for modules |
| US | Working voltage for activating the actuators |
| N1 | Supply 1 |
| N2 | Supply 2 |
| E1 | Input 1 |
| A1 | Output 1 |
| EW1 | Input 1 wiring |
| AW1 | Output 1 wiring |
| F1 | Automatic circuit breaker 1 or fuse |
| C1 | Capacitor 1 |
| V1 | Isolation diode 1 |
| R1 | Resistor 1 |
| G | Gate |

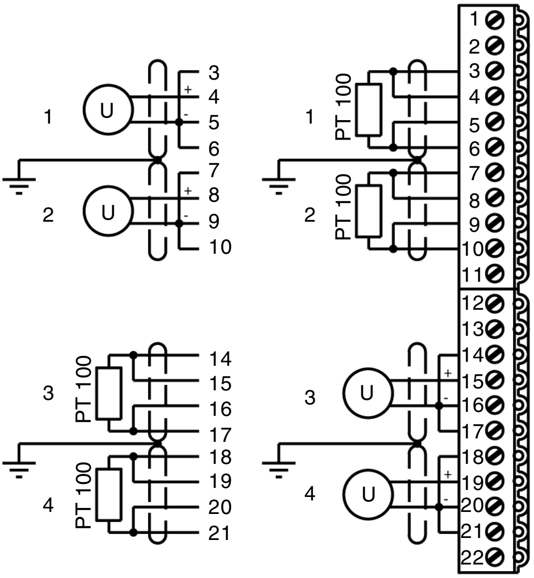
# IEC Wiring Diagrams for A120 Modules

**Overview**

The following diagrams are IEC-compliant versions of the A120 diagrams shown throughout this manual.

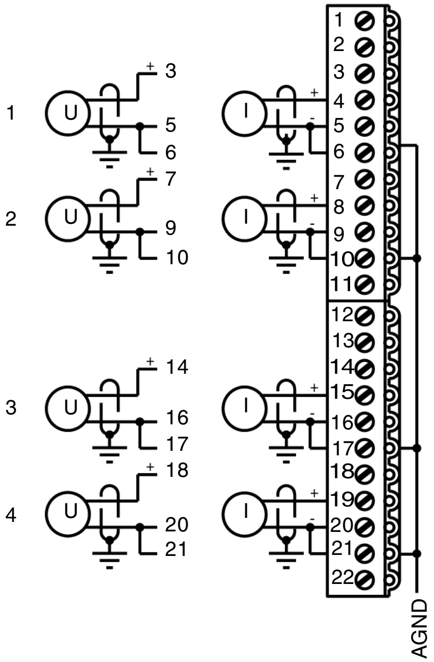
**ADU 204 IEC Wiring Diagram**

The following figure is the IEC wiring diagram for the ADU 204.



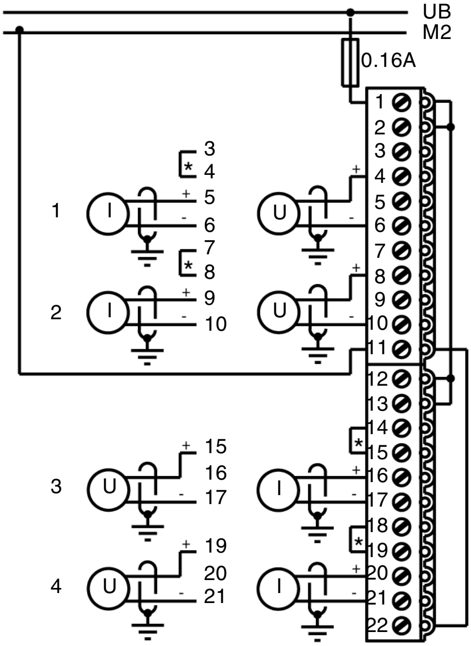
## ADU 205 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the ADU 205.



## ADU 206 IEC Wiring Diagram

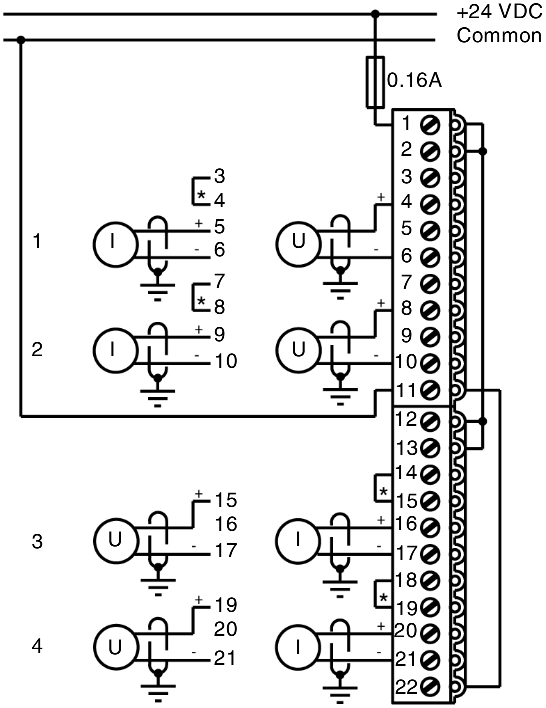
The following figure is the IEC wiring diagram for the ADU 206.



* For current inputs please use the enclosed jumpers

## ADU 210 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the ADU 210.

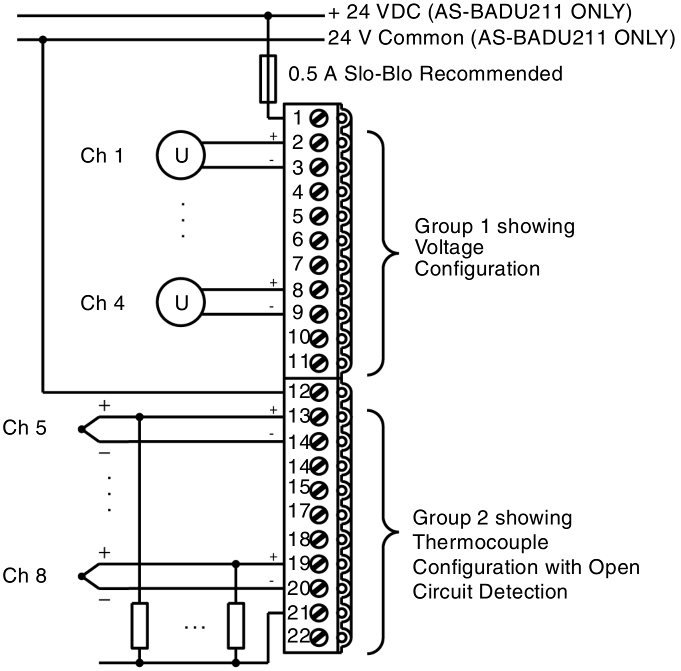


* Apply Jumpers to select
20mA range per channel.

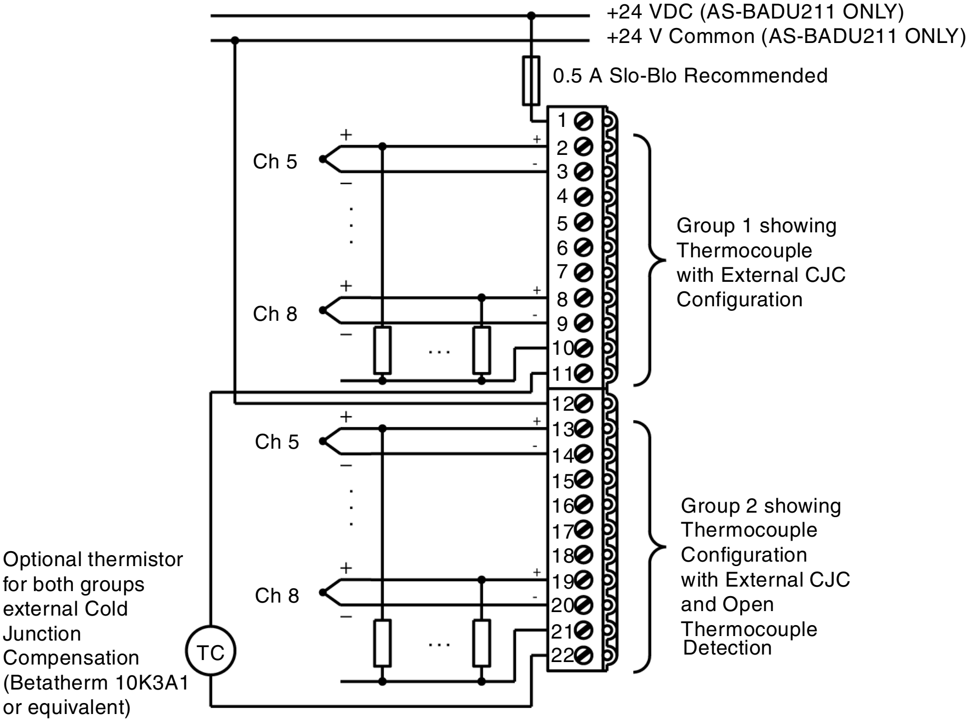
**ADU 211/212 IEC Wiring Diagrams**

The five figures that follow are all ADU 211/212 IEC wiring diagrams.

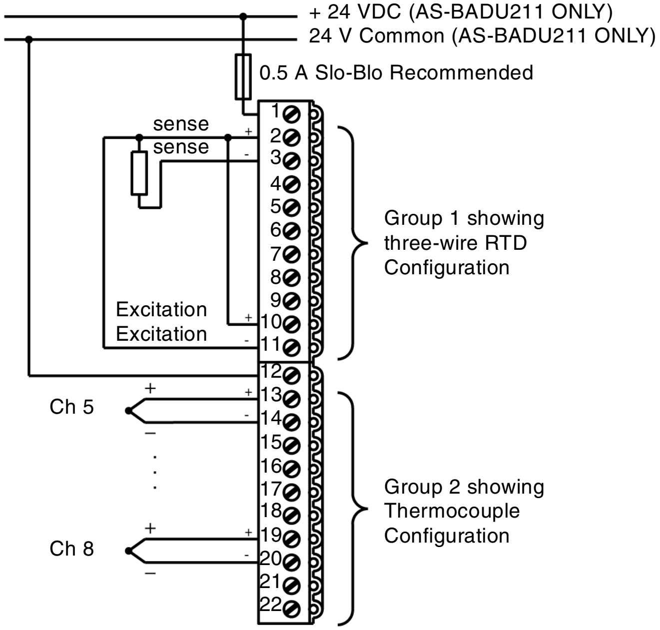
The following figure is an ADU 211/212 IEC wiring diagram.



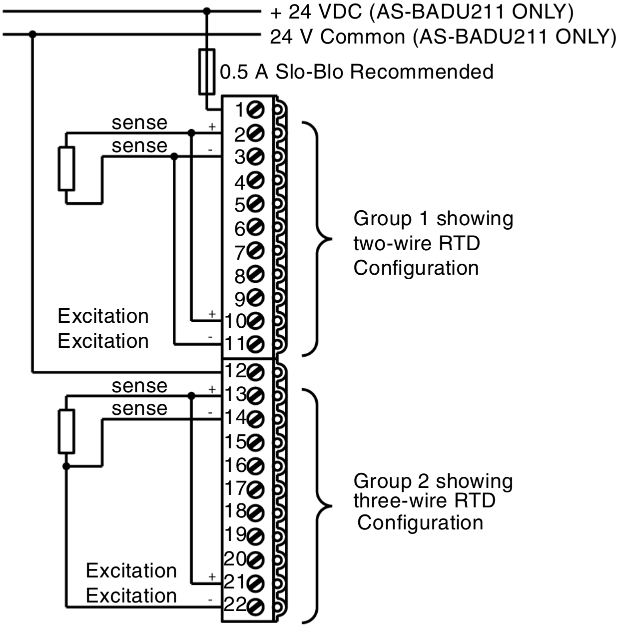
The following figure is an ADU 211/212 IEC wiring diagram.



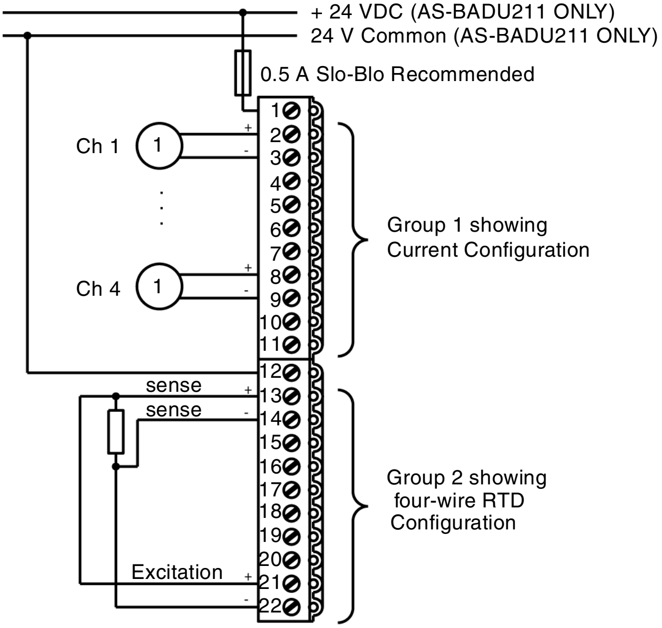
The following figure is an ADU 211/212 IEC wiring diagram.



The following figure is an ADU 211/212 IEC wiring diagram.

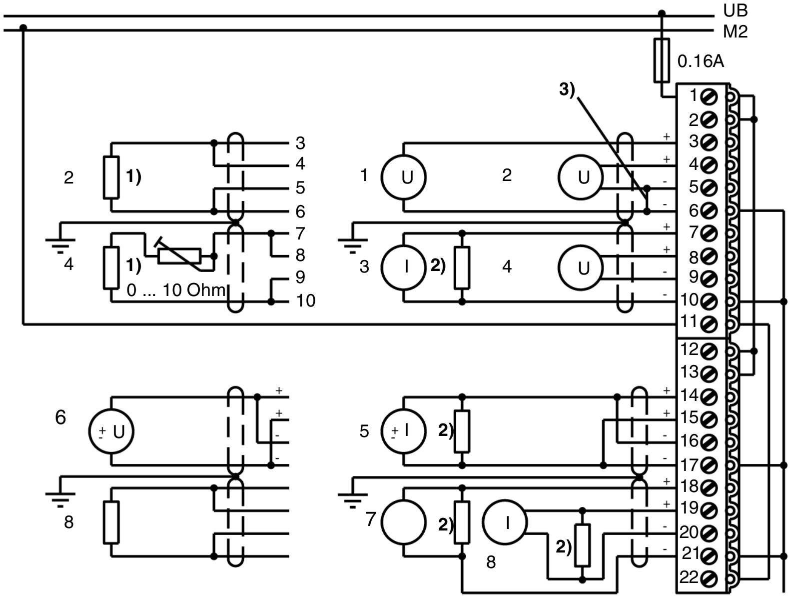


The following figure is an ADU 211/212 IEC wiring diagram.



## ADU 214 IEC Wiring Diagram

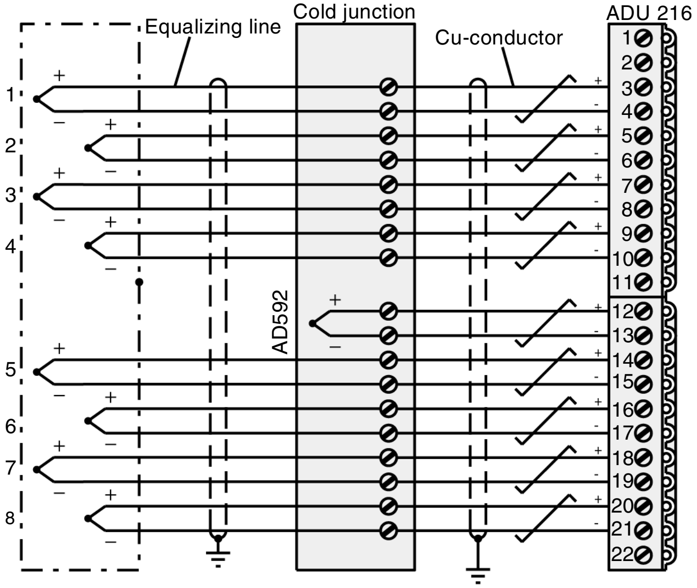
The following figure is the IEC wiring diagram for the ADU 214.



1) Resistance temperature detector Pt 100 ... 1000, Ni 100 ... 1000 or remote resistance detector 0 ... 2000 Ohm
2) External reference resistance 50 or 100 Ohm, 0.1%, 0.125 W, Tk 25
3) See Voltage and Current measuring
4) The common reference point “AGND” is internally connected to 0 V (reference potential of PLC).

## ADU 216 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the ADU 216.



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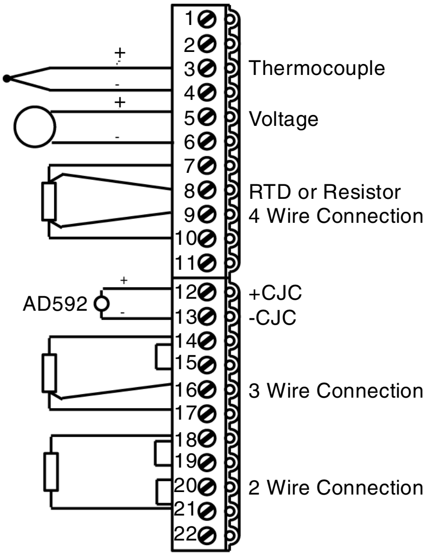
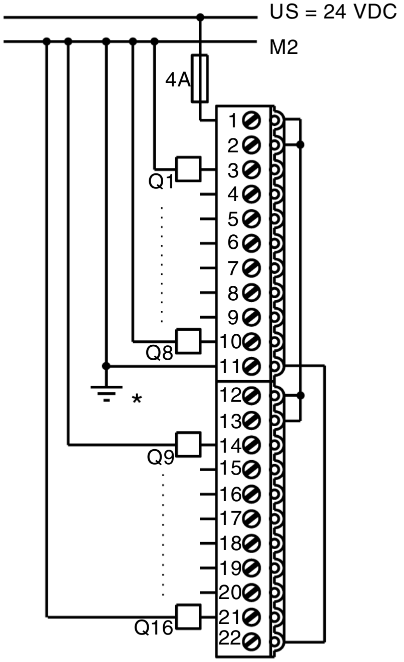
## ADU 257 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the ADU 257.



## DAO 216 IEC Wiring Diagram

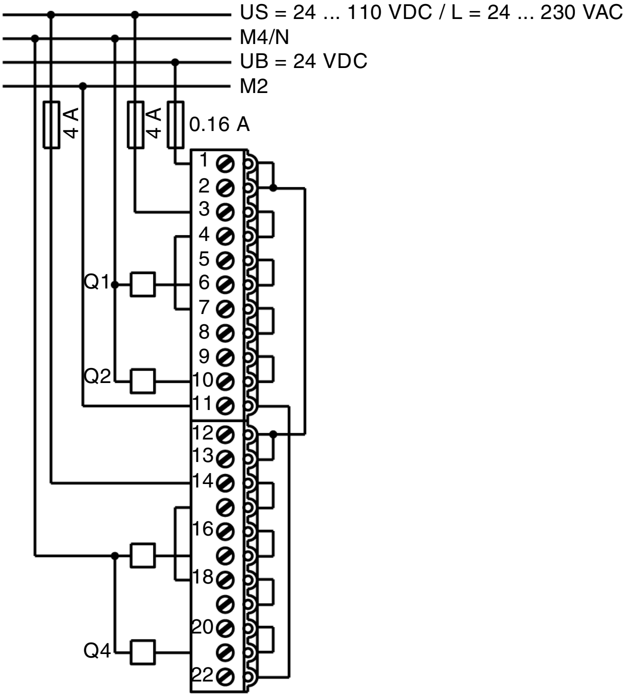
The following figure is the IEC wiring diagram for the DAO 216.



* Terminal 11 should be connected in the shortest possible way to the functional earth (hat rail). In case of connection failure compensating currents can occur via M2→ 0 V path. These lead to the destruction of the protective resistor (R31).

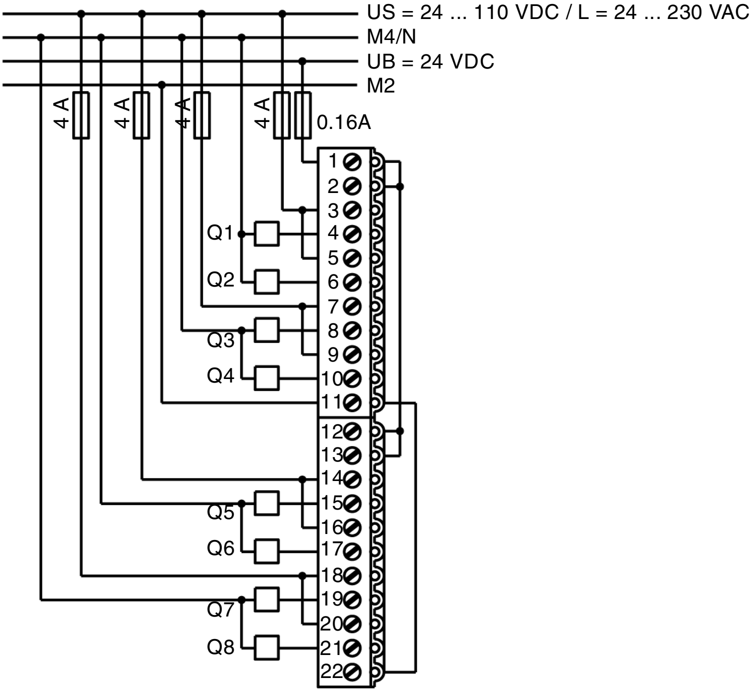
## DAP 204 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DAP 204.



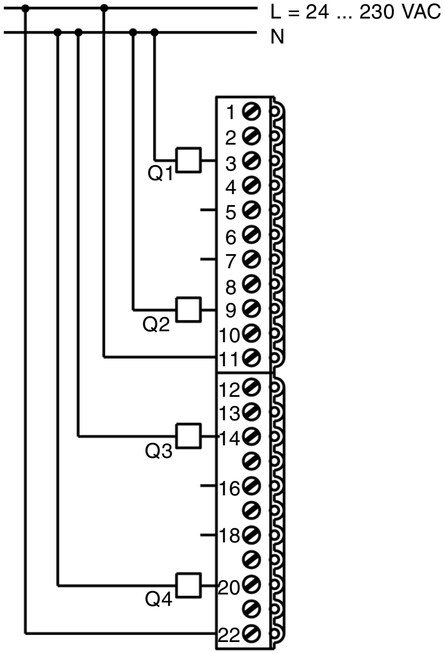
## DAP 208 IEC Wiring Diagram

The following figure is IEC wiring diagram for the DAP 208.



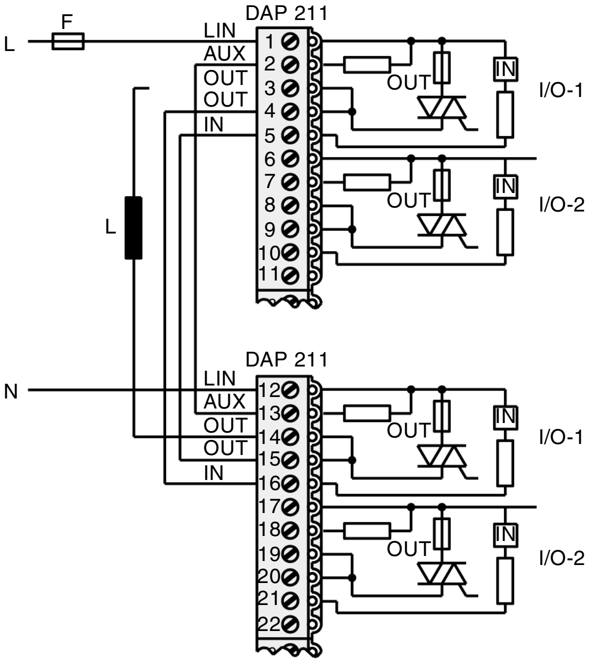
## DAP 210 IEC Wiring Diagram

The following figure is IEC wiring diagram for the DAP 210.



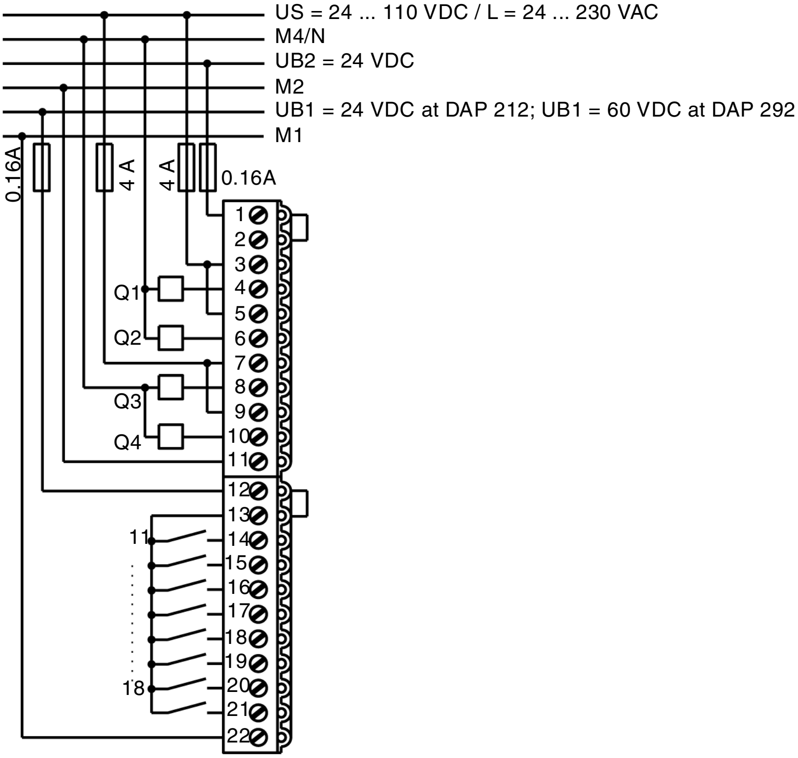
## DAP 211 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DAP 211. Note that this diagram is for Voted (Dual) applications only. See *DAP 211 Combined I/O Module Field Wiring, p. 294*for more information.



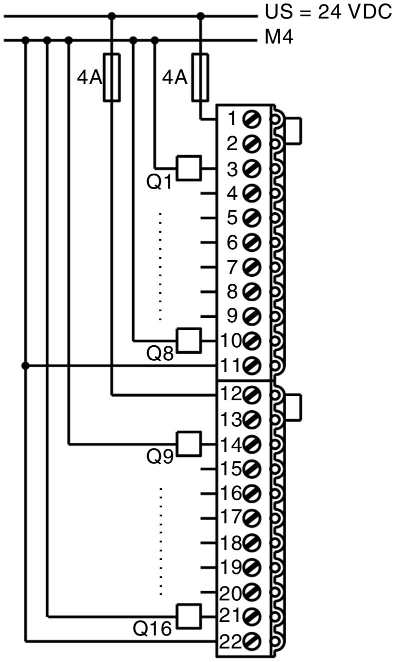
## DAP 212 and DAP 292 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DAP 212 and the DAP 292.



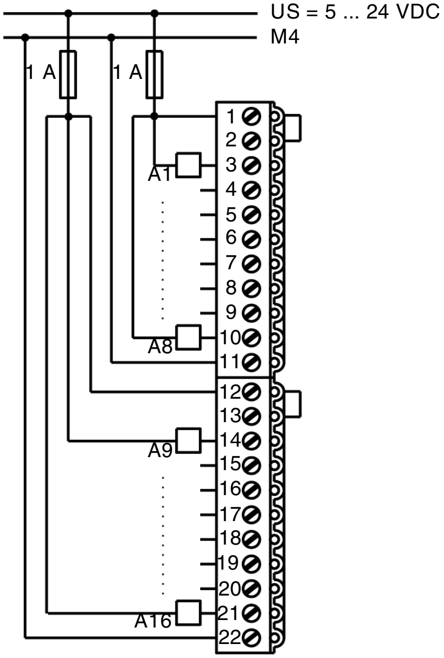
## DAP 216/DAP 216N IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DAP 216/DAP216N.



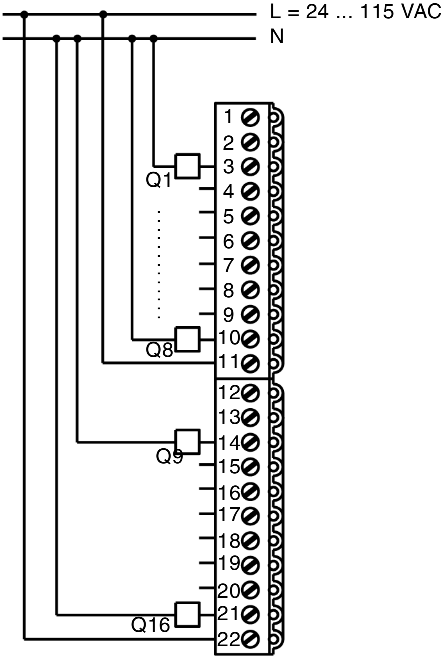
## DAP 217 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DAP 217.



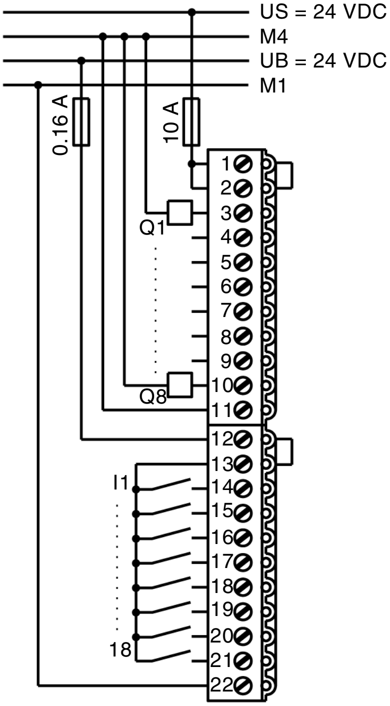
## DAP 218 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DAP 218.



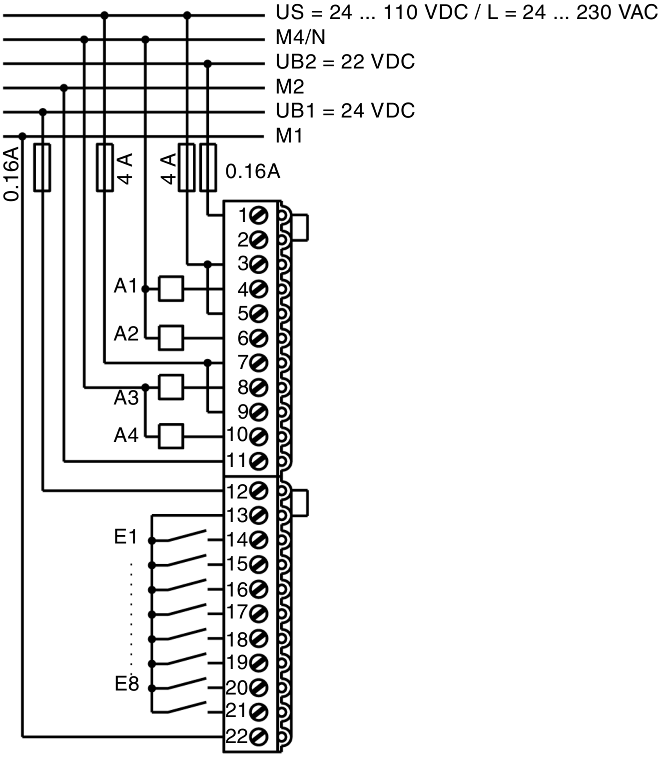
## DAP 220 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DAP 220.



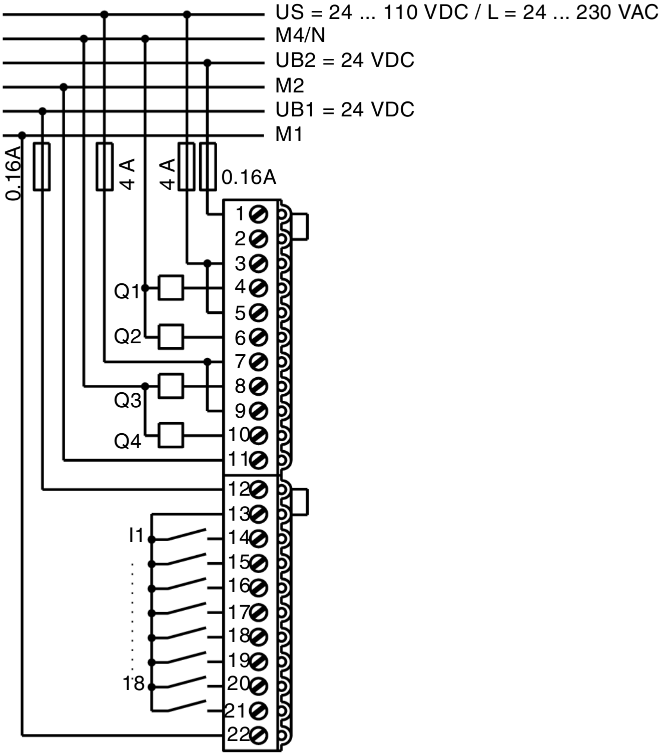
## DAP 252 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DAP 252.



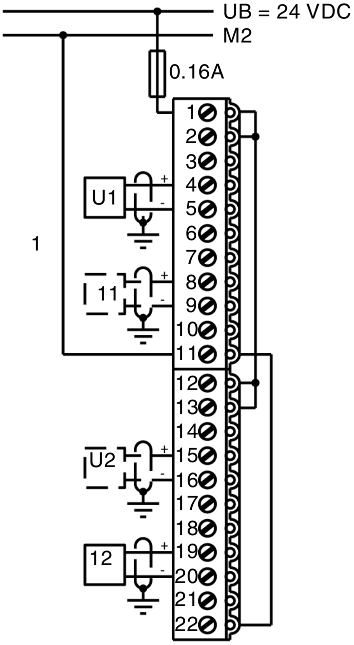
## DAP 253 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DAP 253.



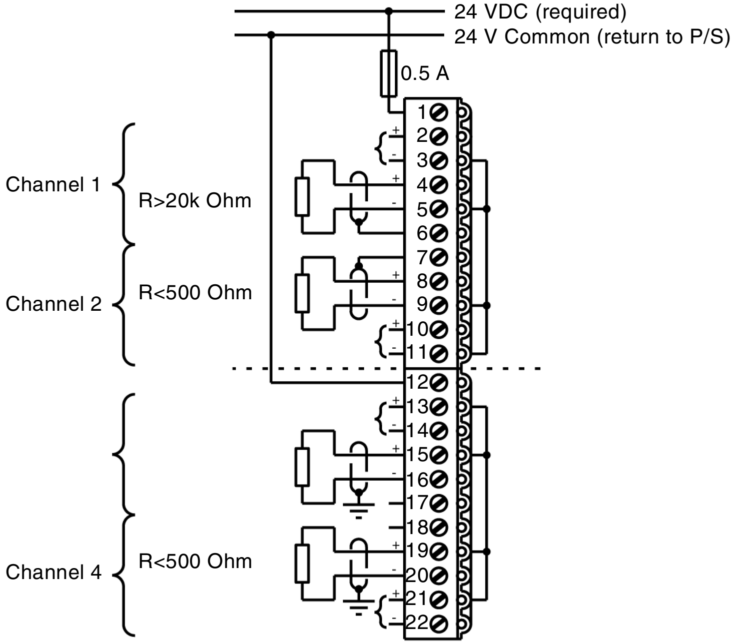
## DAU 202 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DAU 202.



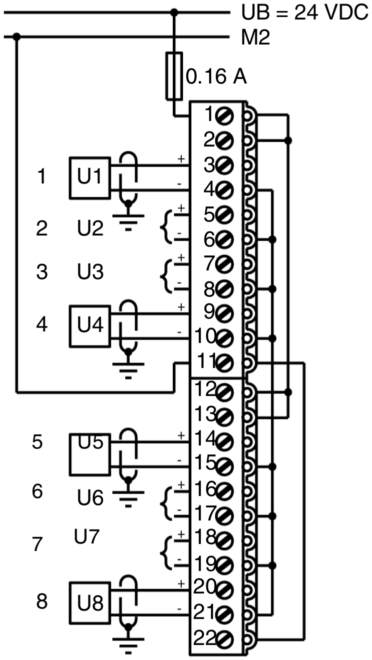
## DAU 204 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DAU 204.



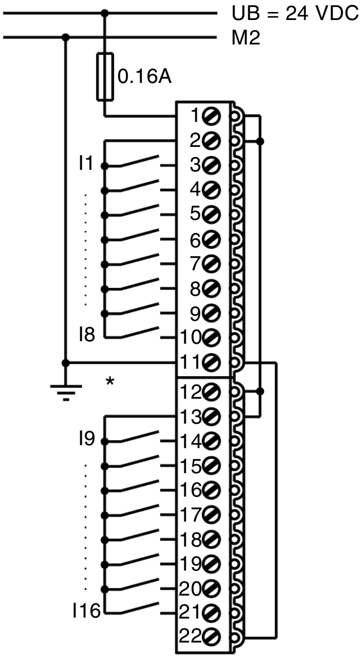
## DAU 208 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DAU 208.



## DEO 216 IEC Wiring Diagram

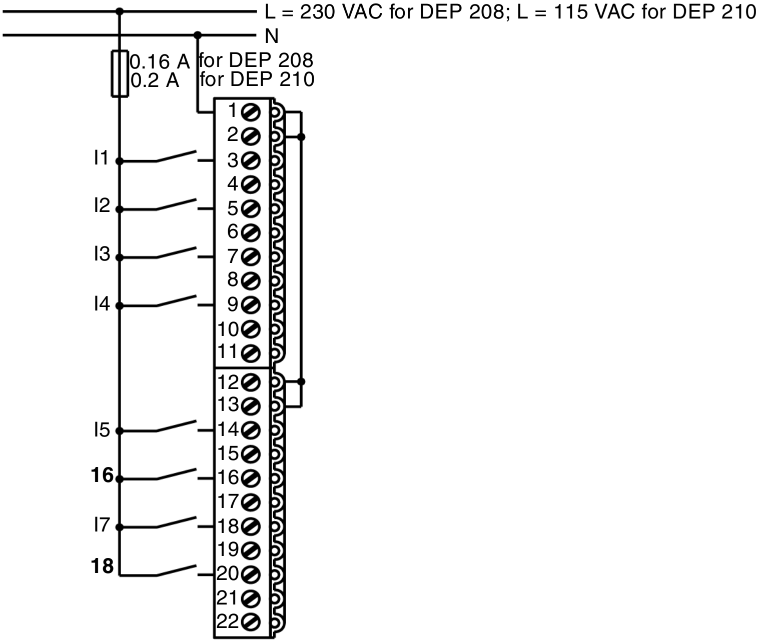
The following figure is the IEC wiring diagram for the DEO 216.



* Terminal 11 should be connected in the shortest possible way to the functional earth (hat rail). In case of connection failure compensating currents can occur via M2→ 0 V path, which lead to the destruction of the protective resistor (R16).

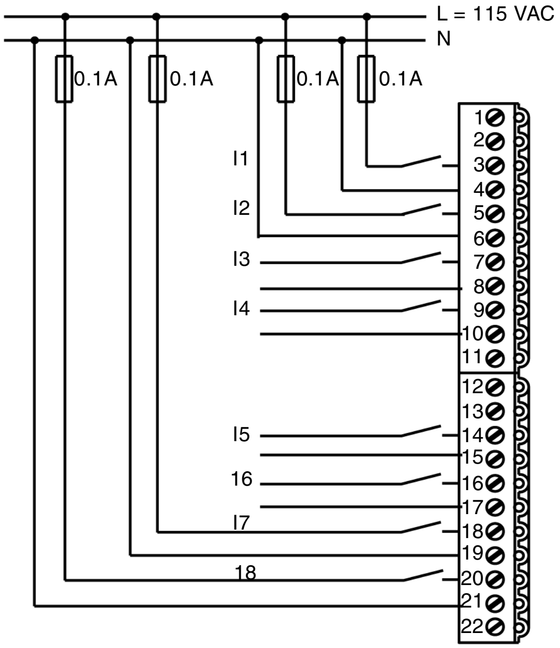
### DEP 208 and DEP 210 IEC Wiring Diagram

The following figure is the IEC wiring diagram for both the DEP 208 and the DEP 210.



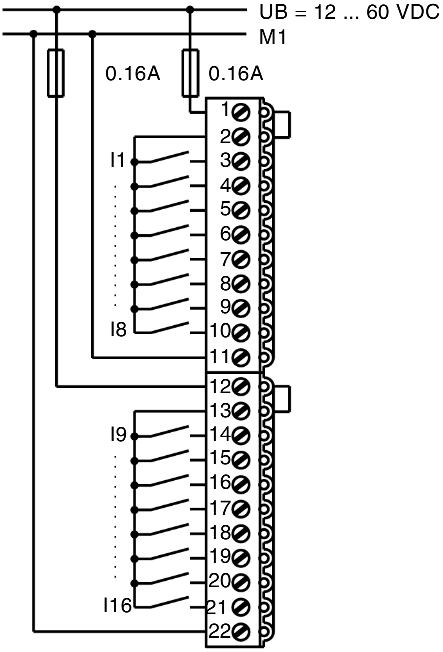
## DEP 211 IEC Wiring Diagram

The following figure is the DEP 211 IEC wiring diagram.



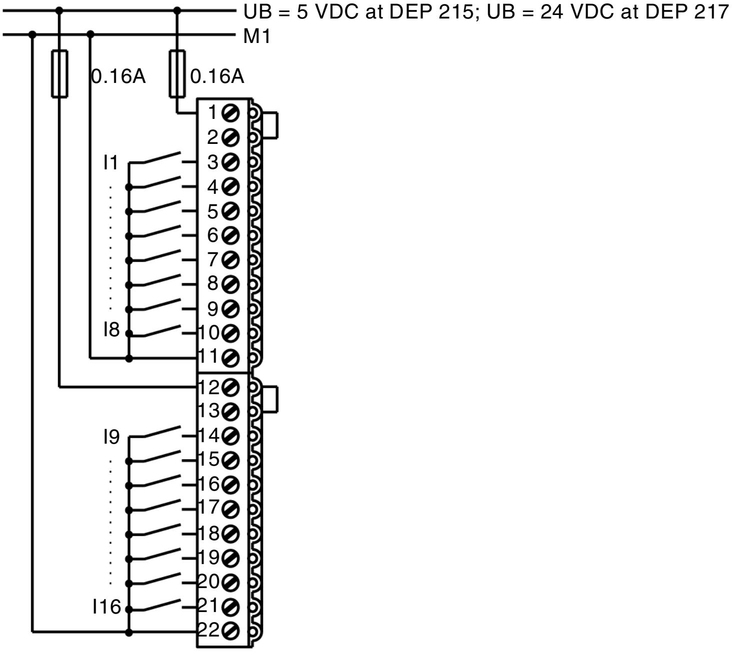
## DEP 214 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DEP 214.



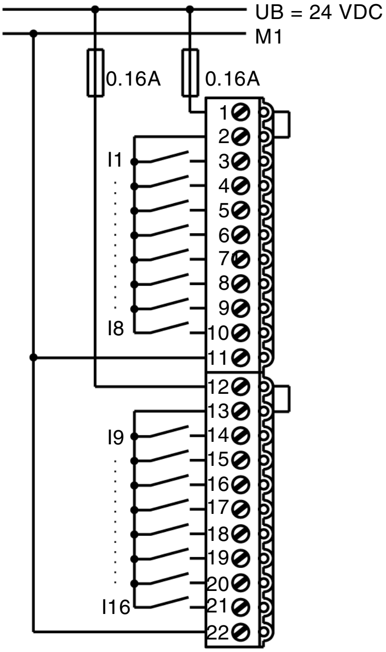
## DEP 215 and DEP 217 IEC Wiring Diagram

The following figure is the IEC wiring diagram for both the DEP 215 and the DEP 217.



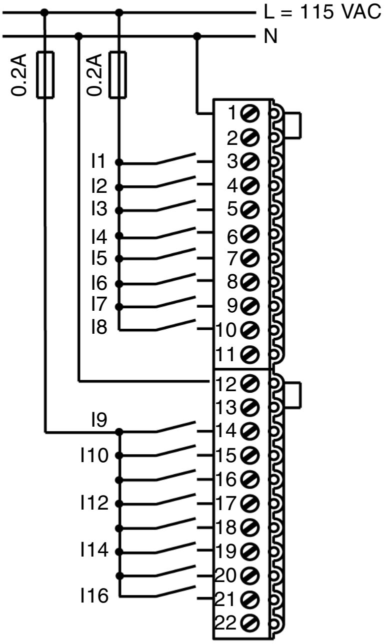
## DEP 216 and DEP 220 IEC Wiring Diagram

The following figure is the IEC wiring diagram for both the DEP 216 and the DEP 220.



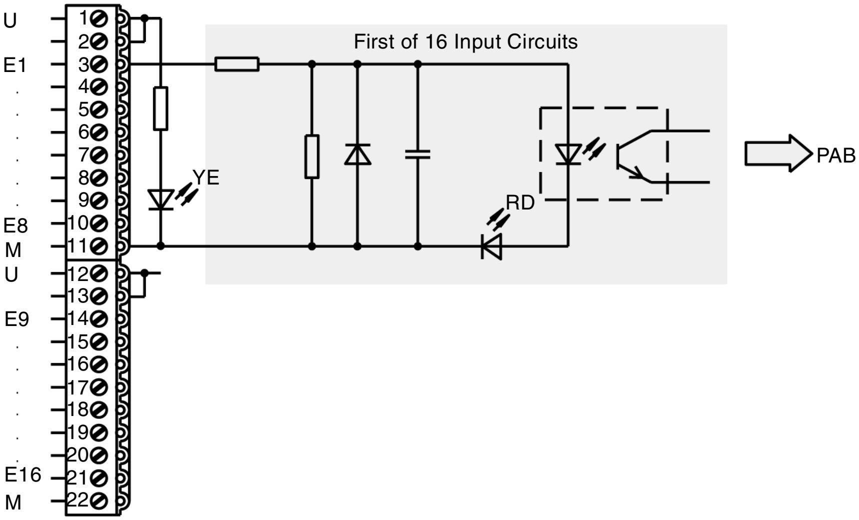
**DEP 218 IEC Wiring Diagram**

The following figure is the IEC wiring diagram for the DEP 218.



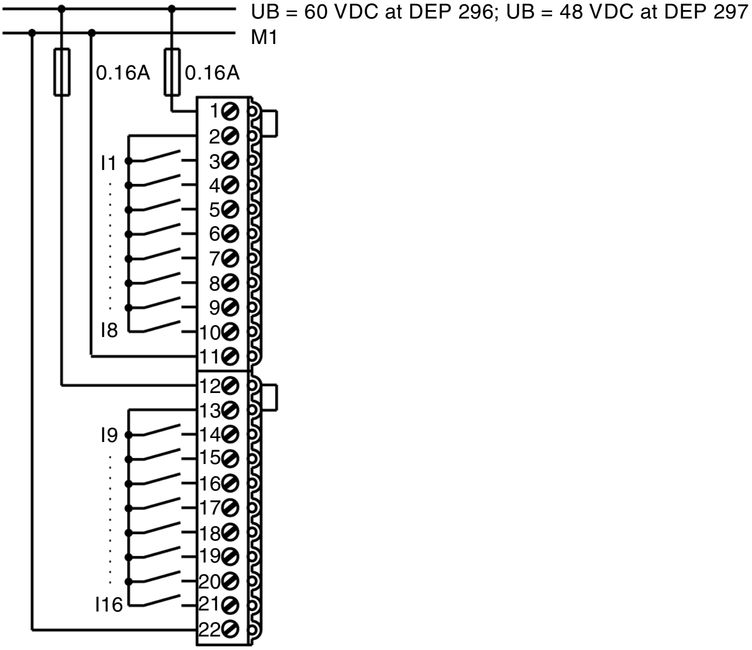
## DEP 257 IEC Wiring Diagram

The following figure is the IEC wiring diagram for the DEP 257.



## DEP 296 and DEP 297 IEC Wiring Diagram

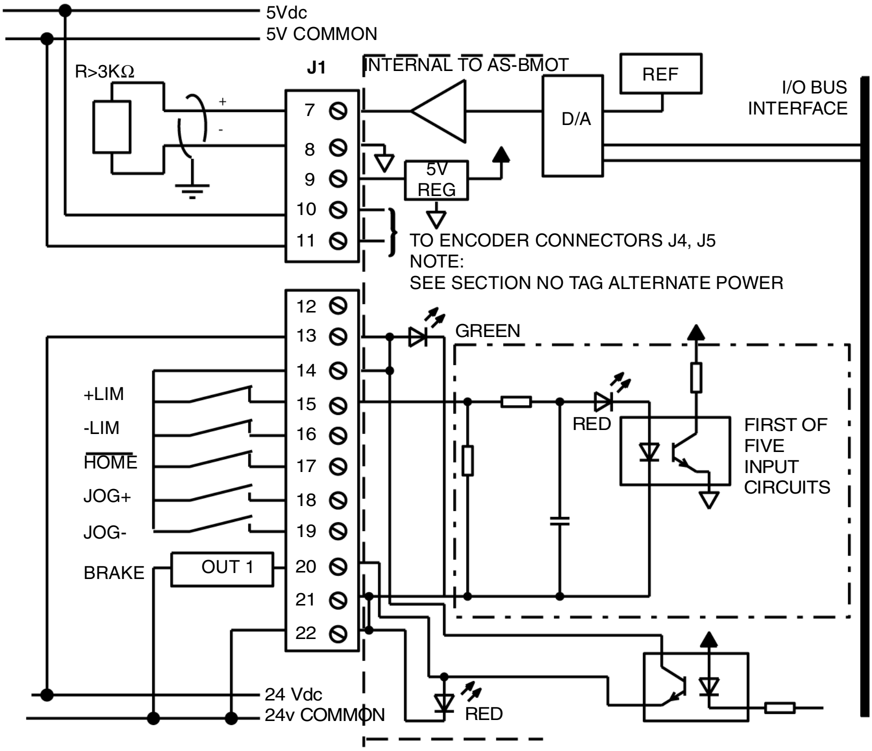
The following figure is the IEC wiring diagram for both the DEP 296 and the DEP 297.



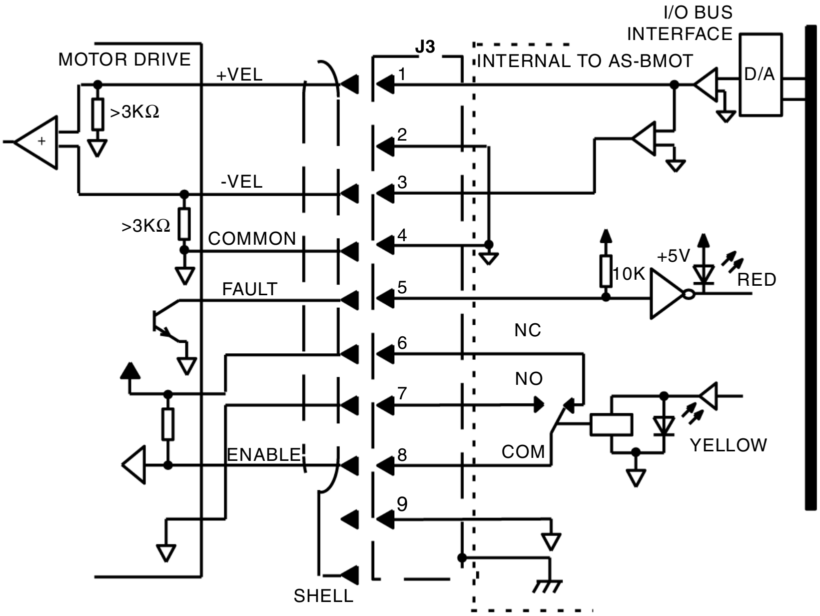
## MOT 201/202 IEC Wiring Diagram

The seven figures that follow are IEC wiring diagrams for the MOT 201, the MOT 202, or both (MOT 201/202), as specified in the introduction to each diagram.

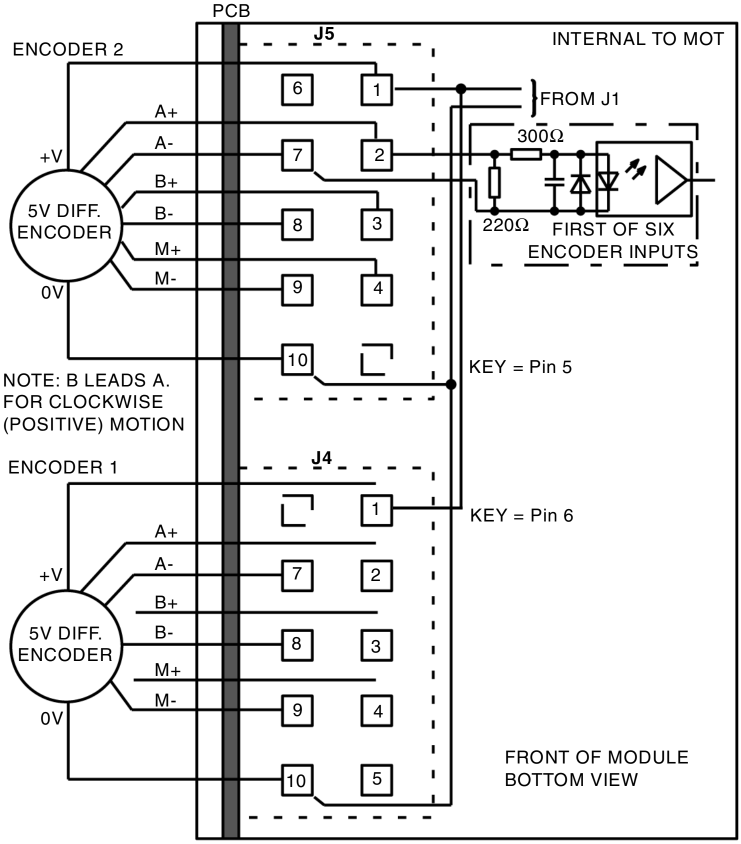
The following figure is an MOT 201/202 IEC wiring diagram.



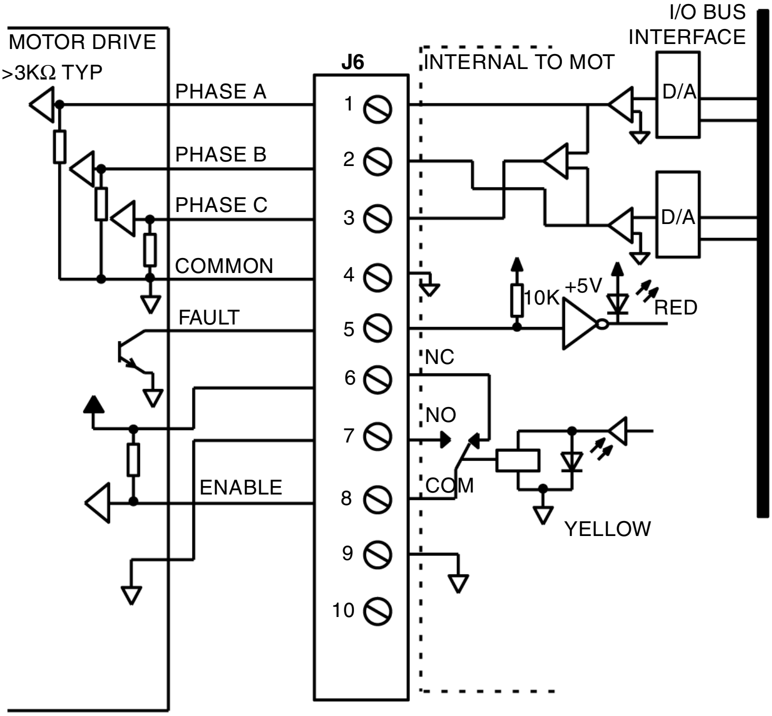
The following figure is an MOT 201 (Motor Drive) IEC wiring diagram.



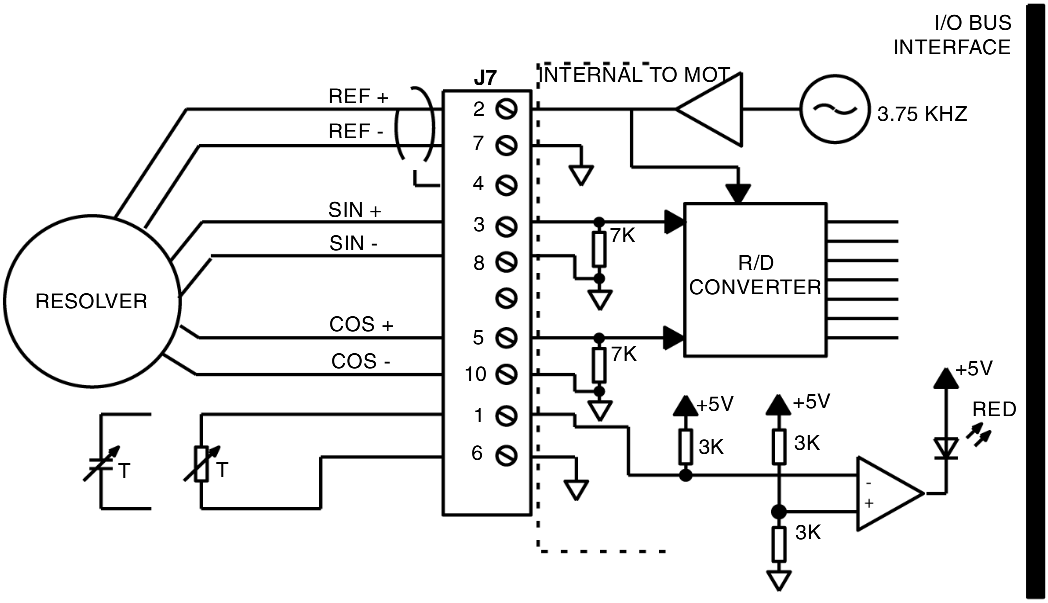
The following figure is an MOT 201/202 (Encoder) IEC wiring diagram.



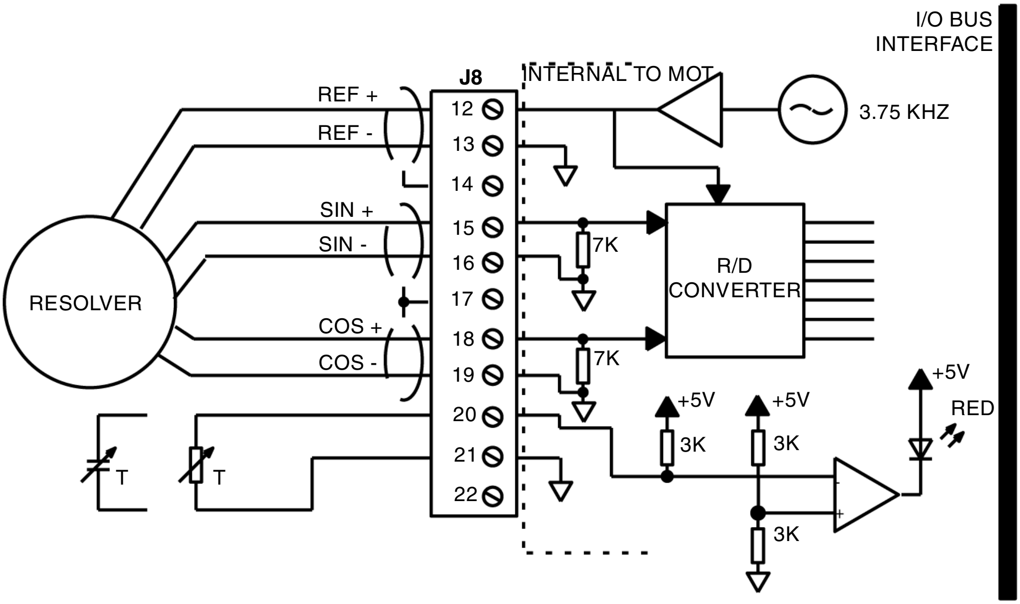
The following figure is an MOT 202 (Motor Drive) IEC wiring diagram.



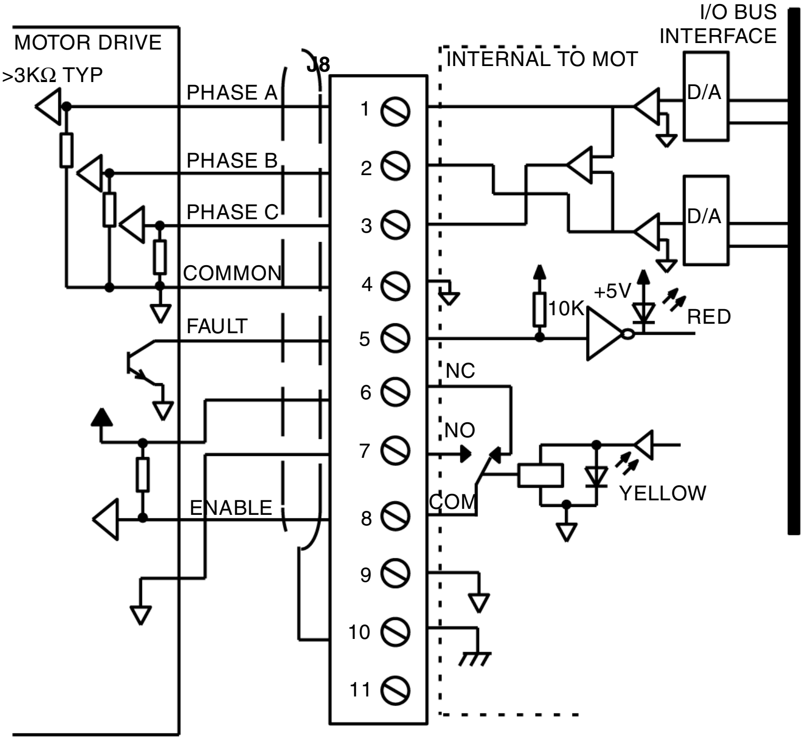
The following figure is an MOT 202 (Resolver) IEC wiring diagram.



The following figure is an MOT 202 (Resolver) IEC wiring diagram.

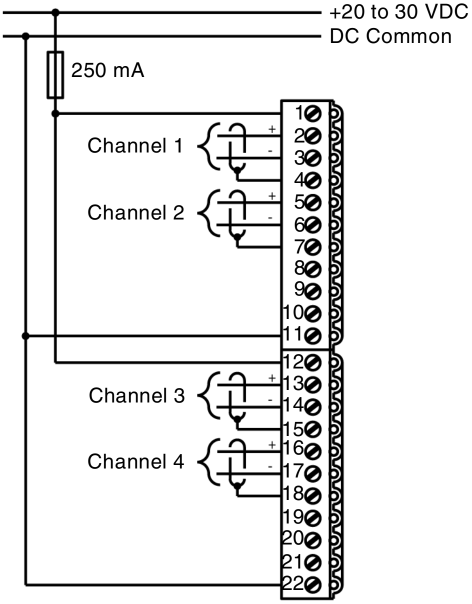


The following figure is an MOT 202 (Motor Driver) IEC wiring diagram.



## VRC/CTR 2xx IEC Wiring Diagram

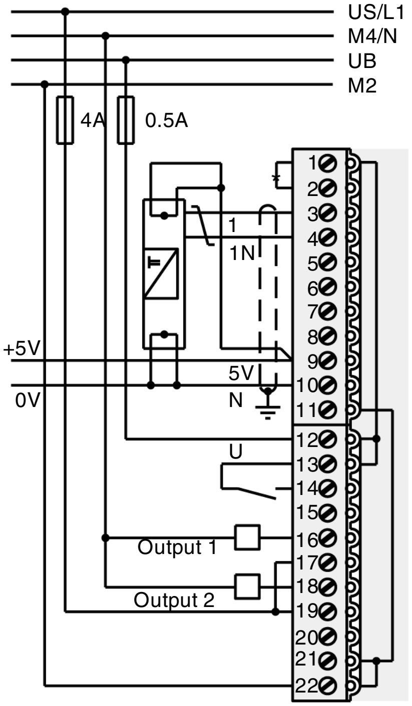
The following figure is the IEC wiring diagram for the VRC/CTR 2xx.



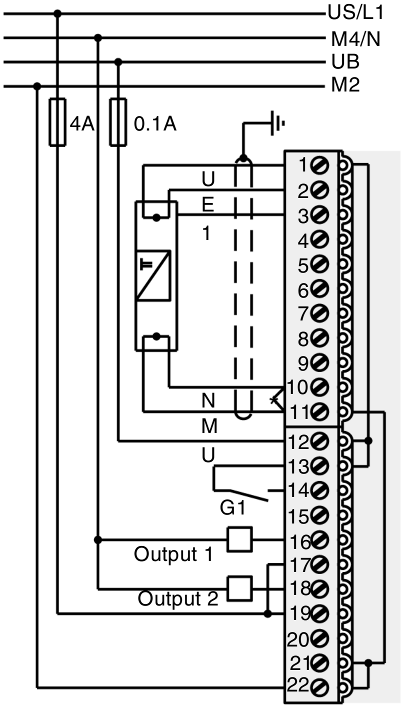
## ZAE 201 IEC Wiring Diagram

Both of the following figures are IEC wiring diagrams for the ZAE 201.

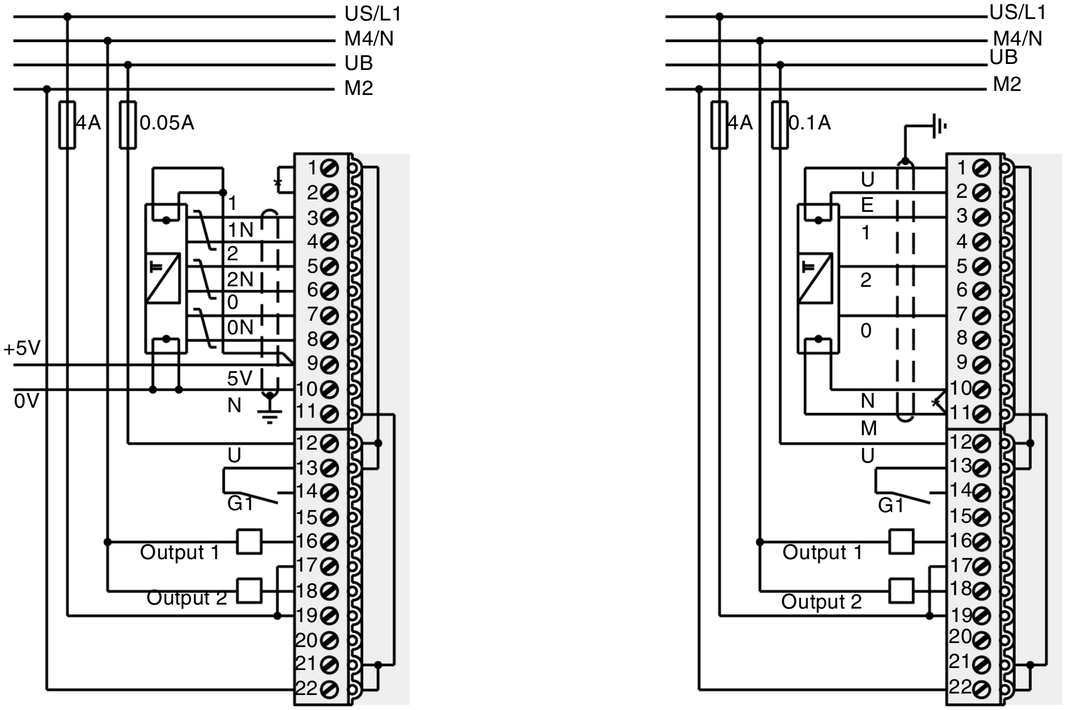
The following figure is a ZAE 201 IEC wiring diagram.



* with Attached Jumpers (as Delivered)



The following figure is a ZAE 201 IEC wiring diagram.

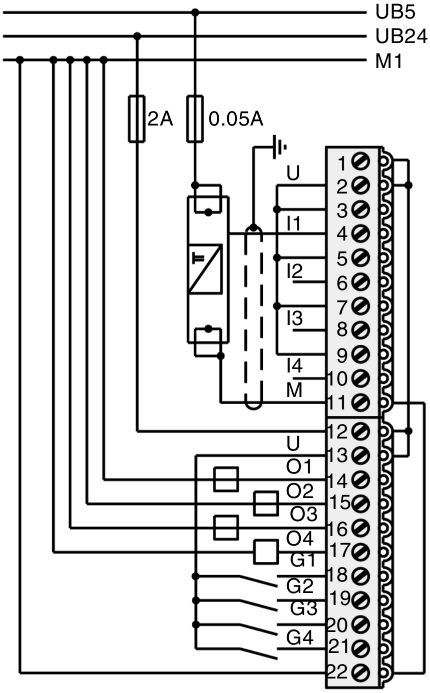


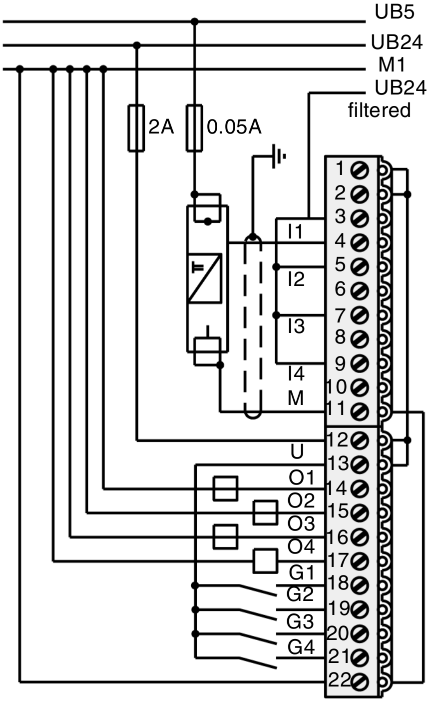
* with Attached Jumpers (as Delivered)

## ZAE 204 IEC Wiring Diagram

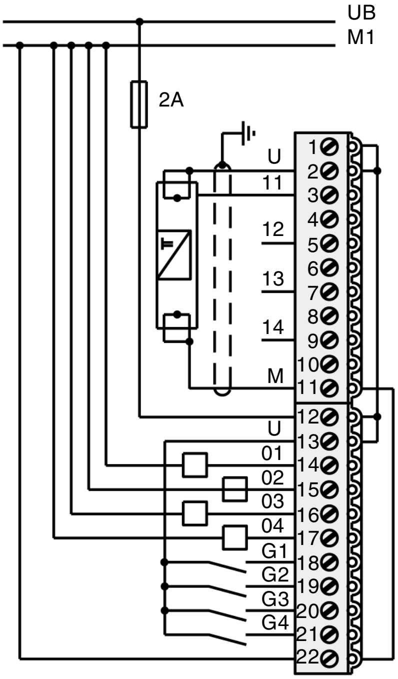
Both of the following figures are IEC wiring diagrams for the ZAE 204.

The following figure is a ZAE 204 IEC wiring diagram.





The following figure is a ZAE 204 IEC wiring diagram.



# I/O Configuration with Concept

# B

## At a Glance

**Introduction**

This chapter describes how to configure A120 Series I/O modules with Concept.

**Note:** When using Modsoft with certain A120 I/O modules you had to build ladder logic to multiplex the data into the PLC. This is no longer required when using Concept programming panel software for these I/O modules: ADU 214/216/211/212, VIC 2xx/VRC 2xx/CTR2xx.

**What's in this Chapter?**

This chapter contains the following topics:

## Multiplexing I/O Data with Concept

**Overview**

If you use Modsoft to configure certain A120 I/O modules, you must build ladder logic to multiplex the data into the PLC. This is not required if you use Concept programming panel software for the following I/O modules: ADU214/216/211/212, VIC2xx/VRC2xx/CTR2xx.

## Configuring A120 Discrete Input Modules with Concept

### Discrete Input Modules

This following information describes how to configure these modules:
- DEO 216 16-point 24 Vdc Discrete Input
- DEP 208 8-point 230 Vac Discrete Input
- DEP 209 8-point 120 Vac Discrete Input
- DEP 210 8-point 115 Vac Isolated Discrete Input
- DEP 211 8-point 115 Vac Isolated Discrete Input
- DEP 214/254/254C 16-point 12 ... 60Vdc Discrete Input
- DEP 215 16-point 5 Vdc TTL Discrete Input
- DEP 216/256/256C 16-point 24 Vdc Discrete Input
- DEP 217 16-point 24 Vdc Discrete Input
- DEP 218 16-point 115 Vac Isolated Discrete Input
- DEP 220 16-point 24 Vdc Discrete Input
- DEP 257 16-point 110 Vdc Discrete Input
- DEP 296 16-point 60 Vdc Isolated Discrete Input
- DEP 297 16-point 48 Vdc Isolated Discrete Input
- DEP 284* 8-point 115 Vac Isolated Discrete Input

*The DEP 284 is a "special", and therefore it is not included in this document.

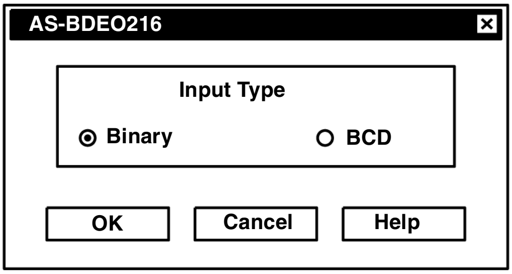
### I/O Configuration Using Concept 2.1 or Higher

Use the following procedure to configure the module.

| Step | Action |
|---|---|
| 1 | Select **Configure** from the menu. |
| 2 | Select **I/O Map** from the menu. |
| 3 | Click on **Edit...** The Local Common CPU Drop dialog appears. |
| 4 | Click on **Module**. The I/O Module Selection dialog appears. |
| 5 | Select **DEPxxx** and click on **OK**. A number and description appear. |
| 6 | In the In Ref field, enter **1x** or **3x** and press **Enter**. The software completes the **In Ref** and **In End** fields. |
| 7 | Click on **Params...** The Input Type dialog appears. |
| 8 | Select either **Binary** or **BCD** and click on **OK**. Binary is the default |

### AS-BDEO-216/ AS-BDEP 214/ 215/ 216/ 217/ 218/ 220/ 254(C)/ 256(C)/ 257(C)/ 296/ 297

The AS-BDEO-216 dialog box, which follows, is used with these modules: AS-BDEO-216/ AS-BDEP 214/ 215/ 216/ 217/ 218/ 220/ 254(C)/ 256(C)/ 257(C)/ 296/ 297.



Input Type

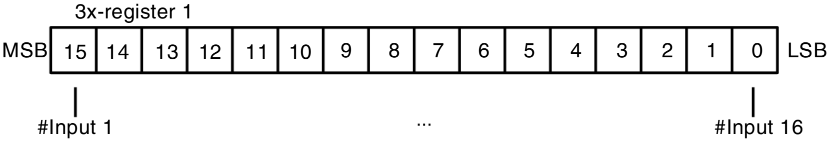
● Binary ○ BCD

**Input Type:** The **Binary** and **BCD** option buttons in the input type section require corresponding choices between 1x-/3x-references (i.e., in binary or BCD). The 1x-references are shown in binary.

### Meanings for the AS-BDEO-216/ AS-BDEP 214/ 215/ 216/ 217/ 218/ 220/ 254(C)/ 256(C)/ 257(C)/ 296/ 297 Module Mapping

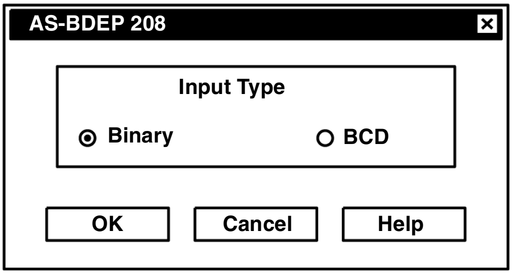
These modules require sixteen 1x-discrete inputs. A single 3x-input register can be mapped instead of sixteen 1x-discrete inputs (shown in the following figure).

The following figure shows the 3x-register arrangement for the above-named modules.



### AS-BDEP 208/ 210/211

The AS-BDEP-208 dialog, shown in the following figure, is used with these modules: AS-BDEP 208/210/211.

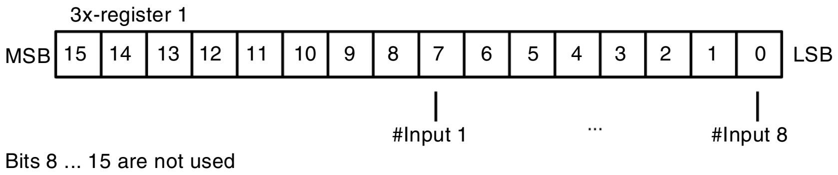


**Input Type:** The **Input Binary** and **BCD** option buttons require a corresponding choice between 1x-/3x-references (i.e., in binary or BCD).

### Meanings for the AS-BDEP 208/ 210/ 211 Module Mapping

These modules require eight 1x-discrete inputs. A single 3x-input register can be mapped instead of eight 1x-discrete inputs.

The following figure shows the 3x-register arrangement for the above-named modules.



> **Note:** Concept provides three ways to display address formats. The default is standard (400001). To change the address format display, use the steps in *Change Address Format Display Procedure, p. 743*. All four formats apply to discrete, analog, and intelligent modules.

### Change Address Format Display Procedure

Use the following steps to modify the address format display.

| Step | Action |
|---|---|
| 1 | From the Main menu, select **Options**, then select **Preferences**. |
| 2 | Select **standard (400001)**, **separator (4:00001)**, or **compact (4:1)**; then click on **OK**. |

## Configuring Discrete Output Modules with Concept

**Discrete Output Modules**

This following information describes how to configure these modules:

- DAO 216 16-point 24 Vdc Discrete Output
- DAP 2x4 4-point 24 ... 110 Vdc/24 ... 250 Vac Relay Discrete Output
- DAP 208/258/258C 8-point 24 ... 110 Vdc/24 ... 250 Vac Relay Discrete Output
- DAP 209 8-point 120 Vac Discrete Output
- DAP 210 8-point 24 ... 240 Vac Discrete Output
- DAP 216(N)16-point 24 Vdc Discrete Output
- DAP 217 16-point 5 ... 24 Vdc Discrete Output
- DAP 218 16-point 24 ... 240 Vac Discrete Output
- DAP 284* 4-point 24 ... 110 Vdc/24 ... 250 Vac Relay Discrete Output (Special, Intrinsically Safe)

*The DAP 284 is a "special", and therefore it is not included in this document.

## I/O Configuration Using Concept 2.1 or Higher

Use the following procedure to configure the module.

| Step | Action |
|---|---|
| 1 | Select **Configure** from the menu. |
| 2 | Select **I/O Map** from the menu. |
| 3 | Click on **Edit**... The Local Common CPU Drop dialog appears. |
| 4 | Click on **Module**. The I/O Module Selection dialog appears. |
| 5 | Select **DAPxxx** and click on **OK**. A number and description appear. |
| 6 | In the **In Ref** field, enter **0x** or **4x** and press **Enter**. The software fills in the **Out Ref** and **Out End** fields. |
| 7 | Click on **Params...** The Output Type and Timeout State dialogs appear. |
| 8 | Select either **Binary** or **BCD** for the Output Type, and either **Last Value** or **User Defined** for the **Timeout State**. Click on **OK**. |

### ⚠ CAUTION

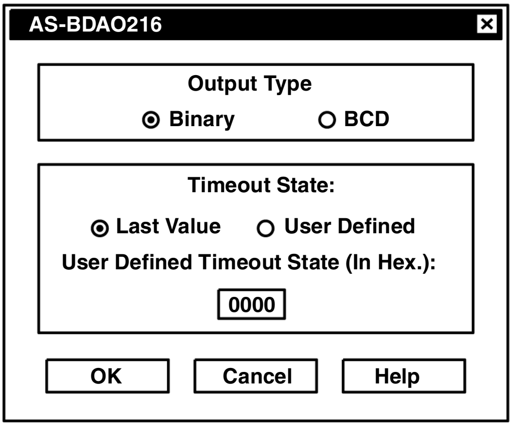
**Power-down or kernel mode.**

The output module Timeout States are valid only in a normal PLC stop state. Therefore, when the PLC powers down or goes into kernel mode, the outputs default to the module’s fail safe state. The Timeout States are defined in the I/O Map module parameter screens.

**Failure to follow this instruction can result in injury or equipment damage.**

### AS-BDAO-216/ AS-DAP-216/N/ 217/218/209

The AS-BDA0-216 dialog box, which follows, isused with the following modules: AS-BDAO-216/ AS-DAP-216/N/ 217/ 218/209.



AS-BDAO216

Output Type

● Binary ○ BCD

Timeout State:

● Last Value ○ User Defined

User Defined Timeout State (In Hex.): 0000

**Output Type:** The **Binary** and **BCD** option buttons require corresponding choices between 0x-/4x-references (i.e., in binary or BCD).

**Timeout State:** The Compact timeout state only reflects a user program in stop mode.

Activation of the **Last Value** option button causes the outputs to retain their last valid value upon user program stop.

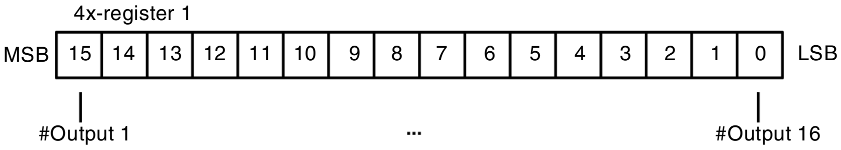
Activation of the **User Defined** option button causes the outputs to assume the value defined in the user-defined timeout state text field.

**User Defined:** If the **User Defined** option button was activated, the corresponding hex value can be entered here.

### Meanings for the AS-BDAO-216/ AS-DAP-216/N/ 217/218/209 Module Mapping

The AS-BDAO-216/ AS-DAP-216/N/ 217/ 218/209 modules require 16 0x-discrete outputs. The **BCD** button will alternatively require mapping to a 4x-output register.

The following figure shows the AS-BDAO-216/ AS-DAP-216/N/ 217/ 218/209 4x register arrangement.

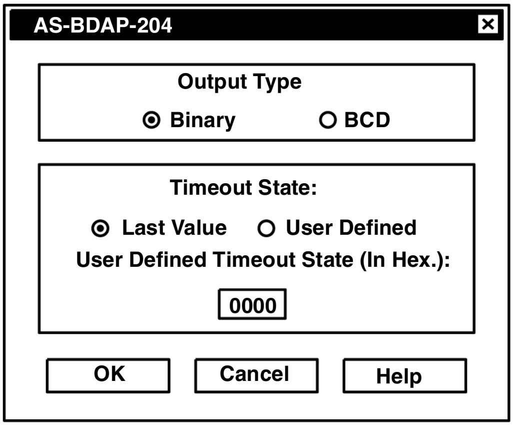


4x-register 1

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MSB | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 | LSB |

## AS-BDAP-204

This AS-DBAP-204 dialog, which follows, is used with the following modules: AS-BDAP-204.



**AS-BDAP-204**

**Output Type**

● **Binary** ○ **BCD**

**Timeout State:**

● **Last Value** ○ **User Defined**

**User Defined Timeout State (In Hex.):** 0000

**Output Type:** The **Binary** and **BCD** option buttons require corresponding choices between 0x-/4x-references (i.e., in binary or BCD).

**Timeout State:** The Compact timeout state only reflects a user program in stop mode.

Activation of the **Last Value** option button causes the outputs to retain their last valid value upon user program stop.

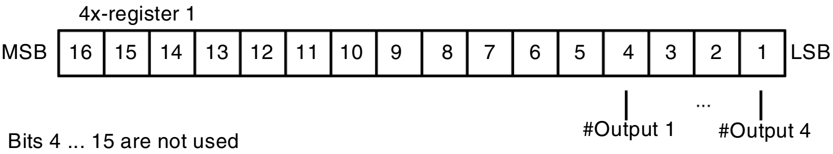
Activation of the **User Defined** option button causes the outputs to take on the value defined in the user-defined timeout state text field.

**User Defined:** If the **User Defined** option button was activated, the corresponding hex value can be entered here.

## Meanings for the AS-BDAP-204 Module Mapping

The AS-BDAP-204 module require four 0x-discrete outputs. The **BCD** option button will alternatively require mapping to a 4x-output register.

The following diagram shows the AS-BDAP-204 4x-register arrangement.



4x-register 1

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MSB | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | LSB |

Bits 4 ... 15 are not used

## Configuring Discrete Combination Modules with Concept

### Discrete Combination Modules

This follwoing information describes how to configure these modules:
- DAP 211 Monitored 4-point in/4-point out 120 Vac Combined I/O
- DAP 212/252/252C 8-point in/4-point out 24 Vdc Combined I/O
- DAP 220/250/250C 8-point in/8-point out 24 Vdc Combined I/O
- DAP 252 8-point in/4-point relay out 24 Vdc LT Combined I/O
- DAP 253 8-point in/4-point relay out 110 Vdc LT Combined I/O
- DAP 292 8-point in/4-point relay out 60 Vdc Combined I/O

### I/O Configuration using Concept 2.1 or Higher

Use the following procedure to configure the module.

| Step | Action |
|---|---|
| 1 | Select **Configure** from the menu. |
| 2 | Select **I/O Map** from the menu. |
| 3 | Click on **Edit...** The Local Common CPU Drop dialog appears. |
| 4 | Click on **Module**. The I/O Module Selection dialog appears. |
| 5 | Select **DAPxxx** and click on **OK**. A number and description appear. |
| 6 | In the **In Ref** field, enter **1x** or **3x** and press **Enter**. The software completes the **In Ref** and **In End** fields. |
| 7 | In the **Out Ref** field, enter **0x** or **4x** and press **Enter**. The software completes the **Out Ref** and **Out End** fields. |
| 8 | Click on **Params...** The Output Type and Timeout State dialogs appear. |
| 9 | Select either **Binary** or **BCD** for the Output Type and either **Last Value** or **User Defined** for the Timeout State. Click on **OK**. |

**⚠ CAUTION**

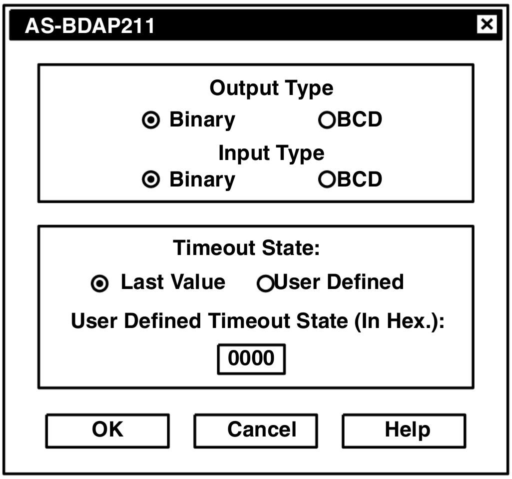
**Power-down or kernel mode.**

The output module Timeout States is valid only in a normal PLC stop state. Therefore, when the PLC powers down or goes into kernel mode, the outputs default to the module’s fail safe state. The Timeout States are defined on the I/O Map module parameter screens.

**Failure to follow this instruction can result in injury or equipment damage.**

### AS-BDAP-211

The AS-BDAP-211dialog, which follows, is used with the following module: AS-BDAP-211



**AS-BDAP211**

**Output Type**
● Binary ○ BCD

**Input Type**
● Binary ○ BCD

**Timeout State:**
● Last Value ○ User Defined

**User Defined Timeout State (In Hex.):** 0000

**Output Type:** The output **Binary** and **BCD** option buttons require corresponding choices between 0x-/4x-references (i.e., in binary or BCD).

**Input Type:** The input **Binary** and **BCD** option buttons require corresponding choices between 1x-/3x-references (i.e., in binary or BCD).

**Timeout State:** The Compact Timeout State only reflects a user program in stop mode.

Activation of the **Last Value** option button causes the outputs to retain their last valid valueupon user program stop.

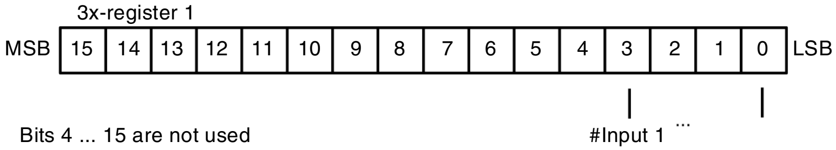
Activation of the **User Defined** option button causes the outputs to take on the value defined in the user-defined timeout state text field.

**User Defined:** If the **User Defined** option button was activated, the corresponding hex value can be entered here.

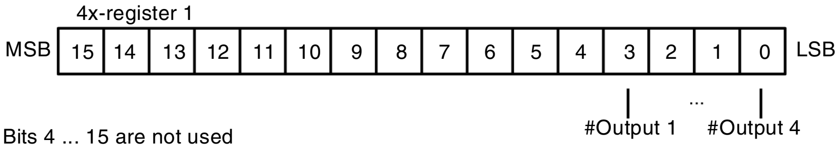
## Meanings for the AS-BDAP-211 Module Mapping

The AS-BDAP-211 modules require four 1x-discrete inputs and four 0x-discrete outputs. The **BCD** option button will alternatively require mapping to a 4x-output register instead of four 0x–discrete outputs. A single 3x-input register can be mapped, instead of four 1x-discrete inputs (as shown in the following figures).

The following figure shows the AS-BDAP-211 3x-register arrangement.

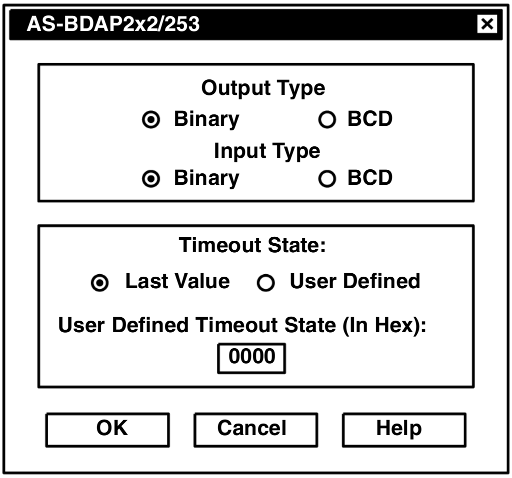


The following figure shows the AS-BDAP-211 4x-register arrangement.



## AS-BDAP-212/ 252(C)/ 253/ 292

The AS-BDAP-212/252(C)/ 253/ 292 dialog box, which follows, is used with the following modules: AS-BDAP-212/ 252(C)/ 253/ 292.



**AS-BDAP2x2/253**

**Output Type**

● **Binary** ○ **BCD**

**Input Type**

● **Binary** ○ **BCD**

**Timeout State:**

● **Last Value** ○ **User Defined**

**User Defined Timeout State (In Hex):** 0000

**Output Type:** The output **Binary** and **BCD** option buttons require corresponding choices between 0x-/4x-references (i.e., in binary or BCD).

**Input Type:** The input **Binary** and **BCD** option buttons require corresponding choices between 1x-/3x-references (i.e., in binary or BCD).

**Timeout State:** The Compact Timeout State only reflects a user program in stop mode.

Activation of the **Last Value** option button causes the outputs to retain their last valid value upon user program stop.

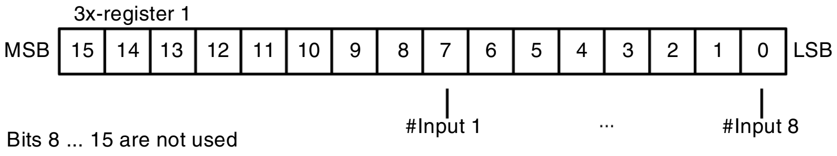
Activation of the **User Defined** option button causes the outputs to assume the value defined in the user-defined timeout state text field.

**User Defined:** If the **User Defined** option button was activated, the corresponding hex value can be entered here.

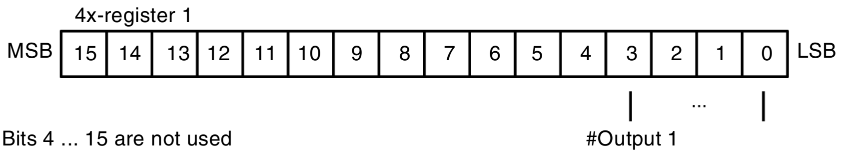
### Meanings for the AS-BDAP-212/ 252(C)/ 253/ 292 Module Mapping

The AS-BDAP-212/ 252(C)/ 253/ 292 modules require eight 1x-discrete inputs and four 0x-discrete outputs. The **BCD** option button will alternatively require mapping to be made to a 4x-output register. A single 3x-input register can be mapped instead of eight 1x-discrete inputs.

The following figure shows the AS-BDAP-212/252(C)/253/292 3x-register arrangement.



The following figure shows the AS-BDAP-212/ 252(C)/253/292 4x-register arrangement.



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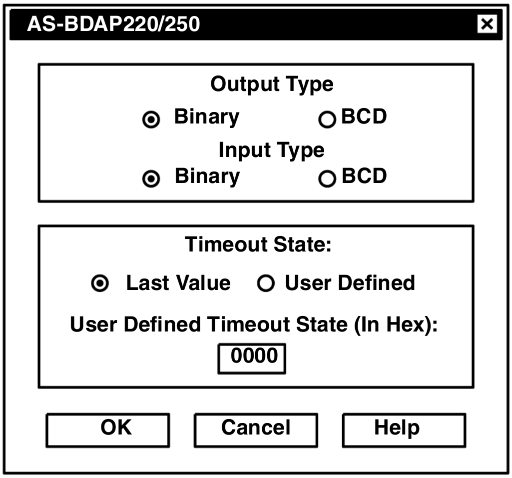
### AS-BDAP-220/ 252(C)

The AS-BDAP220/250(C) dialog, which follows, is used with the following modules: AS-BDAP-220/250(C).



AS-BDAP220/250

Output Type
● Binary ○ BCD
Input Type
● Binary ○ BCD

Timeout State:
● Last Value ○ User Defined

User Defined Timeout State (In Hex): 0000

**Output Type:** The output **Binary** and **BCD** option buttons require corresponding choices between 0x-/4x-references (i.e., in binary or BCD).

**Input Type:** The input **Binary** and **BCD** option buttons require orresponding choices between 1x-/3x-references (i.e., in binary or BCD).

**Timeout State:** The Compact Timeout State only reflects a user program in stop mode.

Activation of the **Last Value** option button causes the outputs to retain their last valid value upon user program stop.

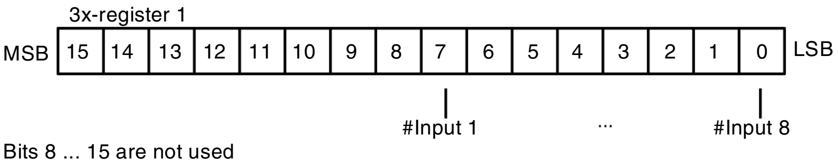
Activation of the **User Defined** option button causes the outputs to take on the value defined in the user-defined timeout state text field.

**User Defined:** If the **User Defined** option button was activated, the corresponding hex value can be entered here.

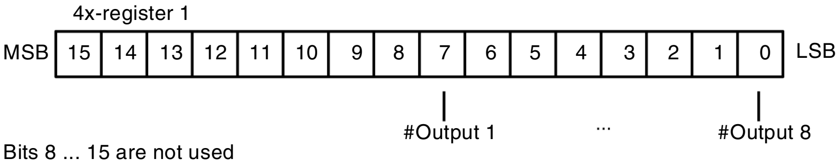
## Meanings for the AS-BDAP-220/ 250(C) Module Mapping

The AS-BDAP-220/ 250(C) modules require eight 1x-discrete inputs and eight 0x-discrete outputs. The output **BCD** option button will alternatively require mapping to a 4x-output register. The input **BCD** option button will require a 3x-input register mapping (as shown in the following two figures).

The following figure shows the AS-BDAP-220/ 250(C) 3x-register arrangement.



The following figure shows the AS-BDAP-220/ 250(C) 4x-register arrangement.



## Configuring Analog Input Modules with Concept

### Analog Input Modules

The following information describes how to configure these modules:

- ADU 204/254/254C 4–point Voltage/RTD Analog Input
- ADU 205 4–point Voltage/Current Analog Input
- ADU 206/256/256C 4–point Voltage/Current Isolated Analog Input
- ADU 210 4–point Voltage/Current Analog Input (Only supported in Concept 2.2 or higher)
- ADU 214 8–point Voltage/Current Isolated Analog Input (Only supported in Concept 2.2 or higher)
- ADU 216 8–point Thermocouple Isolated Analog Input
- ADU 257/257C 8–point Millivolts/RTD/TC/Resistance Analog Input (Only supported in Concept 2.2 or higher)
- ADU 282/282M* 2–point Analog Input (Special, Intrinsically Safe)
- ADU 284* 2-point Analog Input (Special, Intrinsically Safe)
- ADU 211/212 8–point Universal Isolated Analog Input (Not supported in Concept 2.1 or higher)

*This is a "special", and therefore it is not included in this document.

### I/O Configuration Using Concept 2.1 or Higher

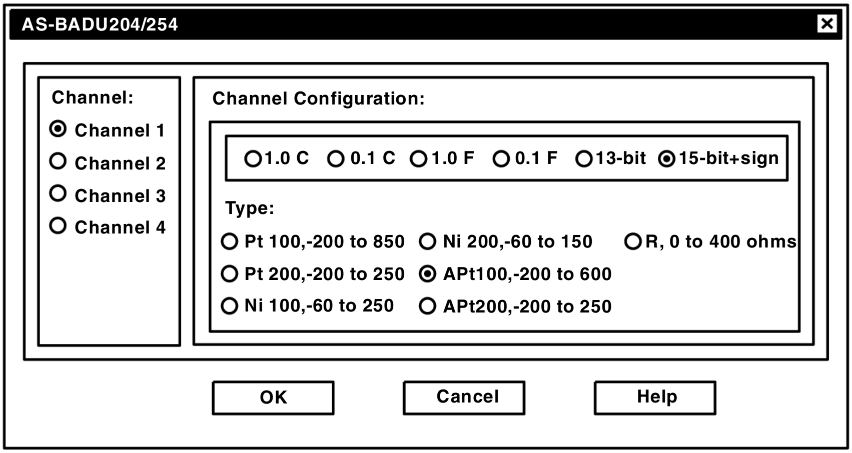
Use the following procedure to configure the module.

| Step | Action |
|---|---|
| 1 | Select **Configure** from the menu. |
| 2 | Select **I/O Map** from the menu. |
| 3 | Click on **Edit...** The Local Common CPU Drop dialog appears. |
| 4 | Click on **Module**. The I/O Module Selection dialog appears. |
| 5 | Select **ADUxxx** and click on **OK**. A number and description appear. |
| 6 | In the **In Ref** field, enter **3x** and press **Enter**. The software completes the **In Ref** and **In End** fields. |
| 7 | Click on **Params...** The applicable configuration dialog appears, depending on the selected module. Refer to the specific modules. |

### Configuring AS-BADU-204/254(C) Modules

The following information applies to the AS-BADU-204/254(C) modules.

The AS-BADU-204/ 254(C) parameter dialog, which follows, is used for the analog modules AS–BADU–204/ 254(C).



AS-BADU204/254

Channel:
● Channel 1
○ Channel 2
○ Channel 3
○ Channel 4

Channel Configuration:
○ 1.0 C ○ 0.1 C ○ 1.0 F ○ 0.1 F ○ 13-bit ● 15-bit+sign

Type:
○ Pt 100,-200 to 850 ○ Ni 200,-60 to 150 ○ R, 0 to 400 ohms
○ Pt 200,-200 to 250 ● APt100,-200 to 600
○ Ni 100,-60 to 250 ○ APt200,-200 to 250

**Channel:** The option buttons here allow the selection of individual channels for configuration, as follows:

- Channel 1 = Pins 3 ... 6
- Channel 2 = Pins 7...10
- Channel 3 = Pins 14 ... 17
- Channel 4 = Pins 18 ... 21

**Channel**–specific option panels are presented for each channel selection. Values entered for a channel are saved automatically when another channel is selected, and therefore are not lost during the definition of another channel.

**Channel Configuration:** Measuring ranges and data formats for temperature measurement data transfer to the Compact PLC can be determined in this list box.

The **1.0 C/F** and **0.1 C/F** option buttons allow a choice of measuring steps of either 1.0 or 0.1 degree (in Centigrade or Fahrenheit). This allows differing displays for the same measurement value, as shown in the following table.

| 1.0 degree Centigrade | 0.1 degree Centigrade |
|---|---|
| -60 | -600 |
| 200 | 2000 |

The remaining option buttons **13–bit** and **15-**+sign (15–bit value + sign) determine the value range to be transferred.

The tables that follow are present values for all configurable resistive temperature sensors, which are listed here:

- Pt 100, -200 to 850
- Pt 200, -200 to 250
- Ni 100, -60 to 250
- Ni 200, -60 to 150
- APt 100, -200 to 600
- APt 200, -200 to 250
- R, 0 to 400 ohms

Pt 100-200 degrees C to 850 degrees C

| **Temp. (degrees C)** | **1.0 C** | **0.1 C** | **1.0 F** | **0.1 F** | **13-bit** | **15-bit + sign** | **Measuring step/ value range** |
|---|---|---|---|---|---|---|---|
| <-205 | -32768 | -32768 | -32768 | -32768 | 0 | -32768 | Under-range |
| -200 | -200 | -2000 | -328 | -3280 | 3132 | -7529 | Nominal range |
| 0 | 0 | 0 | +32 | +320 | 4096 | 0 | |
| +850 | +850 | +8500 | +1562 | +15620 | 8191 | 32000 | |
| >+870 | +32767 | +32767 | +32767 | +32767 | 8191 | +32767 | Overrange |

Pt 200-200 degrees C to 250 degrees C

| **Temp. (degrees C)** | **1.0 C** | **0.1 C** | **1.0 F** | **0.1 F** | **13-bit** | **15-bit + sign** | **Measuring step/ value range** |
|---|---|---|---|---|---|---|---|
| <-205 | -32768 | -32768 | -32768 | -32768 | 0 | -32768 | Under-range |
| -200 | -200 | -2000 | -328 | -3280 | 819 | -25600 | Nominal range |
| 0 | 0 | 0 | +32 | +320 | 4096 | 0 | |
| +250 | +250 | +2500 | +482 | +4820 | 8191 | 32000 | |
| >+256 | +32767 | +32767 | +32767 | +32767 | 8191 | +32767 | Overrange |

Ni 100-60 degrees C to 250 degrees C

| **Temp. (degrees C)** | **1.0 C** | **0.1 C** | **1.0 F** | **0.1 F** | **13-bit** | **15-bit + sign** | **Measuring step/ value range** |
|---|---|---|---|---|---|---|---|
| <-61 | -32768 | -32768 | -32768 | -32768 | 0 | -32768 | Under-range |
| -60 | -60 | -600 | -76 | -760 | 3113 | -7680 | Nominal range |
| 0 | 0 | 0 | +32 | +320 | 4096 | 0 | |
| +250 | +250 | +2500 | +482 | +4820 | 8191 | 32000 | |
| >+256 | +32767 | +32767 | +32767 | +32767 | 8191 | +32767 | Overrange |

Ni 100-60 degrees C to 150 degrees C

| Temp. (degrees C) | 1.0 C | 0.1 C | 1.0 F | 0.1 F | 13-bit | 15-bit + sign | Measuring step/ value range |
|---|---|---|---|---|---|---|---|
| <-61 | -32768 | -32768 | -32768 | -32768 | 0 | -32768 | Under-range |
| -60 | -60 | -600 | -76 | -760 | 2458 | -12800 | Nominal range |
| 0 | 0 | 0 | +32 | +320 | 4096 | 0 | |
| +150 | +150 | +1500 | +302 | +3020 | 8191 | 32000 | |
| >+151 | +32767 | +32767 | +32767 | +32767 | 8191 | +32767 | Overrange |

APt 100-200 degrees C to 600 degrees C

| Temp. (degrees C) | 1.0 C | 0.1 C | 1.0 F | 0.1 F | 13-bit | 15-bit + sign | Measuring step/ value range |
|---|---|---|---|---|---|---|---|
| <-205 | -32768 | -32768 | -32768 | -32768 | 0 | -32768 | Under-range |
| -200 | -200 | -2000 | -328 | -3280 | 2731 | -10667 | Nominal range |
| 0 | 0 | 0 | +32 | +320 | 4096 | 0 | |
| +600 | +600 | +6000 | +1112 | +11120 | 8191 | 32000 | |
| >+614 | +32767 | +32767 | +32767 | +32767 | 8191 | +32767 | Overrange |

APt 200-200 degrees C to 250 degrees C

| Temp. (degrees C) | 1.0 C | 0.1 C | 1.0 F | 0.1 F | 13-bit | 15-bit + sign | Measuring step/ value range |
|---|---|---|---|---|---|---|---|
| <-205 | -32768 | -32768 | -32768 | -32768 | 0 | -32768 | Under-range |
| -200 | -200 | -2000 | -328 | -3280 | 819 | -25600 | Nominal range |
| 0 | 0 | 0 | +32 | +320 | 4096 | 0 | |
| +250 | +250 | +2500 | +482 | +4820 | 8191 | 32000 | |
| >+256 | +32767 | +32767 | +32767 | +32767 | 8191 | +32767 | Overrange |

R, 0 to 400 ohms

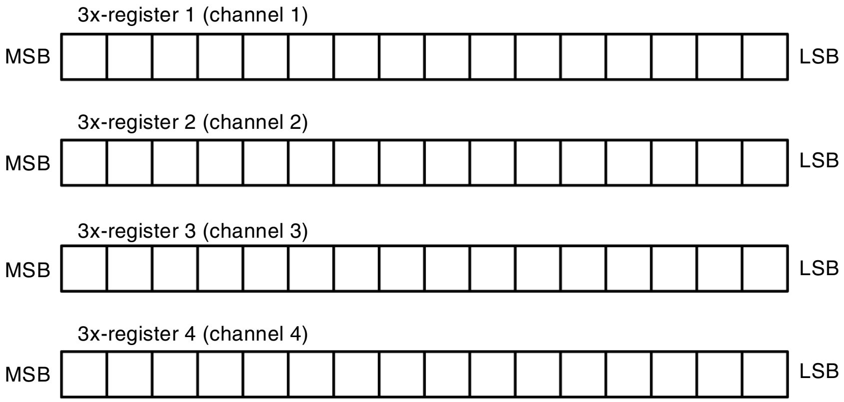
| Resistance in W | 13-bit | 15-bit + sign | Value range |
|---|---|---|---|
| 0 | 0 | 0 | Recommended nominal range |
| 100 | 2048 | +8000 | |
| 200 | 4096 | +16000 | |
| 399.902 | 8191 | +32000 | |
| >= 400 | 8191 | +32767 | Overrange |

**Type:** In this section, an option button can be used to choose a resistive temperature sensor type for the selected channel, or a direct resistance measurement can be performed.

**Note:** The type R, 0 to 400 ohms button, only selects values whose size has been determined to be either **13–bit** or 1**5–bit + sign** through the appropriate option buttons.

### Meanings for the AS-BADU-204/254(C) Module Mapping

The AS-BADU-204/254(C) modules require four 3x-input registers addressed in sequence, beginning with channel 1 as shown here.

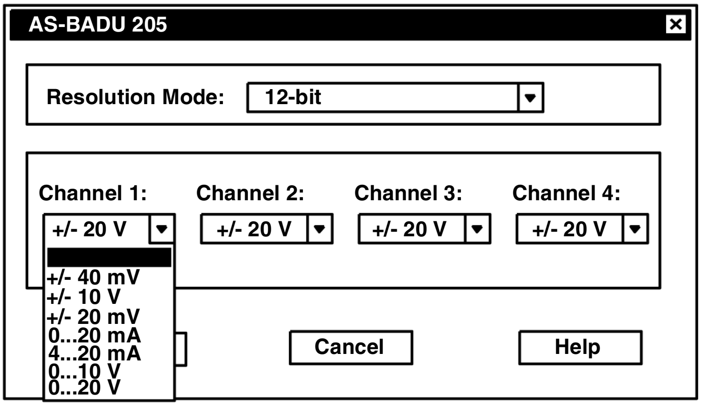


**Note:** Refer to*Concept I/O Map Status Words, p. 816*.

**AS-BADU-205**

The following information applies to the AS-BADU-205 module.

The 20AS-BADU-205 parameter dialog, which follows, is valid for the analog module AS-BADU-205.



Resolution Mode: 12-bit

Channel 1: +/- 20 V

Channel 2: +/- 20 V

Channel 3: +/- 20 V

Channel 4: +/- 20 V

**Resolution Mode:** This list box defines the value range for all channels:

- 12-bit
- 12-bit + sign
- 13-bit
- 15-bit + sign
- 16-bit

**Channel 1 ... 4:** The desired measuring ranges can be chosen in these list boxes.

**Note:** The combination of current and voltage ranges is not allowed. Pay attention to the switches on the rear of the module.

The measuring ranges can be chosen from the following selections:

- +/- 20 VDC
- +/- 40 mA
- +/- 10 VDC
- +/- 20 mA
- 0 ... 20 mA
- 4 ... 20 mA
- 0 ... 10 VDC
- 0 ... 20 VDC

### +/- 20 mA, +/- 40 mA

| Input current (mA) | 12-bits | 13-bits | 16-bits | 12-bits + sign | 15-bits + sign | Range |
|---|---|---|---|---|---|---|
| <-20/-40 | 0 | 0 | 0 | -4095 | -32768 | Under-range |
| -20/-40 | 0 | 0 | 0 | -4095 | -32000 | Nominal range |
| 0 | 2048 | 4096 | 32768 | 0 | 0 | |
| +20/+40 | 4095 | 8191 | 65520 | +4095 | +32000 | |
| >+20/+40 | 4095 | 8191 | 65520 | +4095 | +32767 | Overrange |

### +/- 10 VDC, +/- 20 VDC

| Input voltage (VDC) | 12-bits | 13-bits | 16-bits | 12-bits + sign | 15-bits + sign | Range |
|---|---|---|---|---|---|---|
| <-10/-20 | 0 | 0 | 0 | -4095 | -32768 | Under-range |
| -10/-20 | 0 | 0 | 0 | -4095 | -32000 | Nominal range |
| 0 | 2048 | 4096 | 32768 | 0 | 0 | |
| +10/+20 | 4095 | 8191 | 65520 | +4095 | +32000 | |
| >+10/+20 | 4095 | 8191 | 65520 | +4095 | +32767 | Overrange |

### 0 ... 10 VDC, 0 ... 20 VDC

| Input voltage (VDC) | 12-bits | 13-bits | 16-bits | 12-bits + sign | 15-bits + sign | Range |
|---|---|---|---|---|---|---|
| < 0 | 0 | 0 | 0 | -4095 | -32768 | Under-range |
| 0 | 0 | 0 | 0 | 0 | 0 | Nominal range |
| 10/20 | 4095 | 8191 | 65520 | +4095 | +32000 | |
| >10/20 | 4095 | 8191 | 65520 | +4095 | +32767 | Overrange |

### 0 ... 20  mA

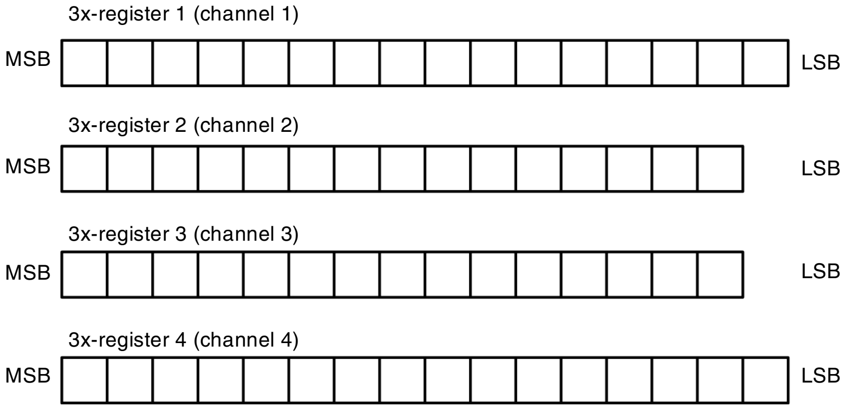
| Input current (mA) | 12-bits | 13-bits | 16-bits | 12-bits + sign | 15-bits + sign | Range |
|---|---|---|---|---|---|---|
| < 0 | 0 | 0 | 0 | -4095 | -32768 | Under-range |
| 0 | 0 | 0 | 0 | 0 | 0 | Nominal range |
| 20 | 4095 | 8191 | 65520 | +4095 | +32000 | |
| >20 | 4095 | 8191 | 65520 | +4095 | +32767 | Overrange |

4 ... 20 mA

| **Input current (mA)** | **12-bits** | **13-bits** | **16-bits** | **12-bits + sign** | **15-bits + sign** | **Range** |
|---|---|---|---|---|---|---|
| < 0 ... 2 | 0 | 0 | 0 | 0 | 0 | Wire breakage |
| 2.1 ... 3.61 | 0 | 0 | 0 | 0 | -32768 | Under-range |
| 3.62 ... 3.99 | 0 | 0 | 0 | 0 |  | Tolerable range |
| 4 | 0 | 0 | 0 | 0 | 0 | Nominal range |
| 20 | 4095 | 8191 | 65520 | +4095 | +32000 |  |
| >20 | 4095 | 8191 | 65520 | +4095 | +32767 | Overrange |

## Meanings for the AS-BADU-205 Module Mapping

The AS–BADU–205 module requires four 3x–input registers addressed in sequence, beginning with channel 1 (as shown in the following figure).

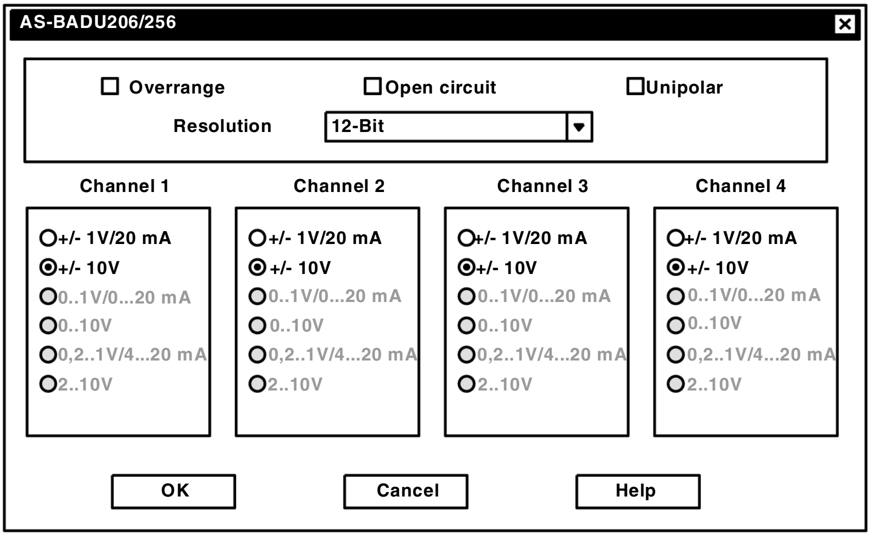


**Note:** Refer to *Concept I/O Map Status Words, p. 816.*

**AS-BADU-206/ 256(C)**

The following information describes the AS-BADU-206/256(C) modules.

The AS-BADU-206/ 256(C) parameter dialog shown below is valid for the analog modules AS–BADU–256/ (C).



AS-BADU206/256

☐ Overrange ☐ Open circuit ☐ Unipolar

Resolution: 12-Bit

| Channel 1 | Channel 2 | Channel 3 | Channel 4 |
|---|---|---|---|
| ○ +/- 1V/20 mA | ○ +/- 1V/20 mA | ○ +/- 1V/20 mA | ○ +/- 1V/20 mA |
| ● +/- 10V | ● +/- 10V | ● +/- 10V | ● +/- 10V |
| ○ 0..1V/0...20 mA | ○ 0..1V/0...20 mA | ○ 0..1V/0...20 mA | ○ 0..1V/0...20 mA |
| ○ 0..10V | ○ 0..10V | ○ 0..10V | ○ 0..10V |
| ○ 0,2..1V/4...20 mA | ○ 0,2..1V/4...20 mA | ○ 0,2..1V/4...20 mA | ○ 0,2..1V/4...20 mA |
| ○ 2..10V | ○ 2..10V | ○ 2..10V | ○ 2..10V |

**Overrange:** Activation of the **Overrange** option button enables range exception monitoring. Any range exceptions then trigger a corresponding message within the first input status word (bits 0 ... 3).

**Open circuit:** Activation of the **Open circuit** (wire breakage) option button enables open-circuit monitoring. Any subsequent error messages are then visible within the first input status word (bits 4 ... 7).

**Unipolar:** Selection of the **Unipolar** option button restricts choices to the unipolar measuring ranges (e.g. 0 ... 20 mA/ 0 ... 10 V).

**Resolution:** This list box defines the value range for all channels:

- 11-bit + sign
- 12-bit
- 15-bit + sign
- 16-bit

**Channel 1 ... 4:** The measuring ranges for channels 1-4 can be chosen from the tables that follow.

### Measuring ranges 0 ... 10 VDC/2 ... 10 VDC, 0 ... 20 mA/4 ... 20 mA

| **Voltage (VDC)** | **Current (mA)** | **12-bits** | **16-bits** | **11-bits + sign** | **15-bits + sign** | **Range** |
|---|---|---|---|---|---|---|
|  |  | 0 | 0 | 0 | 0 | Under-range |
|  |  | 0 | 0 | 0 | 0 | Neg. tolerance range |
| 0/2 | 0/4 | 0 | 0 | 0 | 0 | Nominal range |
| 10 | 20 | 4000 | 64000 | +2000 | +32000 |  |
| 10.01 ... | 20.02 ... | 4001 | 64016 | +2001 | +32016 | Pos. tolerance range |
| >= 10.24/ 10.19 | >= 20.48/ 20.39 | 4095 | 65520 | +2047 | +32760 | Overrange |

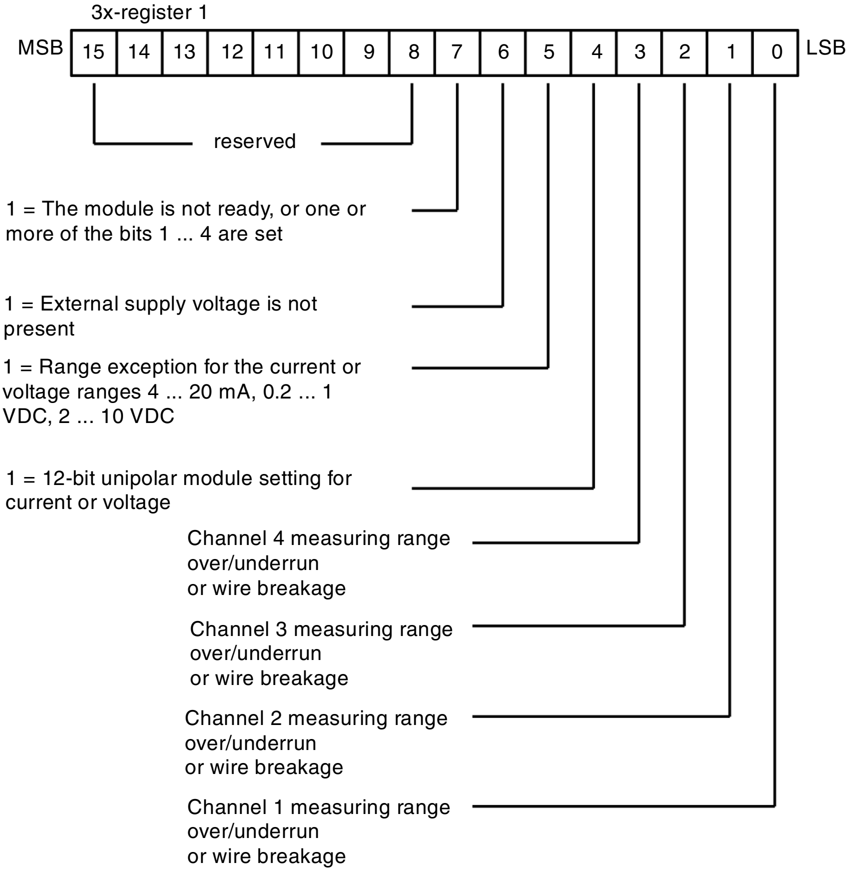
### Measuring ranges +/- 10 VDC/ +/- 20 mA

| **Voltage (VDC)** | **Current (mA)** | **12-bits** | **16-bits** | **11-bits + sign** | **15-bits + sign** | **Range** |
|---|---|---|---|---|---|---|
| <=-10.24 | <=-20.48 | 0 | 0 | -2048 | -32768 | Under-range |
| -10.01 | -20.02 | 47 |  | -2001 | -32016 | Neg. tolerance range |
| -10.00 | -20 | 48 | 768 | -2000 | -32000 | Nominal range |
| 0 | 0 | 2048 | 32768 | 0 | 0 |  |
| +10.00 | +20 | 4048 | 64768 | +2000 | +32000 |  |
| +10.01 ... | +20.02 ... | 4049 |  | +2001 | +32016 | Pos. tolerance range |
| >=10.24 | >=20.48 | 4095 | 65520 | +2047 | +32752 | Overrange |

### AS-BADU-206/ 256(C) Module Input Status Word

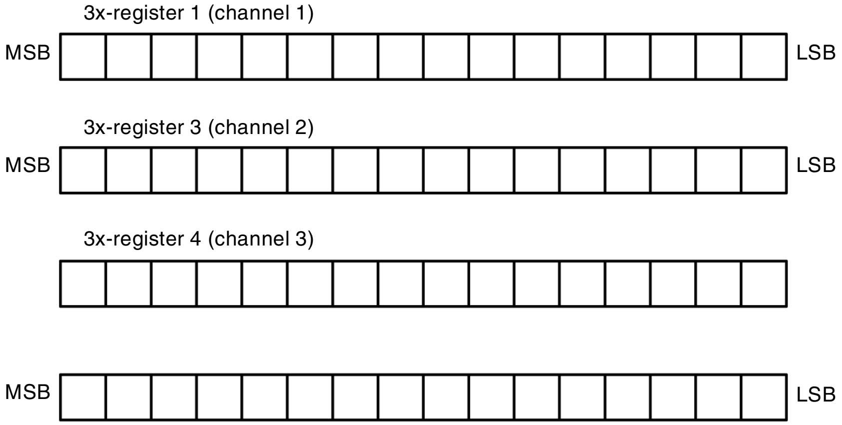
The AS–BADU–206/256 modules require five 3x–input registers addressed in sequence, beginning with the input status word, then channel. (Refer to the following two figures.)

The following figure shows the AS-BADU-206/ 256(C) 3x module status word.



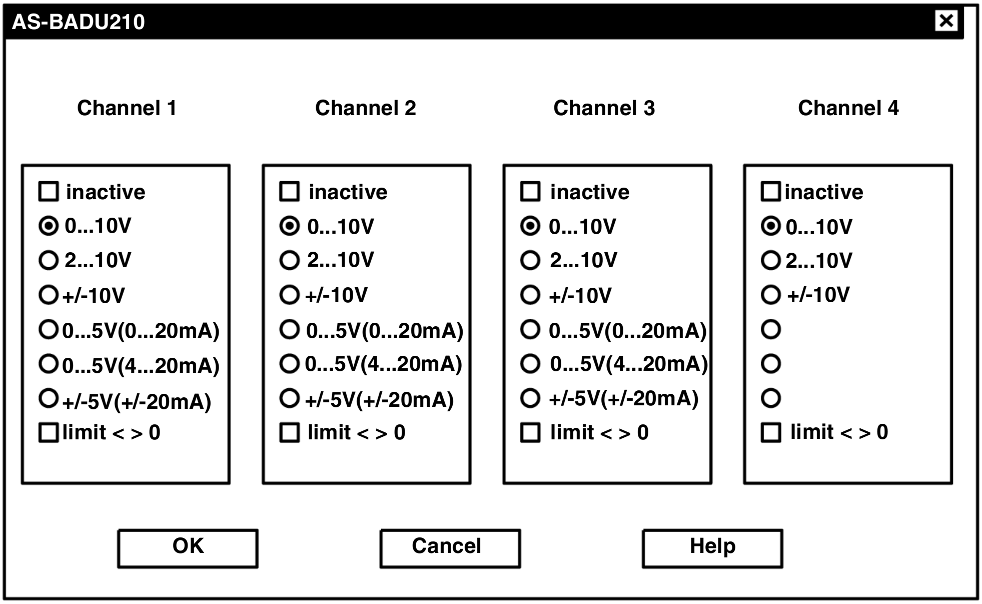
### Meanings for the AS-BADU-206/ 256(C)Module Mapping

The following figure shows the AS-BADU-206/ 256(C) 3x-register arrangement.



**AS–BADU–210** The following information applies to the AS-BADU-210 module.

The dialog, which follows, works with the analog module AS–BADU–210.



AS-BADU210

| Channel 1 | Channel 2 | Channel 3 | Channel 4 |
|---|---|---|---|
| ☐ inactive | ☐ inactive | ☐ inactive | ☐ inactive |
| ● 0...10V | ● 0...10V | ● 0...10V | ● 0...10V |
| ○ 2...10V | ○ 2...10V | ○ 2...10V | ○ 2...10V |
| ○ +/-10V | ○ +/-10V | ○ +/-10V | ○ +/-10V |
| ○ 0...5V(0...20mA) | ○ 0...5V(0...20mA) | ○ 0...5V(0...20mA) | ○ |
| ○ 0...5V(4...20mA) | ○ 0...5V(4...20mA) | ○ 0...5V(4...20mA) | ○ |
| ○ +/-5V(+/-20mA) | ○ +/-5V(+/-20mA) | ○ +/-5V(+/-20mA) | ○ |
| ☐ limit < > 0 | ☐ limit < > 0 | ☐ limit < > 0 | ☐ limit < > 0 |

**Channel 1 ... 4:**

For Chanel ... 4, use the following guidelines:

- Select inactive when channel is not used.
- Select limit < > 0 if you want to use the 1.6% rated value without causing an error for uniplar ranges only.

Use the information in the following tables to choose the measuring ranges for channels 1 to 4.

Conversion Values of Voltage Inputs

| **Analog value 0 ... 5 V** | **Analog value 0 ... 10V** | **Analog value 1 ... 5 V** | **Analog value 2 ... 10 V** | **Analog value +/–5 V** | **Analog value +/–10 V** | **Decimal value** | **Notes** |
|---|---|---|---|---|---|---|---|
| <-0.080 | <-0.16 | <+0.52 | <+1.04 | <-5.12 | <-10.24 | -32 767 | underflow error |
|  |  |  |  | -5.119 ... -5.00 | -10.239... -10.00 | -32 766... -32 001 | overload range |
| -0.08 ... -0.00 | -0.16 ... -0.00 | +0.52 ...<br>+0.936 ...<br>+0.99 | +1.04 ..<br>+1.87 ...<br>+1.99 |  |  | 0 (-3 840) 0 (-512) 0 (-1) | overload range |
|  |  |  |  | -5.00 | -10.00 | -32 000 | linear |
|  |  |  |  | -2.50 | -5.00 | -16 000 | linear |
|  |  |  |  | -0.50 | -1.00 | -3 200 | linear |
|  |  |  |  | -0.25 | -0.50 | -1 600 | linear |
|  |  |  |  | -0.05 | -0.10 | -320 | linear |
|  |  |  |  | -0.005 | -0.01 | -32 | linear |
|  |  |  |  | -0.0025 | -0.005 | -16 | linear |
| 0 | 0 | 1 | 2 | 0 | 0 | 0 | linear |
| 0.0025 | 0.005 | 1.002 | 2.004 | +0.0025 | +0.005 | +16 | linear |
| 0.005 | 0.01 | 1.004 | 2.008 | +0.005 | +0.01 | +32 | linear |
| 0.05 | 0.10 | 1.04 | 2.08 | +0.05 | +0.10 | +320 | linear |
| 0.25 | 0.50 | 1.20 | 2.40 | +0.25 | +0.50 | +1 600 | linear |
| 0.50 | 1.00 | 1.40 | 2.80 | +0.50 | +1.00 | +3 200 | linear |
| 2.50 | 5.00 | 3.00 | 6.00 | +2.50 | +5.00 | +16 000 | linear |
| 5.00 | 10.00 | 5.00 | 10.00 | +5.00 | +10.00 | +32 000 | rated value |
| 5.000... 5.119 | 10.000... 10.239 | 5.00... 5.09 | 10.00... 10.19 | +5.000.. +5.119 | +10.00... +10.239 | +32 001... +32 766 | overload range |
| >5.12 | >10.24 | >5.09 | >10.19 | >+5.20 | >+10.24 | >+32 767 | overflow error |

**Note:** Brackets denote range with limiting value –1.6%. No brackets denotes range with limiting value 0.

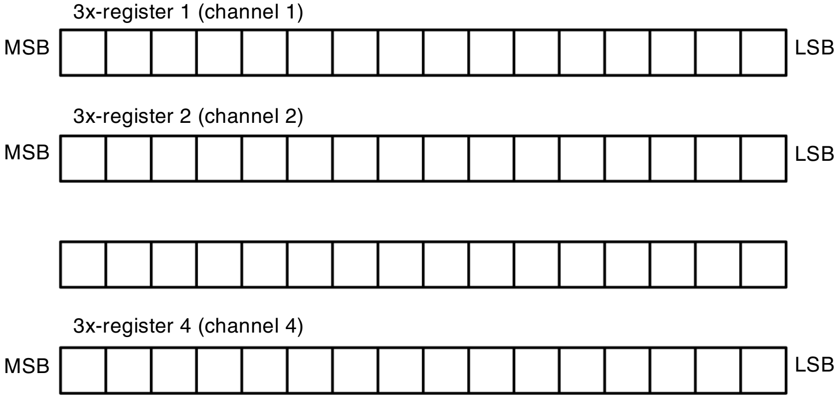
Conversion Values of Current Inputs

| **Analog value 0 ... 20 mA** | **Analog value 4 ... 20 mA** | **Analog value +/–20 mA** | **Decimal value** | **Notes** |
|---|---|---|---|---|
| <-0.32 | <+2.08 | <-20.479 | -32 767 | underflow error |
| | | -20.478 ... -20.000 | -32 766 ... -32 001 | overload range |
| -0.32 ... -0.00 | +2.08 ... +3.74 ... +3.99 | | 0 (-3 840) 0 (-512) 0 (-1) | overload range |
| | | -20.00 | -32 000 | linear |
| | | -10.00 | -16 000 | linear |
| | | -2.00 | -3 200 | linear |
| | | -1.00 | -1 600 | linear |
| | | -0.20 | -320 | linear |
| | | -0.02 | -32 | linear |
| | | -0.01 | -16 | linear |
| 0 | +4 | 0 | 0 | linear |
| +0.01 | +4.008 | +0.01 | +16 | linear |
| +0.02 | +4.016 | +0.02 | +32 | linear |
| +0.20 | +4.16 | +0.20 | +320 | linear |
| +1.00 | +4.80 | +1.00 | +1 600 | linear |
| +2.00 | +5.60 | +2.00 | +3 200 | linear |
| +10.00 | +12.00 | +10.00 | +16 000 | linear |
| +20.00 | +20.00 | +20.00 | +32 000 | rated value |
| +20.000 ... +20.478 | +20.00 ... +20.38 | +20.000 ... +20.478 | +32 001 ... +32 766 | overload range |
| >+20.479 | >+20.38 | >+20.479 | >+32 767 | overflow error |

**Note:** Brackets denote range with limiting value –1.6%. No brackets denotes range with limiting value 0.

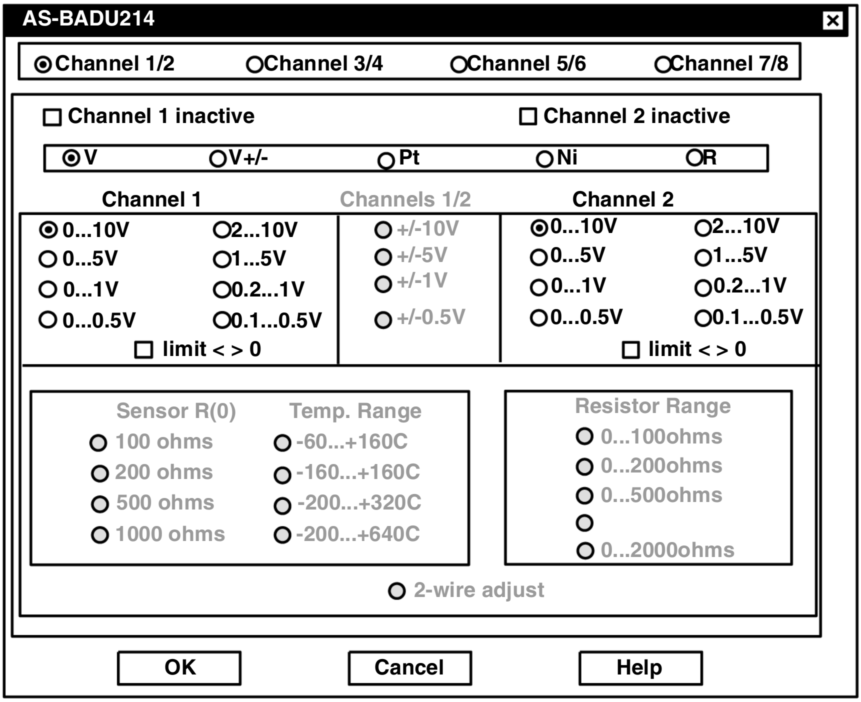
### Meanings for the AS–BADU–210 Module Mapping

The AS–BADU–210 module requires four 3x–input registers addressed in sequence, beginning with channel 1 as shown below.



**Note:** Refer to *Concept I/O Map Status Words, p. 816* for Concept I/O Map Status Words.

**AS–BADU–214** The following dialog is valid for the analog module AS–BADU–214.



AS-BADU214

● Channel 1/2 ○ Channel 3/4 ○ Channel 5/6 ○ Channel 7/8

☐ Channel 1 inactive ☐ Channel 2 inactive

● V ○ V+/- ○ Pt ○ Ni ○ R

Channel 1

● 0...10V ○ 2...10V
○ 0...5V ○ 1...5V
○ 0...1V ○ 0.2...1V
○ 0...0.5V ○ 0.1...0.5V
☐ limit < > 0

Channels 1/2

○ +/-10V
○ +/-5V
○ +/-1V
○ +/-0.5V

Channel 2

● 0...10V ○ 2...10V
○ 0...5V ○ 1...5V
○ 0...1V ○ 0.2...1V
○ 0...0.5V ○ 0.1...0.5V
☐ limit < > 0

Sensor R(0)

○ 100 ohms
○ 200 ohms
○ 500 ohms
○ 1000 ohms

Temp. Range

○ -60...+160C
○ -160...+160C
○ -200...+320C
○ -200...+640C

Resistor Range

○ 0...100ohms
○ 0...200ohms
○ 0...500ohms
○
○ 0...2000ohms

○ 2-wire adjust

**Channel 1 ... 8:** Bipolar measurements are configured in pairs. Either channel of the pair may be made inactive. Also, the 2–wire adjust is used for 2 or 3 wire 10 ohm compensation.

The measuring ranges for channels 1 to 8 can be chosen in these sections.

Conversion Values of Unipolar Voltage Inputs

| **0...0.5 V** | **0...1 V** | **0...5 V** | **0...10 V** | **0.1...0.5 V** | **0.2...1 V** | **1...5 V** | **2...10 V** |
|---|---|---|---|---|---|---|---|
| < –0.008 | < –0.016 | < –0.08 | < –0.16 | < +0.052 | < +0.104 | < +0.52 | < +1.04 |
|  |  |  |  | +0.052 | +0.104 | +0.52 | +1.04 |
| –0.008 ... | –0.016 ... | –0.08 .. | –0.16 .. | +0.094 ... | +0.187 ... | +0.936 ... | +1.87 ... |
| –0.000 | –0.000 | –0.00 | –0.00 | +0.099 | +0.199 | +0.99 | +1.99 |
| 0 | 0 | 0 | 0 | 0.1 | 0.2 | 1 | 2 |
| 0.000 02 | 0.000 03 | 0.000 16 | 0.000 31 | 0.100 0 | 0.200 0 | 1.000 1 | 2.000 3 |
| 0.000 25 | 0.000 5 | 0.002 5 | 0.005 | 0.100 2 | 0.200 4 | 1.002 | 2.004 |
| 0.000 5 | 0.001 | 0.005 | 0.01 | 0.100 4 | 0.200 8 | 1.004 | 2.008 |
| 0.005 | 0.01 | 0.05 | 0.10 | 0.104 | 0.208 | 1.04 | 2.08 |
| 0.025 | 0.05 | 0.25 | 0.50 | 0.12 | 0.24 | 1.20 | 2.40 |
| 0.05 | 0.10 | 0.50 | 1.00 | 0.14 | 0.28 | 1.40 | 2.80 |
| 0.25 | 0.50 | 2.50 | 5.00 | 0.30 | 0.60 | 3.00 | 6.00 |
| 0.50 | 1.00 | 5.00 | 10.00 | 0.50 | 1.00 | 5.00 | 10.00 |
| 0.500 0 ... | 1.000 0 ... | 5.000 ... | 10.000 ... | 0.500 ... | 1.000 ... | 5.00 ... | 10.00 ... |
| 0.511 9 | 1.023 9 | 5.119 | 10.239 | 0.509 | 1.019 | 5.09 | 10.19 |
| >=0.512 | >=1.024 | >=5.12 | >=10.24 | >0.509 | >1.019 | >5.09 | >10.19 |
| NOTE: Numbers not in parentheses = range with + limit. |  |  |  |  |  |  |  |

### Conversion Values of Unipolar Voltage Inputs (continued)

| **15-BIT** | **NOTES** |
|---|---|
| –32,767 | underflow error |
| 0 (–3,840) | overload range |
| 0 (–512) | |
| 0 (–1) | |
| 0 | rated value |
| +1 | |
| +16 | |
| +32 | |
| +320 | Linear Range |
| +1 600 | |
| +3 200 | |
| +16 000 | |
| +32 000 | rated value |
| +32 001 ... | |
| +32 766 | overload range |
| +32 767 | overflow error |

**Note:** Numbers in parentheses = range with + and - limit.

## Conversion Values of Bipolar Voltage Inputs

| **+/-0.5 V** | **+/-1 V** | **+/-5 V** | **+/-10 V** |
|---|---|---|---|
| <= –0.512 | <= –1.024 | <= –5.12 | <= –10.24 |
| –0.511 9 ... | –1.023 ... | –5.119 ... | –10.239 ... |
| –0.500 0 | –1.000 | –5.000 | –10.000 |
| –0.50 | –1.00 | –5.00 | –10.00 |
| –0.25 | –0.50 | –2.50 | –5.00 |
| –0.05 | –0.10 | –0.50 | –1.00 |
| –0.025 | –0.05 | –0.25 | –0.50 |
| –0.005 | –0.01 | –0.05 | –0.10 |
| –0.000 5 | –0.001 | –0.005 | –0.01 |
| –0.000 25 | –0.000 5 | –0.002 5 | –0.005 |
| 0 | 0 | 0 | 0 |
| +0.000 02 | +0.000 03 | +0.000 16 | +0.000 31 |
| +0.000 25 | +0.000 5 | +0.002 5 | +0.005 |
| +0.000 5 | +0.001 | +0.005 | +0.01 |
| +0.005 | +0.01 | +0.05 | +0.10 |
| +0.025 | +0.05 | +0.25 | +0.50 |
| +0.05 | +0.10 | +0.50 | +1.00 |
| +0.25 | +0.50 | +2.50 | +5.00 |
| +0.50 | +1.00 | +5.00 | +10.00 |
| +0.500 0 ... | +1.000 0 ... | +5.000 ... | +10.000 ... |
| +0.511 9 | +1.023 9 | +5.119 | +10.239 |
| >= +0.512 | >= +1.024 | >= +5.12 | >= +10.24 |

Conversion Values of Bipolar Voltage Inputs (continued)

| **15-BIT** | **NOTES** |
|---|---|
| –32,767 | underflow error |
| –32 766 | overload range |
| –32 001 | |
| –32 000 | rated value |
| –16 000 | |
| –3 200 | |
| –1 600 | |
| –320 | |
| –32 | |
| –16 | |
| 0 | linear range |
| +1 | |
| +16 | |
| +32 | |
| +320 | |
| +1 600 | |
| +3 200 | |
| +16 000 | |
| +32 000 | rated value |
| +32 001 ... | |
| +32 766 | overload range |
| +32 767 | overflow error |

## Conversion Values of Current Inputs

| **0...10 mA** | **0...20 mA** | **2...10 mA** | **4...20 mA** | **+20 mA** |
|---|---|---|---|---|
| < –0.16 | < –0.32 | < +1.04 | < +2.08 | <= –20.479 |
| | | | | –20.478 ... |
| | | | | –20.000 |
| | | +1.04 ... | +2.08 ... | |
| –0.16... | –0.32... | +1.87 ... | +3.74 ... | |
| –0.00 | –0.00 | +1.99 | +3.99 | |
| | | | | –20.00<br>–10.00<br>–2.00<br>–1.00<br>–0.20<br>–0.02<br>–0.01 |
| 0 | 0 | +2 | +4 | 0 |
| +0.005 | +0.01 | +2.004 | +4.008 | +0.01 |
| +0.01 | +0.02 | +2.008 | +4.016 | +0.02 |
| +0.1 | +0.20 | +2.08 | +4.16 | +0.20 |
| +0.5 | +1.00 | +2.40 | +4.80 | +1.00 |
| +1 | +2.00 | +2.80 | +5.60 | +2.00 |
| +5 | +10.00 | +6.00 | +12.00 | +10.00 |
| +10.0 | +20.00 | +10.00 | +20.00 | +20.00 |
| +10.000... | +20.000... | +10.00... | +20.00... | +20.000... |
| +10.239 | +20.478 | +10.19 | +20.38 | +20.478 |
| >= +10.24 | >= +20.479 | > +10.19 | > +20.38 | >= +20.479 |

Conversion Values of Current Inputs (continued)

| **15-BIT** | **NOTES** |
|---|---|
| –32,767 | underflow error |
| –32 766 | overload range |
| –32 001 | |
| 0 (–3 840) | |
| 0 (–512) | |
| 0 (–1) | |
| –32 000 | rated value |
| –16 000 | |
| –3 200 | |
| –1 600 | |
| –320 | |
| –32 | |
| –16 | |
| 0 | linear range |
| +1 | |
| +16 | |
| +32 | |
| +320 | |
| +1 600 | |
| +3 200 | |
| +16 000 | |
| +32 000 | rated value |
| +32 001 ... | |
| +32 766 | overload range |
| +32 767 | overflow error |

**Note:** NOTE: Numbers in parentheses + range with +/– limit

## Conversion Values of Temperature Inputs

| **-60 ... +160oC** | **-160 ... +160oC** | **-200 ... +320oC** | **-200 ... +640oC** |
|---|---|---|---|
| < –60 | < –160 | < –200 | < –200 |
|  | –160 |  |  |
|  | –100 | –200 |  |
| –60 | –60 | –120 |  |
| –50 | –50 | –100 | –200 |
| –16 | –16 | –32 | –64 |
| 0 | 0 | 0 | 0 |
| +0.005 | +0.005 | +0.01 | +0.02 |
| +0.08 | +0.08 | +0.16 | +0.32 |
| +0.16 | +0.16 | +0.32 | +0.64 |
| +8 | +8 | +16 | +32 |
| +16 | +16 | +32 | +64 |
| +80 | +80 | +160 | +320 |
| +160 | +160 | +320 | +640 |
| +160.005 ... | +160.005 ... | +320.01 ... | +640.02 ... |
| +163.83 | +163.83 | +327.66 | +655.32 |
| >= +163.84 | >= +163.84 | >= +327.67 | >= +655.34 |

Conversion Values of Temperature Inputs (continued)

| **15-BIT** | **NOTES** |
|---|---|
| –32,767 | measuring range underflow (error) |
| –32 000 | rated value |
| –22 000 | |
| –12 000 | |
| –10 000 | |
| –3 200 | |
| 0 | linear range |
| +1 | |
| +16 | |
| +32 | |
| +320 | |
| +1 600 | |
| +3 200 | |
| +16 000 | |
| +32 000 | rated value |
| +32 001 ... | |
| +32 766 | overload range |
| +32 767 | measuring range overflow error |

### Conversion Values for Resistance Inputs

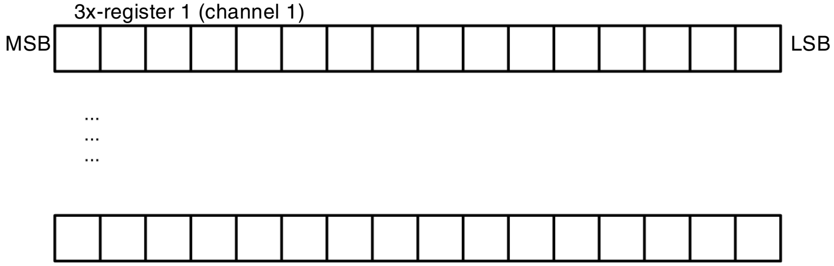
| **0...100 Ω** | **0...200 Ω** | **0...500 Ω** | **0...1000 Ω** | **0...2000 Ω** |
|---|---|---|---|---|
| < –1.6 | < –3.2 | < –8 | < –16 | < –32 |
| 0...–1.6 | 0...–3.2 | 0...–8 | 0...–16 | 0...–32 |
| 0 | 0 | 0 | 0 | 0 |
| 0.003 | 0.006 | 0.015 | 0.03 | 0.06 |
| 0.05 | 0.1 | 0.25 | 0.5 | 1 |
| 0.1 | 0.2 | 0.5 | 1 | 2 |
| 1 | 2 | 5 | 10 | 20 |
| 5 | 10 | 25 | 50 | 100 |
| 10 | 20 | 50 | 100 | 200 |
| 50 | 100 | 250 | 500 | 1000 |
| 100 | 200 | 500 | 1000 | 2000 |
| 100.00 ... | 200.00 ... | 500.01 ... | 1000.03 ... | 2000.06 ... |
| 102.39 | 204.78 | 511.97 | 1023.94 | 2047.88 |
| >= 102.40 | >= 204.79 | >= 511.98 | >= 1023.97 | >= 2047.94 |

### Conversion Values of Resistance Inputs (continued)

| **15-BIT** | **NOTES** |
|---|---|
| –32 767 | underflow error |
| 0 | overload range |
| 0 | rated value |
| +1 | |
| +16 | |
| +32 | |
| +320 | |
| +1 600 | linear range |
| +3 200 | |
| +16 000 | |
| +32 000 | rated value |
| +32 001 ... | |
| +32 766 | overload range |
| +32 767 | overflow error |

### Meanings for the AS–BADU–214 Module Mapping

The AS–BADU–214 module requires eight 3x–input registers addressed in sequence, beginning with channel 1 as shown in the figure below.



**Note:** Refer to *Concept I/O Map Status Words, p. 816* for Concept I/O Map Status Words.

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### AS-BADU 216 8-point Thermocouple Isolated Analog Input

**Note:** This modules does not require any params... screens.

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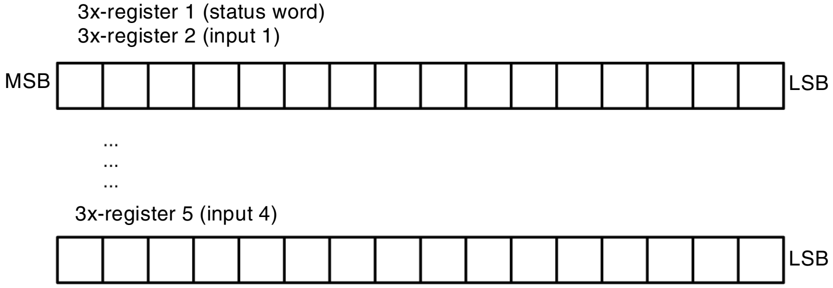
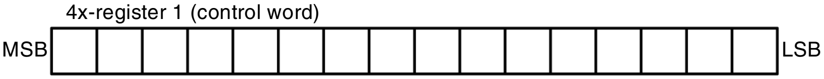
### Meanings for the AS-BADU-216 Module Mapping

The AS–BADU–216 module requires five 3x–input registers, addressed in sequence beginning with the first register. Refer to *ADU 216 Analog Input Module, p. 169* for details on the 3x status word for this module (as shown below.



**Note:** Refer to *Concept I/O Map Status Words, p. 816* for Concept I/O Map Status Words.

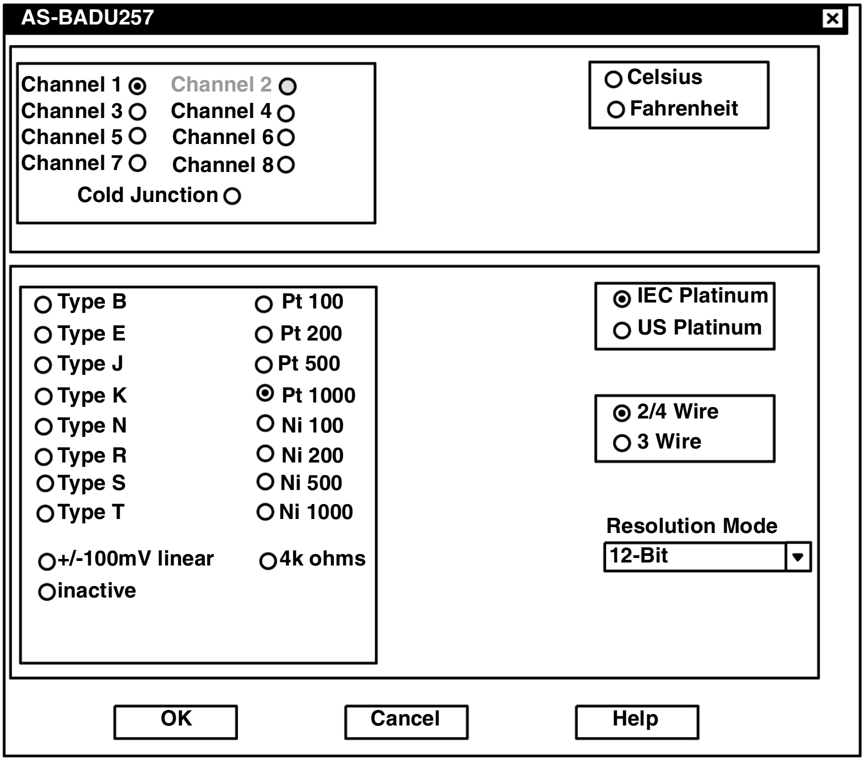
The AS–BADU–216 module requires one 4x–output register, addressed in sequence beginning with the first register. Refer to *ADU 216 Analog Input Module, p. 169* for details on the 4x control word for this module as shown below.



### AS–BADU–257/ 257C

**Note:** The ADU 257 may operate in two different modes: either as a ADU 257 or as an ADU 216. This description ONLY applies the ADU 257 mode. For the ADU 216 description, refer to *ADU 216 Analog Input Module, p. 169* or *I/O Configuration of A120 Series I/O Modules with Modsoft, p. 821*.

The following dialog is valid for the analog module AS–BADU–257.



Resolution Mode: 12-Bit

**Channel 1 ... 8:** Cold junction compensation is selectable for the module. Eight thermocouple types are supported. Two RTD types with various resistances are supported. Two linear ranges are offered. Two temperature units are available. Either IEC or US platinum RTDs are supported. RTD connections allowed are 2, 3, 4–wire.

**Resolution:** This list box defines the value range for all channels:

- 12-bit
- 16-bit
- 15-bit + sign
- 32-bit

The measuring ranges for channels 1 to 8 can be chosen in these sections.

+/– 100mV Range and Data Display Format

| **Millivoltage** | **12 bit** | **16 bit** | **15 bit + sign high resolution** | **IEEE 754 floating point** | **Range** |
|---|---|---|---|---|---|
| <+102.4mV | +4095 | +65535 | +32767 | +1.024 E02 | Overrange |
| >+100mV ... +102.4mV | +4095 | +65535 | +32001 ... +32766 | +1.0 E02 ... +1.024 E02 | Pos. tolerance range |
| +100mV | +4095 | +65535 | +32000 | +1.0 E02 | Nominal |
| 0mV | +2048 | +32768 | 0 | 0 | |
| –100mV | 0 | 0 | –32000 | –1.0 E02 | |
| <– 100mV ... – 102.4mV | 0 | 0 | –32001 ... –32766 | <–1.0 E02 ... – 102.4 E02 | Neg. tolerance range |
| <–102.4mV | 0 | 0 | –32767 | –1.024 E02 | Underrange |

0 ... 4000W Range and Data Display Format

| **Resistance** | **12 bit** | **16 bit** | **15 bit + sign high resolution** | **IEEE 754 floating point** | **Range** |
|---|---|---|---|---|---|
| >4095W | +4095 | +65535 | +32767 | +4.096 E03 | Overrange |
| >4000 ... 4095W | +4095 | +65535 | +32001 ... +32766 | >+4.0 E03 ... +4.095 E03 | Pos. tolerance range |
| 4000W | +4095 | +65535 | +32000 | +4.0 E03 | Nominal |
| 0W | 0 | 0 | 0 | 0 | |
| | 0 | 0 | –2 | –2.0 E00 | Broken wire |

IEC 751 Pt100,200,500,1000 –200 ... +850 C (–328 ... +1562 F) Range and Data Display Format

| **RTD** | **12 bit** | **16 bit** | **15 bit + sign 0.1C (0.1F)** | **IEEE 754 floating point** | **Range** |
|---|---|---|---|---|---|
| >+850C (+1562F) | +4095 | +65535 | +8501 (+15621) | 8.501 E02 (1.5621 E03) | Overrange |
| +850C (+1562F) | +4095 | +65535 | +8500 (+15620) | 8.500 E02 (1.562 E03) | Nominal |
| 0 (+32F) | +780 | +12483 | 0 (+320) | 0 (3.20 E01) | |
| –200C (–328F) | 0 | 0 | –2000 (–3280) | –2.00 E02 (–3.28 E02) | |
| <–200C (–328F) | 0 | 0 | –2001 (–3281) | –2.001 E02 (–3.281 E02) | Underrange |
| | 0 | 0 | –2002 (–3282) | –2.002 E02 (–3.282 E02) | Broken wire |

SAMA (US) Pt100,200,500,1000 –200 ... +650 C (–328 ... +1112 F) Range and Data Display Format

| **RTD** | **12 bit** | **16 bit** | **15 bit + sign 0.1C (0.1F)** | **IEEE 754 floating point** | **Range** |
|---|---|---|---|---|---|
| >+600C (+1112F) | +4095 | +65535 | +6001 (+11121) | 6.001 E02 (1.113 E03) | Overrange |
| +600C (+1112F) | +4095 | +65535 | +6000 (+11120) | 6.000 E02 (1.112 E03) | Nominal |
| 0C (+32F) | +1024 | +16384 | 0 (+320) | 0 (3.20 E01) | |
| –200C (–328F) | 0 | 0 | –2000 (–3280) | –2.00 E02 (–3.28 E02) | |
| <–200C (–328F) | 0 | 0 | –2001 (–3281) | –2.001 E02 (–3.281 E02) | Underrange |
| | 0 | 0 | –2002 (–3282) | –2.002 E02 (–3.282 E02) | Broken wire |

DIN43760 Ni100,200,500,1000 –60 ... +250 C (–76 ... +482 F) Range and Data Display Format

| RTD | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+250C (+482F) | +4095 | +65535 | +2501 (+4821) | 2.501 E02 (4.821 E02) | Overrange |
| +250C (+482F) | +4095 | +65535 | +2500 (+4820) | 2.500 E02 (4.820 E02) | Nominal |
| 0C (+32F) | +793 | +12684 | 0 (+320) | 0 (3.20 E01) | |
| –60C (–76F) | 0 | 0 | –600 (–760) | –6.00 E01 (–7.6 E01) | |
| <–60C (–76F) | 0 | 0 | –601 (–761) | –6.01 E01 (–7.61 E01) | Underrange |
| | 0 | 0 | –602 (–762) | –6.02 E01 (–7.62 E01) | Broken wire |

Thermocouple Type R,S –50 ... +1768 C (–58 ... +3214.4 F) Range and Data Display Format

| TC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+1768C (+3214.4F) | +4095 | +65535 | +17681 (+32146) | 1.7681 E03 (3.2146 E03) | Overrange |
| +1768C (+3214.4F) | +4095 | +65535 | +17680 (+32144) | 1.7680 E03 (3.2144 E02) | Nominal |
| 0C (+32F) | +113 | +1802 | 0 (+320) | 0 (3.20 E01) | |
| –50C (–58F) | 0 | 0 | –500 (–580) | –5.00 E01 (–5.80 E01) | |
| <–50C (–58F) | 0 | 0 | –501 (–582) | –5.01 E01 (–5.82 E01) | Underrange |
| | 0 | 0 | –502 (–584) | –5.02 E01 (–5.84 E01) | Broken wire |

### Thermocouple Type B +50 ... +1800 C (+122 ... +3272 F) Range and Data Display Format

| TC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+1800C (+3272F) | +4095 | +65535 | +18001 (+32722) | 1.8001 E03 (3.2722 E03) | Overrange |
| +1800C (+3272F) | +4095 | +65535 | +18000 (+32720) | 1.8000 E03 (3.2720 E03) | Nominal |
| 50C (+122F) | 0 | 0 | +500 (+1220) | 5.00 E01 (1.220 E02) | |
| <50C (+122F) | 0 | 0 | +499 (+1218) | 4.99 E01 (1.218 E02) | Underrange |
| | 0 | 0 | +498 (+1216) | 4.98 E01 (1.216 E02) | Broken wire |

### Thermocouple Type J –210 ... +1200 C (–346 ... +2192 F) Range and Data Display Format

| TC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+1200C (+2192F) | +4095 | +65535 | +12001 (+21922) | 1.2001 E03 (2.1922 E03) | Overrange |
| +1200C (+2192F) | +4095 | +65535 | +12000 (+21920) | 1.2000 E03 (2.1920 E03) | Nominal |
| 0C (+32F) | +610 | +9761 | 0 (+320) | 0 (3.20 E01) | |
| –210C (–346F) | 0 | 0 | –2100 (–3460) | –2.100 E02 (–3.460 E02) | |
| <–210C (–346F) | 0 | 0 | –2101 (–3462) | –2.101 E02 (–3.462 E02) | Underrange |
| | 0 | 0 | –2102 (–3464) | –2.102 E02 (–3.464 E02) | Broken wire |

### Thermocouple Type T –270 ... +400 C (–454 ... +752 F) Range and Data Display Format

| TC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+400C (+752F) | +4095 | +65535 | +4001 (+7522) | 4.001 E02 (7.522 E02) | Overrange |
| +400C (+752F) | +4095 | +65535 | +4000 (+7520) | 4.000 E02 (7.520 E02) | Nominal |
| 0C (+32F) | +1650 | +26410 | 0 (+320) | 0 (3.20 E01) | |
| –270C (–454F) | 0 | 0 | –2700 (–4540) | –2.700 E02 (–4.540 E02) | |
| <–270C (–454F) | 0 | 0 | –2701 (–4542) | –2.701 E02 (–4.542 E02) | Underrange |
| | 0 | 0 | –2702 (–4544) | –2.702 E02 (–4.544 E02) | Broken wire |

### Thermocouple Type E –270 ... +1000 C (–454 ... +1832 F) Range and Data Display Format

| TC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+1000C (+1832F) | +4095 | +65535 | +10001 (+18322) | 1.0001 E03 (1.8322 E03) | Overrange |
| +1000C (+1832F) | +4095 | +65535 | +1000 (+18320) | 1.0000 E03 (1.8320 E03) | Nominal |
| 0C (+32F) | +871 | +13933 | 0 (+320) | 0 (3.20 E01) | |
| –270C (–454F) | 0 | 0 | –2700 (–4540) | –2.700 E02 (–4.540 E02) | |
| <–270C (–454F) | 0 | 0 | –2701 (–4542) | –2.701 E02 (–4.542 E02) | Underrange |
| | 0 | 0 | –2702 (–4544) | –2.702 E02 (–4.544 E02) | Broken wire |

Thermocouple Type K –270 ... +1372 C (–454 ... +2501.6 F) Range and Data Display Format

| **TC** | **12 bit** | **16 bit** | **15 bit + sign 0.1C (0.1F)** | **IEEE 754 floating point** | **Range** |
|---|---|---|---|---|---|
| >+1372C (+2501.6F) | +4095 | +65535 | +13721 (+25018) | 1.3721 E03 (2.5018 E03) | Overrange |
| +1372C (+2501.6F) | +4095 | +65535 | +13720 (+25016) | 1.3720 E03 (2.5016 E03) | Nominal |
| 0C (+32F) | +673 | +10776 | 0 (+320) | 0 (3.20 E01) | |
| –270C (–454F) | 0 | 0 | –2700 (–4540) | –2.700 E02 (–4.540 E02) | |
| <–270C (–454F) | 0 | 0 | –2701 (–4542) | –2.701 E02 (–4.542 E02) | Underrange |
| | 0 | 0 | –2702 (–4544) | –2.702 E02 (–4.544 E02) | Broken wire |

Thermocouple Type N –270 ... +1300 C (–454 ... +2372 F) Range and Data Display Format

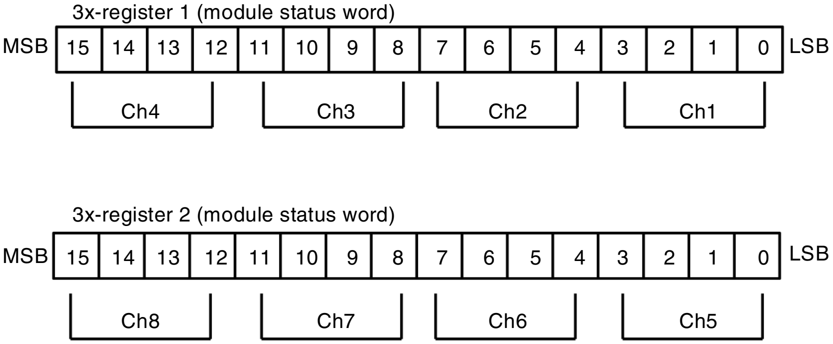
| **TC** | **12 bit** | **16 bit** | **15 bit + sign 0.1C (0.1F)** | **IEEE 754 floating point** | **Range** |
|---|---|---|---|---|---|
| >+1300C (+2372F) | +4095 | +65535 | +13001 (+23722) | 1.3001 E03 (2.3722 E03) | Overrange |
| +1300C (+2372F) | +4095 | +65535 | +13000 (+23720) | 1.3000 E03 (2.3720 E03) | Nominal |
| 0C (+32F) | +704 | +11270 | 0 (+320) | 0 (3.20 E01) | |
| –270C (–454F) | 0 | 0 | –2700 (–4540) | –2.700 E02 (–4.540 E02) | |
| <–270C (–454F) | 0 | 0 | –2701 (–4542) | –2.701 E02 (–4.542 E02) | Underrange |
| | 0 | 0 | –2702 (–4544) | –2.702 E02 (–4.544 E02) | Broken wire |

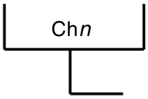
Cold Junction Sensor AD592 –25 ... +105 C (–13 ... +221 F) Range and Data Display Format

| CJC | 12 bit | 16 bit | 15 bit + sign 0.1C (0.1F) | IEEE 754 floating point | Range |
|---|---|---|---|---|---|
| >+125C (+257F) | +4095 | +65535 | +1051 (+2212) | 1.051 E02 (2.212 E02) | Overrange |
| +125C (+257F) | +4095 | +65535 | +1050 (+2210) | 1.050 E02 (2.210 E02) | Nominal |
| 0C (+32F) | +683 | +10923 | 0 (+320) | 0 (3.20 E01) | |
| –25C (–13F) | 0 | 0 | –250 (–130) | –2.50 E01 (–1.30 E01) | |
| <–25C (–13F) | 0 | 0 | –251 (–132) | –2.51 E01 (–1.32 E01) | Underrange |
| | 0 | 0 | –252 (–134) | –2.52 E01 (–1.34 E01) | Broken wire |

**Meanings for the AS–BADU–257 Module Mapping**

The AS–BADU–257 module requires twenty 3x–input registers addressed in sequence, beginning with two module status 3x registers, 16 data channel 3x registers (channels 1 ... 8), and two cold junction sensor 3x registers as shown below.





The following errors apply to each channel:

Channel OK = 0000

Channel overrange error = 0001

Channel underrange error = 0010

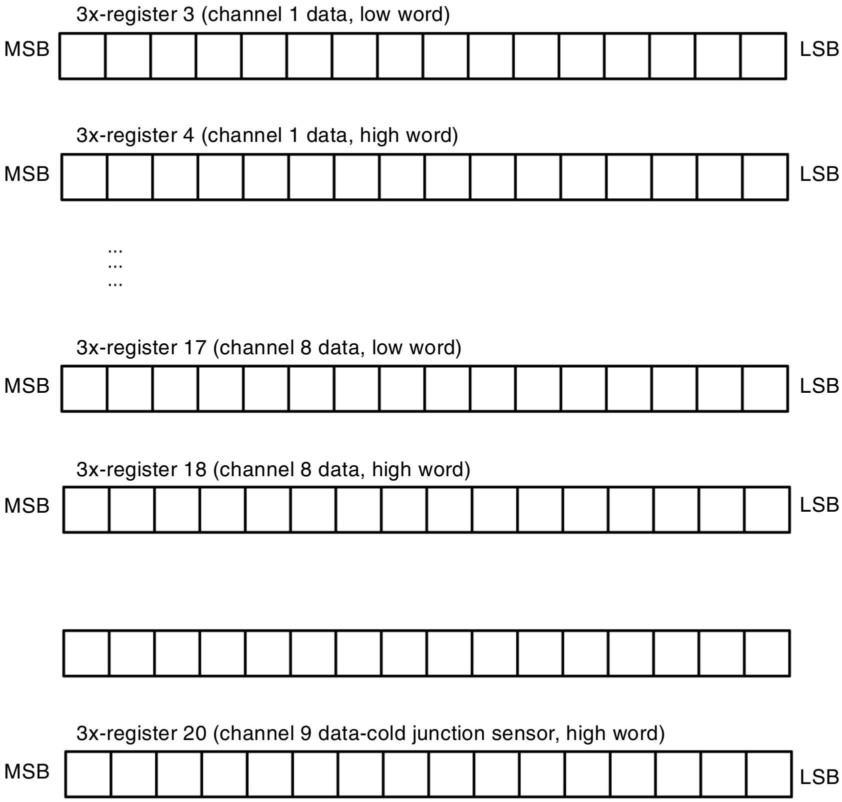
Broken wire error = 0011

Invalid parameter error = 0100

Cold junction error = 0101 (applies to TC parameters ONLY)

(All others are reserved)

The following figure shows the AS-BADU-257 3x-register arrangement.



## Analog Output Modules

### Analog Output Modules

The following information describes how to configure these modules:
- DAU 202/252/252C 2-point 24 Vdc Voltage/Current Analog Output
- DAU 204 4-point 24 Vdc Voltage/Current Analog Output
- DAU 208 8-point +/-10 Vdc Isolated Analog Output
- DAU 282* 2-point 24 Vdc Voltage/Current Analog Output (Special, Intrinsically Safe)

*The DAU 282 is a "special", and therefore it is not included in this document.

### I/O Configuration using Concept 2.1 or Higher

Use the following procedure to configure the module.

| Step | Action |
|---|---|
| 1 | Select **Configure** from the menu. |
| 2 | Select **I/O Map** from the menu. |
| 3 | Click on **Edit...** The Local Common CPU Drop dialog appears. |
| 4 | Click on **Module**. The I/O Module Selection dialog appears. |
| 5 | Select **DAU202/252/252C** or **DAU-208** and click on **OK**. A number and description appear. |
| 6 | In the **In Ref** field, enter **0x** or **4x** and press **Enter**. The software completes the **Out Ref** and **Out End** fields. |
| 7 | Click on **Params...** The appropriate configuration dialogs appear, depending on the module selected. Refer to the specific modules. |

**⚠ CAUTION**

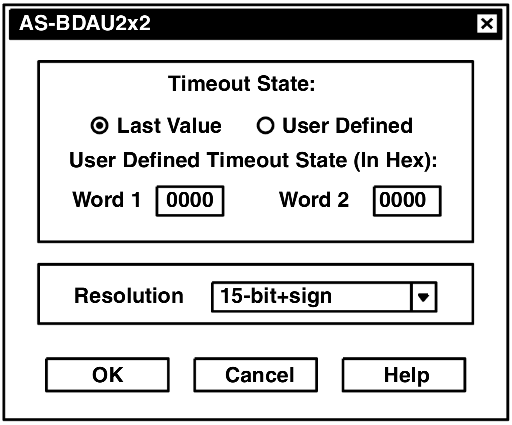
**Power-down or kernel mode.**

The output module Timeout States is valid only in a normal PLC stop state. Therefore, when the PLC powers down or goes into kernel mode, the outputs default to the module’s fail safe state. The Timeout States are defined on the I/O Map module parameter screens.

**Failure to follow this instruction can result in injury or equipment damage.**

## AS-BDAU-202/ 252(C)

The following dialog is valid for the following modules: AS-BDAU-202/ 252(C).



Timeout State:

● Last Value ○ User Defined

User Defined Timeout State (In Hex):

Word 1 0000 Word 2 0000

Resolution 15-bit+sign

**Timeout State:**

The Compact Timeout State only reflects a user program in stop mode.

Activation of the User Defined option button causes the outputs to take on the value defined in the user-defined timeout state text field.

**Last Value**

Activation of the Last Value option button causes the outputs to retain their last valid value upon user program stop.

**User Defined:**

Activation of the User Defined option button causes the outputs to take on the hex values defined in the user-defined timeout state text fields Word 1/2.

**Resolution Mode**

This list box defines the value range for all channels:

- 12-bit
- 15-bit + sign

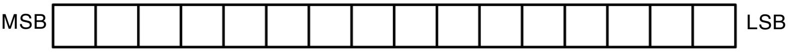
Measuring ranges +/- 10 VDC/ +/- 20 mA

| Voltage (VDC) | Current (mA) | 12-bits | 15-bits + sign | Range |
|---|---|---|---|---|
| -10.24 ...<br>-10.005 | -20.48 ...<br>-20.01 | 0<br>47 | -32768<br>-32016 | Under-range |
| -10.00<br>0<br>+10.00 | -20.00<br>0<br>+20.00 | 48<br>2048<br>4048 | -32000<br>0<br>+32000 | Nominal range |
| +10.005 ...<br>+10.24 | +20.01 ...<br>+20.48 | 4049<br>4095 | +32016<br>+32752 | Overrange |

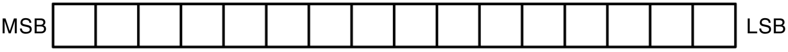
## Meanings for the AS-BDAU-202/ 252(C) Module Mapping

The AS-BDAU-202/ 252(C) modules require two 4x-output registers, as shown below.

4x-register 1 (channel 1)

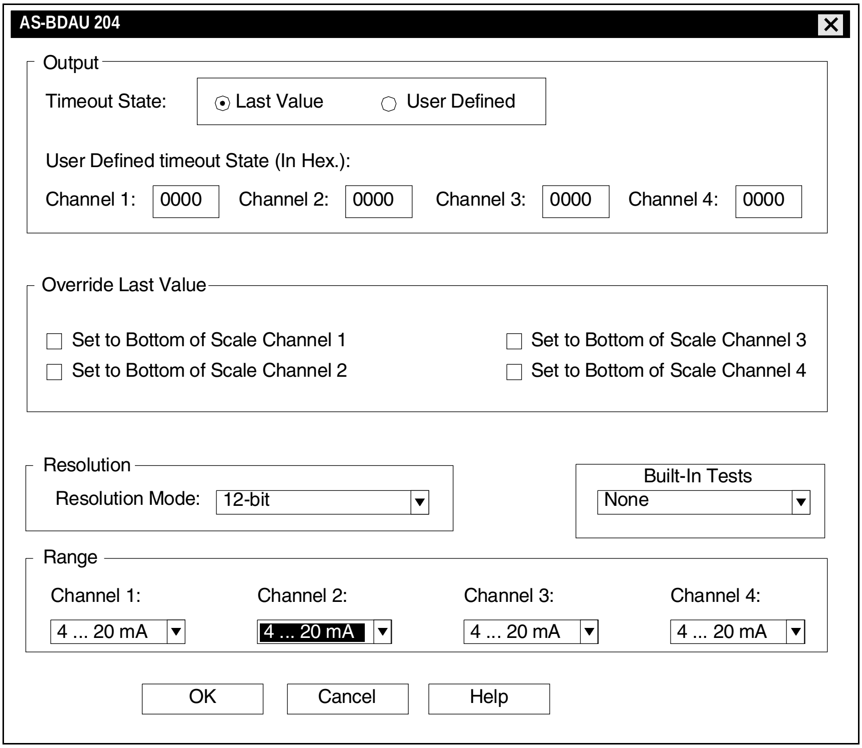


4x-register 2 (channel 2)



**AS-BDAU-204**

This following dialog is valid for the analog module AS-BDAU-204.



**Timeout State**The Compact Timeout State only reflects a user program in stop mode.

Activation of the Last Value option button causes the outputs to retain their last valid value upon user program stop.

**User Defined:** Activation of the User Defined option button causes the 4 outputs to take on the hex values defined in the user-defined timeout state text fields Channel 1/4.

**Override Last Value:** Activation of the Set to Bottom of Scale Channel x option button causes channel x output to be set to the lowest value of the selected measuring range (Range) upon user program stop.

Example: For a selected measuring range of 4 ... 20 mA the output will carry 4 mA upon user program stop, and thus guarantee a defined switch-off behavior.

**Note:** Activation of the Set to Bottom of Scale option button disables any further alteration of the user-defined timeout state text field for the particular channel.

**Resolution Mode:** This list box defines the output value range for all channels:

- 11-bit
- 12-bit
- 15-bit + sign
- 16-bit

**Built-In Tests:** This list box can cause the execution of module built-in tests either automatically at power-up, or during on-line operation. The module's green LED lights as long as no functional fault is determined.

Selection of Category 2 (+/- 10 VDC) restricts the built-in tests exclusively to the +/- 10 VDC measuring range (Range).

Selection of Category 3 (4 ... 20 mA) restricts the built-in tests exclusively to the 4 ... 20 mA measuring range (Range). "None" can be selected if the execution of built-in tests is not desired.

**Range:**Measuring ranges for the individual channels can be chosen in these list boxes.

- 0 ... 1 VDC
- 0 ... 5 VDC
- 0 ... 10 VDC
- 0 ... 20 mA
- 4 ... 20 mA
- +/- 1 VDC
- +/- 5 VDC
- +/- 10 VDC

0 ... 1 VDC, 0 ... 5 VDC, 0 ... 10 VDC

| **0 ... 1 VDC** | **0 ... 5 VDC** | **0 ... 10 VDC** | **11-bits** | **12-bits** | **15-bits + sign** | **16-bits** | **Range** |
|---|---|---|---|---|---|---|---|
| 0 ... 1 VDC | 0 ... 5 VDC | 0 ... 10 VDC | 11-bits | 12-bits | 15-bits + sign | 16-bits | Range |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | Nominal range |
| 0.5 | 2.5 | 5 | 1024 | 2048 | 16000 | 32768 | |
| 1 | 5 | 10 | 2047 | 4095 | 32000 | 65520 | |

0/4 ... 20 mA

| **0 ... 20 mA** | **4 ... 20 mA** | **11-bits** | **12-bits** | **15-bits + sign** | **16-bits** | **Range** |
|---|---|---|---|---|---|---|
| 0 | 4 | 0 | 0 | 0 | 0 | Nominal range |
| 10 | 12 | 1024 | 2048 | 16000 | 32768 | |
| 20 | 20 | 2047 | 4095 | 32000 | 65520 | |

+/- 1 VDC, +/- 5 VDC, +/- 10 VDC

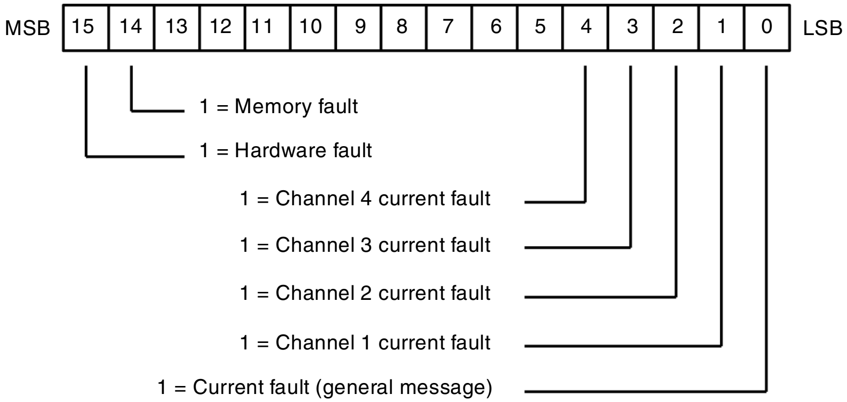
| **+/- 1 VDC** | **+/- 5 VDC** | **+/- 10 VDC** | **11-bits** | **12-bits** | **15-bits + sign** | **16-bits** | **Range** |
|---|---|---|---|---|---|---|---|
| -1 | -5 | -10 | 0 | 0 | -32000 | 0 | Nominal range |
| 0.5 | 2.5 | 0 | 1024 | 2048 | 0 | 32768 | |
| +1 | +5 | +10 | 2047 | 4095 | +32000 | 65520 | |

## Meanings for the AS-BDAU-204 Module Mapping

The AS-BDAU-204 module requires one 3x-input register and five 4x-output registers. The 4x-output registers are addressed in sequence, beginning with channel 1. See the following figures.

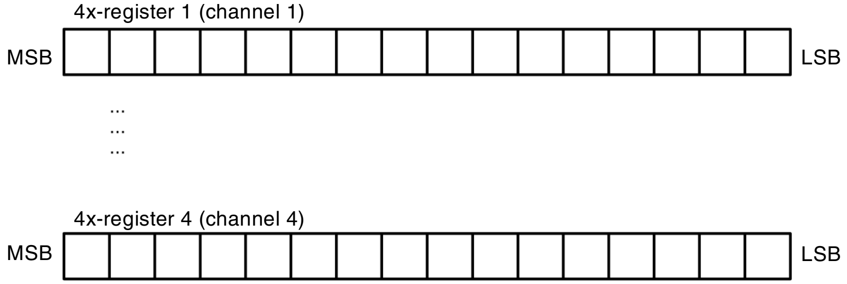
The following figure shows the AS-BDAU-204 3x-register arrangement.

3x-register 1 (module status word)



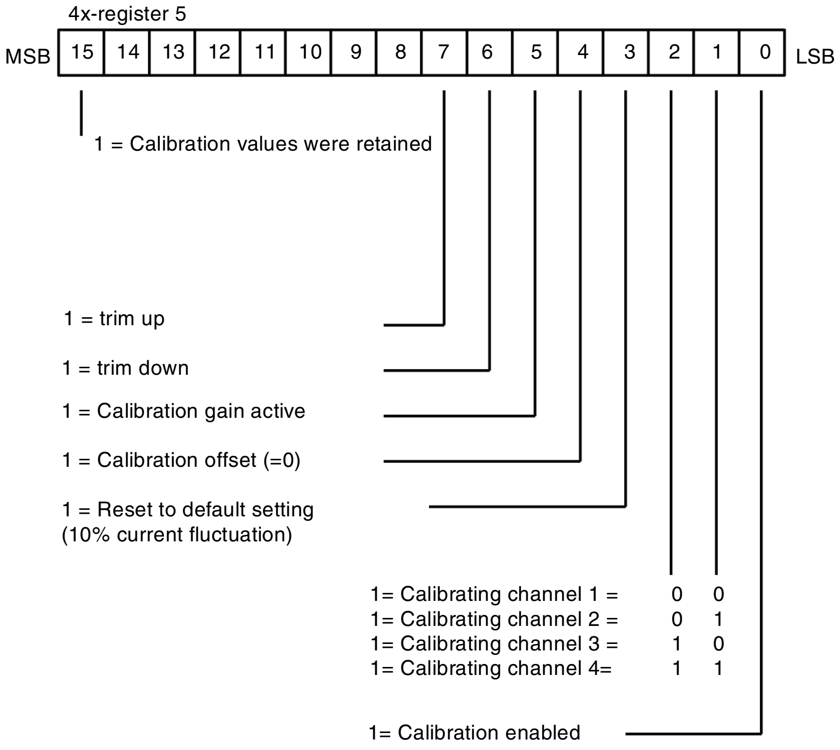
Bits 5 ... 13 are not used

The following figure shows the AS-BDAU-204 4x-register arrangement.



### Runtime Control Word

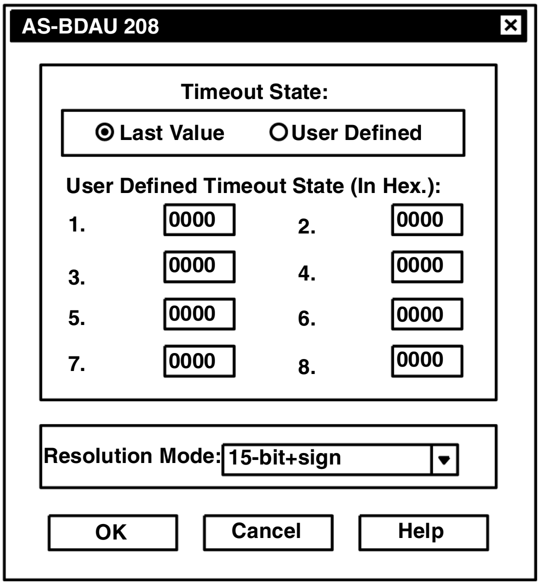
The runtime control word supports the following calibration properties:



Bits 8 ... 14 are not used

## AS-BDAU-208

The following dialog is valid for the analog module AS-BDAU-208.



AS-BDAU 208

Timeout State:

● Last Value ○ User Defined

User Defined Timeout State (In Hex.):

1. 0000
2. 0000
3. 0000
4. 0000
5. 0000
6. 0000
7. 0000
8. 0000

Resolution Mode: 15-bit+sign

### Timeout State

The Compact Timeout State only reflects a user program in stop mode.

Activation of the Last Value option button causes the outputs to retain their last valid value upon user program stop.

If the User Defined option button was activated, the 8 corresponding hex values can be entered here.

### User Defined:

If the User Defined option button was activated in the timeout state section, the corresponding hex values can be entered in the text boxes 1/8, determining one value for each of the 8 output registers.

### Resolution Mode

This list box defines the output value range for all channels:

- 12-bit
- 15-bit + sign

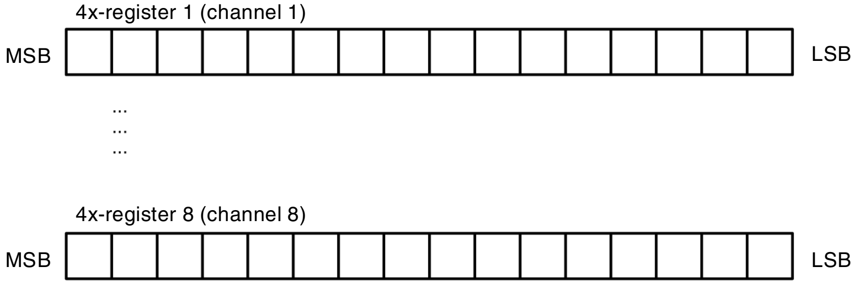
## Measuring Range

The +/- 10 VDC measuring range representation can be gathered from the following table:

| **+/- 10 VDC** | **12-bits** | **15-bits + sign** | **Range** |
|---|---|---|---|
| -10.24 ... | 0 | -32768 | Under-range |
| -10.005 | 47 | -32016 | |
| -10.00 | 48 | -32000 | Nominal range |
| 0 | 2048 | 0 | |
| +10.00 | 4048 | +32000 | |
| +10.005 ... | 4049 | +32016 | Overrange |
| +10.24 | 4095 | +32752 | |

**Meanings for the AS-BDAU-208 Module Mapping**

The AS-BDAU-208 module requires eight 4x-output registers. The 4x-output registers are addressed in sequence, beginning with channel 1 as shown below.



## Intelligent Modules

### Intelligent Modules

This section describes how to configure the following modules:

- FRQ-204/254 Frequency
- MOT 201 Motion -Encoder Only
- MOT 202 Motion-Resolver and Encoder
- VIC-2xx (Not supported in Concept 2.1 or higher)
- VRC 200/CTR 205/212/224 (Not supported in Concept 2.1 or higher)
- ZAE 201 Counter/Positioner

### I/O Configuration of FRQ Modules using Concept 2.1 or Higher

Use the following procedure to configure the module.

| Step | Action |
|---|---|
| 1 | Select Configure from the menu. |
| 2 | Select I/O Map from the menu. |
| 3 | Click on Edit... The Local Common CPU Drop dialog appears. |
| 4 | Click on Module. The I/O Module Selection dialog appears. |
| 5 | Select FRQ--204/205 and click on OK. A number and description appear. |
| 6 | In the In Ref field, enter 3x and press Enter. The software fills in the In Ref and In End fields. |
| 7 | Click on Params... |

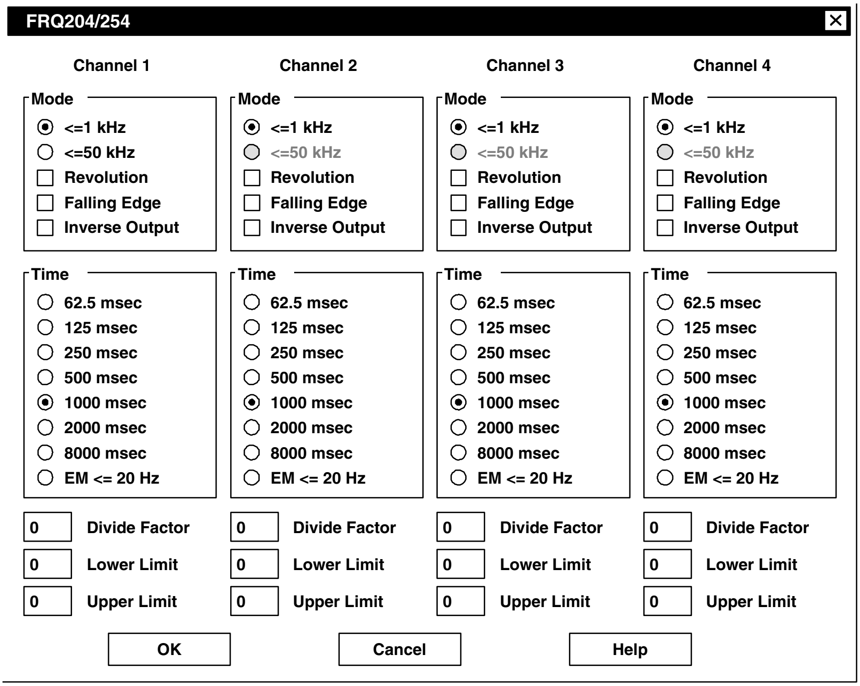
### I/O Configuration of Motion and Counter/ Positioner Modules using Concept 2.1 or Higher

Use the following procedure to configure the module.

| Step | Action |
|---|---|
| 1 | Select Configure from the menu. |
| 2 | Select I/O Map from the menu. |
| 3 | Click on Edit... The Local Common CPU Drop dialog appears. |
| 4 | Click on Module. The I/O Module Selection dialog appears. |
| 5 | Select MOT--2X or ZAE--201 and click on OK. A number and description appear. |
| 6 | In the In Ref field, enter 3x and press Enter. The software fills in the In Ref and In End fields. |
| 7 | In the Out Ref field, enter 4x and press Enter. The software fills in the Out Ref and Out End fields. |
| 8 | Click on OK. (No Params are required for these modules.) |

## AS-BFRQ 204/ 254

The following dialog is valid for the AS-BFRQ 204/ 254 modules (frequency/ revolution counters).



FRQ204/254

| Channel 1 | Channel 2 | Channel 3 | Channel 4 |
|---|---|---|---|
| **Mode** | **Mode** | **Mode** | **Mode** |
| ● <=1 kHz | ● <=1 kHz | ● <=1 kHz | ● <=1 kHz |
| ○ <=50 kHz | ○ <=50 kHz | ○ <=50 kHz | ○ <=50 kHz |
| ☐ Revolution | ☐ Revolution | ☐ Revolution | ☐ Revolution |
| ☐ Falling Edge | ☐ Falling Edge | ☐ Falling Edge | ☐ Falling Edge |
| ☐ Inverse Output | ☐ Inverse Output | ☐ Inverse Output | ☐ Inverse Output |
| **Time** | **Time** | **Time** | **Time** |
| ○ 62.5 msec | ○ 62.5 msec | ○ 62.5 msec | ○ 62.5 msec |
| ○ 125 msec | ○ 125 msec | ○ 125 msec | ○ 125 msec |
| ○ 250 msec | ○ 250 msec | ○ 250 msec | ○ 250 msec |
| ○ 500 msec | ○ 500 msec | ○ 500 msec | ○ 500 msec |
| ● 1000 msec | ● 1000 msec | ● 1000 msec | ● 1000 msec |
| ○ 2000 msec | ○ 2000 msec | ○ 2000 msec | ○ 2000 msec |
| ○ 8000 msec | ○ 8000 msec | ○ 8000 msec | ○ 8000 msec |
| ○ EM <= 20 Hz | ○ EM <= 20 Hz | ○ EM <= 20 Hz | ○ EM <= 20 Hz |
| 0 Divide Factor | 0 Divide Factor | 0 Divide Factor | 0 Divide Factor |
| 0 Lower Limit | 0 Lower Limit | 0 Lower Limit | 0 Lower Limit |
| 0 Upper Limit | 0 Upper Limit | 0 Upper Limit | 0 Upper Limit |

### Channel 1 ... 4

The individual channels are configured in the columns Channel 1 ... 4. Enter the desired counting frequency as offered (4 x <=1 kHz, 1 x <=50 kHz)

### Mode

The counting frequency can be selected in this section with the <=1 kHz or <=50 kHz option buttons.

**Note:** Channel 1 can be alternatively driven with counting frequencies of up to 50 kHz.

Revolution counting mode is activated through the Revolution option button. Selecting the Revolution Mode changes the actual value received from Hz to rev/min.

Activate the Falling Edge option button to trigger on the negative counting edge (1->0). The default setting is positive edge (0->1).

Activation of the Inverse Output option button causes negation of both channel limit signals.

FRQ204 Mode Configuration Example

| **Mode Selection** | **Time (Gating Time)** | **Units of Measure** | **Actual Input Signal Value** | **Display Value Received** |
|---|---|---|---|---|
| 1kHz | 1 ... 7 | Hz | 247 Hz | 247 |
| 50kHz | 1 ... 7 | Hz | 26780 Hz | 26780 |
| Revolution | 1 ... 7 | Rev/Min. | 14820 Rev/Min. | 14820 |
| Revolution/ 50kHz | 1 ... 7 | Rev/Min. | 29654 Rev/Min. | 29654 |
| 1kHz | 8 | Hz | 14.286 Hz | 14286 |
| Revolution | 8 | Rev/Min. | 857.1 Rev/Min. | 8571 |

### Time

Time is the frequency of how often the counts are updated. The gating time for frequency/revolution measurements can be selected in this section.

- 62.5 msec
- 125 msec
- 250 msec
- 500 msec
- 1000 msec
- 2000 msec
- 8000 mesc
- EM <= 20 Hz

The 62.5 to 8000 msec presets open the measurement window a corresponding period for input signal summation, which can then be converted into Hz or RPM units.

The EM <= 20 Hz option button causes the measurement to be derived from the slope time rather than the gate time. This results in higher precision for frequencies up to 20 Hz or below 1200 RPM, which are achieved in a shorter gate-time period.

### Divide Factor

The divide factor actually divides your counts by the number you enter. A factor can be entered in this text field. The factor entered here is used for the connection of incremental encoders, sensors, or similar devices with high resolution, i.e. >1 count per revolution. As a value, the number of impulses per revolution has to be given. For example, if you have a 256 pulse/revolution encoder, then you would enter 256. The real frequency response speed is returned from the FRQ 204. The default value is 1. If you enter 0 it will be seen as a 1.

### Lower Limit

This establishes the lower limit of your range. The lower limiting threshold for minimum frequency or revolution monitoring (as well as wire breakage), can be entered in this text field. Values falling short of this preset value initiate status bits within the first input register (bits 0 ... 3), and in the status register of the drop station. Measurements continue and remain uninfluenced. When the lower limit is exceeded the corresponding module outputs are set.

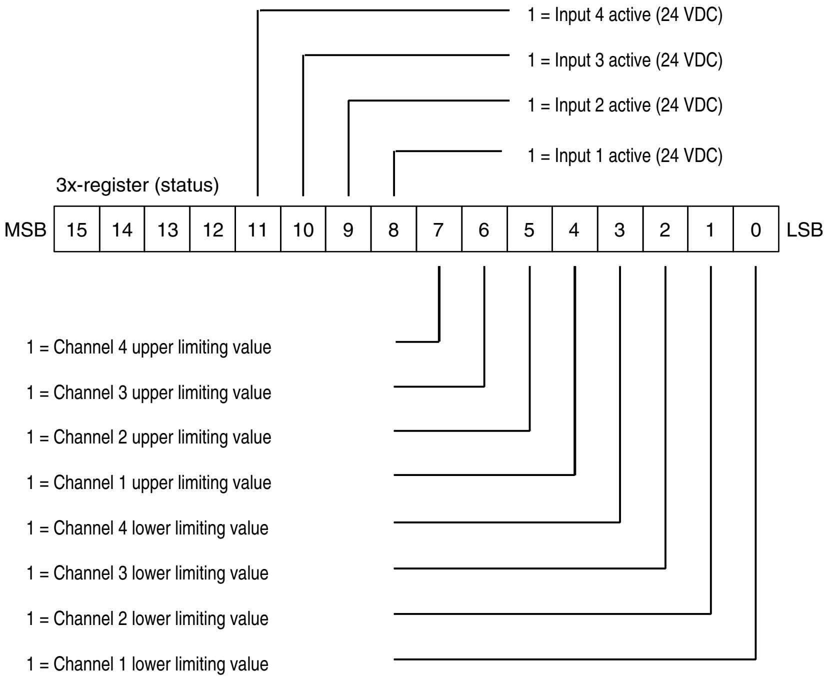
### Upper Limit

This establishes the upper limit of your range. The upper limiting threshold for maximum permissible frequency or revolution monitoring can be entered in this text field. Values falling short of this preset value initiate status bits within the first input register (bits 4 ... 7), and in the status register of the drop station. Measurements continue and remain uninfluenced. When the upper limit is exceeded the corresponding module outputs are set.

---

## Meanings for the AS-BFRQ 204/ 254 Module Mapping

The frequency counting modules require five 3x-input registers, as shown in *AS-BFRQ 204/ 2 Registers, p. 807* and *AS-BFRQ 204/ 2 Registers, p. 807* below.

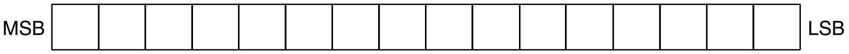


Bits 12 ... 15 are not used

### AS-BFRQ 204/ 2 Registers

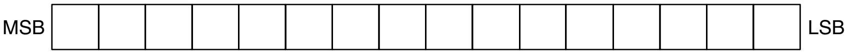
The following figures shows the AS-BRFQ 204/254 3x-status register (top) and the AS-BFRQ 204/ 254 3x +1 ... +4 data register (bottom).

3x-register +1 (frequency/revolution data)



...
...
...

3x-register +4 (frequency/revolution data)



**Note:** Refer to*Concept I/O Map Status Words, p. 816* for Concept I/O Map Status Words.

### AS-BMOT-201/ 202

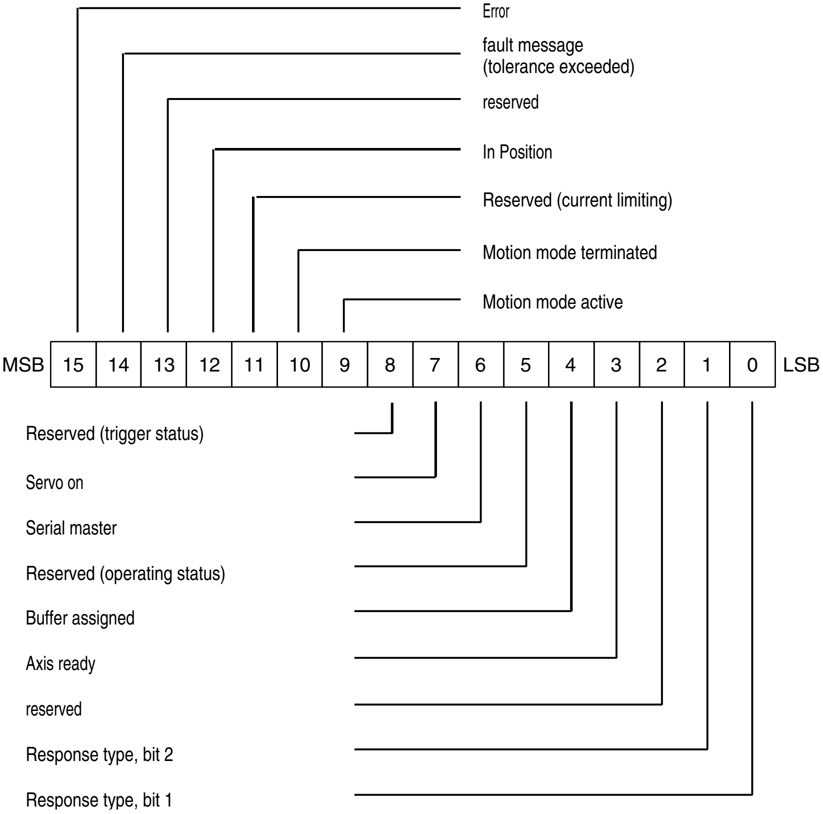
**Note:** These modules do not require any params... screens.

The AS-BMOT-201/ 202 modules require six 3x-input registers and six 4x-output registers.

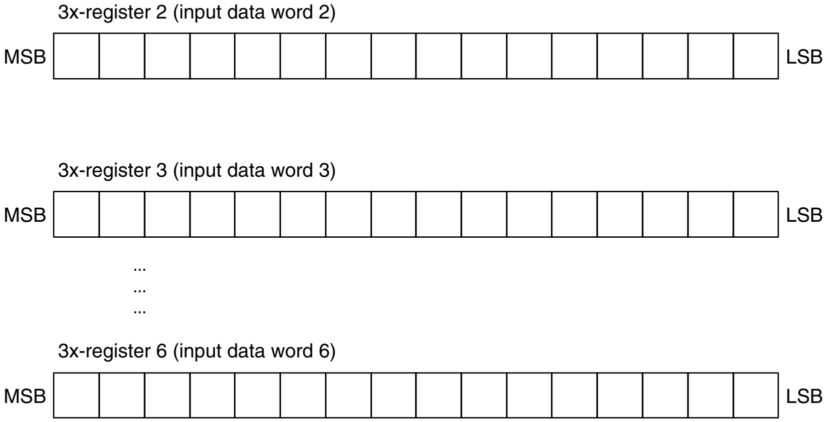
### Meanings for the AS-BMOT-201/ 202 Module Mapping

The following figure shows the AS-BMOT-201/ 202 3x-register arrangement.

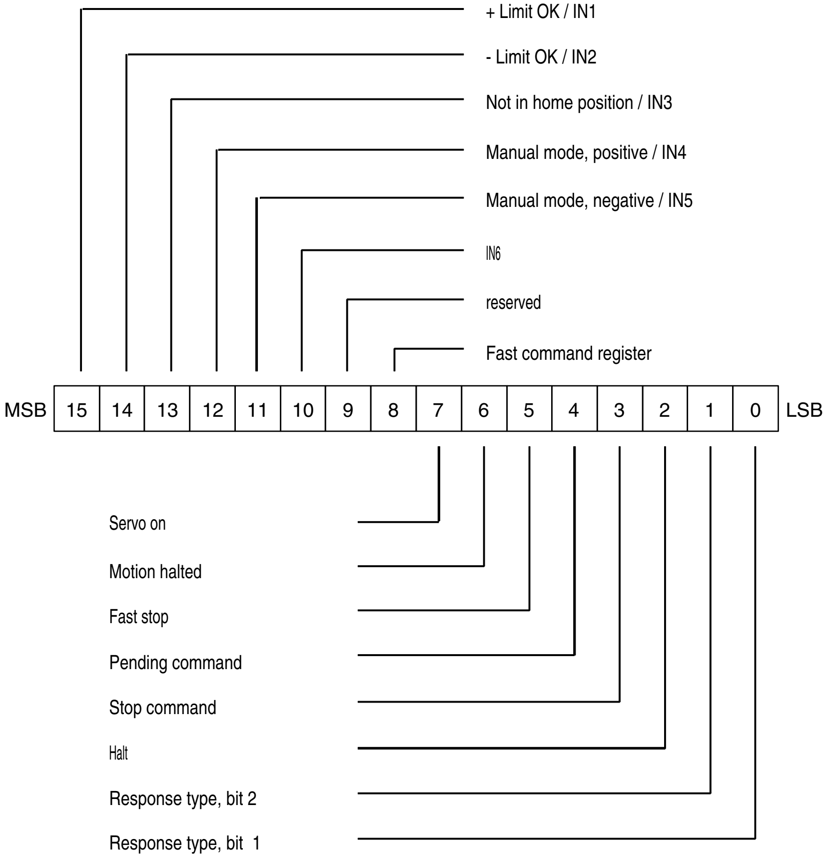
3x-register 1 (status word)



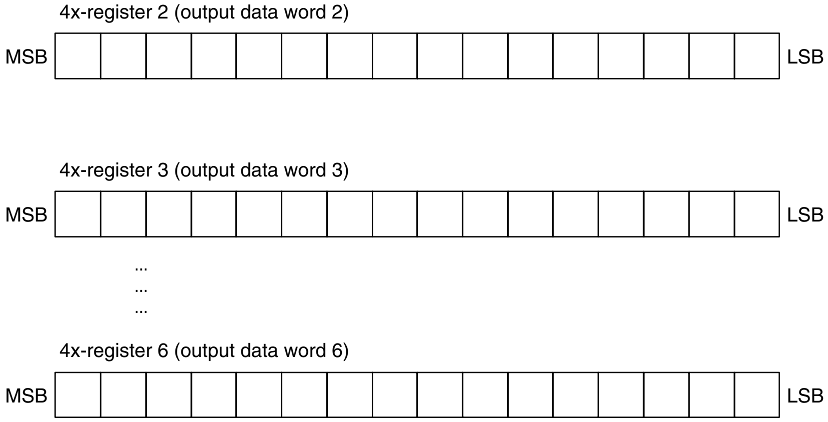
The following figure shows the AS-BMOT-201/ 202 3x-register arrangement.



The following figure shows the AS-BMOT 201/ 202 4x-register arrangement.



The following figure shows the S-BMOT-201/ 202 4x-register arrangement.



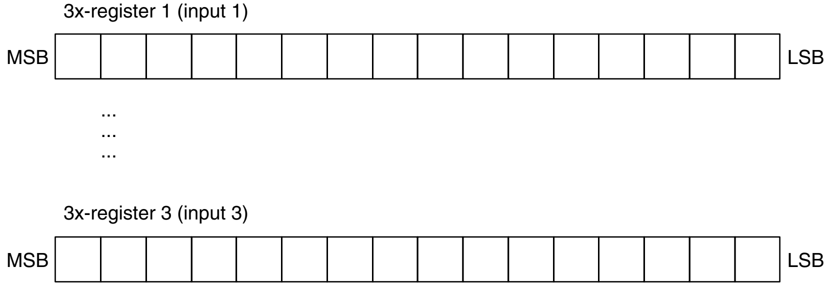
## AS-BZAE-201

**Note:** This module does not require any params... screens.

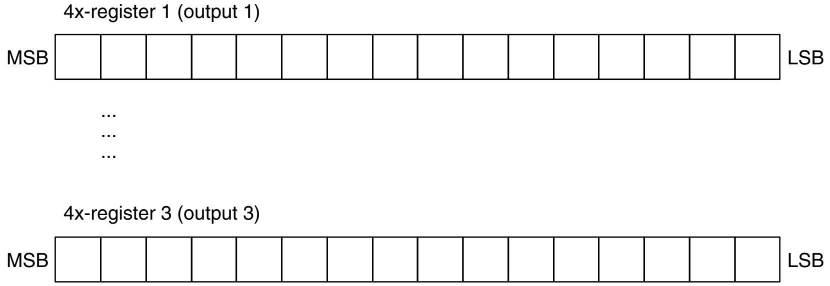
The AS-BZAE-201 module requires three 3x-input registers and three 4x-output registers.

### Meanings for the AS-BZAE-201 Module Mapping

The following figure shows the AS-BZAE-201 3x-register arrangement.



The following figure shows the AS-BZAE-201 4x-register arrangement.



## Communication Interfaces

### Communication Interfaces

This section describes how to configure the following modules:

- BKF-201 (16W)/BKF-201 (64W) Interbus S Master
- BKF-202 Interbus S Slave
- DEA-202 Interbus S Interface (No Mapping required)
- DEA-203253/243C Profibus DP Slave Module (No Mapping required)
- MVB-258/258A*

*The MVB-258/258A is a "special,"and therefore it is not included in this document.

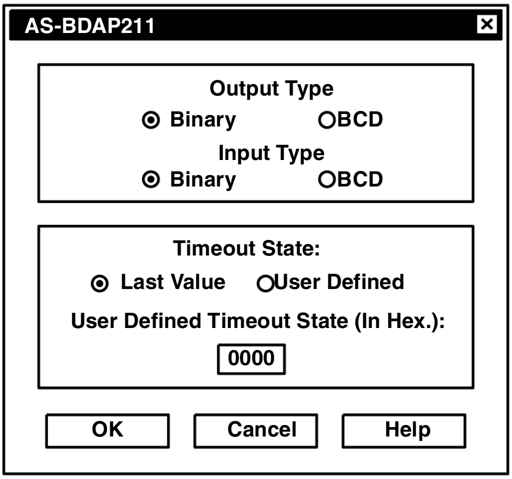
### I/O Configuration Using Concept 2.1 or Higher

Instructions for configuring the BKF-201 (16W) and BKF-201(64W) follow.

| Step | Action |
|---|---|
| 1 | Select **Configure** from the menu. |
| 2 | Select **I/O Map** from the menu. |
| 3 | Click on **Edit...** The Local Common CPU Drop dialog appears. |
| 4 | Click on **Module**. The I/O Module Selection dialog appears. |
| 5 | Select **BKF** and click on **OK**. A number and description appear. |
| 6 | In the **In Ref** field, enter 3x and press **Enter**. The software completes the **In Ref** and **In End** fields. |
| 7 | In the **Out Ref** field, enter **4x** and press **Enter**. The software completes the **Out Ref** and **Out End** fields. |
| 8 | Click on **Params...** The Timeout State for Outputs on IBS dialog appears.) |
| 9 | Select either **Set to Zero** or Hold Last Value and click on **OK**. |

### AS-BBKF-201 / 202

The following dialog is used with the communication module AS-BBKF-201 (16 words/64 words).  A different dialog box is used for AS–BBKF–202 (16 words); it is very similar.



AS-BDAP211

Output Type

● Binary ○ BCD

Input Type

● Binary ○ BCD

Timeout State:

● Last Value ○ User Defined

User Defined Timeout State (In Hex.): 0000

### Timeout state for outputs on IBS

The Compact timeout state only reflects a user program in stop mode.

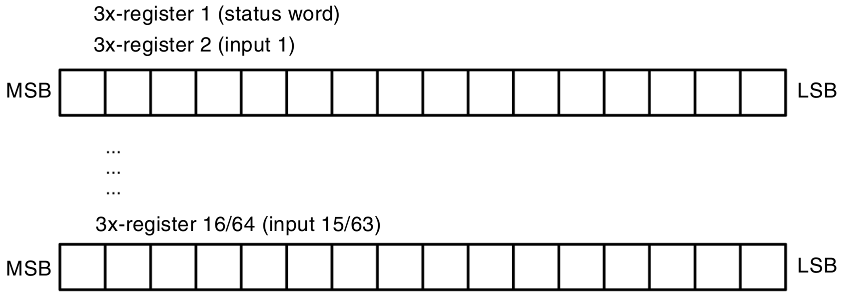
Activation of the **Set to Zero** option button causes outputs to be set to 0 upon user program stop, and thus guarantee a defined switch-off behavior.

Activation of the **Hold Last Value** option button causes the outputs to retain their last valid value upon user program stop.

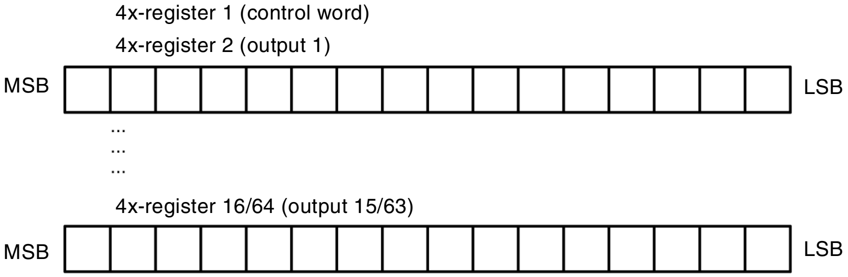
**Meanings for the AS-BBKF-201/ 202 Module Mapping**

The AS-BBKF-201 module requires 16 or 64 4x-output registers; the AS-BBKF-202 module requires 16 4x-output registers addressed in sequence, beginning with the first register (refer to the following figure(s). Refer to *BKF 201 (16W) & (64W) InterBus S Master Module, p. 217* and *BKF 202 InterBus S Slave Module, p. 235* for details about the 4x control word for these modules.

The following figures show the AS-BBKF-201/202 3x-register arrangement.



The AS-BBKF-201 module requires 16 or 64 3x-input registers, the AS-BBKF-202 module requires 16 3x-input registers, addressed in sequence beginning with the first register (refer to the figure below). Refer to *BKF 201 (16W) & (64W) InterBus S Master Module, p. 217* and *BKF 202 InterBus S Slave Module, p. 235* for details on the 3x status word for these modules.



# Concept I/O Map Status Words

## Status Words

**Note:** All other modules do not provide status word information.

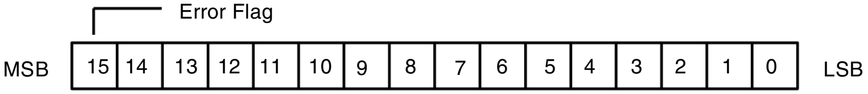
The following lists the modules that provide Concept I/O Map Status Words. Most provide only an error flag, yet others provide additional error information.

The following table shows I/O Map Status Word Error Flags and Additional Error Information.

| I/O Module | Error Flag Meaning (Refer to Figure 54) | Provides Additional Error Information |
|---|---|---|
| ADU204/254/254C | Not applicable | Yes. Refer to *ADU 204/254/254(C) Status Word, p. 817*. |
| ADU205 | Not applicable | Yes. Refer to *ADU 205 Status Word, p. 817*. |
| ADU206 | 1=Group signal when detail status information is available | |
| ADU210 | 1=Group signal when detail status information is available | Yes. Refer to *ADU 210 Status Word, p. 818*. |
| ADU214 | 1=Group signal when detail status information is available | Yes. Refer to *ADU 214 Status Word, p. 819*. |
| ADU216 | 1=Group signal when detail status information is available | |
| ADU257 | 1=Group signal when detail status information is available | Yes. Refer to *ADU 257 Status Word, p. 820*. |
| BKF201/202 | 1=Module error | |
| DAP208/210/258/258C | 1=Overload on one or more outputs | |
| DAP220/250/250C | 1=Power missing, or overload on one or more outputs | |
| DAU202/252/252C | 1=Error during generation of the internal +/-15V supply | |
| DAU208/258 | 1=Error during generation of the internal +/-15V supply | |
| FRQ204/254 | 1=Overflow of a counter or overload on one or more outputs | Yes. Refer to *FRQ 204/254 Status Word, p. 820*. |

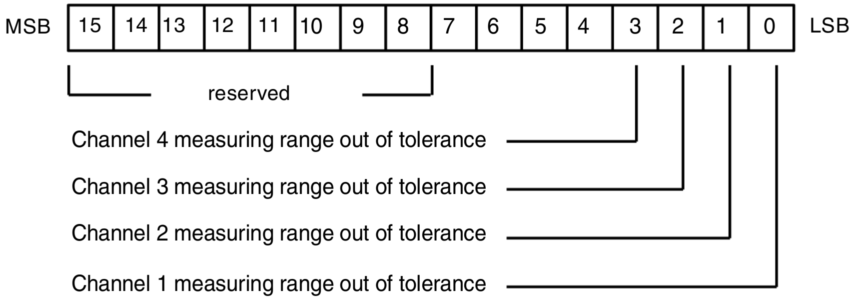
### Status Word Error Flag

The following figure shows the Status Word Error Flag.



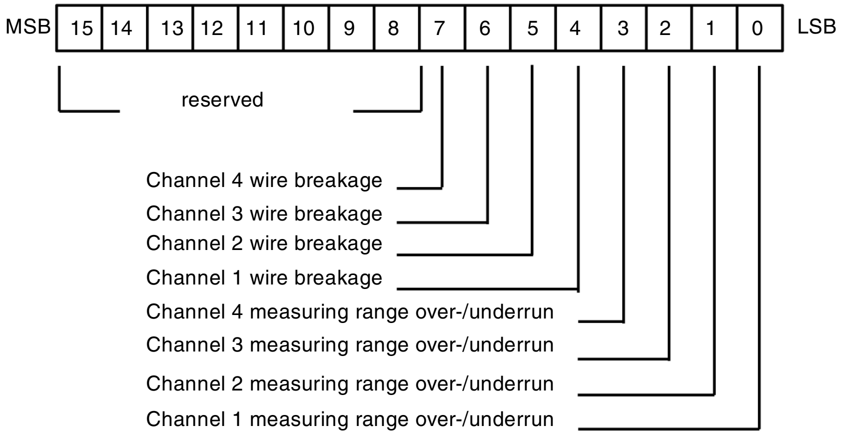
### ADU 204/254/254(C) Status Word

The following figure shows the ADU 204/254/254(C) Status Word.



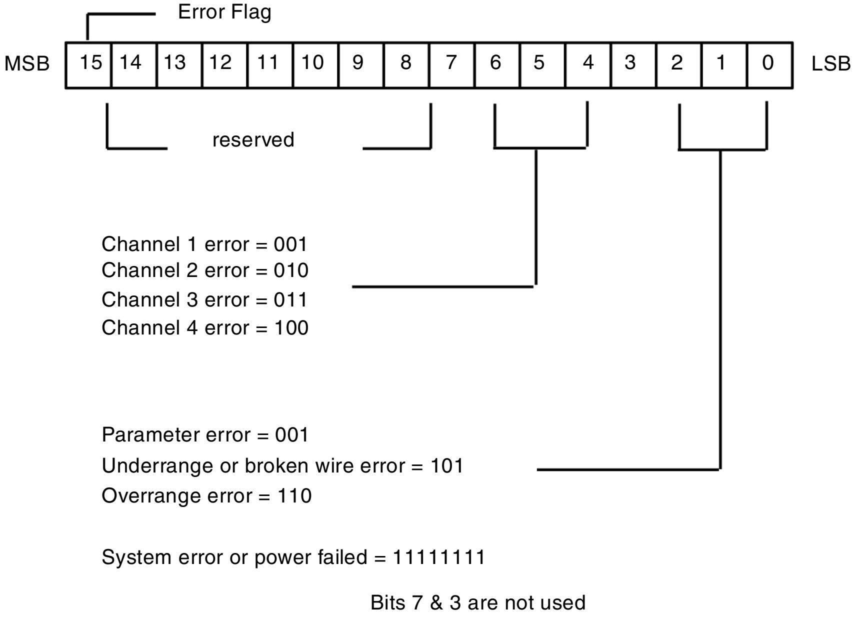
### ADU 205 Status Word

The following figure shows the ADU 205 Status Word.



### ADU 210 Status Word

The following figure shows the ADU 210 Status Word.



Channel 1 error = 001
Channel 2 error = 010
Channel 3 error = 011
Channel 4 error = 100

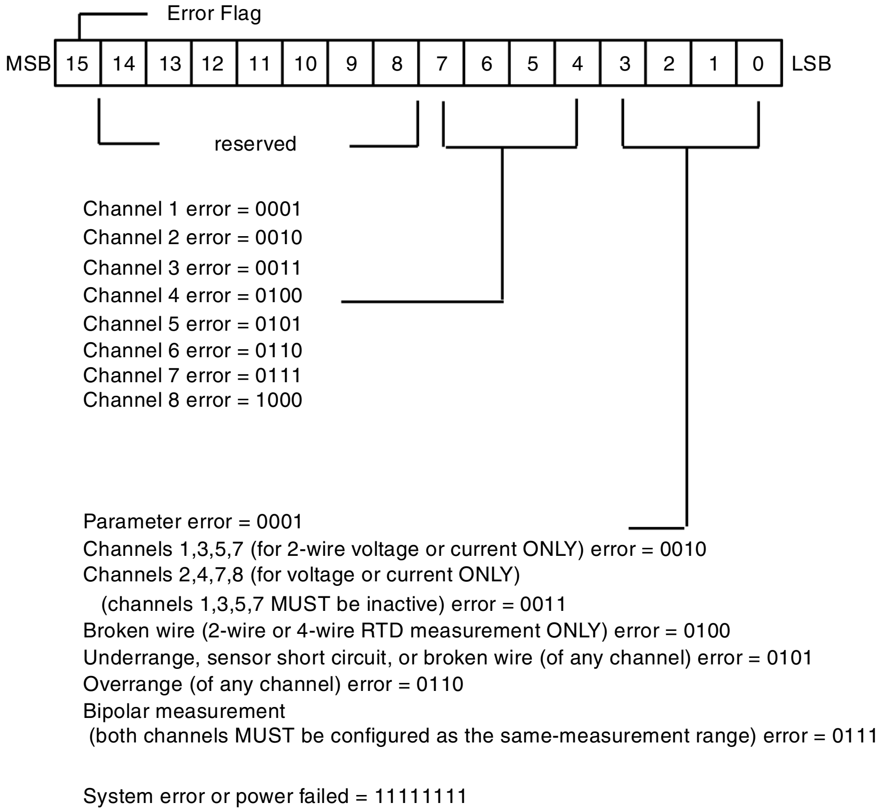
Parameter error = 001
Underrange or broken wire error = 101
Overrange error = 110

System error or power failed = 11111111

Bits 7 & 3 are not used

**ADU 214 Status Word**

The following figure shows the ADU 214 Status Word.



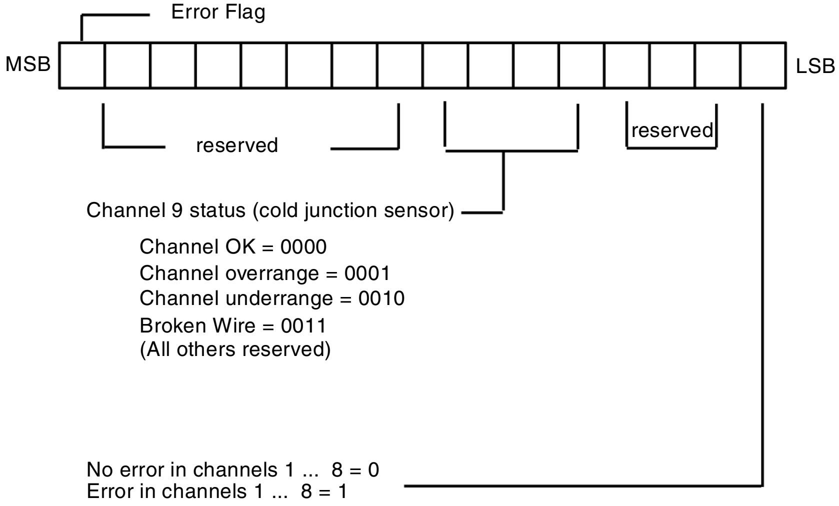
Channel 1 error = 0001
Channel 2 error = 0010
Channel 3 error = 0011
Channel 4 error = 0100
Channel 5 error = 0101
Channel 6 error = 0110
Channel 7 error = 0111
Channel 8 error = 1000

Parameter error = 0001
Channels 1,3,5,7 (for 2-wire voltage or current ONLY) error = 0010
Channels 2,4,7,8 (for voltage or current ONLY)
(channels 1,3,5,7 MUST be inactive) error = 0011
Broken wire (2-wire or 4-wire RTD measurement ONLY) error = 0100
Underrange, sensor short circuit, or broken wire (of any channel) error = 0101
Overrange (of any channel) error = 0110
Bipolar measurement
(both channels MUST be configured as the same-measurement range) error = 0111

System error or power failed = 11111111

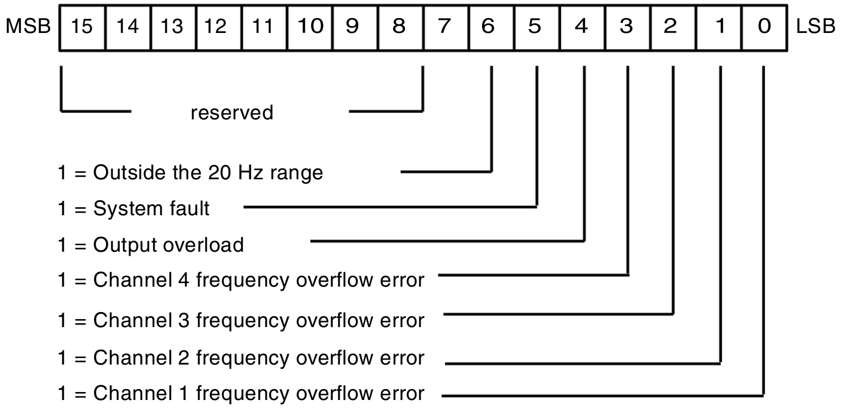
**ADU 257 Status Word**

The following figure shows the ADU 257 Status Word.



**FRQ 204/254 Status Word**

The following figure shows the FRQ 204/254 Status Word.



Bit 7 is not used

# I/O Configuration of A120 Series I/O Modules with Modsoft

# C

## At a Glance

**Purpose**

This chapter describes the configuration of A120 Series I/O modules with Modsoft.

**What's in this Chapter?**

This chapter contains the following topics:

## Configuring A120 Discrete Input Modules with Modsoft

### Discrete Input Modules

This following information describes how to configure the following modules:
- DEO 216 16-point 24 Vdc Discrete Input
- DEP 208 8-point 230 Vac Discrete Input
- DEP 209 8-point 120 Vac Discrete Input
- DEP 210 8-point 115 Vac Isolated Discrete Input
- DEP 211 8-point 115 Vac Isolated Discrete Input
- DEP 214 16-point 12 ... 60Vdc Discrete Input
- DEP 215 16-point 5 Vdc TTL Discrete Input
- DEP 216 16-point 24 Vdc Discrete Input
- DEP 217 16-point 24 Vdc Discrete Input
- DEP 218 16-point 115 Vac Isolated Discrete Input
- DEP 220 16-point 24 Vdc Discrete Input
- DEP 257 16-point 110 Vdc Discrete Input
- DEP 296 16-point 60 Vdc Isolated Discrete Input
- DEP 297 16-point 48 Vdc Isolated Discrete Input
- DEP 284* 8-point 115 Vac Isolated Discrete Input (Not supported in Modsoft 2.6 or lower)

*The DEP 284 is a "special", and therefore it is not included in this document.

### I/O Configuration Using Modsoft 2.6 or Lower

Use the following procedure to configure A120 discrete input modules using Modsoft.

| Step | Action |
|---|---|
| 1 | Select I/O Map (or press F4). This places you at rack 1, slot position 101...105. |
| 2 | Move the cursor to slot 104. |
| 3 | Hold the **Shift key** and press the **? key**. This displays a list of possible I/O modules. |
| 4 | Select **DEPxxx**. |
| 5 | Enter the input reference **10001** and press the **Enter key**. The software automatically fills in the input range. If you are using a 3x register, the cursor automatically moves to Data Type. |
| 6 | Select either **Binary** or **BCD** and press the **Enter key**. |
| 7 | Choose **Quit** (or press **F9**). Escape to the Modsoft main menu. |
| 8 | Refer to individual module chapters for more information. |

## Configuring A120 Discrete Output Modules with Modsoft

### Discrete Output Modules

The following information describes how to configure these modules:

- DAO 216 16-point 24 Vdc Discrete Output
- DAP 204 4-point 24 ... 110 Vdc/24 ... 250 Vac Relay Discrete Output
- DAP 208 8-point 24 ... 110 Vdc/24 ... 250 Vac Relay Discrete Output
- DAP 209 8-point 120 Vac Discrete Output
- DAP 210 8-point 24 ... 240 Vac Discrete Output
- DAP 216(N)16-point 24 Vdc Discrete Output
- DAP 217 16-point 5 ... 24 Vdc Discrete Output
- DAP 218 16-point 24 ... 240 Vac Discrete Output
- DAP 284* 4-point 24 ... 110 Vdc/24 ... 250 Vac Relay Discrete Output (Special, Intrinsically Safe) (Not supported in Modsoft 2.6 or lower)

*This is a "special", and therefore it is not included in this document.

### I/O Configuration Using Modsoft 2.6 or Lower

Use the following procedure to configure the A120 discrete output modules using Modsoft.

| Step | Action |
|---|---|
| 1 | Select **I/O Map** (or press **F4**). This places you at rack 1, slot position 101...105. |
| 2 | Move the cursor to slot **104**. |
| 3 | Hold the **Shift key** and press the **? key**. This displays a list of possible I/O modules. |
| 4 | Select **DAPxxx.** |
| 5 | Enter the input reference 10001 and press the **Enter key**. The software automatically fills in the output range. If you are using a 3x register and a 4x register, the cursor automatically moves to Data Type. |
| 6 | Select either **Binary** or **BCD** and press the **Enter** key. |
| 7 | Choose **Quit** (or press **F9**). Escape to the Modsoft main menu. |
| 8 | Refer to individual module chapters for more information. |

## Configuring A120 Discrete Combination Modules with Modsoft

### Discrete Combination Modules

The following information describes how to configure these modules:

- DAP 211 Monitored 4-point in/4-point out 120 Vac Combined I/O (Requires a loadable (SW–IODR–001) for proper operation using certain PLCs (A984–1xx, E984–24x/251/255) with Modsoft. Refer to *Installing the Loadables for A120 Series I/O Modules, p. 869* for details).
- DAP 212 8-point in/4-point out 24 Vdc Combined I/O
- DAP 220 8-point in/8-point out 24 Vdc Combined I/O
- DAP 252 8-point in/4-point relay out 24 Vdc LT Combined I/O
- DAP 253 8-point in/4-point relay out 110 Vdc LT Combined I/O
- DAP 292 8-point in/4-point relay out 60 Vdc Combined I/O

### I/O Configuration Using Modsoft 2.6 or Lower

Use the following procedure to configure A120 discrete output modules using Modsoft.

| Step | Action |
|---|---|
| 1 | Select **I/O Map** (or press **F4**). This places you at rack 1, slot position 101...105. |
| 2 | Move the cursor to slot **104**. |
| 3 | Hold the **Shift key** and press the **? key**. This displays a list of possible I/O modules. |
| 4 | Select **DAPxxx**. |
| 5 | Enter the input reference 10001 and press the **Enter key**. The software automatically fills in the input range. |
| 6 | Enter the output reference **0001** and press the **Enter key**. The software automatically fills in the input range. If you are using a 3x register and a 4x register, the cursor automatically moves to Data Type. |
| 7 | Select either **Binary** or **BCD** and press the **Enter key**. |
| 8 | Choose **Quit** (or press **F9**). Escape to the Modsoft main menu. |
| 9 | Refer to individual module chapters for more information. |

## Configuring A120 Analog Input Modules with Modsoft

### Analog Input Modules

This section describes how to configure the following modules:

- ADU 204 4-point Voltage/RTD Analog Input
- ADU 205 4-point Voltage/Current Analog Input
- ADU 206 4-point Voltage/Current Isolated Analog Input
- ADU 210 4-point Voltage/Current Analog Input (Not supported in Modsoft)
- ADU 214 8-point Voltage/Current Isolated Analog Input
- ADU 216 8-point Thermocouple Isolated Analog Input
- ADU 257/257C 8-point Voltage/RTD/TC Analog Input (Not supported in Modsoft) NOTE: If the ADU257s DIP switch is set to the ADU216 mode, the ADU257 operates just like an ADU216 module. Refer to *Overview of the ADU 257 Analog Input Module, p. 187*.
- ADU 282/282M* 2-point Analog Input (Special, Intrinsically Safe) (Not supported in Modsoft 2.6 or lower).
- ADU 284* 2-point Analog Input (Special, Intrinsically Safe) (Not supported in Modsoft 2.6 or lower)
- ADU 211/212 8-point Universal Isolated Analog Input

*This is a "special", and therefore it is not included in this document.

### I/O Configuration Using Modsoft 2.6 or Lower

Use the following procedure to configure A120 discrete output modules using Modsoft.

| Step | Action |
|---|---|
| 1 | Select **I/O Map** (or press **F4**). This places you at rack 1, slot position 101...105. |
| 2 | Move the cursor to slot **104**. |
| 3 | Hold the **Shift key** and press the **? key**. This displays a list of possible I/O modules. |
| 4 | Select **ADUxxx.** |
| 5 | Enter the input reference **3x** and press the **Enter key**. The software automatically fills in the input range. |
| 6 | Enter the output reference **4x** and press the **Enter key**. The software automatically fills in the input range. If you are using a 3x register and a 4x register, the cursor automatically moves to Data Type. |
| 7 | Select either **Binary** or **BCD** and press the **Enter key**. |
| 8 | Choose **Quit** (or press **F9**). Escape to the Modsoft main menu. |
| 9 | Refer to individual module chapters for more information. |

## Configuring A120 Analog Output Modules with Modsoft

### Analog Output Modules

This section describes how to configure the following modules:

- DAU 202 2-point 24 Vdc Voltage/Current Analog Output
- DAU 204 4-point 24 Vdc Voltage/Current Analog Output
- DAU 208 8-point +/-10 Vdc Isolated Analog Output
- DAU 282* 2-point 24 Vdc Voltage/Current Analog Output (Special, Intrinsically Safe) (Not supported in Modsoft 2.6 or lower)

*The DAU 282 is a "special", and therefore it is not included in this document.

### I/O Configuration Using Modsoft 2.6 or Lower

Use the following procedure to configure A120 discrete output modules using Modsoft.

| Step | Action |
|---|---|
| 1 | Select **I/O Map** (or press **F4**). This places you at rack 1, slot position 101...105. |
| 2 | Move the cursor to slot **104**. |
| 3 | Hold the **Shift key** and press the **? key**. This displays a list of possible I/O modules. |
| 4 | Select **DAUxxx**. |
| 5 | Enter the output reference **4x** and press the **Enter key**. The software automatically fills in the input range. If you are using a 4x register, the cursor automatically moves to Data Type. |
| 6 | Select either **Binary** or **BCD** and press the **Enter key**. |
| 7 | Choose **Quit** (or press **F9**). Escape to the Modsoft main menu. |
| 8 | Refer to individual module chapters for more information. |

## Configuring A120 Intelligent Modules with Modsoft

### Intelligent Modules

This section describes how to configure the following modules:
- FRQ-204/254 Frequency
- (Not supported in Modsoft 2.6 or lower)
- MOT 201 Motion-Encoder Only
- MOT 202 Motion-Resolver and Encoder
- VIC-2xx High-Speed Input
- VRC 200/CTR 205/212/224 Variable Reluctance Counter/Counter
- ZAE 201 Counter/Positioner
- ZAE 204 High-Speed Counter

### I/O Configuration Using Modsoft 2.6 or Lower

Use the following procedure to configure A120 discrete output modules using Modsoft.

| Step | Action |
|---|---|
| 1 | Select **I/O Map** (or press **F4)**. This places you at rack 1, slot position 101...105. |
| 2 | Move the cursor to slot **104**. |
| 3 | Hold the **Shift key** and press the **? key**. This displays a list of possible I/O modules. |
| 4 | Select **XXXxxx**. |
| 5 | Enter the input reference **3x** and press the **Enter key**. The software automatically fills in the input range. |
| 6 | Enter the output reference **4x** and press the **Enter key**. The software automatically fills in the input range. If you are using a 3x register and a 4x register, the cursor automatically moves to Data Type. |
| 7 | Select either **Binary** or **BCD** and press the **Enter key**. |
| 8 | Choose **Quit** (or press **F9**). Escape to the Modsoft main menu. |
| 9 | Refer to individual module chapters for more information. |

## Configuring A120 Communication Interfaces with Modsoft

### Communication Interfaces

The following communication interfaces are not supported in Modsoft 2.6 or lower:
- BKF-201 (16W)/BKF-201 (64W) Interbus S Master
- BKF-202 Interbus S Slave (Not supported in Modsoft 2.6 or lower)
- DEA-202 Interbus S Interface (Not supported in Modsoft 2.6 or lower)
- DEA-203/253/243C Profibus DP Slave Module (Not supported in Modsoft 2.6 or lower)
- MVB-258/258A* (Not supported in Modsoft 2.6 or lower)

*The MVB-258/258A is a "special", and therefore it is not included in this document.

### I/O Configuration Using Modsoft 2.6 or Lower

**Note:** The modules are not supported in Modsoft 2.6 or lower.

# Modsoft Application Examples for Selected A120 Series I/O Modules

# D

## At a Glance

**Purpose**

This chapter provides examples of how to use selected Series A120 I/O modules with Modsoft's Ladder Logic.

**What's in this Chapter?**

This chapter contains the following topics:

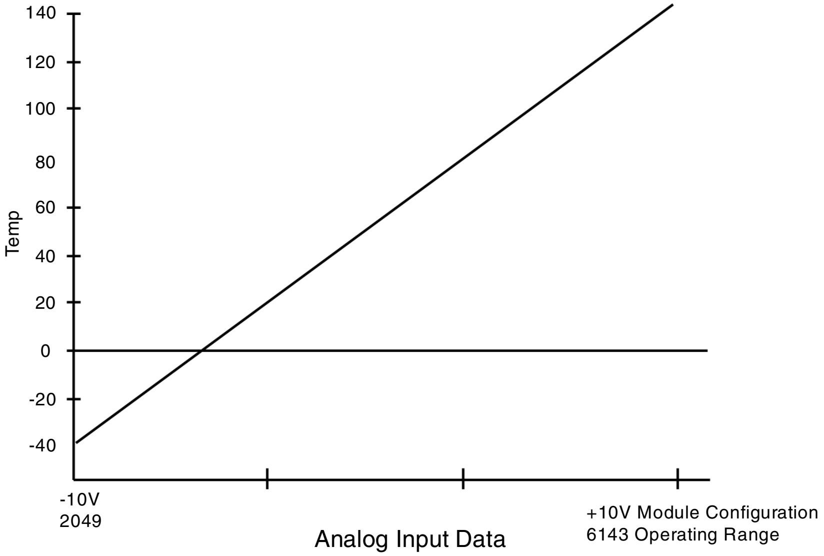
## ADU 205 Application Example

**Overview**

In many applications, analog signals are scaled to engineering units that indicate units such as I/O points,degrees C, gal/min, cm/s, etc.  An operator may view the scaled analog input data via LED displays, screen displays on a monitor, or report printouts.

**Temperature Example**

For example, assume that the -10 ... +10 V signal is being used to represent a temperature between -40 ... +140 F. The following figure shows the **Signal-to-Temperature Relationship**.

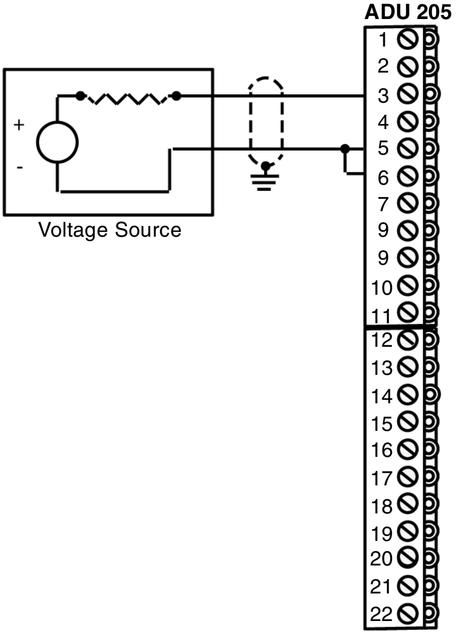


To appropriately display this analog data as a temperature value, you can use an ADU 205 Analog Input module I/O Mapped as follows: 30001-30004 input registers and binary.

## Field Wiring Illustration

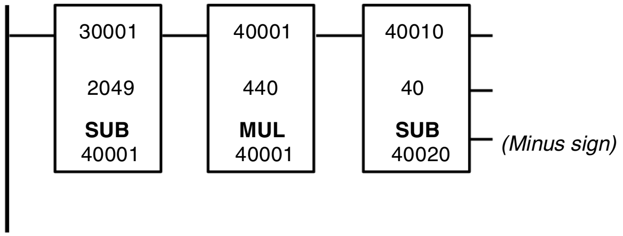
The following information describes how to field wire the ADU 205. The information consists of a field wiring illustration and a procedure (see *Procedure for Generating Logic, p. 832*.

The following figure illustrates how to field wire the ADU 205.



## Procedure for Generating Logic

Use the following procedure to generate the ladder logic.

| Step | Action |
|---|---|
| 1 | Divide the temperature range, 180 degrees, by 4095.<br>(180 / 4095 = .044) |
| 2 | Obtain the MUL block constant by multiplying the result by 10,000.<br>(.044 x 10,000 = 440) |
| 3 | Generate the ladder logic to subtract the 2049 offset multiply the analog input by the constant; the high order result register will contain the range. Then subtract the Y-intercept, -40, to obtain the answer, as shown.<br> <br>This logic generates the scaled value in register 40020 from the analog signal in 30001. Only the high order result of the MUL operation is used, and no compensation for round-off is used in this example. |

## DAU 204 Application Example

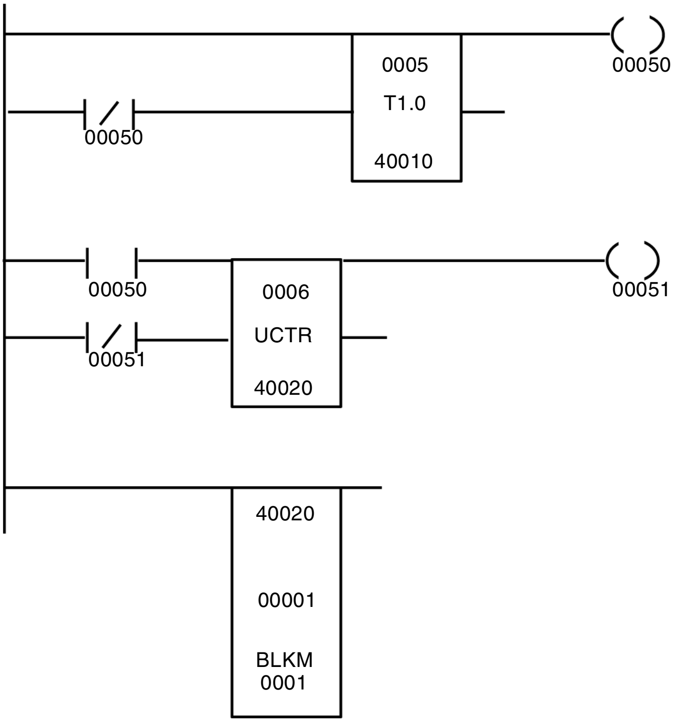
### How the Module Ramps Outputs through to the Full Scale

The figures in this map show a ladder logic program that uses 1 timer (register 40010) and 1 upcounter (register 40020) to decrement all 4 output channel registers of the DAU204 (registers 40001 through 40004). This is very easily done using block moves and 5 holding registers (registers 40011 through 40015). With the module configured for 4 ... 20 mA output on all four channels (0 in register 40005), each channel is decremented from the top of the scale (4095) to the bottom of the scale (0) in 5 second intervals. After each interval, the outputs are changed to different values, again for 5 seconds. The counter is then reset, which starts the sequence again.

**Note:** This is only an example showing how the module operates to ramp the outputs through the full scale. The ladder logic (four networks) are not required to operate the module.

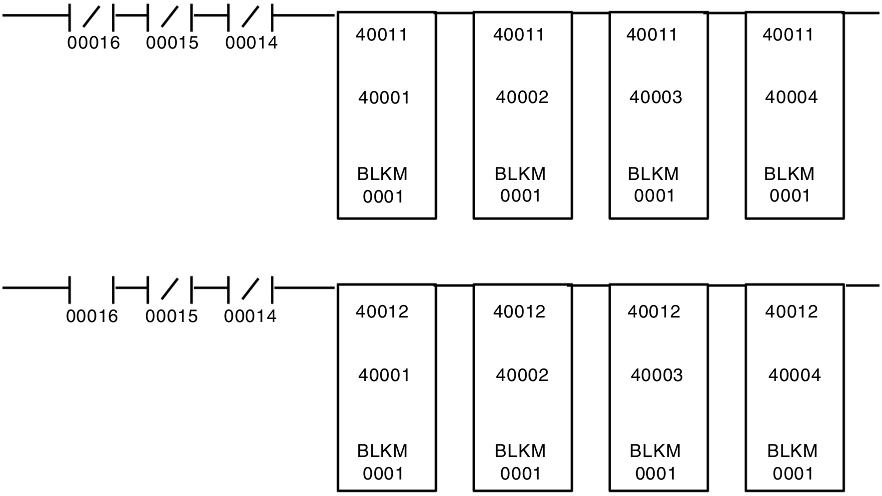
**Network 1 Example**

The following figure illustrates the logic for Network 1.



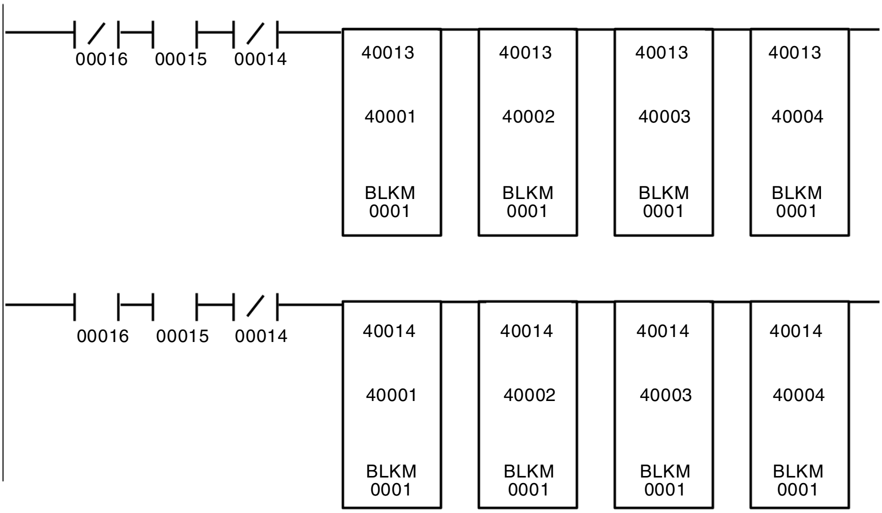
**Network 2 Example**

The following figure illustrates the logic for Network 2.



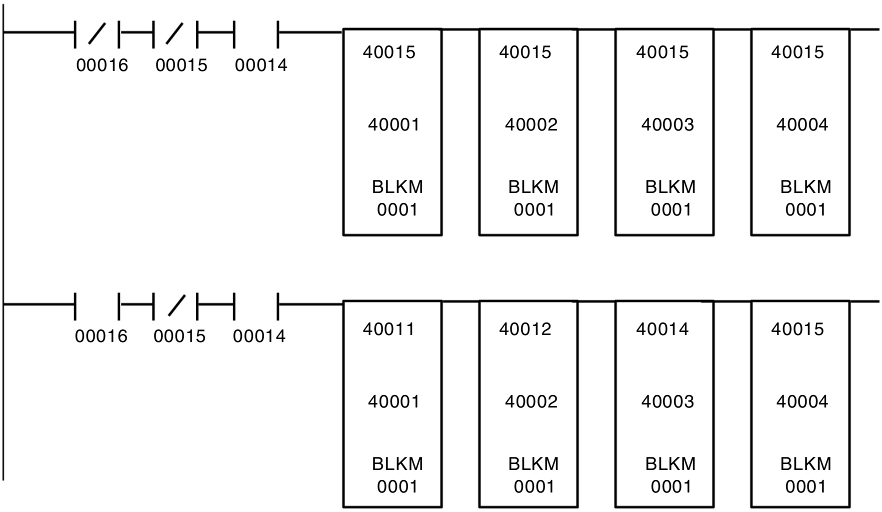
**Network 3 Example**

The following figure illustrates the logic for Network 3.



### Network 4 Example

The following figure illustrates the logic for Network 4.



### Reference Data

The following figure shows the reference data for the DAU 204 application example.

REFERENCE DATA

| | |
|---|---|
| 30001 | 0000000000000000 |
| 40001 | 4095 Dec |
| 40002 | 3072 Dec |
| 40003 | 1027 Dec |
| 40004 | 0 Dec |
| 40005 | 0 Dec |
| 40006 | 0 Dec |

| | |
|---|---|
| 40010 | 1 Dec |
| 40020 | 5 Dec |
| 40011 | 4095 Dec |
| 40012 | 3072Dec |
| 40013 | 2045 Dec |
| 40014 | 1027 Dec |
| 40015 | 0 Dec |

## VRC/CTR 2xx (VIC2xx) Application Notes

### Controlling the Module

The VRC/CTR module is structured to minimize the amount of I/O resources required to operate the module. A total of six registers, set up as two separate groups of three registers each (three 3**x** input and three 4**x** output registers) is the total amount of resources dedicated to the module. Note that some individual registers are designed for use within the ladder program as contacts or coils.

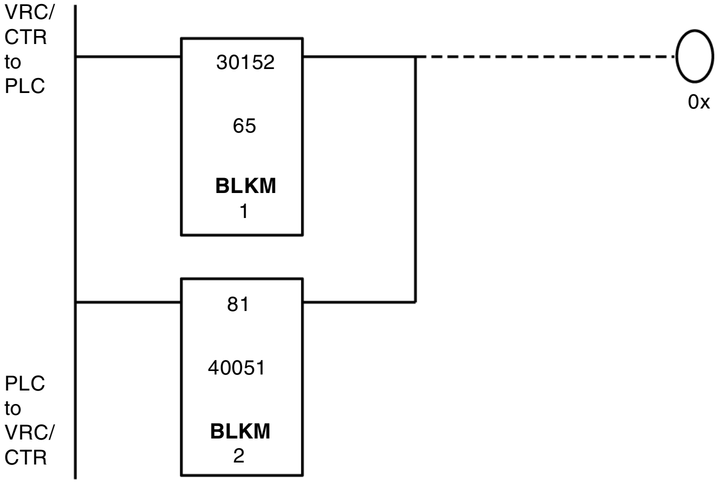
*Ladder Logic Example 1, p. 838*, which follows, shows how to move data from a word format into a bit location for use as a contact or coil within the ladder program. (This is only one example. You can accomplish the same result differently.)

In this example, the command will copy the data from input register 30152 (16 bits) into sixteen consecutive bit locations starting at output reference 00065. It will also copy 32 bit locations starting at output reference 81 and move the data into two (2) consecutive holding registers starting at 4005. Refer to the figures in *Accompanying Bit Functions, p. 839* to see the bit functions that will be in place with *Ladder Logic Example 1, p. 838*.

Some of the individual registers are designed for use within the ladder program as contacts or coils. With this ladder program, you can easily manipulate coils or simply monitor bits within the ladder program to control or monitor the VRC/CTR module.

## Ladder Logic Example 1

The following figure illustrates how to move data from a word format into a bit location for use as a contact or coil within the ladder program. This example assigns registers 30150 ... 30152 and 40050 ... 40052 to the VRC/CTR module.



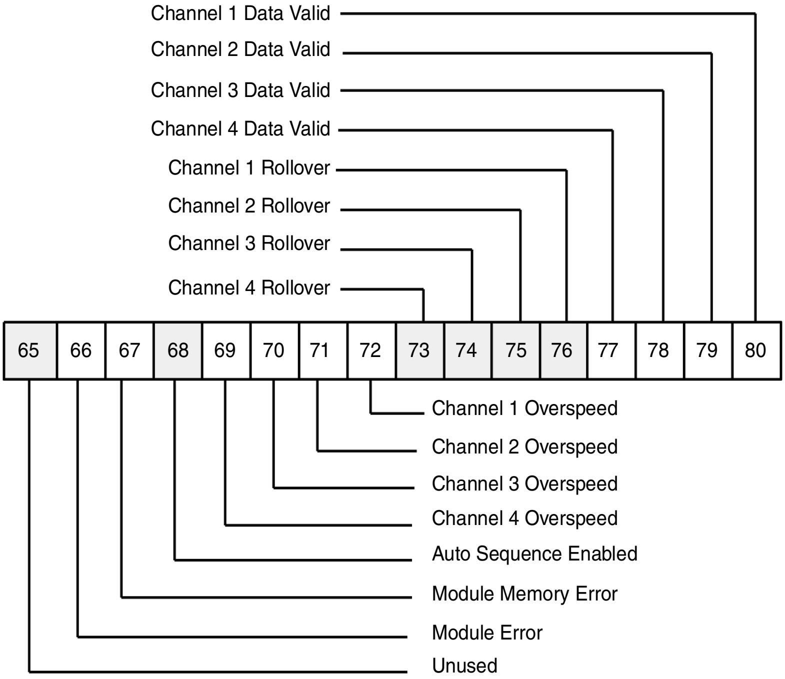
In this figure, the command will copy the data from input register 30152 (16 bits) into sixteen consecutive bit locations starting at output reference 00065. It will also copy 32 bit locations starting at output reference 81 and move the data into two (2) consecutive holding registers starting at 40051.

**Note:** For consistency, it is recommended that the rung of logic illustrated in this figure be placed after all logic associated with the VRC/CTR module. This does not affect the module, but it may be important for consistent control of the module.

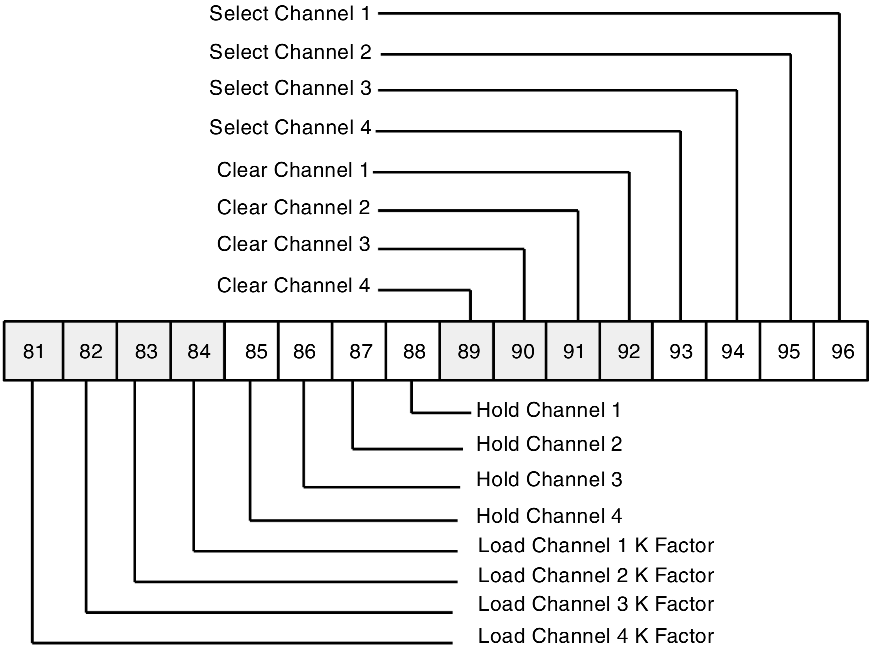
**Accompanying Bit Functions**

The following figures show the bit functions that will be in place with *Ladder Logic Example 1, p. 838*.

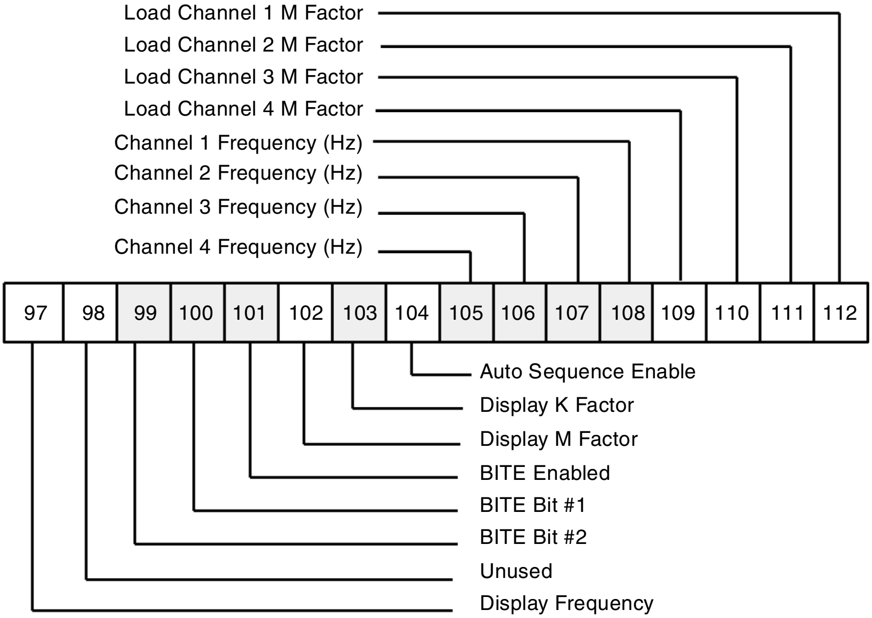
If you were to program as shown in *Ladder Logic Example 1, p. 838*, the output references would allow you to control and monitor the VRC/CTR module, as shown in the following figure.



The following figure depicts **Output Register #2, VRC/CTR Control Word 1** (as it would appear if accompanying *Ladder Logic Example 1, p. 838*).



The following figure depicts **Output Register #3, VRC/CTR Control Word 2** (accompanying (as it would appear if accompanying *Ladder Logic Example 1, p. 838*).



**Factor Values**

The VRC/CTR module can accept K and Meter factor data to process the incoming pulse information.

**K Factor**

The VRC/CTR module uses K factor information specific to the field device attached to each channel. K factor values may be any number from 1 ... 65,535, and are used in conjunction with the Meter factor value to calculate the incoming pulse information. Typically, the K factor number is imprinted on the side of the field device or listed in the documentation associated with the device.

## Meter Factor

During typical use, sensing device characteristics change due to wear, material accumulation, or other items that impact performance. A meter factor value may be used to adjust the original K factor value to account for these deviations. The value used for a meter factor is multiplied into the K factor, and the result used to modify the incoming information. Meter factor values typically take the form of floating point variables from 0.0001 ... 1.9999.

To accomplish this, the VRC/CTR module assumes a decimal point in a standard integer value, as the information in the follow table shows.

| PLC Data | VRtC/CTR Data |
|---|---|
| 5000 | 0.5000 |
| 12550 | 1.2550 |

The module's meter factor defaults to a value of unity 1 (or 10000 integer). If a channel's characteristics need to be modified, the user may insert the meter factor value in the appropriate channel, and the module then calculates all incoming data based on the corrected value.The C factor = (K x M)/10,000.

The following table provides some examples.

| Original K Factor | Meter Factor | C Factor | # Received Pulses | Displayed Data |
|---|---|---|---|---|
| 1000 | 1.0000 | 1000 | 9500 | 9 |
| 1000 | 0.9875 | 987.5 | 10500 | 10 |
| 3800 | 1.0155 | 3859 | 38500 | 9 |
| 1775 | 0.9725 | 1726 | 23471 | 13 |

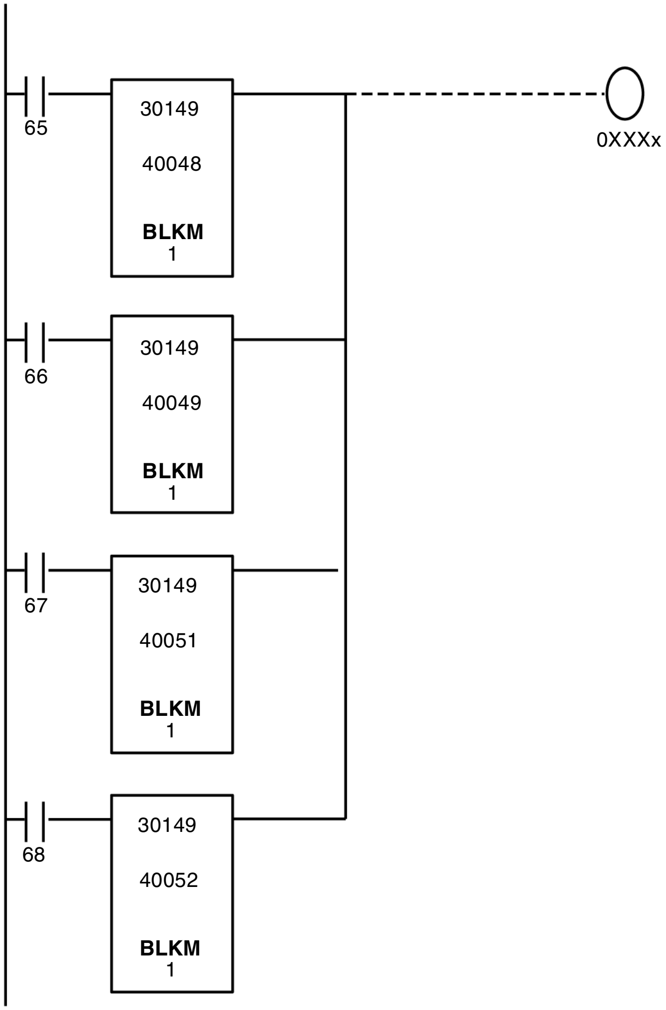
By manipulating bits in Write register 3 (control word 2), you may view the contents of each channel's K Factor, Meter Factor, or C (calculated) factor value.

## Auto Sequence

To minimize the amount of ladder programming required to operate the module, the VRC/CTR has the capability to autoscan the four input channels. If enabled, the auto sequence feature scans through channels 1 ... 4 (in order) every **1**/**2** s. (All channels are updated every 2 s.)

The Compact 984 or Micro ladder program simply needs to monitor four status bits assigned to input register 3 (bits 1 ... 4 in the module). These bits turn ON if the data for that channel is valid.

The following ladder logic example, **Ladder Logic Example #2**, shows how to use the data valid bits to move data into a specific holding register for use within the ladder program. Moving data into specific holding registers allows for each channel to be viewed at any time.



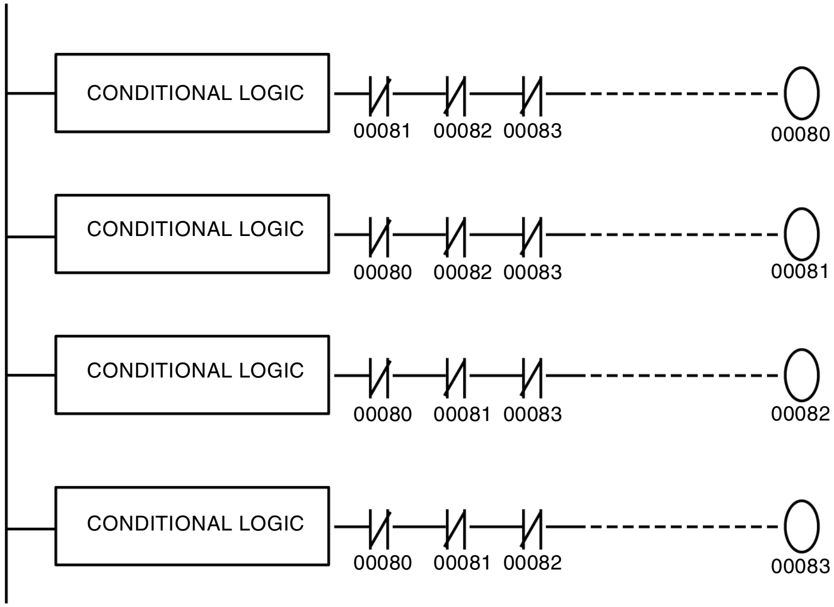
[Please review the *Controlling the Module, p. 837* and the *Accompanying Bit Functions, p. 839* for more information about register operation.] By using these four valid data bits, the ladder program distinguishes which channel is displayed at any given moment in time. By moving the data that is displayed for each channel (based on the status of these bits) into specific registers for use by the program, the ladder program can better utilize the information in other sections of the ladder program.

---

**Manual Operation**

Manual selection of channels is controlled by four bits located in output word 2, VRC/CTR control word 1. By setting these bits ON or OFF, you may select a specific channel for monitoring.

Using the above example (see *Auto Sequence, p. 842*), all you would need to do is program four (4) coils in the ladder program, as shown in the following figure.



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**Overspeed Bits**

It is recommended that the user monitor the overspeed bits in the ladder program. For the VRC–200 version of the module, the overspeed bits signal that the data from the module is potentially inaccurate. For these applications, it is recommended that the overspeed bits be monitored in ladder logic and flag an overspeed condition.

# A120 Option Modules

E

## At a Glance

**Introduction**

This chapter describes several A120 modules that are options.

**What's in this Chapter?**

This chapter contains the following topics:

## SIM 203 Analog Simulator Module

### General

The SIM 203 simulator module is an A120 option that allows you, for instructional purposes, to generate two analog signals - 0 ... 1V or 0 ... 10V (toggle switch selectable) and to display one 10V output signal from a Compact 984 controller output module. The SIM 203 outputs interface to the controller through the ADU 204 and ADU 205 input modules.

**Note:** The SIM 203 Module is a simulator module used for training purposes only. It is not a functional Compact 984 I/O module.
Note that also for instructional purposes only, the DAU 202 module may be used to output an analog signal to the SIM 203 readout. For more information, see the *Brief Product Description, p. 368*.

### Operation

The design of the SIM 203 uses the same form factor as the standard A120 I/O modules do; however, the SIM 203 has no bus connection in back. The SIM 203 fits in any available slot in a DTA housing, and it can be mounted in any available I/O slot (in the same way that a standard A120 I/O module is mounted). The SIM 203 can also be mounted directly on a DIN rail.

The SIM 203 has an interconnection cable that can be brought out either through the top or the bottom of the module cover. The individual cable wires can be connected to the corresponding terminal assignments of the ADU 204, ADU 205, or DAU 202. The module can also be connected to the analog terminals of a Modicon Micro model 612.

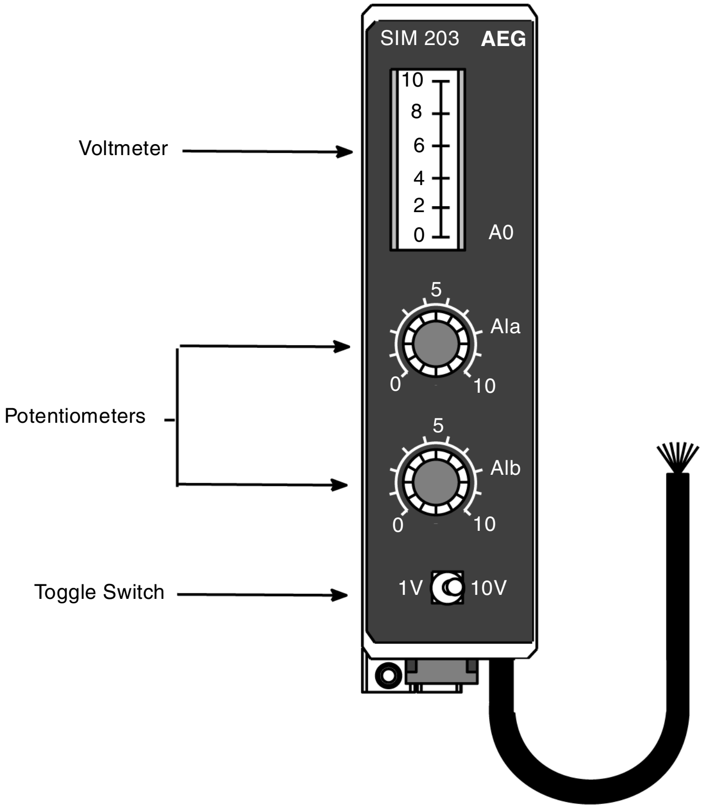
**Design**

The following list and figure describe the structure of the SIM 203.

The SIM 203 has the following principal parts:

- One output voltmeter (0 V ... +10 V)
- Two input potentiometers
- One toggle switch, which has the following two positions:
  - Toggle switch left position: 0 V ... +1 V (used with ADU 204’s PT100 slot)
  - Toggle switch right position: 0 V ... +10 V (used with ADU 205’s 10 V slot)

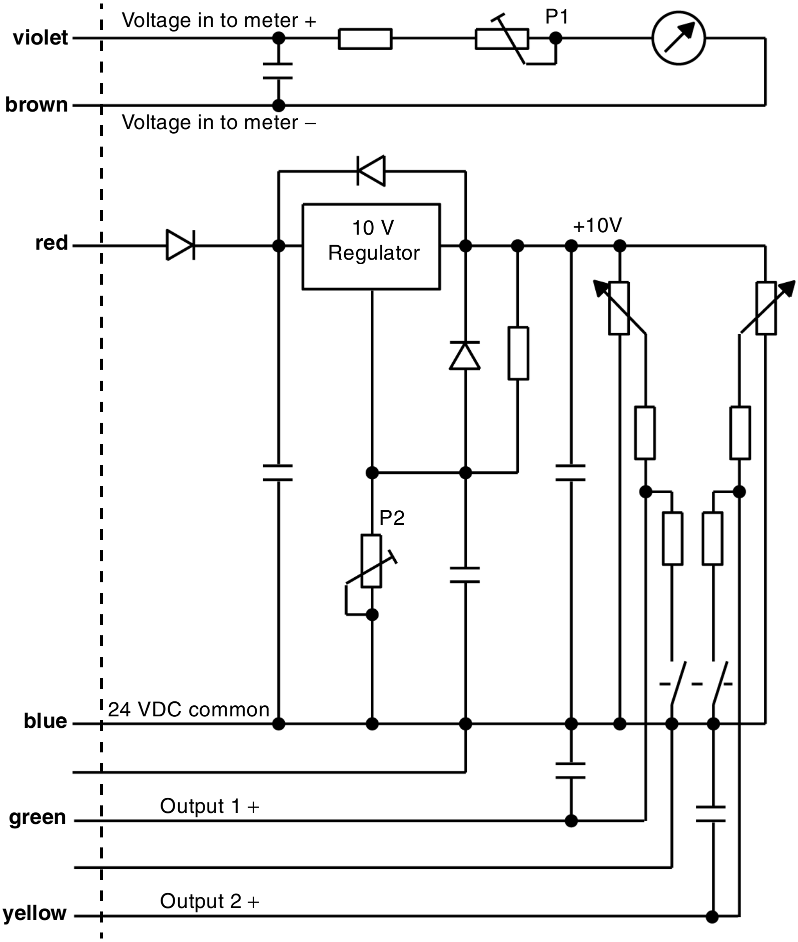
The following figure shows the front view of the SIM 203 Module.



**Wiring**

The SIM 203 module receives power from the 24 Vdc source on the controller. All of the units in the configuration must be properly grounded.

The wiring diagram, which follows, shows the connections for the SIM 203.



## Specifications

The following table lists specifications of the SIM 203 option module.

| **Electrical Characteristics** | |
|---|---|
| Power Supply Voltage and Current Required | 24 Vdc, 50 mA maximum |
| Signals to Controller | 2 analog signals, selectable |
| Output | 0 V ... +1 V |
| Input | 0 V ... +10 V |
| Input Signal from Controller | 1 analog signal: 0 V ... +10 V |
| **Physical Characteristics** | |
| Module | Standard A120 module form factor |
| Operating and Monitoring Devices | 2 potentiometers, 1 toggle switch, 1 voltmeter |
| Connections | Stripped wires, to be clamped to screw/clamp type terminals of A120 modules |
| **Dimensions** | |
| W x H x D | 40.3 x 145 x 117.5 mm (1.6 x 5.6 x 4.5 in) |

## SIM 216 Binary Simulator Module

**General**

For instructional purposes, the SIM 216 Binary Simulator module allows you to generate up to 16 binary input signals (24 Vdc) for Compact 984 controller modules.

The SIM 216 outputs interface to the controller through the DEO 216 and DEP 216 input modules, and the DAP 212 and DAP 220 combined I/O modules.

The SIM 216 module's power load is 24 Vdc, and it contains a thermally controlled resistor fuse, which adopts high resistance if loads exceed 0.65A. The fuse reassumes low resistance if load is reduced.

**Note:** The SIM 216 Module is a simulator module used for training purposes only. It is not a functional Compact 984 I/O module.

**Operation**

The design of the SIM 216 uses the same form factor as the standard A120 I/O modules do; however, the SIM 216 has no bus connection in back. The SIM 216 fits in any available slot in a DTA housing, and it can be mounted in any available I/O slot (in the same way that a standard A120 I/O module is mounted). The SIM 216 can also be mounted directly on a DIN rail.

The SIM 216 has an interconnection cable that can be brought out either through the top or the bottom of the module cover. The cable terminates into two 11-pole screw/ clamp-type terminals, to which the corresponding terminal assignments of the DEO 216, DEP 216, DAP 212, and DAP 220 are connected.

**Design**

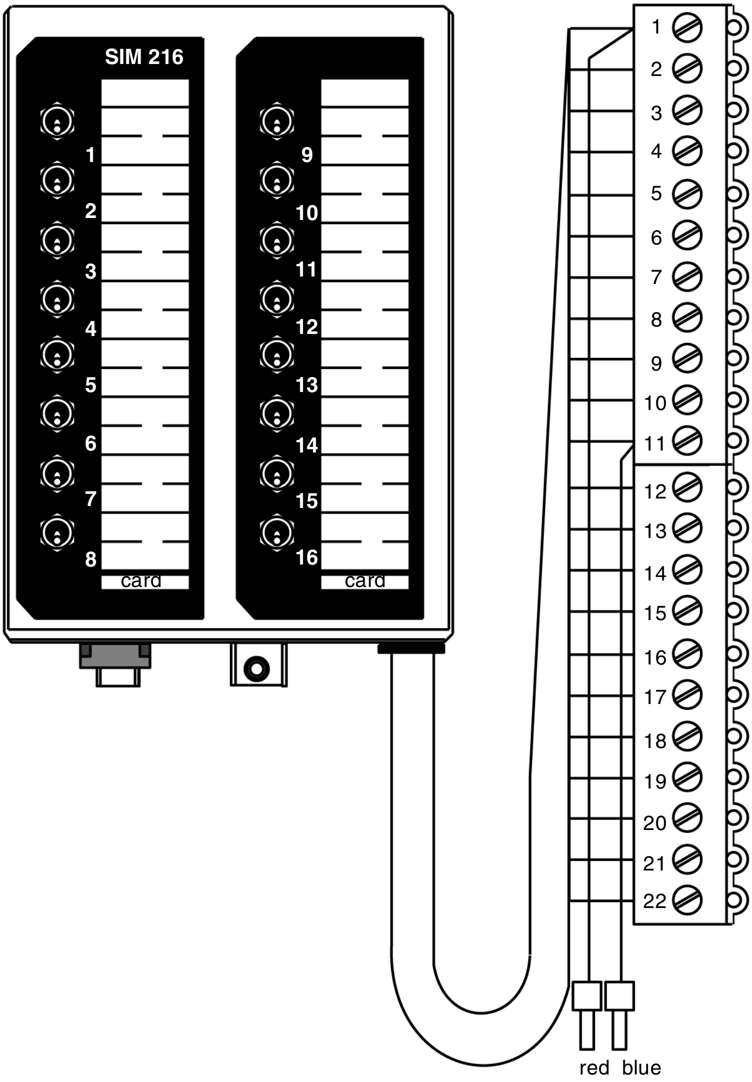
The following list and figure describe the structure of the SIM 216.

The SIM 216 has the following principal parts (which are shown in the figure):

- 16 toggle switches, including 2 latched and 1 jog switch
- Two 11-pole terminal strips, numbered 1-11 and 12-22

Note the two rows of removable cards alongside the toggle switches (refer to the figure). Use these cards to label the switches by function, voltage, input signal source, and so forth. It is suggested that you photocopy the original cards and use the photocopies to ensure a ready supply of labels.

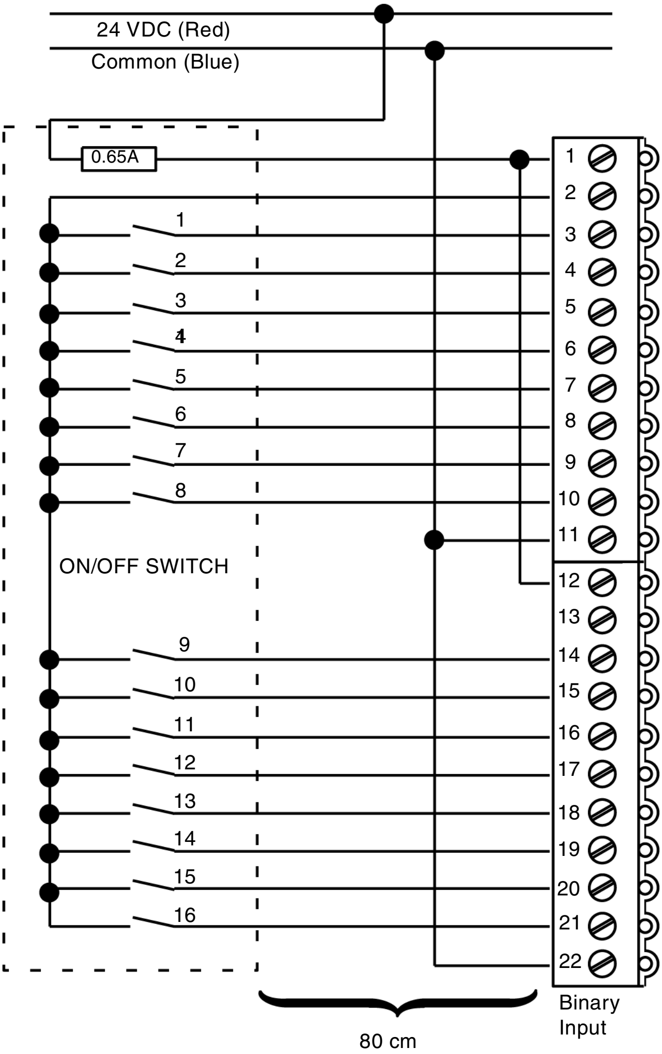
The following figure shows the SIM 216 front view and wiring terminals.



**Wiring**

The SIM 216 module can receive power from the 24 Vdc source on the controller. Make sure that all units in the configuration are properly grounded.

The wiring diagram, which follows, shows the connections for the SIM 216.

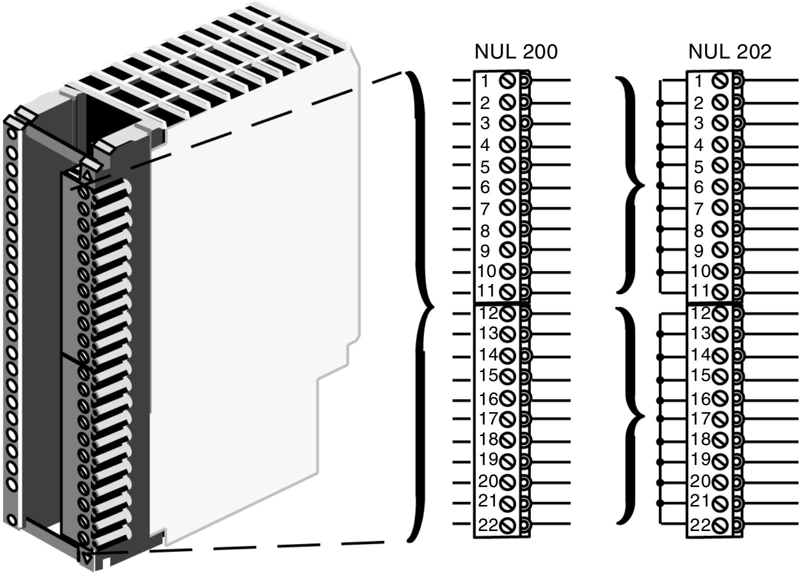


## NUL 200 and 202 Modules

**Design**

Two types of empty units, the NUL 200 and the NUL 202, are available. The design of these units uses the same form factor as the standard A120 I/O modules do. They fit in any available slot in a DTA housing, and allow you to prewire modules for future use.

The following figure shows the NUL 200 and the NUL 202.



**The NUL 200 Unit**

The NUL 200 is an empty unit that is used for the following: fixing cables not currently in use, field wiring reserve I/O slots, as a terminator, or as a rest for the snap-in front cover plate. It can be used in a partially configured DTA backplane, and it can be mounted in any available I/O slot, as does a standard A120 I/O module. The terminal screw connectors are all isolated from one another and from the I/O bus.

## NUL 200 Specifications

The following table describes the NUL 200 specifications.

| | | |
|---|---|---|
| Connectors | 22 isolated terminal screws for field wire cross-sections; 0.25 ... 2.5 mm2 | |
| Maximum Voltage | Between Adjacent Terminals | < or = 50 V |
| | Nonadjacent Terminals | < 250 V |

## The NUL 202 Unit

The NUL 202 is an empty unit that can be used for terminal multiplication. There are two groups of 11 terminal screws to terminate field wiring connections. The two internally combined groups may be used as connection multipliers for two potentials. The unit can be used in a partially configured DTA backplane, and it can be mounted in any available I/O slot as does a standard A120 I/O module.

## NUL 202 Specifications

The following table describes the NUL 202 specifications.

| | | |
|---|---|---|
| Connectors | Two groups of 11 terminal screws for field wire distribution; 0.25 ... 2.5 mm2 | |
| Maximum Voltage | < or = 50 V | |
| | Sum Current/Connector | 10 A (maximum) |

# Requirements for CE Compliance

## F

## At a Glance

**Introduction**

This chapter describes how to ensure your installation of A120 Series I/O modules is in compliance with the European Directive for EMC 89/336/EEC.

**Note:** The E984--258/265/275/285 PLCs meet EMC requirements by design. Therefore, this chapter does not apply to these four PLC models.

**What's in this Chapter?**

This chapter contains the following topics:

## CE Compliance Requirements for Compact 984 Group 1

### Group 1 Requirements

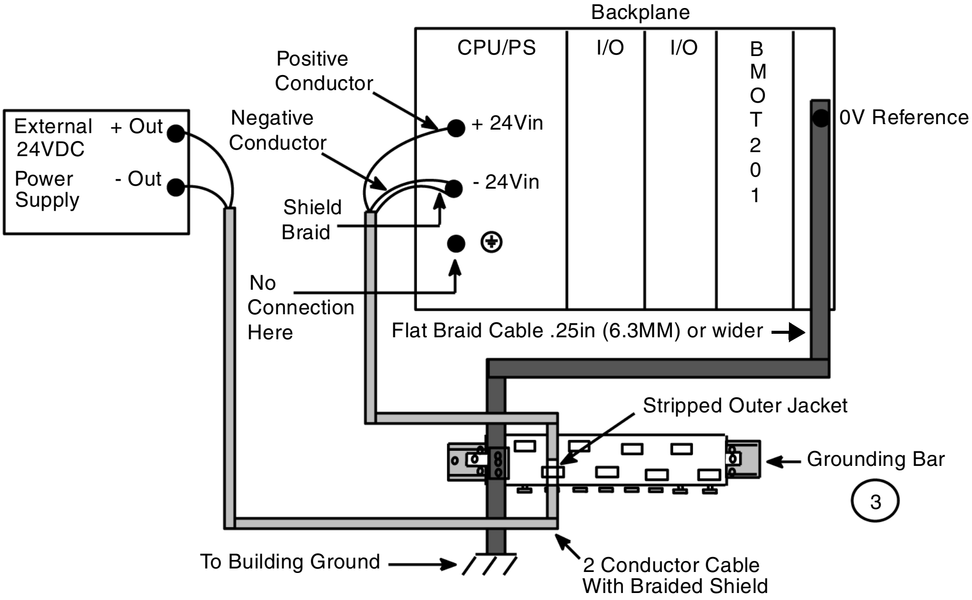
This section covers the installation requirements necessary to maintain compliance with the European Directive for EMC 89/336/EEC for certain (PC-A984-145, PC-E984-241, PC-E984-245, PC-E984-251, PC-E984-255, AS-BDAP-210, AS-BDAP-218, AS-BVIC-200, AS-BVIC-205, AS-BVIC-212, AS-BVIC-224, AS-BVRC-200, AS-BCTR-205, AS-BCTR-212, AS-BCTR-224, AS-BADU-211, AS-BADU-212, AS-BADU-204 and AS-BMOT-201) Compact 984 components.

**Note:** For details regarding specific I/O modules, please refer to the *A120 Series I/O Modules User Guide* (890 USE 109 00 formerly GM-A984-IOS).

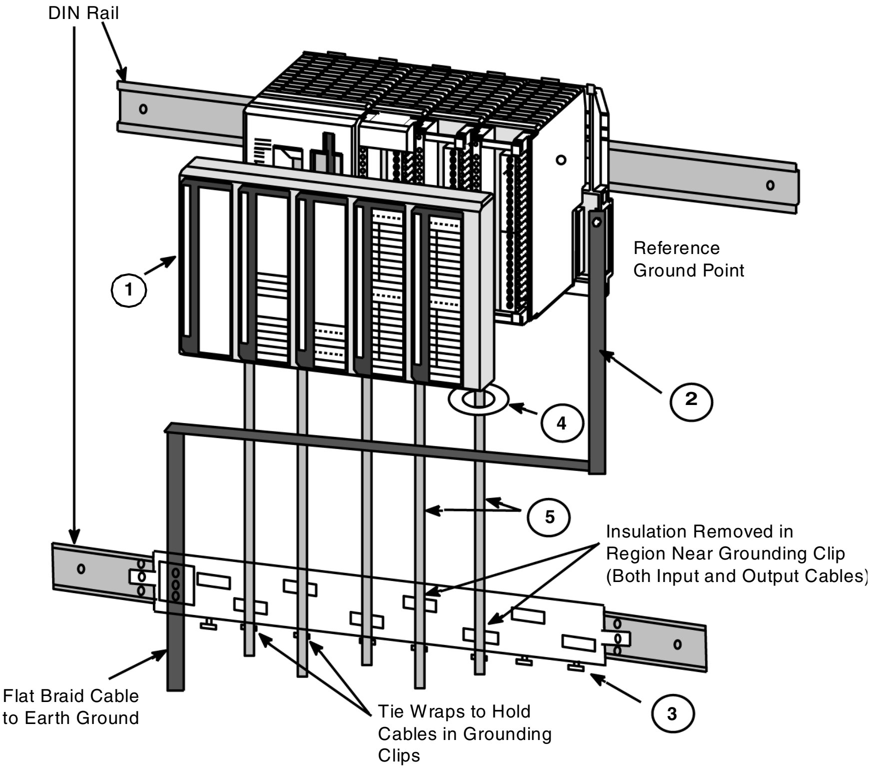
The following requirements should be followed for installations complying with the CE marking:

- Use Braided Shielded Cable on all power supply, communications, and I/O lines. Either the Modicon Grounding Bar (Modicon part number 043509693) or a compatible device may be used. The cable should have at least 80% shield coverage. When using the Grounding Bar, the Outer Diameter of the shield should be in the range of 0.189 ... 0.240 in (4.8 ... 6.0 mm).
- All cable shields must be grounded using the clips on the Grounding Bar as shown below. Alternatively, the user may supply an equivalent low impedance RF ground clamp.
- CPU/PS ground terminal (⊕) must be left open as shown.
- Install braided earth ground as shown below from building earth ground to grounding clip (or clips as required) and to backplane 0 Volt reference.
- Use the plastic faceplate supplied with the backplane to cover the front of modules.
- If using a BMOT-201 module, all cables (Motor I/O Cable, Encoder Cable and I/O Cable) exiting the BMOT-201 module must pass through a large Ferrite Bead (Steward part number 28 B2400-000).

The following figure shows a schematic view of the CE compliance requirements.



The following figure depicts the CE compliance requirements.



The following table is the Parts List for the Callout used in the two previous figures.

| Callout | Vendor (or equivalent) | Part Number | Description | Instructions |
|---|---|---|---|---|
| 1 | Modicon | Shipped with backplane | Plastic Cover | Installation is Required. |
| 2 | | | Flat Braid Cable .25in(6.3mm) or wider | |
| 3 | Modicon | 043509693 | Grounding Bar | All cable shields must be grounded. |
| 4 | Steward (Outside the United States call Livingston, Scotland at (0044) 1-506-414-200) | 28 B2400-000 | Ferrite Bead 1.37in(34.8mm) I.D.; 2.5in(63.5mm) O.D.; .44in(11.2mm) Thick | **For a BMOT-201 ONLY:** All cables (Motor I/O, Encoder and I/O cables) must pass through this large ferrite bead. Secure it with a tie wrap or equivalent. |
| 5 | | | Braided Shielded Cable. 80% shield coverage, # of conductor and gauge per user requirements. | |

## CE Compliance Requirements for Compact 984 Group 2

**Group 2 Requirements**

This section covers the installation requirements necessary to maintain compliance with the European Directive for EMC 89/336/EEC for certain (AS-HDTA-200, AS-HDTA-201, AS-HDTA-202, AS-BDAO-216, AS-BDAP-204, AS-BDAP-208, AS-BDAP-211, AS-BDAP-212, AS-BDAP-216, AS-BDAP-216N, AS-BDAP-217, AS-BDAP-220, AS-BDAP-250, AS-BDAP-252, AS-BDAP-292, AS-BDEO-216, AS-BDEP-208, AS-BDEP-210, AS-BDEP-211, AS-BDEP-214, AS-BDEP-215, AS-BDEP-216, AS-BDEP-217, AS-BDEP-218, AS-BDEP-220, AS-BDEP-257, AS-BDEP-254, AS-BDEP-296, AS-BDEP-297, AS-BADU-204, AS-BADU-205, AS-BADU-206, AS-BADU-210, AS–BADU–214, AS-BADU-216, AS-BADU-254, AS-BADU-256, AS-BADU-257, AS-BDAU-202, AS-BDAU-208, AS-BFRQ-204, AS-BBKF-201, AS-BZAE-201, AS-BZAE-204 and AS–BDEA–203) Compact 984 components. These particular modules operating voltages are Ub (24Vdc), working voltages Us (24Vdc/230Vac).

This open equipment apparatus must be mounted within an enclosure to prevent personal injury resulting from accessibility to live parts. This enclosure shall be opened by the use of a tool only.

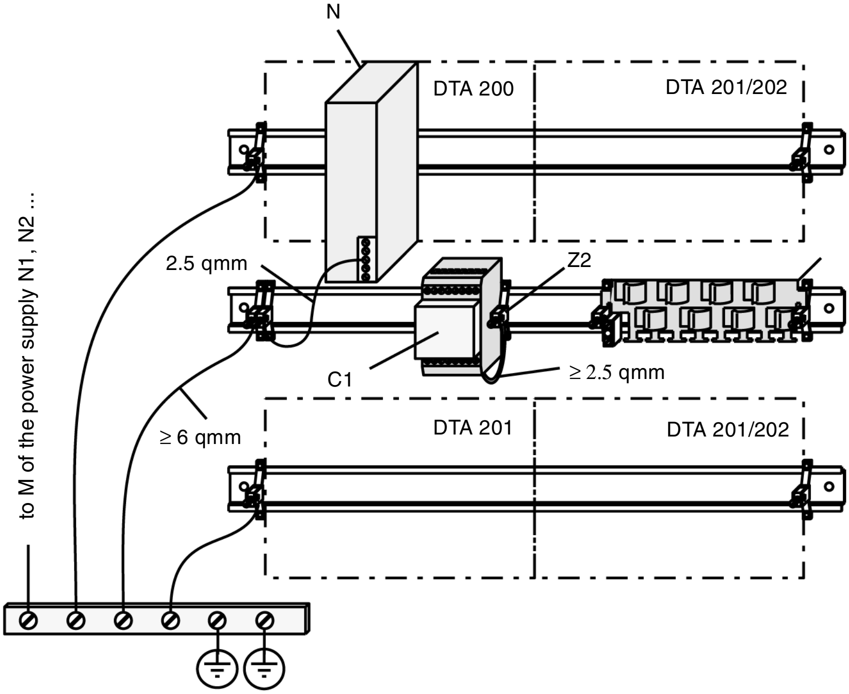
The following requirements should be followed for installations complying with the CE marking:

- Install equipment following approved EMC practices, i.e., protective earthing and functional earthing, connections with good conductivity, and grounding cables of sufficient cross section
- Avoid all sources of electrical disturbance in proximity of the equipment, encapsulation with metallic walls
- Use manufacturer approved cabling
- Use EMC compliant grounding of cable shielding (proper mechanical connection, connection surface, clamps)
- Separate data and signal cable routing, which emit disturbances (e.g. power cables with switching transients)
- Use the prescribed suppression filters and their competent installation

## Improvement of the EMC Stability on the Modules

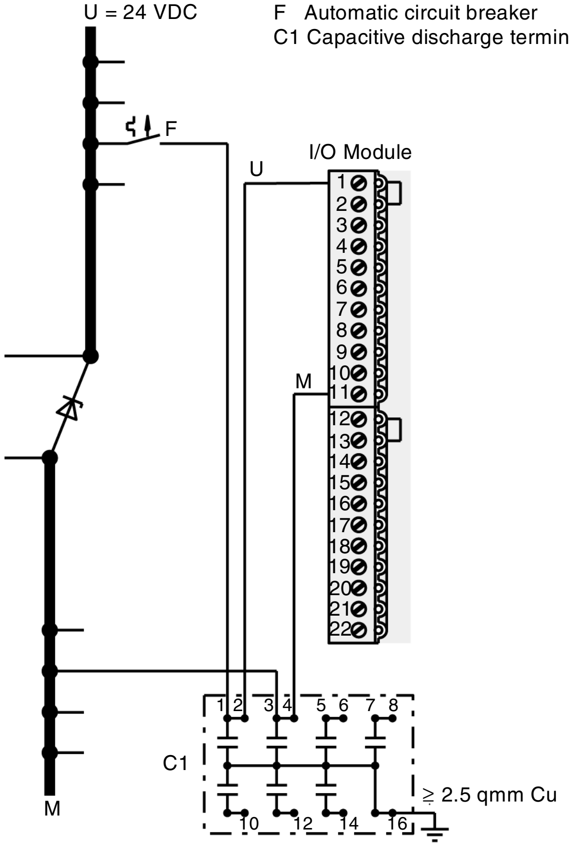
To improve EMC stability on the modules, it is recommended that the U (voltage) and M (common) connections used here have as short as possible capacitive discharge from the terminal towards the functional earth. This is the purpose of the capacitive discharge terminal (GND 001), which is shown in the following figure. In an environment that has a high interference level, an increase of the capacity on the C1 from 2.2 nF to 22 nF is recommended.

The following figure shows the use of the capacitive discharge terminal to improve EMC stability.



C1 Capacitive discharge terminal GND 001
N Power supply modules CPU / DEA / ASP / P120
Z2 Earthing cleat EDS 000
Z3 Cable earthing bar CER 001

The following figure shows another view of the capacitive discharge terminal.



**Earthing System of the Top Hat Rails and Modules**

The earthing system of the 0 V on the rack is already preset when delivered. More details are described in *Earthing System of the Shielded Cable Lines, p. 865* (the following section). To have noise-free operation, perform the following earthing system measures described in that section.

## Earthing System of the Shielded Cable Lines

The following table provides an overview of recommended shielded cables.

| Type | Features | Use |
|---|---|---|
| KAB-2277-LI | shielded, 3 x 0.14 qmm | DCF 77E to KOS |
| KAB-2205-LI | shielded, twisted-pair, 2 x 2 x 0.5 qmm | System fieldbus to DEA 201; inputs, outputs for ADU and DAU; counting input for ZAE 204; pulse counter for ZAE 201 |
| KAB-0505-LI | shielded, 5 x 0.5 qmm | Output unit on TXT 201 |
| KAB-0875-LI | shielded, 8 x 0.75 qmm | Sensors and drives for POS 202 |
| KAB-1005-LI | shielded, twisted-pair, 5 x 2 x 0.5 qmm | Group line to ZAE 204; position sensing for ZAE 201; sensors and drives for POS 202 |
| KAB-1014-LI | shielded, 10 x 0.14 qmm | Sensor for POS 202 |
| KAB PROFIB | shielded, inflexible,<br>2 x 0.64 qmm | PROFIBUS to DEA 203 |

# Technical Assistance

# G

## At a Glance

**Purpose**

This chapter describes resources that may prove useful in the installation and troubleshooting of A120 series I/O modules.

**What's in this Chapter?**

This chapter contains the following topics:

## Schneider Automation Customer Service Numbers

**Schneider Automation Telephone Numbers**

Schneider Automation telephone numbers are as follows:

- To call us from anywhere in North America except from within the state of Massachusetts: 1-(800)-468-5342
- To call us from within Massachusetts or from outside North America: 1-(978)-975-5001
- To call us in Seligenstadt, Germany: (49) 6182 81 2900, or fax us at (49) 6182 81 2492

When calling the *Schneider Automation* 800 telephone number, you will get a recording asking you to enter a one digit code for the type of service you request provided you use a *touch tone* telephone. The service categories and the extra digit responses for touch tone phones are:

The service categories - and *extra digit* code responses for push-button phones - are:

| | |
|---|---|
| 1 | Hardware or software technical support |
| 2 | Order entry, buying hardware or software |
| 3 | Modfax |
| 4 | Training/course registration inquiries |
| 5 | General information other than above. |

**Note:** MODFAX: For available hardware data sheets, application notes, and software information. Recommended catalogue MC-FAX-DIR, which is the master of all available catalogues, (only twelve pages) lists all catalogues available on the MODFAX system.

**Note:** BBS (Schneider Automation's Customer Service Bulletin Board): For Modsoft updates, conversion utilities, hardware and software help, field service bulletins, Modbus and Modbus Plus help, software revision levels, FLASH EXEC updates for Modicon equipment, and more. Parameters are up to 56.6k baud, no parity, 8 data, 1 stop, phone 1-(978)-975-9779.

## Installing the Loadables for A120 Series I/O Modules

### Overview

The following information describes how to install loadables.

### General Procedure

The SW-IODR-001 (Rev 1.20 or higher) loadable is available from the Customer Service Bulletin Board Service (978/975-9779). Note that all users of the A984- 1XX, Micro 512, and Micro 612 PLCs may be required to perform the following steps if a particular I/O module is not included in the module table.

| Step | Action |
|---|---|
| 1 | From the Main Menu, select **F-files to download**. |
| 2 | Then select **0-loadables**. |

### Update the Modsoft GCNFA120.SYS File (If Less Than Ver. 2.1)

The following information must appear in the *GCNFA120.SYS* file in the *Modsoft/ Runtime* directory, if the file version is less than Ver. 2.1. Edit your file accordingly.

- BMOT201,110,0,12,12,1-AXIS MOTN ,1,
- BMOT202,111,0,12,12,1-AXIS MOTN ,1,
- DEP211,17,0,1,0,8-I 110VAC ,0,
- DEP215,46,0,2,0,16-I 5VDC TTL ,0,
- DEP217,45,0,2,0,16-I 24VDC ,0,
- DEP214,20,0,2,0,16-I 10-60VDC ,0,
- DAP217,42,0,0,2,16-O 24VDC ,0,
- VIC2XX,120,0,6,6,COUNTER ,0,
- ADU211,118,0,6,6,8 CHN ANALOG ,0,
- ADU216,59,0,10,2,8 CHN A/D TC ,0,
- ADU214,36,0,6,4,4/8 CHN A/D ,1,
- ADU204,32,0,8,0,4 CHN 0.5V ,1,
- DAU204,117,0,2,12,4 CHN OUTPUT ,1,
- DAP211,10,0,1,1,4 MIXED I/O ROVAC ,0,

## Procedure for Installing the SW-IODR-001 Loadable

Use the following steps to install the SW-IODR-001 Loadable.

| Step | Action |
|---|---|
| 1 | Using Modsoft, from the OFFLINE Mode menu, select **PROGRAM**. |
| 2 | Once the program is loaded, select **CONFIG**uration. |
| 3 | From the Configuration Overview Screen, select **LOADABLE**. |
| 4 | To install the loadable, select **DIR**ectory and enter the applicable file name, for example, `drive:\MODSOFT\PROGRAM\SVI.DAT`. The file names are listed in *Applicable File Names and Modules, p. 870*, immediately following this procedure. |
| 5 | Once the file is loaded, select **EDIT**, and then **INSERT**. |
| 6 | Select the applicable loadable, for example, *#SVI*. The names of the loadables are listed in *DX Loadable Configuration Files and File Names, p. 870*. |
| 7 | To load the program into the PLC, return to the Main Menu and select **TRANSFER**. |
| 8 | Select **File to PLC**. The loadable will now be installed in the PLC as part of the configuration and user logic. |

## Applicable File Names and Modules

The following table lists the file names for the modules to load in *Procedure for Installing the SW-IODR-001 Loadable, p. 870*.l

| File Name | Module |
|---|---|
| BMOT.DAT | BMOT20X |
| DSC1.DAT | DEP211, 214,215, 217, and DAP217/211 |
| SVI.DAT | ADU211,VIC2XX, and DAU204 |
| ADU216.DAT | ADU216 |
| ADU214.DAT | ADU214 |

## DX Loadable Configuration Files and File Names

The following table lists the configuration file names for the loadables to use in *Procedure for Installing the SW-IODR-001 Loadable, p. 870*.l

| DX Loadable Configuration File | File Name |
|---|---|
| #MOT | BMOT.DAT |
| #DS1 | DSC1.DAT |
| #SVI | SVI.DAT |
| #216 | ADU216.DAT |
| #214 | ADU214.DAT |
| Note that the Rev, size, and opcode will vary from file to file. | |

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