Modicon
512/612 Micro PLC
Hardware User Manual

890 USE 145 00 Ver 1.0

Contents

General Hardware Characteristics

Hardware Characteristics

- On-board CPU, memory, fixed I/O circuitry, and power supply
- 16 MHz CPU speed for handling I/O throughput
- A built-in time-of-day clock
- A parallel expansion port for up to three racks of A120 I/O modules
- 24 VDC high-speed inputs that can be configured to operate as dedicated hardware interrupts and/or a user-configurable counter/timer/interrupt input
- Two RS-232 ports, **comm 1** and **comm 2**, for communication with programming devices and with ASCII input/display devices
- Comm 2 of 61204 (only) supports Modbus master XMIT block. Default condition is slave. XMIT enabled permits port to be temporary Modbus master ASCII or RTU mode.
- Comm 1 or Comm 2 of 512xx and 612xx supports comm block, which is Modbus master ASCII only.
- An RS-485 port for serial I/O expansion with other Modicon Micro PLCs

The 612 models also support four analog input channels and two analog output channels.

The AC units (Models 51201 and 51202) have an on-board 24 VDC power supply that provides 150 mA. This supply is suitable for driving the hardware interrupts or the 24 VDC I/O points in an AC environment.

Customer Part Number	Power Supply	
110CPU51200	24 VDC	16 (24 VDC) in 12 relay out
110CPU61200	24 VDC	16 (24 VDC) in 12 relay out 4 analog in 2 analog out
110CPU51201	115 VAC	16 (115 VAC) in 8 triac out 4 relay out
110CPU51202	230 VAC	16 (230 VAC) in 8 triac out 4 relay out
110CPU51203	24 VDC	16 (24 VDC) in 12 (24 VDC) FET out
110CPU61203	24 VDC	16 (24 VDC) in 12 (24 VDC) FET out 4 analog in 2 analog out
110CPU61204	24 VDC	16 (24 VDC) in 12 relay out 4 analog in 2 analog out

PLC Operating Modes

The PLCs can operate in any one of three modes:

- As a *single* PLC—i.e., a stand-alone programmable control system
- As a *parent* PLC on an I/O expansion link—with the ability to access the fixed I/O resources of the PLC(s) in child operating mode on the link
- As a *child* PLC whose fixed I/O resources can be accessed by the parent on an I/O expansion link

☞ **Note** Whenever A120 I/O is used in a child PLC, the logic that controls the A120 I/O must be run in the child. A parent cannot access the A120 I/O connected to a child—it can access only fixed I/O resources of its children.

Memory Resources

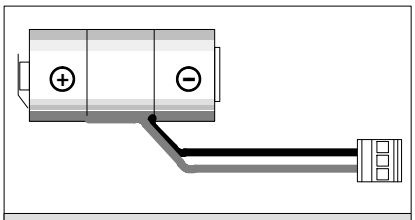
- 128 kbytes of RAM
- 2048 words available for program memory
- 2048 words of data memory
- 110CPU61204 PLC has 8192 words of user data memory

☞ **Note** The execution buffer is large enough to load the XMIT loadable or the Gas loadable without reducing the 8K of available user logic.

Memory Backup Options

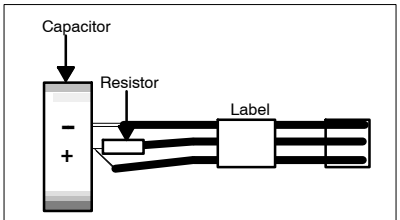
User memory—for the system configuration and application program—can be backed up in three ways:

- Using an optional (110XCP98000) lithium battery assembly



110XCP98000 Lithium Battery Assembly

- Using an optional (110XCP99000) battery capacitor assembly



110XCP99000 Battery Capacitor Assembly

- Writing the information to a reserved area in the PLC's Flash RAM

The optional lithium battery or battery capacitor will automatically back up the current user memory in the event of a power shutdown. The battery can safely back up the data for one year. The battery capacitor can back up a typical user logic program for 72 hr.

☞ **Note** The 110XCP990000 battery capacitor must be charged in a powered-up PLC for at least 24 hours to assure full memory backup.

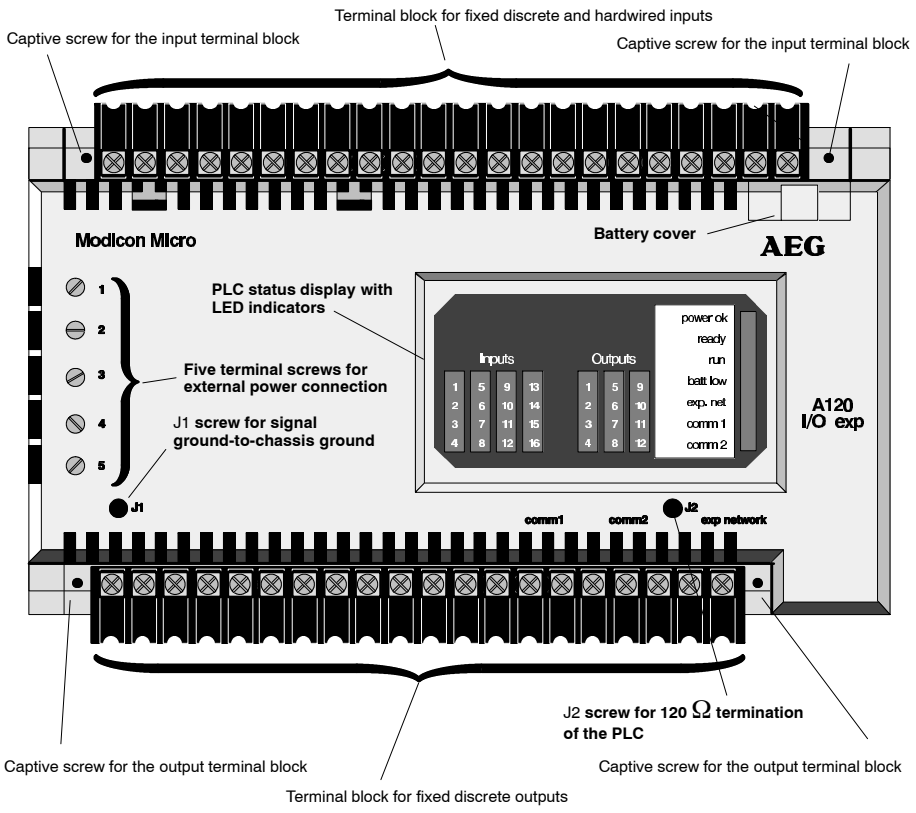
The ability to back up user memory by writing it to Flash RAM is a standard feature of all Micro PLCs, except the 61204. Because of limitations of Flash storage capabilities in 61204, a battery is the only method available to backup user memory. Memory backed up in Flash remains completely nonvolatile over time.

If you are using Flash RAM backup, save the changes you make in your program and/or system configuration at the end of each edit session. The **Save to Flash** command is issued from your panel software.

Whenever PLC power is lost and then restored, the system firmware first attempts to restore any battery-backed memory. If there is no battery-backed memory, then it will restore any configuration and/or programming information stored in Flash—remember that information in Flash is only as current as the last time you issued a **Save to Flash** command. If there is no user memory saved in Flash, the firmware will assign the PLC a set of default configuration parameters and no logic program will exist.

General Hardware Overview

Front View of a 512 PLC*



* The 612 PLC has an additional set of terminal blocks for analog I/O (see page 11).

The I/O Terminal Blocks

The terminal block at the top of the PLC provides screw terminal connections for the 16 fixed discrete inputs and the high-speed interrupt and counter/timer/interrupt inputs. The terminal block at the bottom of the PLC provides screw terminal connections for the fixed discrete outputs (groups of relay, triac, and/or FET outputs).

To make field wiring easier, terminal blocks can be removed from the PLC base. To remove a terminal block, loosen the two captive screws on the left and right of the block with a slotted screwdriver until they spring free of their mating pieces in the unit base. Then use the screwdriver to pop the block out of the PLC base.

Use a Philips #2 screwdriver to make the field wire connections to the terminal screws, then push the terminal blocks back on the PLC base.

The J1 and J2 Screws

Two factory-set screws are installed on the front of the unit. The **J1** screw is located below the power connectors on the left front of the unit, and the **J2** screw is located below the PLC status display on the right front of the unit.

The position of the **J1** screw in the PLC housing determines whether there is conventional signal ground-to-chassis grounding or grounding at different potentials for non-grounded applications.

When **J1** is fully tightened—i.e., in its factory-set position—both signal ground and chassis ground in the PLC are tied together and to the input power terminal block ground screw. This is the preferred method of grounding for all single, parent, or child PLCs whenever solid earth ground is available.

When the **J1** is loosened (counterclockwise), it disconnects earth ground from signal ground. The PLC can now be connected as part of a non-grounded or single-point ground system. In a single-point ground system, only one PLC needs to be tied to chassis ground (**J1** screw tightened); all other PLCs in the system can be referenced to this single point over the I/O expansion link (their **J1** screws loosened). The expansion link must always be attached to prevent communication errors in the ungrounded PLCs.

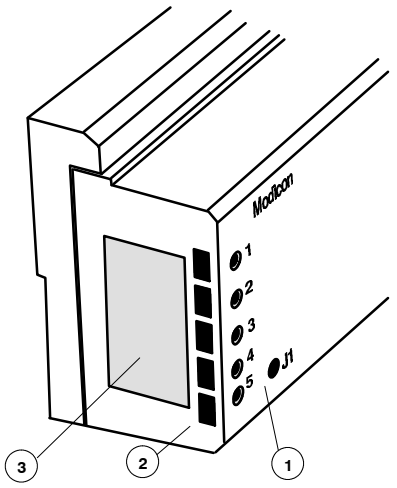
Caution Before you power up your system, make sure that all the PLCs are at the same earth ground potential to reduce communication errors, ground loop lockups, and damage to the PLCs or other attached devices.

The **J2** screw provides 120 Ω termination for the PLC when it is tightened—**J2** is shipped from the factory in a tightened position. When the PLC is operating in *single* mode or when it is a *parent* or *child* at the head or tail end of an I/O expansion link, the **J2** screw must remain tightened. When the PLC resides in a non-terminating location on an I/O expansion link, the **J2** screw must be loosened by one turn.

Wiring External Power

External connections to the power supply are made at the five terminal screws located on the left front of the PLC. The wires from the external source are fed to the appropriate screws through slots along the left side of the PLC, as shown in the following illustration.

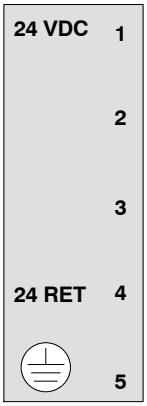
A Left Front Isoview of the PLC



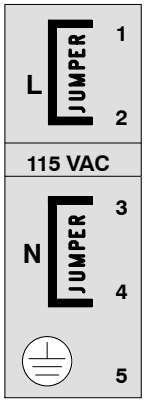
1. Five terminal screws for external power wiring
2. Side slots for leading wires from the power source to the terminal screws
3. Label indicating power wiring scheme

The label affixed to the left front of the PLC indicates the power wiring scheme.

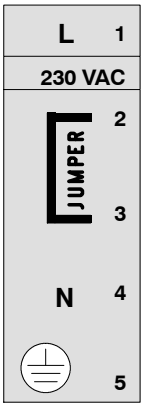
- Model 110CPU51200, 110CPU61200, 110CPU51203, 110CPU61204, and 110CPU61203 PLCs use a 24 VDC external power source, wired like this:



- Model 11051201 PLCs use a 115 VAC external power source, wired like this:



- Model 51202 PLCs use a 230 VAC external power source, wired like this:



The labels for the power source terminal connections are in red lettering.

Note Add a wire loop between the pins labeled **JUMPER**.

PLC Status Display

The display panel on the front of the Micro PLCs uses light-emitting diodes (LEDs) to indicate the health and status of the unit's CPU, battery, communication ports, and fixed I/O points. The column of LEDs on the right side of the unit indicates PLC status:

PLC Status LEDs	
LED	**Function**
power ok	A green LED turned ON when internal power is OK
ready	An amber LED that is ON when the PLC has passed its power-up diagnostics, and remains ON as long as the PLC is healthy
run	A green LED that is ON when the PLC has started and is solving logic and that flashes when the PLC has power but cannot find a valid configuration/ operating mode
battery low	A red LED that goes ON when the internal battery needs to be replaced (Replacement should be within 14 days of the initial LED indication.) This LED also goes ON if a problem is detected in the optional battery capacitor or if the capacitor is not fully charged.
exp. link	A green LED that goes ON steadily when valid communications occur on the I/O expansion link, and flashes when errors occur on the link. similar **exp link** indications occur in both PLCs involved in the communication
comm 1	A green LED that flashes when communi--cations occur on the first RS-232 port
comm 2	A green LED that flashes when communications occur on the second RS-232 port

The array of LEDs on the left side of the display indicates the status of the fixed discrete I/O points on the PLC. Each fixed input and output point lights a number (1 ... 16 for inputs, 1 ... 12 for outputs) with a red LED when the associated discrete point is ON.

To reference the physical I/O point to an LED number in the display, refer to the field wiring diagrams presented in this book.

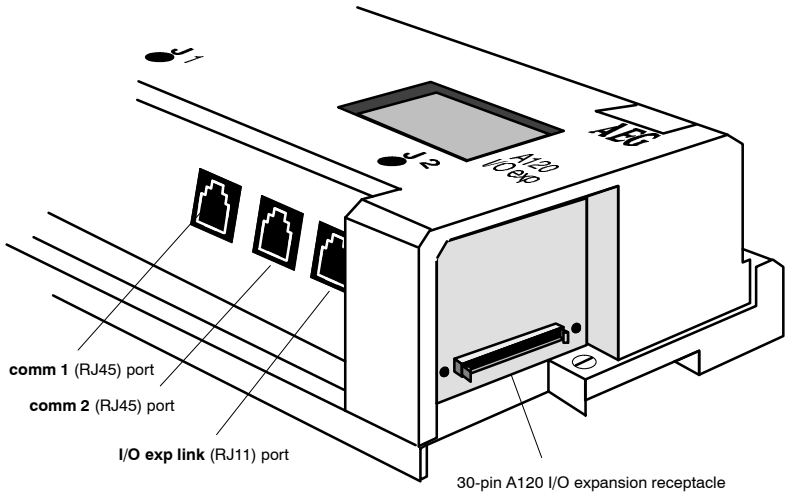
If the **run** LED on the right is flashing in conjunction with any of the input LEDs, an error has been detected. The pattern of the input LED flashes indicates the nature of the error. The person programming the PLC can refer to the ***Modicon Micro Ladder Logic Manual*** (890 USE 146 00) for a description of system crash codes.

Comm Ports

Two RS-232 (**comm 1** and **comm 2**) ports and one RS-485 (**I/O exp link**) port are located on the bottom of each unit. The RS-232 ports use eight-position RJ45 (phone jack-type) connectors. The RS-485 port uses a six-position RJ11 (phone jack-type) connector.

The comm ports are multi-functional, and under the control of the system firmware, Their capabilities are described in the ***Modicon Micro Ladder Logic Manual*** (890 USE 146 00) and your panel software documentation.

Bottom Isoview of the PLC



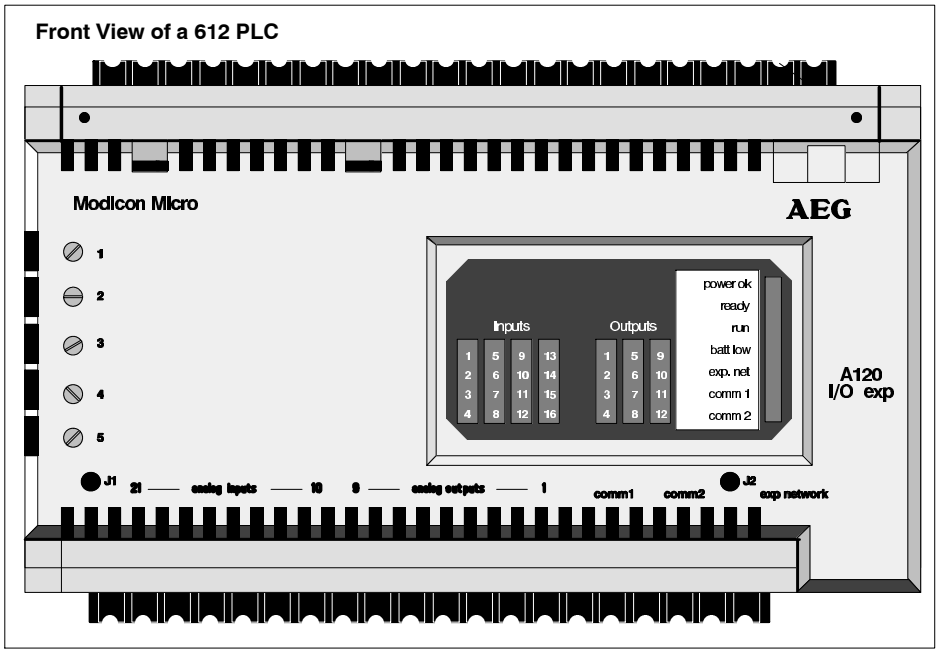
A120 I/O Expansion Port

A dedicated A120 I/O parallel expansion port is located on the right side of the unit. It is a 30-pin, dual-row receptacle with locking tabs. It will accept the connector on the left side of a DTA 201 or DTA 202 rack, which houses the A120 I/O modules.

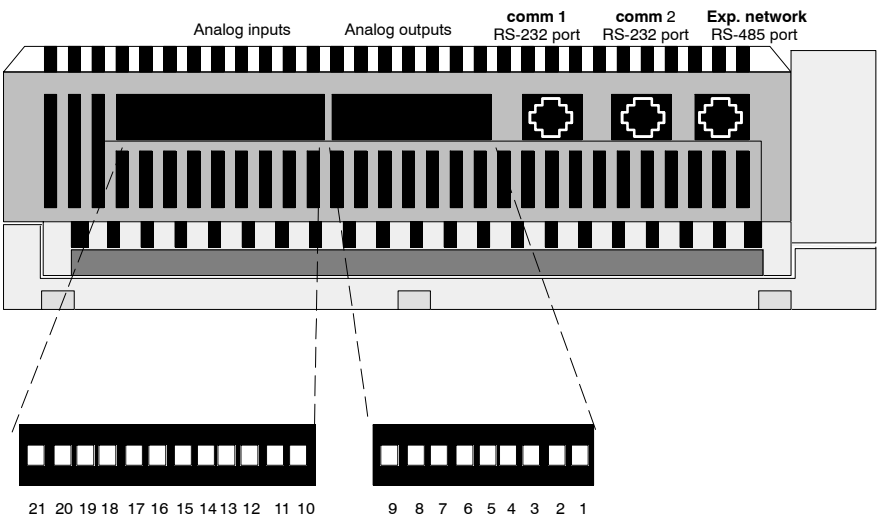
Fixed Analog I/O in the 612 Models

The 110CPU61200, 62103 and 61204 PLCs have the additional feature of fixed analog inputs and outputs. The analog I/O is labeled across the lower left front of the unit assembly, the inputs labeled 21 ... 10 from left to right and the outputs labeled 9 ... 1 left to right. Here is how the front of the unit looks:

Front View of a 612 PLC



The additional connectors for analog input and output channels are located on the bottom of the unit to the left of the comm ports. The illustration on the following page shows the pin positions.



A Bottom View of a 612 CPU Unit

Two analog connectors are provided with the 612 PLCs—a 12-pin analog input connector and a 9-pin analog output connector. Each pin number is displayed on the connector.

Base Unit Specifications

Electrical

Input voltages	
120 VAC input	96 ... 132 V RMS, 47 ... 63 Hz
230 VAC input	192 ... 264 V RMS, 47 ... 63 Hz
24 VDC input	19.2 ... 30.0 VDC
Output voltage	
24 VDC output	20.5 ... 29.0 VDC @ .15 A maximum
Output ripple and noise	
24 VDC output	2.5 V peak-to-peak @ 100/120 Hz maximum
Electrical immunity	
ESD	IEC 801-2, level 3
Radiated EMI	IEC 801-3, level 3
Fast transient	IEC 801-4, level 2
Surge transient	IEC 801-5, level 3
Input power interrupt	
AC inputs	< 0.5 period with no affect
DC inputs	< 1 ms with no affect
Ring wave	IEEE-STD 472 (1974) IEC-255-4, level 3
Isolation voltages	
AC in to system ground	1780 V RMS, 1 min
AC in to chassis ground	1780 V RMS, 1 min
DC in to system ground	500 V RMS, 1 min
Input Power Specifications **(Values in Amps)**	

Part Number	I/O and CPU Description		Base Unit More than 6 Outputs ON	Add if Hand–Held is Used	Add if PAB is Used
110CPU51200	DC Relay CPU 24V	.30	.50	.05	.125
110CPU61200	DC Relay CPU 24V	.30	.50	.05	.125
110CPU61204	DC Relay CPU 24V	.30	.50	.05	.125
110CPU51203	DC/DC FET CPU 24V	.25	.27	.05	.125
110CPU61203	DC/DC FET CPU 24V	.25	.27	.05	.125

Input Power Specifications (continued)
(Values in VA)

Part Number	I/O and CPU Description		Base Unit More than 6 Outputs ON	Add if Hand–Held is Used	Add if PAB is Used
110CPU51201	115VAC/Triac CPU 115V	21.0	23.1	2.1	5.25
110CPU51202	230VAC/Triac CPU 230V	21.0	23.1	2.1	5.25

Input voltage fuses
AC inputs — $^1/_4$ A SB in each primary input transformer
DC inputs — 1.6 A SB in series with the input circuit

Power for external devices
for a programming panel — +5 VDC @ 150 mA continuous (maximum)
for A120 I/O expansion — +5 VDC @ 250 mA continuous (maximum)

Environmental

Operating Temperature	0 ... 60 degrees C
Storage Temperature	–40 ... +85 degrees C
Relative Humidity	95% noncondensing
Altitude	3800 m (15,000 ft)
Shock	30 g for 11 ms, 3 pulses/axis for up to 18 pulses
Vibration	10 ... 62 Hz @ .075 mm displacement amplitude, 62 ... 500 Hz @ 1 g Duration: 23 min @ 2 sweeps/axis on 3 mutually orthogonal axes at a rate of 1 octave/min
Dimensions	
Height (including I/O terminal blocks):	158.75 mm (6.25 in)
Width:	254 mm (10 in)
Depth:	76 mm (3 in)
Weight	1.45 kg (3.2 lb)
Chemical Environmental	Enclosures are made of Lexan, a polycarbonate that can be damaged by strong alkaline solutions

Agency Approvals

All models are F.M. Class I, Div. 2 approved (except for the 61204 which is pending), and are designed to meet VDE 0160 standards

The following models are UL 508 Listed for Industrial Control Equipment and CSA 142 Certified for process control equipment:

110CPU51200
110CPU51201
110CPU51202
110CPU61200
110CPU61203
110CPU61204

The 110CPU51203 is CSA Certified, with UL pending

CE Compliance

To maintain compliance with the European Directive on EMC (89/336/EEC), the Micro controller must be installed in accordance with these installation instructions.

Conformal Coating

The 61204 is available as an option with conformal coating, (110CPU61204C).

Optional Hardware Part Numbers

RS-232 communication cable assemblies (with RJ45 connectors on both ends)	
1 m (3 ft)	110XCA28201
3 m (10 ft)	110XCA28202
6 m (20 ft)	110XCA28203
RS-485 I/O expansion link cable assemblies (with RJ11 connectors on both ends)	
61 cm (2 ft)	110XCA17101
3 m (10 ft)	110XCA17102
6 m (20 ft)	110XCA17103
1000 ft reels of flat cable	
Eight-position (for RS-232)	490NAA00010
Six-position (for RS-485)	490NAA00020
RJ45 connectors (20/box)	490NAD00010
RJ11 connectors (20/box)	490NAD00020
RJ type connector tool	490NAB00010
RJ11 die set	490NAB00011
RJ45 die set	490NAB00012
RJ11 Y–connector	110XCA10100
RJ45 adapter connections	
9-pin	
Premade for PC-ATs	110XCA20300
Wire-it-yourself (male)	110XCA20301
Wire-it-yourself (female)	110XCA20302
25-pin	
Premade for PC-XTs	110XCA20400
Wire-it-yourself (male)	110XCA20401
Wire-it-yourself (female)	110XCA20402
Lithium battery assembly	110XCP98000
Battery capacitor assembly	110XCP99000
Spare I/O terminal strips and covers	
Input (22-pin)	110XTS00122
Output (20-pin)	110XTS00120

Partial Sampling of Available A120 I/O Modules

Discrete Input Modules	
8 point 230 VAC	AS-BDEP-208
8 point 115 VAC	AS-BDEP-209
8 point 115 VAC	AS-BDEP-210
16 point 24 VDC (isolated)	AS-BDEP-216
16 point 24 VDC (non–isolated)	AS-BDEO-216
16 point 24 VDC Fast Response	AS-BDEP-220
16 point 115 VAC	AS-BDEP-218
Discrete Output Modules	
4 point Relay	AS-BDAP-204
8 point Relay	AS-BDAP-208
8 point 115 VAC	AS-BDAP-209
8 point 24-230 VAC	AS-BDAP-210
16 point 115 VAC	AS-BDAP-218
16 point 24 VDC (isolated)	AS-BDAP-216
16 point 24 VDC	AS-BDAO-216
Discrete Combination Modules	
8 point 24 VDC in / 4 point Relay out	AS-BDAP-212
8 point 24 VDC in / 8 point 24 VDC / 2 A out	AS-BDAP-220
Analog Input Modules	
4 channel +500 mV RTD	AS-BADU-204
4 channel +10 V/+20 mA	AS-BADU-205
4 channel 12 bit	AS-BADU-206
8 channel 12 bit RTD TC Vdc mA	AS–BADU-21x
8 channel 12 bit RTD Vdc mA	AS–BADU-214
8 channel 15 bit TC Vdc	AS–BADU-216
Analog Output Modules	
2 channel +10V / +20 mA	AS-BDAU-202
8 channel +10 V	AS-BDAU-208
Intelligent Modules	
4 point turbine meter/frequency	AS-BVRC-2xx
4 point high speed input	AS-BCTR-2xx
4 channel 50 kHz high speed counter	AS-BZAE-204

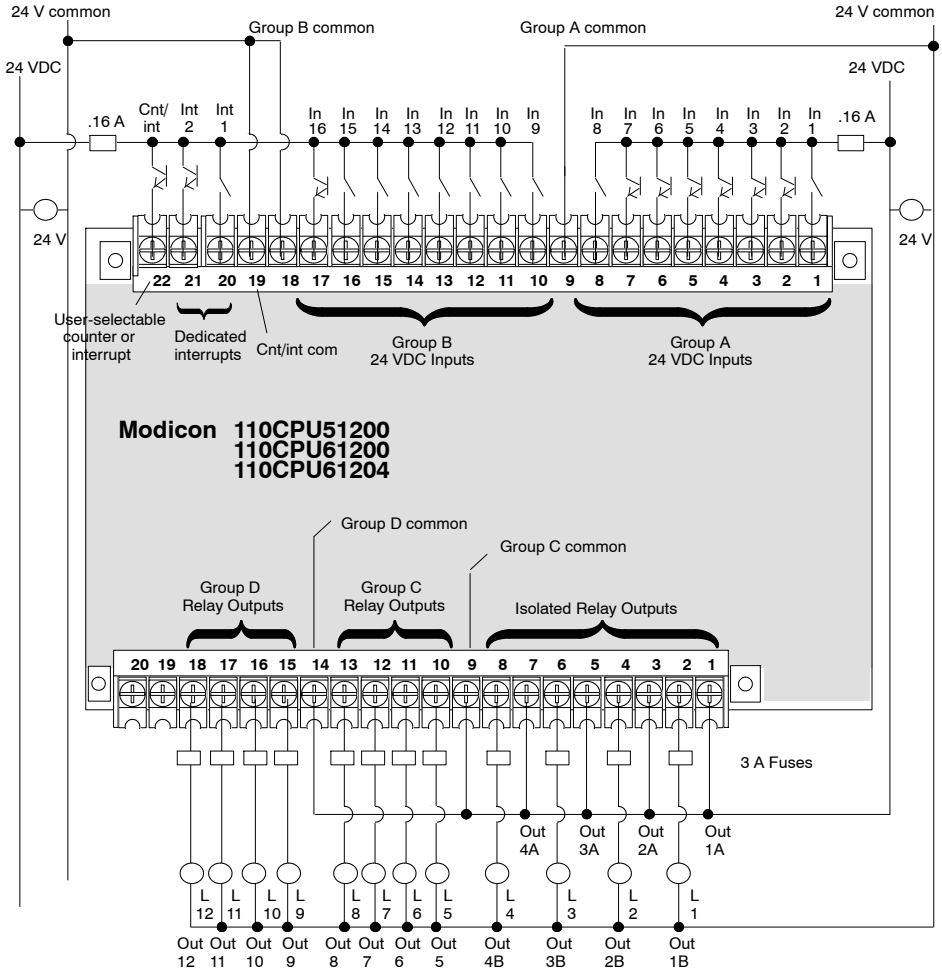
For more details and a complete listing of all current A120 I/O modules, see ***Modicon A120 Series I/O Modules User Guide***, 890USE10900 formerly GM-A984-IOS.

Fixed I/O Specifications

110CPU51200/61200 Field Wiring (under 24 VDC power)

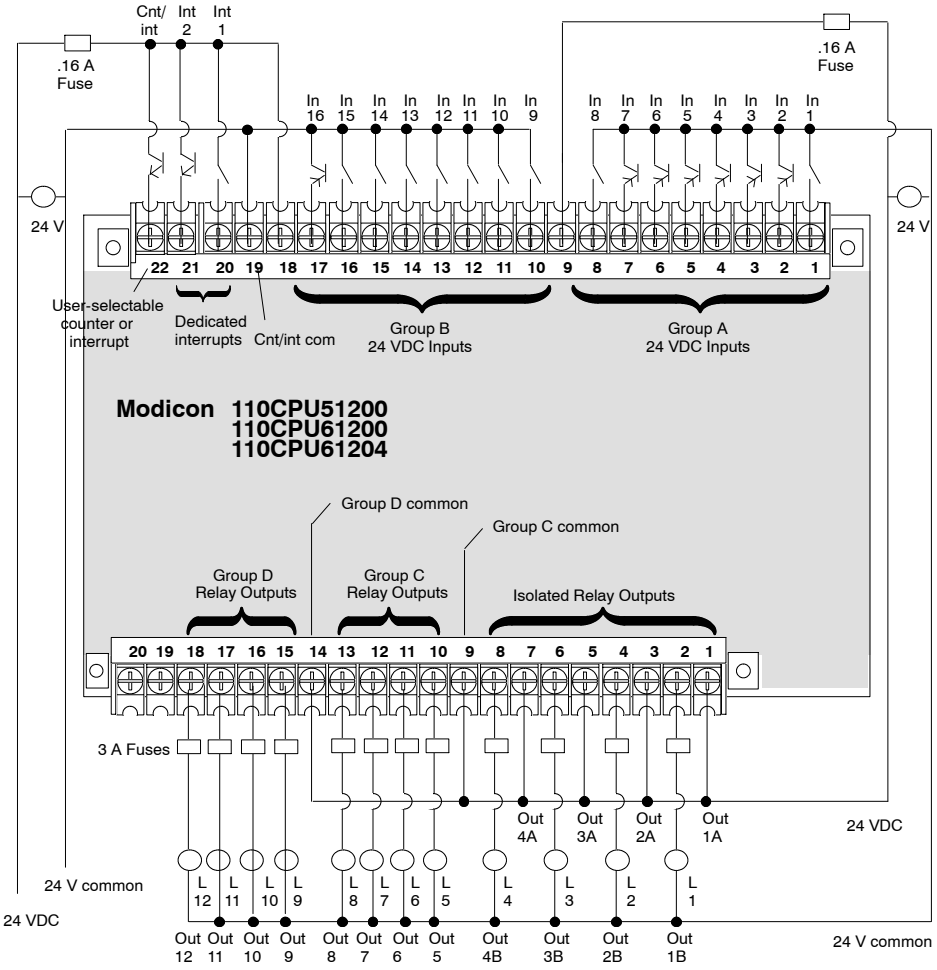
Fixed Discrete I/O Topology		
I/O Type	**Number of I/O Points**	**Number of Groups**
24 VDC inputs	16	2 groups of 8
24 VDC user-selectable counter/interrupt	1	1 group of 3
24 VDC dedicated high-speed interrupts	2	
Relay outputs	12	2 groups of 4 and 4 individually isolated

with Source-configured 24 VDC Inputs



Note Fast-blow fuses are recommended for input and output protection.

with Sink-configured 24 VDC Inputs



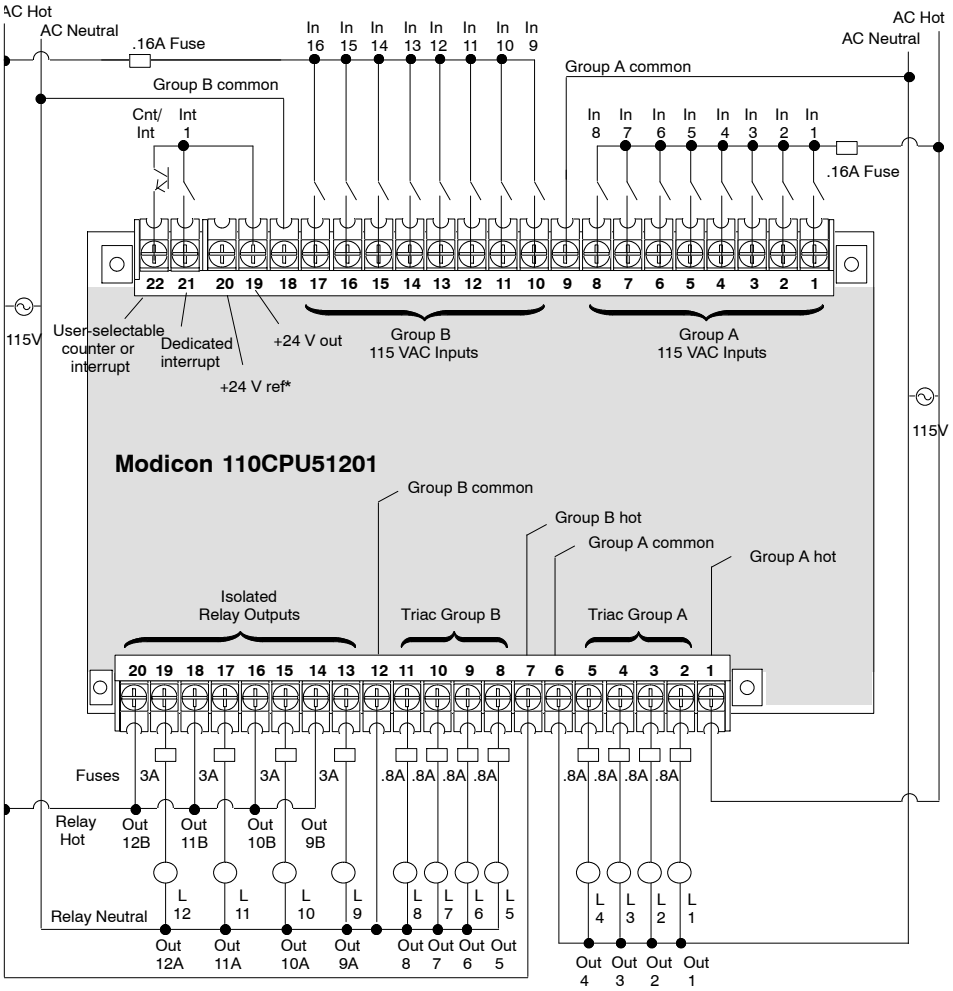
Note Fast-blow fuses are recommended for input and output protection.

☞ **Note** To reduce the risk that electrical noise from field I/O devices will effect Micro operation, we recommend that a separate 24 VDC power source be used for the field I/O. A dual power-source configuration can also be beneficial in preventing a failure in a single field device from shutting down power to the PLC.

☞ **Note** The wiring for the analog I/O of the 612s is shown in the simplified schematics on pages 40 (for the inputs) and 42 (for the outputs).

110CPU51201 Field Wiring (under 115 VAC power)

Fixed I/O Topology		
I/O Type	**Number of I/O Points**	**Number of Groups**
115 VAC inputs	16	2 groups of 8
24 VDC user-selectable counter/interrupt	1	1 group of 2
24 VDC dedicated high-speed interrupts	1	
Triac outputs	8	2 groups of 4
Relay outputs	4	individually isolated

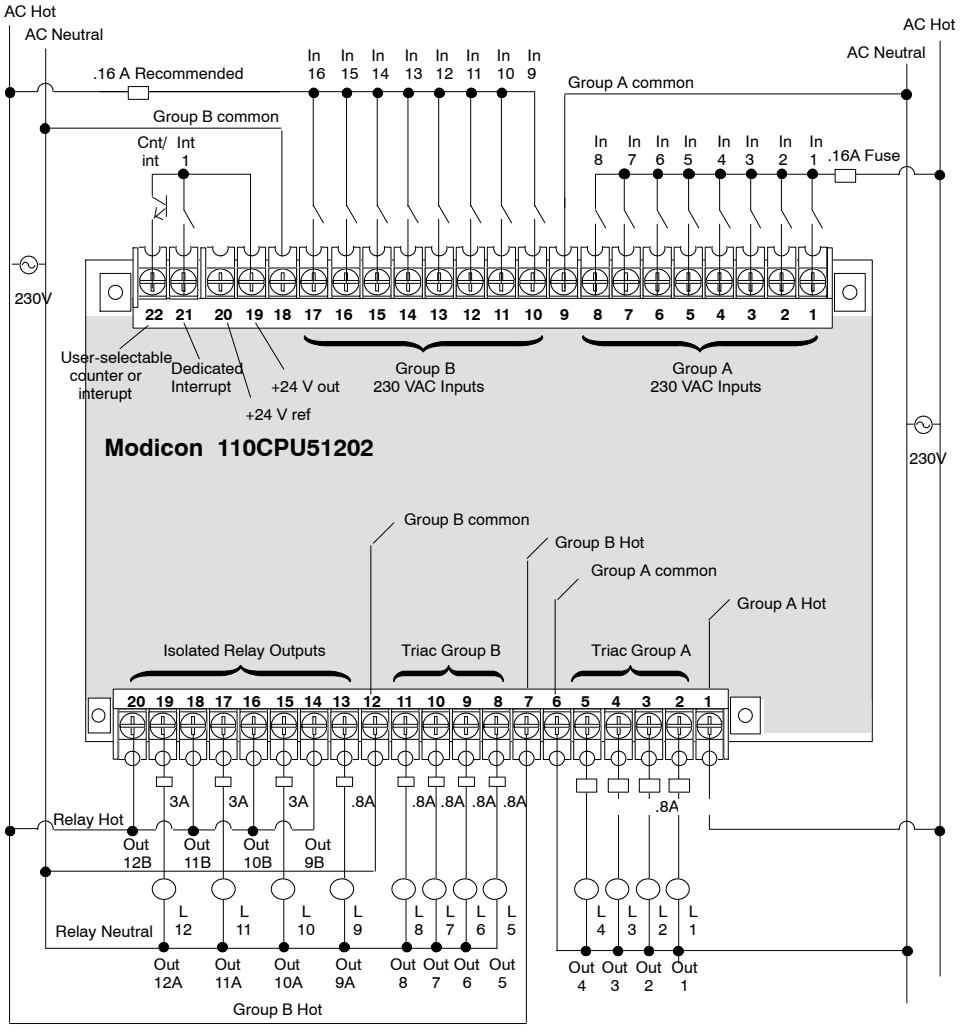


* The 24 V power supply from pins 19 and 20 in the top block provide up to 150 mA at 24 V.

Note Fast-blow fuses are recommended for input and output protection.

110CPU51202 Field Wiring (under 230 VAC power)

Fixed I/O Topology		
I/O Type	**Number of I/O Points**	**Number of Groups**
230 VAC inputs	16	2 groups of 8
24 VDC user-selectable counter/interrupt	1	1 group of 2
24 VDC dedicated high-speed interrupts	1	
Triac outputs	8	2 groups of 4
Relay outputs	4	individually isolated

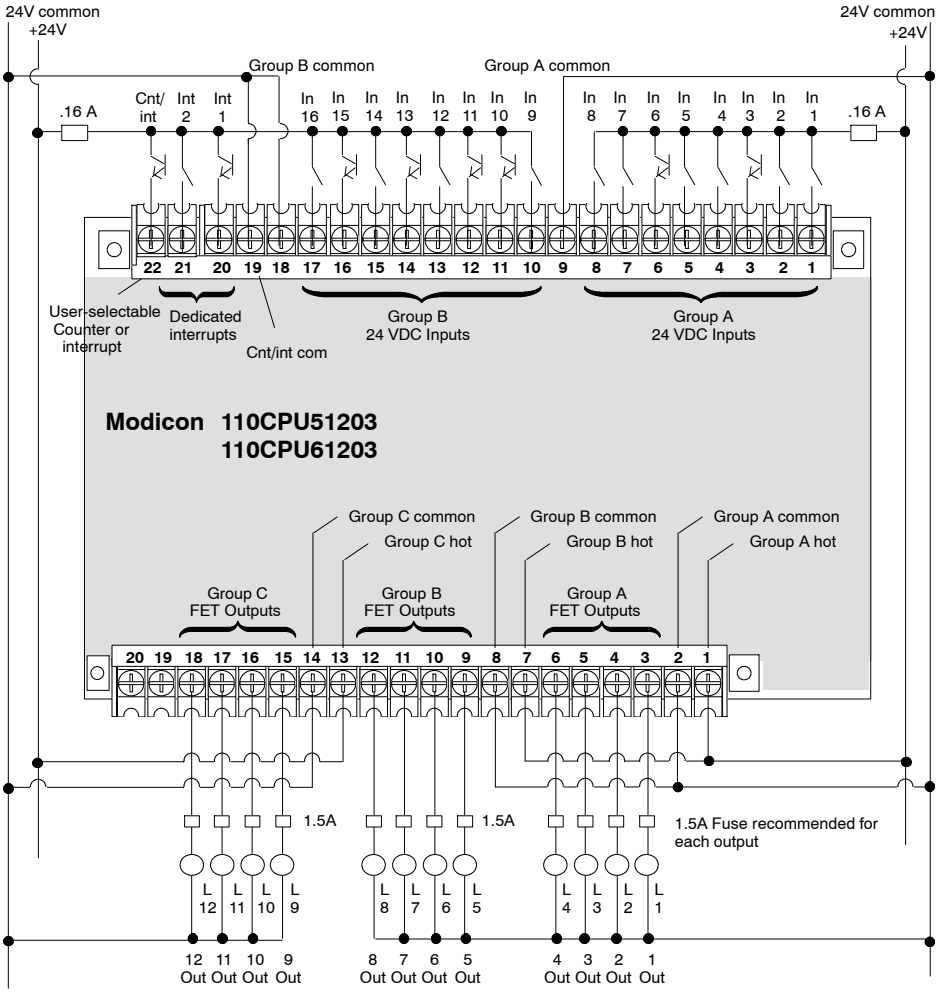


Note: Fast-blow fuses are recommended for input and output protection

110CPU51203/61203 Field Wiring (under 24 VDC Power)

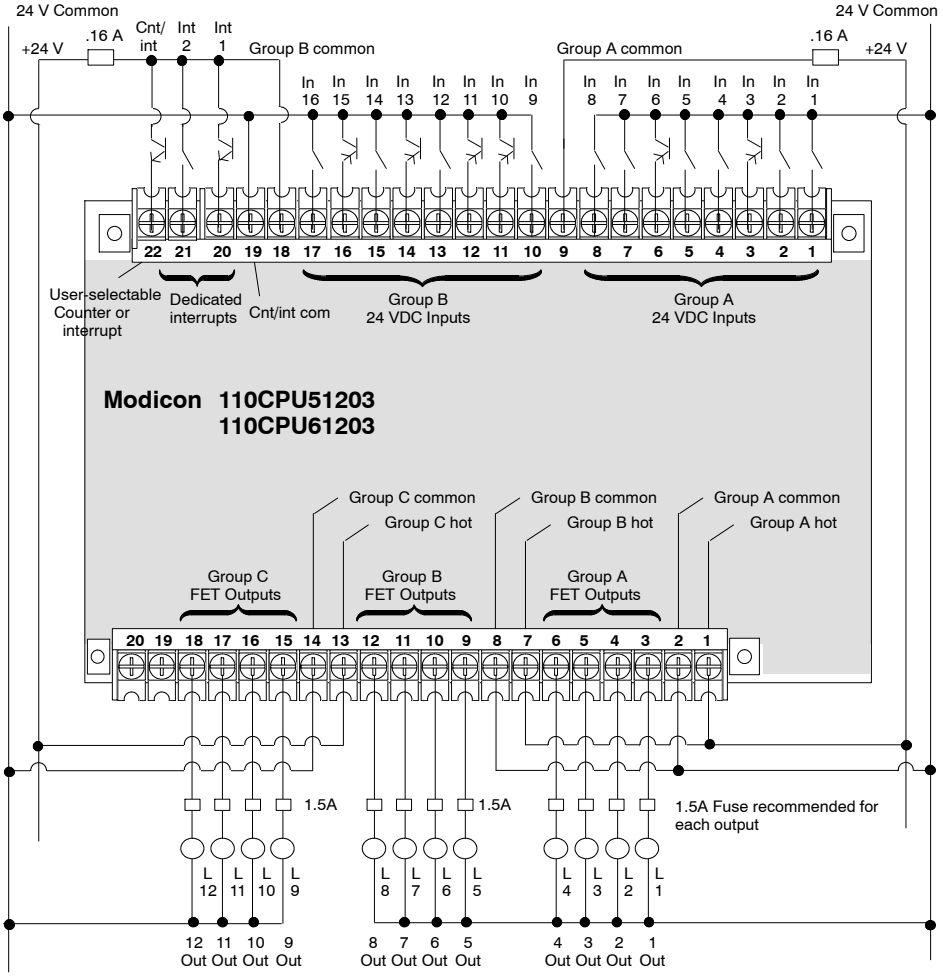
Fixed Discrete I/O Topology		
I/O Type	**Number of I/O Points**	**Number of Groups**
24 VDC inputs	16	2 groups of 8
24 VDC user-selectable counter/interrupt	1	1 group of 3
24 VDC dedicated high-speed interrupts	2	
24 VDC (FET) outputs	12	3 groups of 4

with Source-configured 24 VDC Inputs



Note Fast-blow fuses are recommended for input and output protection.

with Sink-configured 24 VDC Inputs



Note Fast-blow fuses are recommended for input and output protection.

☞ **Note** To reduce the risk that electrical noise from field I/O devices will effect Micro operation, we recommend that a separate 24 VDC power source be used for the field I/O. A dual power-source configuration can also be beneficial in preventing a failure in a single field device from shutting down power to the PLC.

☞ **Note** The wiring for the analog I/O of the 110CPU61203 is shown in the simplified schematics on pages 40 (for the inputs) and 42 (for the outputs).

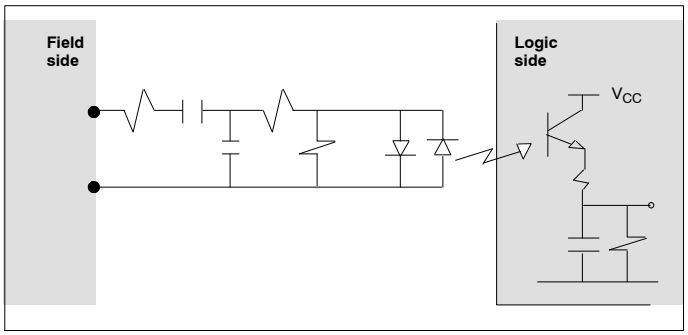
115 VAC Inputs

Electrical Characteristics

ON level	79 ... 132 VAC with a maximum source impedance of 6.2 kΩ @ 60 Hz
ON current @ 120 VAC	10 mA
OFF level	0 ... 20 VAC
Maximum OFF state input current	1.7 mA @ 20 V
Minimum ON state input current	6.5 mA @ 79 V
Input impedance	12 kΩ @ 60 Hz

Circuit Characteristics

Simplified schematic



Isolation	
Method	Opto-coupler
Channel-to-bus	1780 VAC, 2 kV DC
Group-to-group	1780 VAC, 2 kV DC
Addressing	16 discrete bits in 1 register in
Maximum wire length	100 m
Wire size	20 AWG
Response time	
ON→OFF	25 ... 30 ms
OFF→ON	25 ... 30 ms

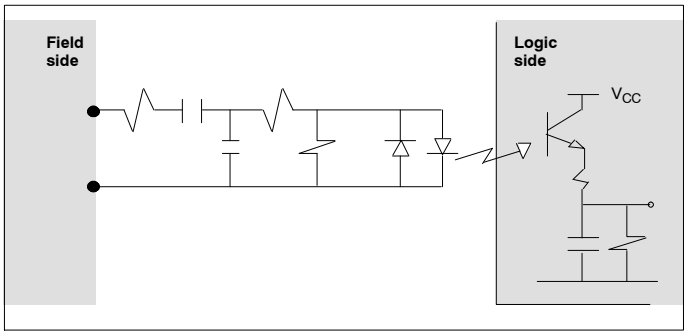
230 VAC Inputs

Electrical Characteristics

ON level	164 ... 253 VAC with a maximum source impedance of 16 kΩ
OFF level	0 ... 40 VAC
ON state input	7 mA @ 230 VAC, 50 Hz
OFF current	1.2 mA maximum @ 40 VAC
Maximum OFF state current	1.2 mA @ 40 VAC
Minimum ON state current	5.0 mA @ 164 VAC
Input impedance	33 kΩ @ 50 Hz

Circuit Characteristics

Simplified schematic



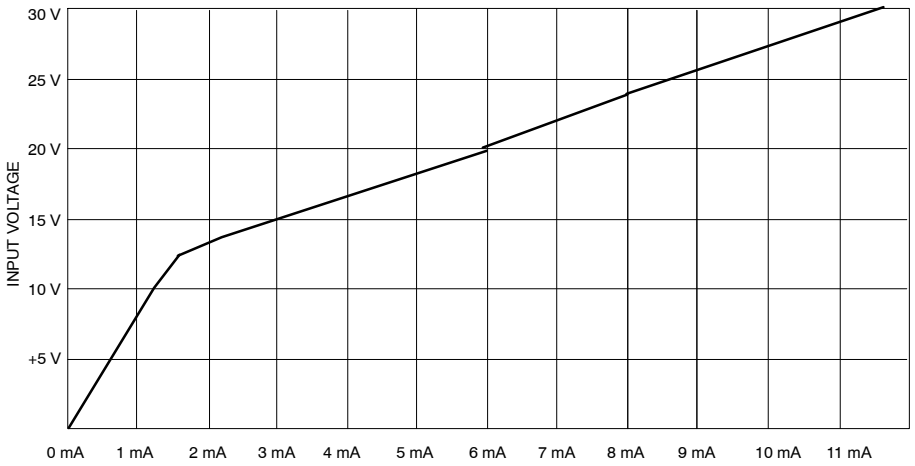
Isolation	
Method	Opto-coupler
Channel-to-bus	1780 VAC, 2500 VDC
Group-to-group	1780 VAC, 2500 VDC
Maximum wire length	100 m
Wire size	14 AWG
Response time	
ON→OFF	25 ... 30 ms
OFF→ON	25 ... 30 ms

24 VDC Inputs

Electrical Characteristics for Source (True High) Inputs

ON level	15 ... 30 VDC, source impedance < 1.5 kΩ
OFF level	0 ... 5 VDC
Minimum ON state input current	3.4 mA @ 15 VDC
Maximum OFF current	.6 mA @ 5 V
Maximum input impedance	7.8 kΩ when OFF 3.0 kΩ when ON @ 24 VDC input

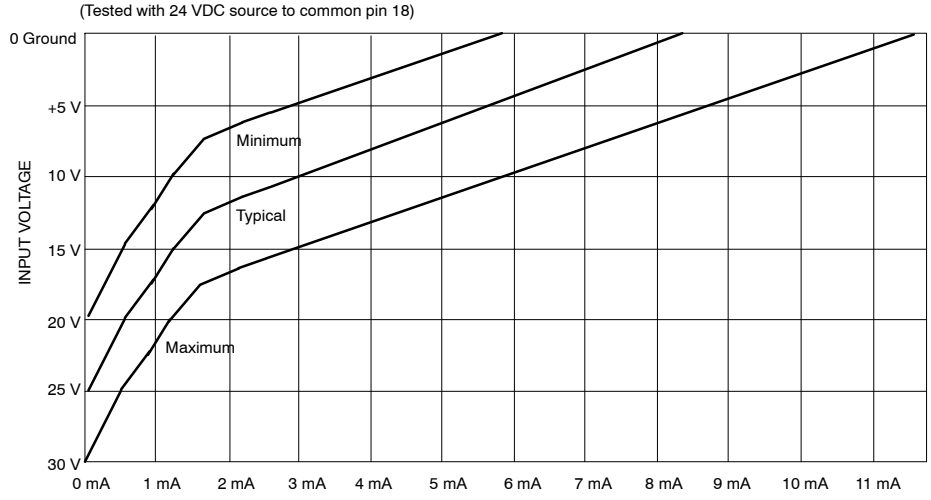
Typical impedance curve



Electrical Characteristics for Sink (True Low) Inputs

ON level	Source ground to (source voltage – 15 V)
OFF level	Source voltage to (source voltage – 5 V)
Minimum ON state input current	3.4 mA with 20 ... 30 V source
Maximum OFF current	.7 mA with 20 ... 30 V source
Maximum input voltage	30 VDC
Maximum input impedance	7.8 kΩ when OFF 3.0 kΩ when ON @ 24 VDC

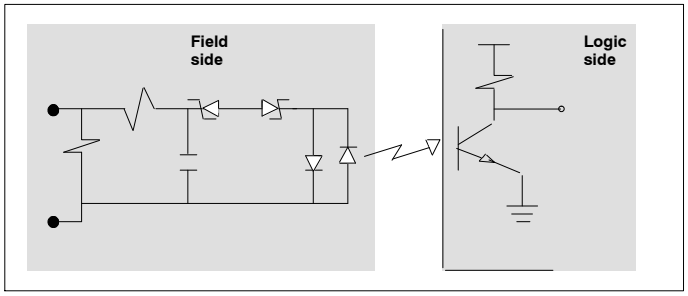
Typical impedance curve



☞ **Note** We recommend the use of three-wire proximity switches on these inputs.

Circuit Characteristics

Simplified schematic



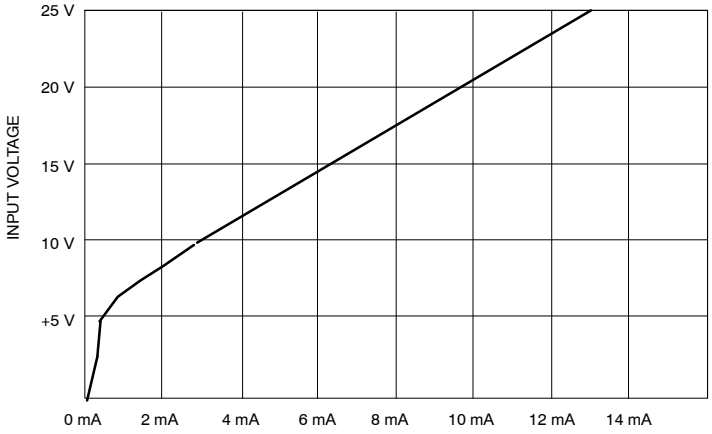
Isolation	
Method	Opto-coupler
Channel-to-bus	1780 VAC, 2500 VDC
Group-to-group	1780 VAC, 2500 VDC
Response time	
ON→OFF	2 ms
OFF→ON	2 ms
Maximum wire length	100 m
Wire size	14 AWG

User-selectable High-speed Counter/interrupt Inputs

Electrical Characteristics

ON level	15 ... 30 VDC
OFF level	0 ... 5 VDC
Minimum ON state input	6 mA @ 24 VDC
Maximum OFF current	0.7 mA @ 5 V
Input impedance	15.8 kΩ when OFF 1.95 kΩ when ON @ 24 VDC
Current draw	12.3 mA @ 24 VDC

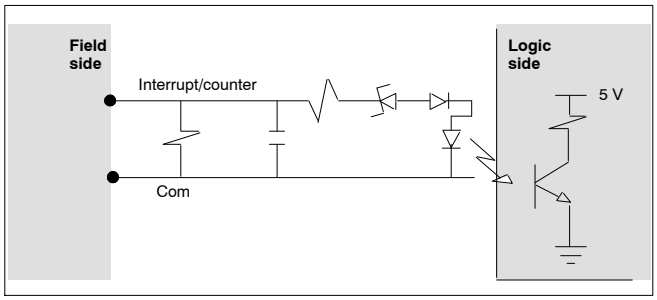
Typical impedance curve



☞ **Note** We recommend the use of three-wire proximity switches on these inputs.

Circuit Characteristics

Simplified schematic



Isolation	
Method	Opto-coupler
Channel-to-bus	500 VDC
Group-to-group	500 VDC
Addressing	1 register in
Maximum cable length	50 m
Response time	
OFF→ON	10 ... 20 μs
ON→OFF	10 ... 20 μs
Required cable type	Shielded twisted pair, for noise immunity
Wire size	20 AWG
Up-counter positive edge trigger	
Maximum counter rate	5 kHz
Pulse duration	> 100 μs
Interrupt voltage level	To assure reliable system operation, interrupt voltage must be brought from OFF to ON and maintained ON for 350 μs minimum—any pulse duration < 20 μs is filtered

Dedicated High-speed Interrupt Inputs

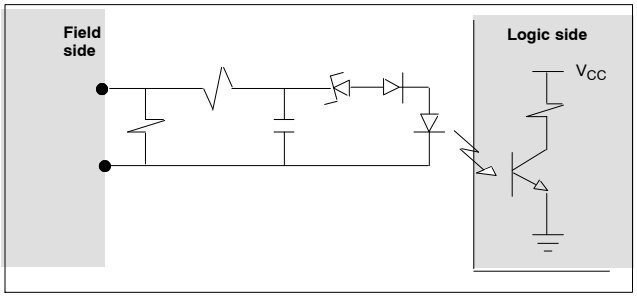
Electrical Characteristics

ON level	15 ... 30 VDC
OFF level	0 ... 5 VDC
Minimum ON state input	6 mA @ 15 VDC
Maximum OFF current	0.3 mA @ 5 V
Maximum input impedance	15.8 kΩ when OFF 1.95 kΩ when ON @ 24 VDC
Current draw	12.3 mA @ 24 VDC

☞ **Note** We recommend the use of three-wire proximity switches on these inputs.

Circuit Characteristics

Simplified schematic



Isolation	
Method	Opto-coupler
Channel-to-bus	500 VDC
Maximum cable length	50 m
Required cable type	Shielded twisted pair, for noise immunity
Wire size	20 AWG
Interrupt voltage level	To assure reliable system operation, interrupt voltage must be brought from OFF to ON and maintained ON for 350 μs minimum—any pulse duration < 50 μs is filtered

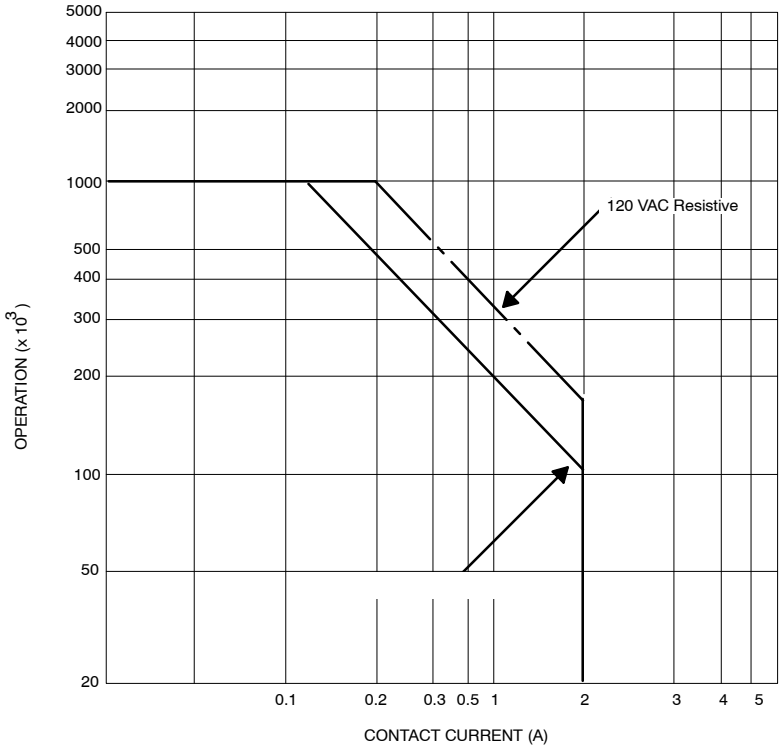
Relay Outputs

Electrical Characteristics

Working voltage range (for all Micro types)	24 ... 30 VDC 24 ... 250 VAC
Maximum load current	2 A/channel
Surge current	20 A for 1 cycle
VA rating	500 VA (switching)
Minimum load current	20 mA
Maximum switching rate	5 Hz
Required external fuse size	User-installed 3 A fuse—e.g. Bussman GMA-V-3.0—in the field wiring between the output terminal screw and the load

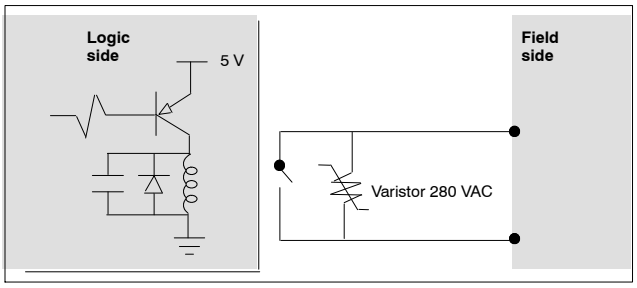
Caution Internal overload protection is not provided for these outputs—external fusing is required.

Derating curve



Circuit Characteristics

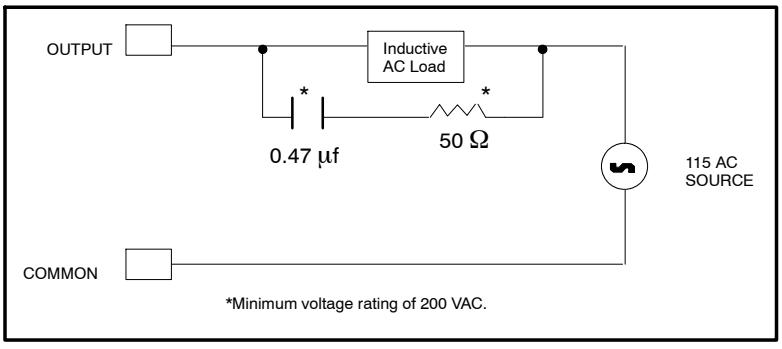
Simplified schematic

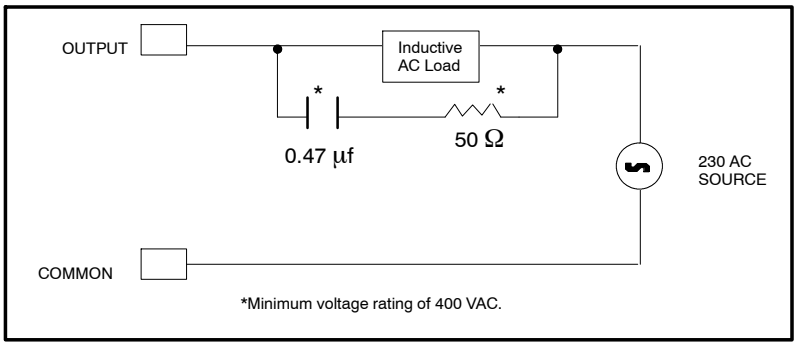


Isolation	
Channel-to-bus	1780 VAC, 2500 VDC
Group-to-group	1780 VAC, 2500 VDC
Mechanical operating cycles	20,000,000
Surge withstand capability	4 kV
Response times	
ON→OFF	10 ms
OFF→ON	10 ms
Maximum wire length	100 m
Wire size	
One wire	14 AWG
Two wires	20 AWG

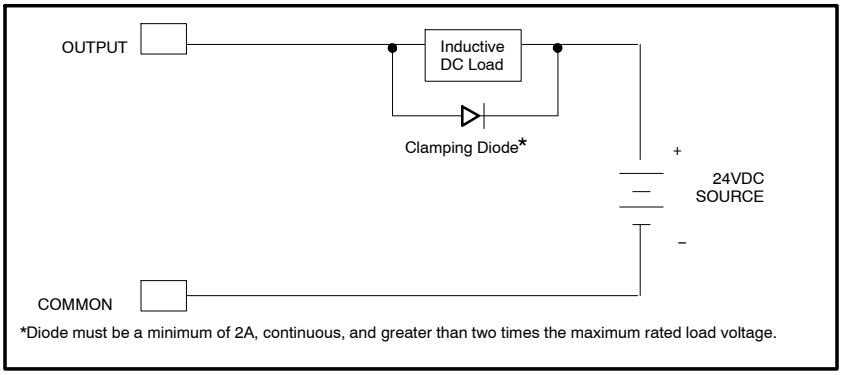
Using Relay Outputs with Inductive Loads

The mechanical relay outputs in Micro controllers must be provided with additional protection when connected to an inductive load. Properly suppressing inductive loads reduces radiated noise and prolongs the life of the relay contacts. The following three figures provide examples of how to suppress various inductive loads.





*Minimum voltage rating of 400 VAC.



*Diode must be a minimum of 2A, continuous, and greater than two times the maximum rated load voltage.

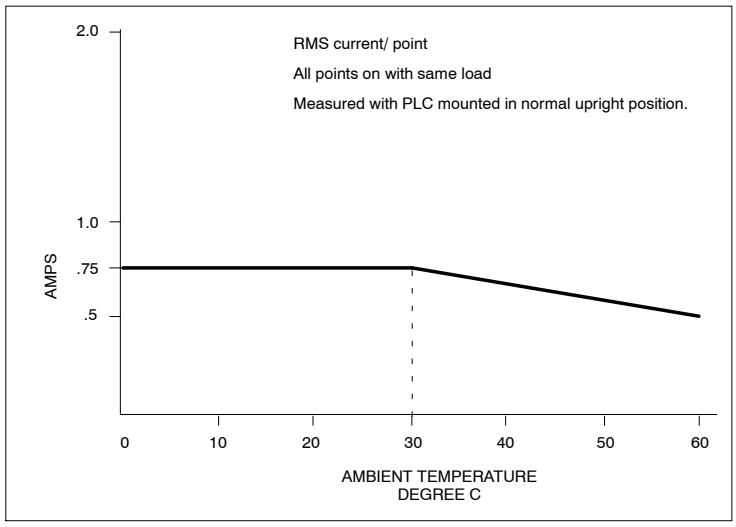
Triac Outputs

Electrical Characteristics

Working voltage	
Continuous range	24 ... 132 VAC for the -01 Models 24 ... 250 VAC for the -02 Models
Maximum	500 VAC for 1 cycle
Frequency of operation	47 ... 63 Hz
Maximum load current	0.5 A/channel
Surge current	5 A for 1 cycle
Minimum load current	50 mA
Maximum OFF state leakage current	1.5 mA
ON state voltage drop	1.5 V
Maximum switching rate	20 Hz
Static DV/DT	300 V/μs
Required external fuse size	User-installed 0.8 A fuse—e.g., Bussman GMA-V-.8—in the field wiring between the output terminal screw and the load

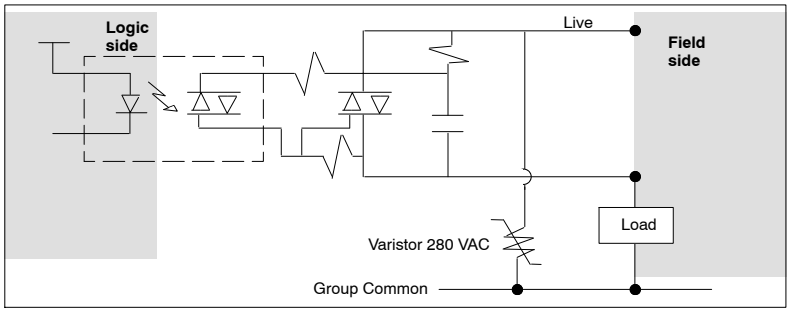
Caution **Internal overload protection is not provided for these outputs—external fusing is required.**

Derating curve



Circuit Characteristics

Simplified schematic

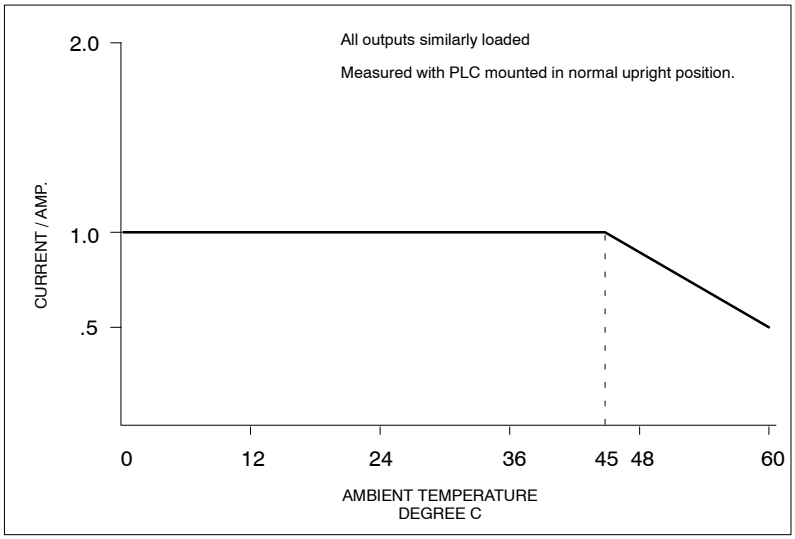


Isolation	
Method	Opto-coupler
Channel-to-bus	1780 VAC, 2500 VDC
Group-to-group	1780 VAC, 2500 VDC
Response times	
ON→OFF	8 ms
OFF→ON	8 ms
Maximum wire length	100 m
Wire size	
One wire	14 AWG
Two wires	20 AWG

24 VDC (FET) Outputs

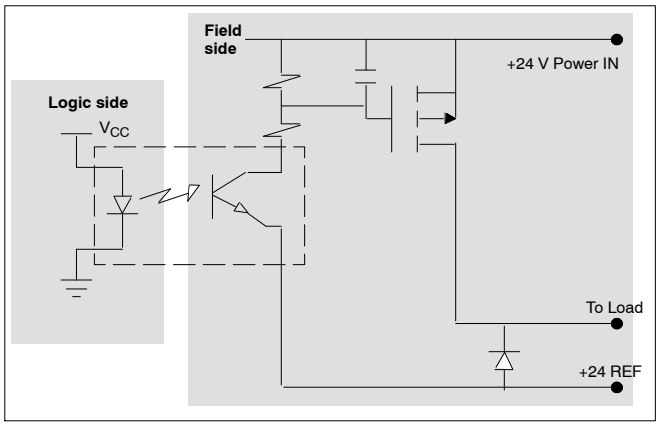
Electrical Characteristics

Working voltage range	20 ... 30 VDC
Continuous	32 V for 10 s
Maximum	56 V for 1.5 ms
ON current (@ 60 degrees C)	0.5 A / channel 2 A / group 6 A total
Surge current	5 A for .5 ms @ 6 pulses / min
Minimum load current	10 mA
Maximum OFF leakage current	1 mA @ 30 V
ON state voltage drop	.4 V @ .5 A
Maximum switching rate	4 Hz inductive
Recommended external fuse size	User-installed 1.5 A fuse—e.g., Bussman GMA-V-1.5—in the field wiring between the output terminal screw and the load. **Note** Internal overload protection is not provided for these outputs, and external fusing is strongly recommended.
Total current / group	2 A @ 60 degrees C
Derating curve	



Circuit Characteristics

Simplified schematic



Isolation	
Channel-to-bus	1780 VAC, 2500 VDC
Group-to-group	500 VAC
Response times	
ON→OFF	1 ms
OFF→ON	1 ms
Maximum wire length	100 m
Wire size	14 AWG

Analog Inputs

Electrical Characteristics

Input channels	
Number	4
Types	Current inputs, 20 mA full scale Voltage inputs, 10 V full scale
Input ranges	±10 V, 0 ... 10 V, 4 ... 20 mA
Input filter	Single-pole low-pass, –3 dB frequency of 10 Hz (±20%)
Input resistance	
Current mode	250 Ω (±0.1%)
Voltage mode	> 20 MΩ
Input protection	
Differential	50 VDC maximum
Channel-to-channel	30 VDC maximum
Over current	25 mA maximum
Common mode range	25 VDC channel-to-channel
Group Isolation	1000 VAC RMS, 1 min. maximum (Analog inputs are isolated from analog outputs, input power, discrete I/O, and communication ports.)
Wire size	
1 wire	12 AWG
2 wires	14 AWG

Conversion

Type	Sigma Delta
Resolution	16 bits for ±10 V 15 bits for 0 ... 10 V 13→14 bits for 4 ... 20 mA
Update time	55 ms/channel if scanned > 55ms; otherwise, 4 times the scan rate.
Differential nonlinearity	No missing codes
Repeatability	±3 counts

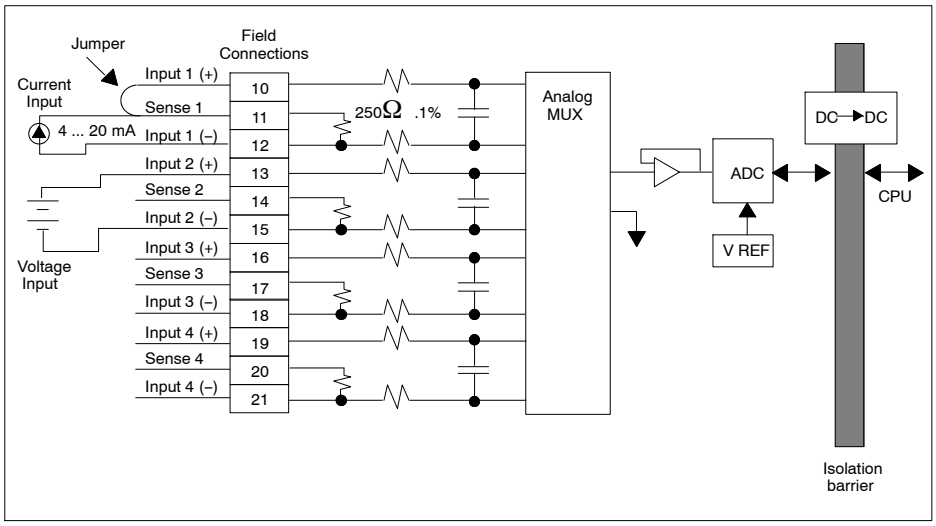
Accuracy (Offset, Gain, and Linearity Errors)*

	Typical	Maximum
Initial @ 25 degrees C	±.025%	±0.1%
Additional drift (0 ... 60 degrees C)	±.07%	±0.25%

* A 250 Ω current-to-voltage conversion resistor contributes an additional error of ±0.1%, ± 25 ppm/degree C (for a 4 ... 20 mA input range).

Input Circuit Characteristics

Simplified Schematic



Note:

To reduce the possibility of erroneous readings if one or more device wires become disconnected, it is recommended that the appropriate input and sense lines be jumpered as shown in the above illustration.

Analog Outputs

Electrical Characteristics

Output channels	
Number	2
Types	Current outputs Voltage outputs
Group Isolation	1000 VAC RMS (60 Hz), 1 min. maximum (Analog outputs are isolated from analog inputs, input power, discrete I/O, and communication ports.)
	1000 VDC, 1 min. maximum
Current range	4 ... 20 mA
Loop supply voltage	
Maximum	30 V
Minimum	12 V
Max loop resistance	$\frac{V_{loop} - 7\ V}{.02} = \text{Max. R}$
Voltage range	0 ... 10 V
Output loads	10 mA maximum .1 μF maximum 1 kΩ minimum

Conversion

Resolution	12 bits
Linearity errors	±.05% maximum
Differential nonlinearity	Guaranteed monotonic
Update time	10 ms/channel

Accuracy (Offset, Gain, and Linearity Errors)

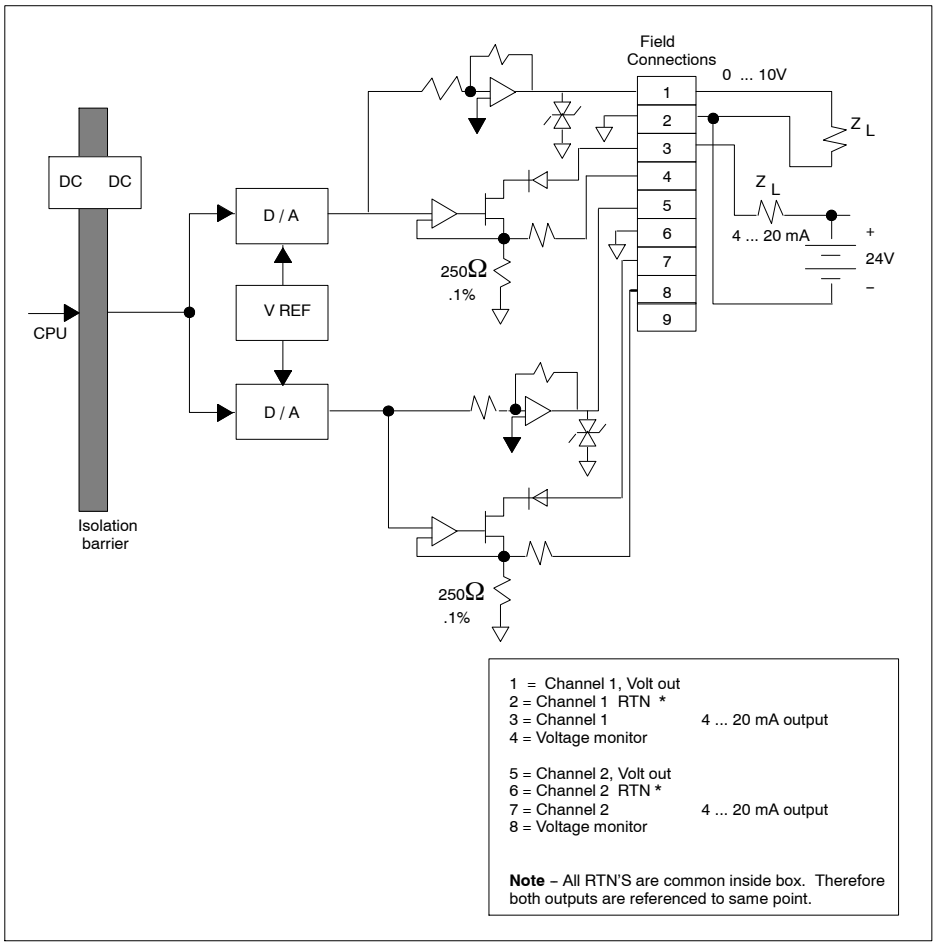
Initial @ 25 degrees C	Typical	Maximum
Volt mode	0.2%	0.35% [200–350 mV]
Current mode	0.35%	0.5%
Additional drift (0 ... 60 degrees C)		
Volt mode	.05%	0.1%
Current mode	0.18%	0.26%

☞ **Note** Additional separate 24 VDC supplies for I/O are not required because these circuits are isolated internally. Separate supplies may be used and can improve system performance by avoiding the interference caused by poor power supply regulation and load transients.

☞ **Note** Twisted shielded pair cable is recommended. Terminate shields to channel return to reduce power supply switching noise.

Output Circuit Characteristics

Simplified Schematic



Installation Guidelines

The Model 512 and 612 PLCs offer a straightforward plug-and-play installation capability.

Mounting Options

A PLC (or a PLC-based I/O expansion link) may be mounted:

- ❒ In a NEMA cabinet
- ❒ On a wall
- ❒ On an EIA rack
- ❒ On DIN rail

☞ **Note** If The PLC uses its A120 I/O expansion capability, the unit and its associated A120 I/O racks must be mounted on DIN rail.

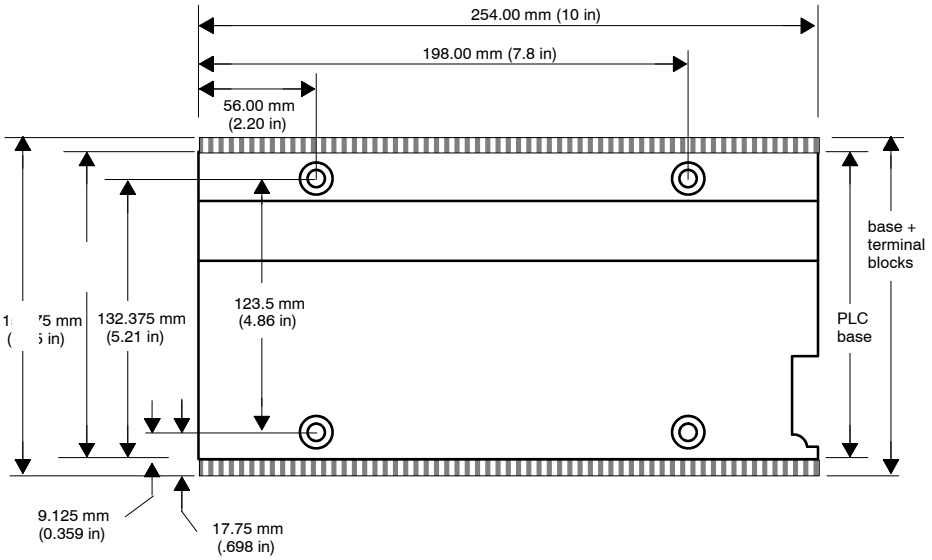
Securing a Unit to a Flat Surface

The PLC housing contains four through-holes—two at the top and two at the bottom—to secure the unit to a flat surface such as a $^1/_4$ in metal plate in a NEMA cabinet.

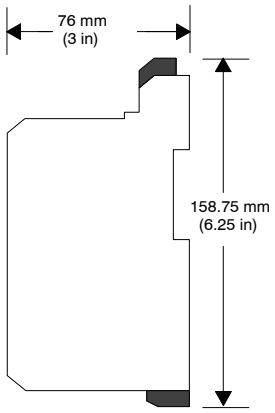
To access these through-holes, remove the I/O terminal blocks at the top and bottom of the unit. The through-hole locations are shown in the dimension drawing below.

The four holes are counter-bored in the housing so that the securing screws will not touch the terminal blocks when they are re-inserted onto the unit.

Use M5 screws. The type and length of the screw depends on the kind of surface on which the units are being mounted—e.g., a machine screw with a minimum length of $^5/_8$ in should be used to mount to a $^1/_4$ in plate.



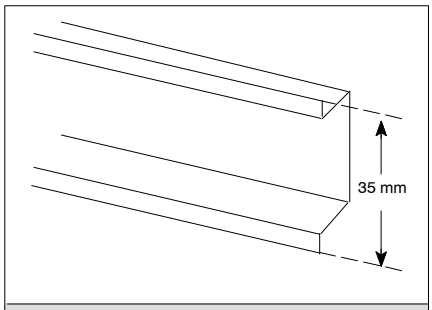
Unit Dimensions



Mounting Units on DIN Rail

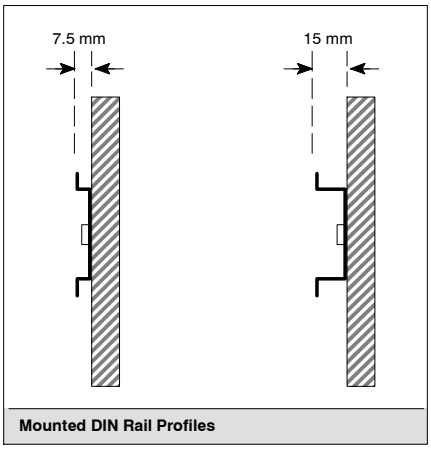
The PLC can be mounted on a DIN EN 50 022 carrier rail. The DIN rail can be attached to a flat mounting surface or hung on an EIA rack or in a NEMA cabinet.

If the PLC uses its A120 I/O expansion capability, the unit and the backplanes that house the A120 modules must be mounted on DIN rail.



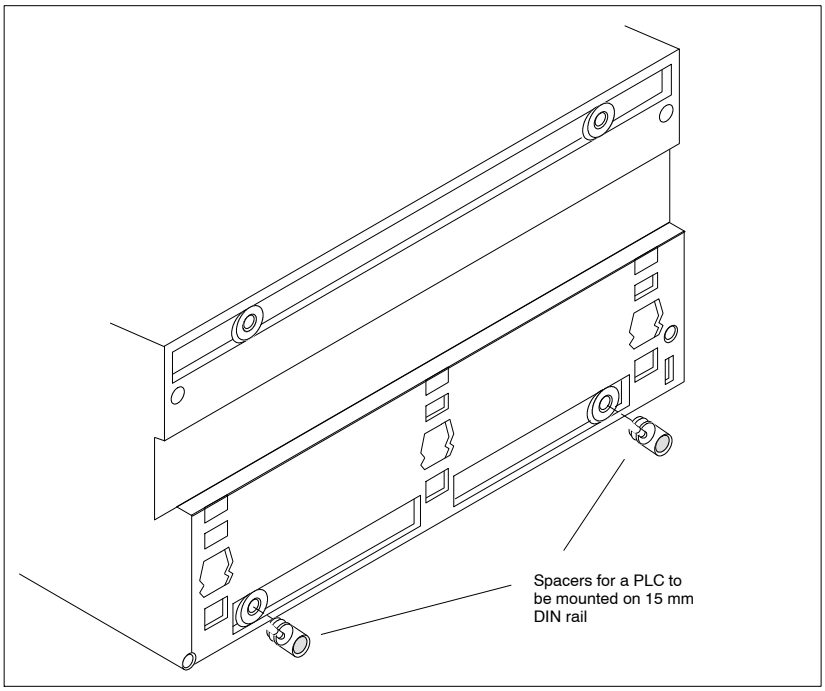
DIN EN 50 022 Carrier Rail

DIN rail may have either 7.5 mm or 15 mm clearance from the mounting surface.



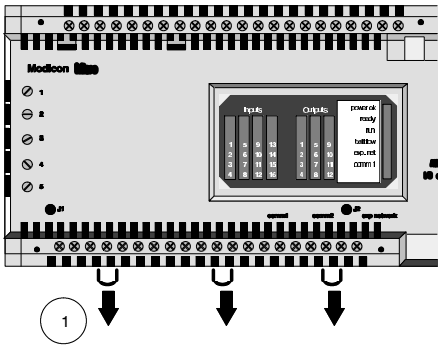
Mounted DIN Rail Profiles

If the PLC is mounted on 15 mm DIN rail, the two spacers shipped with the PLC and should be placed on the lower back of the PLC, as shown below. The spacers keep the unit flush against a flat mounting surface and provide vibration protection.

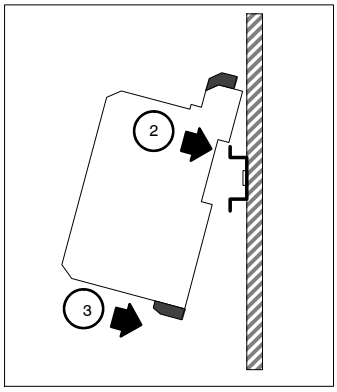


Installing a PLC on DIN Rail

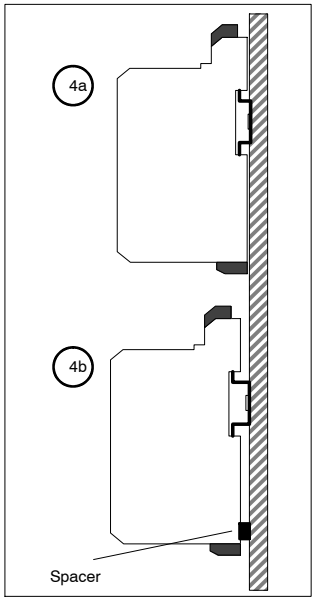
Step 1 Remove the output terminal block on the bottom of the PLC to gain access to the three clips shown in (1). Pull the clips down before placing the unit on the DIN rail.



Step 2 Place the clip on the top of the PLC housing over the top of the DIN rail and drop the unit into place.

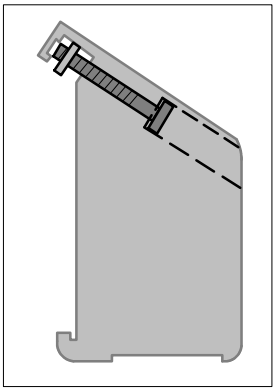


Step 3 If the DIN rail is on a wall or a plate, the unit will fall flush against the surface (see 4a). If you are using a 15 mm DIN rail, insert the two spacers on the lower backside of the unit (see 4b).

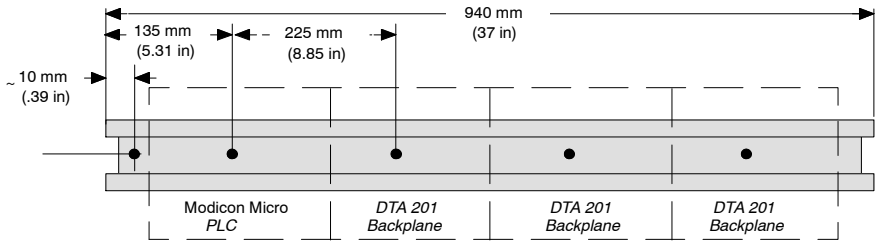


Step 4 Push the three clips on the bottom of the unit up to lock the unit onto the DIN rail, then snap the output terminal block back into place.

Step 5 To keep the Micro PLC assembly from sliding on the DIN rail, we recommend that you place a DIN rail end clamp such as the one shown below on both sides of the unit assembly.



End clamps such as the one above can be ordered from your DIN rail supplier.

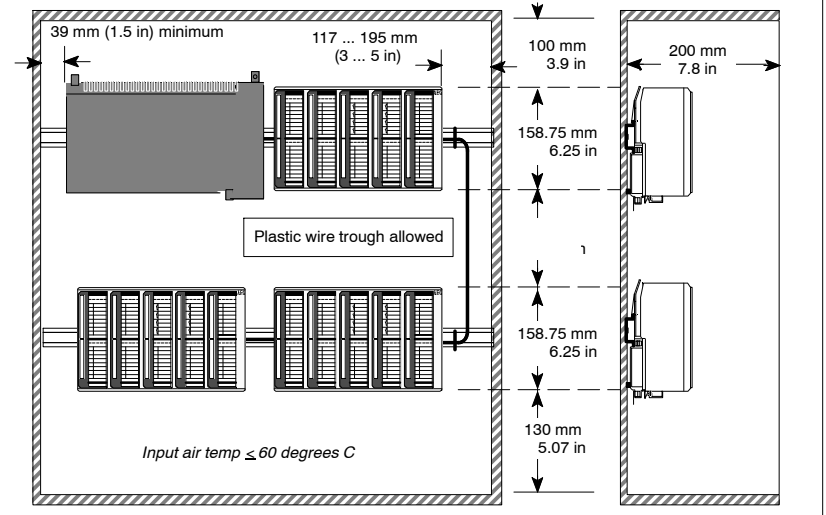


DIN Rail Length to Support A120 I/O Expansion on a Modicon Micro

A DIN rail must be at least 255 mm (10.04 in) long to support a single PLC. To support a PLC with three DTA 201 five-slot backplanes, a DIN rail needs to be at least 940 mm (37 in) long.

Installing a PLC on DIN Rail

Below is an illustration of recommended clearance requirements for mounting PLCs with A120 I/O racks in an enclosure.



Minimum Height and Length Requirements for a NEMA Cabinet Installation

Installing the Optional Battery or Battery Capacitor

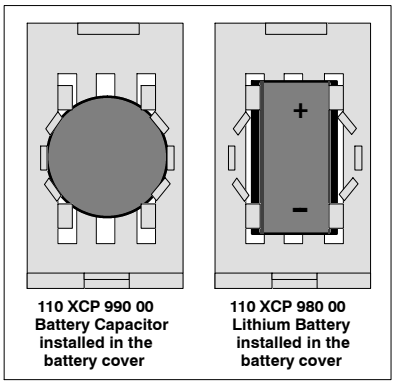
Memory backup may be provided by either a lithium battery assembly (110XCP98000) or a battery capacitor assembly (110XCP99000).

Both assemblies include wire leads and a 3-position feed-thru receptacle connector. They may be ordered as options from Modicon or from your local distributor.

Installing a Battery or Battery Capacitor Assembly

Step 1 With a slotted screwdriver, remove the battery cover from the Micro PLC. This cover is located on the top right corner of the unit above the LED panel.

Step 2 The underside of the cover has a finger pattern that will grab either the lithium battery or the capacitor. Snap the desired component into the cover:



110 XCP 990 00 Battery Capacitor installed in the battery cover

110 XCP 980 00 Lithium Battery installed in the battery cover

Step 3 Connect the 3-position receptacle connector on the assembly to the three pins on the printed circuit board on the PLC beneath the battery cover. The receptacle is keyed so that only the correct connections can be made with the pins.

Step 4 Place the cover back on the PLC unit. The memory backup assembly is now installed and available.

Serial I/O Expansion Link

Up to five PLCs can be interconnected on a serial I/O expansion link. The link contains one *parent* PLC and from one ... four *child* PLCs.

I/O Expansion Link Characteristics	
Number of PLCs	2 ... 5
Physical comm port	RS-485
Cable type	Six-position line long body
Connector type on the cableboth ends	RJ11 male on
Termination	120 Ω
Data rate on the link	125 kbyte (+)
Encoding scheme	NRZ
Length of link500 m (1500 ft) maximum 6 m (20 ft) minimum	

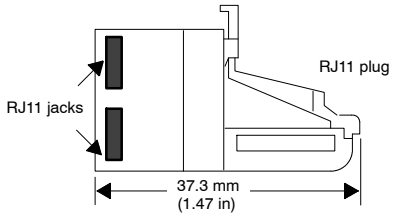
The PLCs are connected to each other on the link via their RS-485 ports. Connections are point-to-point.

Standard six-position, foil-shielded, flat telephone cables with male RJ11 connectors on each end are used to connect the units. Three premade cable assemblies are available:

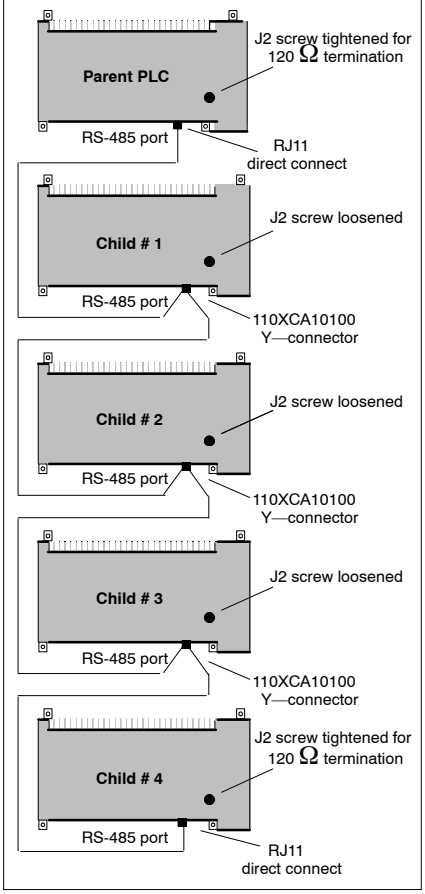
I/O Expansion Link Cables	
Length	**Part Number**
61 cm (2 ft)	110XCA17101
3 m (10 ft)	110XCA17102
6 m (20 ft)	110XCA17103

The RJ11 cable plugs directly into the RS-485 ports on the two units at the head and tail ends of the link. All the other units on the link use a (110XCA10100) RJ11 Y-connector.

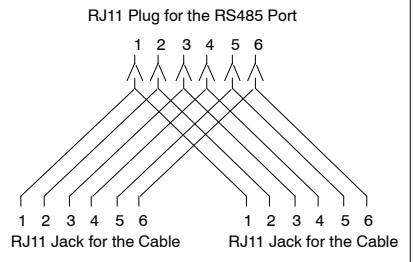
The 110 XCA 101 00 Y-connector



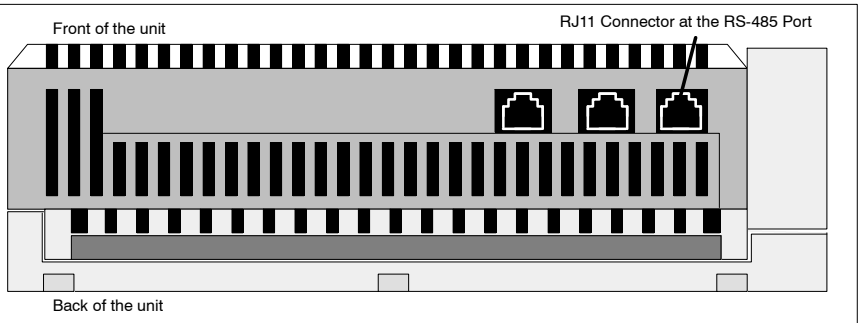
An I/O Expansion Link



110XCA10100 Y-connector Pinouts



Pin 1 = chassis ground
Pin 2 = TXHi
Pin 3 = TXLo



RS-485 Port Location on the Bottom of a PLC

Serial I/O expansion establishes a parent-child relationship between the units on the link. One Micro PLC acts as the parent—its I/O processor can access the fixed I/O resources of all the child PLCs on the link, and its CPU can perform all the logic-solving activities for the fixed I/O resources on the link.

Each child PLC on the link must have a unique numerical address in the range 1 ... 4.

☞ **Note** It is your responsibility as a programmer to make sure that each child has been uniquely addressed when the system is I/O mapped (see ***Modicon Micro Ladder Logic Manual***, 890 USE 146 00, and your panel software documentation for more details). We recommend that you set the child PLCs to RUN mode or power them up before the parent.

Individual child PLCs can be disconnected from the I/O expansion link without disrupting communications between the parent and other child PLCs as long as the disconnection does not break the cable link to the other child PLCs.

⚠ **Caution When a child PLC acts as an intelligent unit on an I/O expansion link—i.e., when the child uses some or all of its fixed I/O resources instead of giving them to the parent—servicing of the hardware interrupts by the child can disrupt predictable logic solving in the parent.**

Terminating the Link

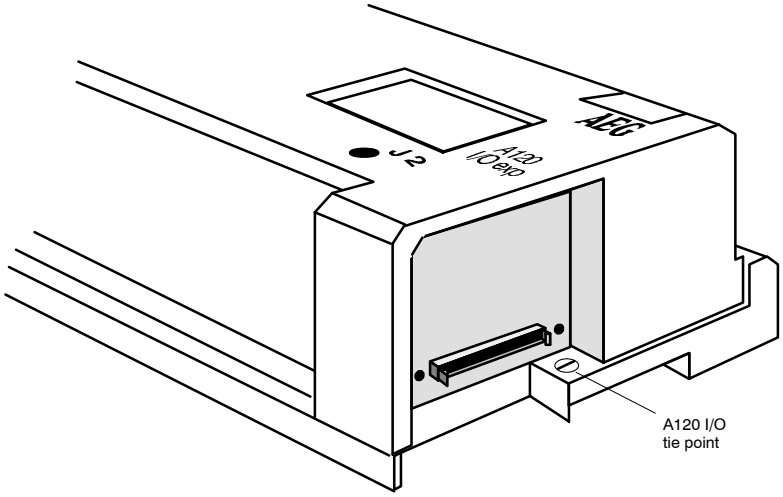
120 Ω termination is provided by tightening the screw labelled **J2** on the front right of the PLC below the LED status display. Units are factory-delivered with the **J2** screw tightened.

The two units on the head and tail ends of an I/O expansion link require termination—i.e., the **J2** screws must be tightened. All other units on the link are not terminated—i.e., their **J2** screw must be loosened by one turn.

A120 I/O Expansion

On the right side of the PLC is a 30-pin connector that allows you to connect the unit to a secondary backplane (or rack) containing A120 I/O modules. This expansion capability can support up to 15 A120 I/O modules (depending on the modules' combined power draw) in up to three DTA racks.

A 512/612 PLC in any operating mode—*single*, *parent*, or *child*—can use A120 I/O expansion. If a PLC using the A120 I/O is a child PLC on an I/O expansion link, the A120 I/O can be accessed only by that child, not by the parent on that expansion link.



Calculating Power Requirements in an A120 I/O Expansion System

The PLC has a 250 mA internal power supply for A120 I/O expansion. When planning an expansion system, you must be aware of the power requirements of the A120 modules you want to use.

To calculate these A120 power requirements, add up the maximum internal power draw specified for each module in your expansion system. Internal power specifications can be found in ***A120 Series I/O Modules User Guide*** 890USE10900 formerly (GM-A984-IOS).

Caution All internal power requirements for the A120 modules must be satisfied by the Modicon Micro PLC. A total internal power supply of 250 mA is available from the PLC for all modules in all racks.

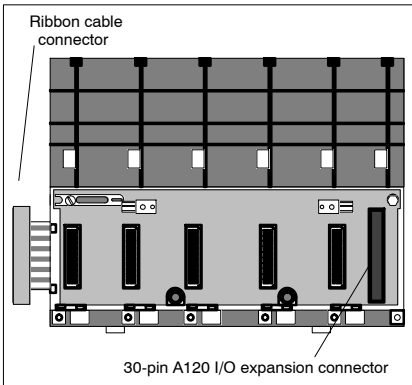
A120 modules such as the BDEP 216 DC input module and the BDAP 208 DC output module, which draw 15 mA each, enable you to power three fully loaded DTA 201 expansion racks.

However, in applications that use A120 modules with large internal power draws—e.g., the BDEP 218 AC input module or the BDAP 210 AC output

module, which draw 60 mA and 88 mA, respectively—you could expend most of your available power with a few modules in a single DTA rack.

A120 I/O Expansion Racks

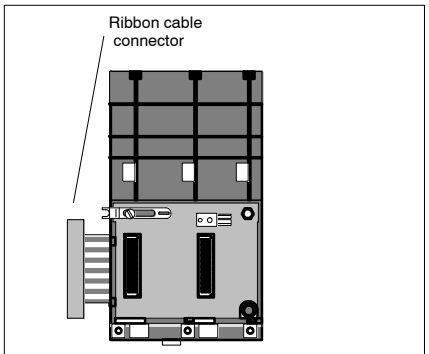
The DTA 201 backplane is 213.4 mm wide x 142 mm high x 31 mm deep. It has an I/O expansion ribbon cable with 30-receptacle connector on its left side that connects it to the unit prior to it and a 30-pin expansion connector on its right side (the same as the one on the PLC) that enables extension to another backplane.



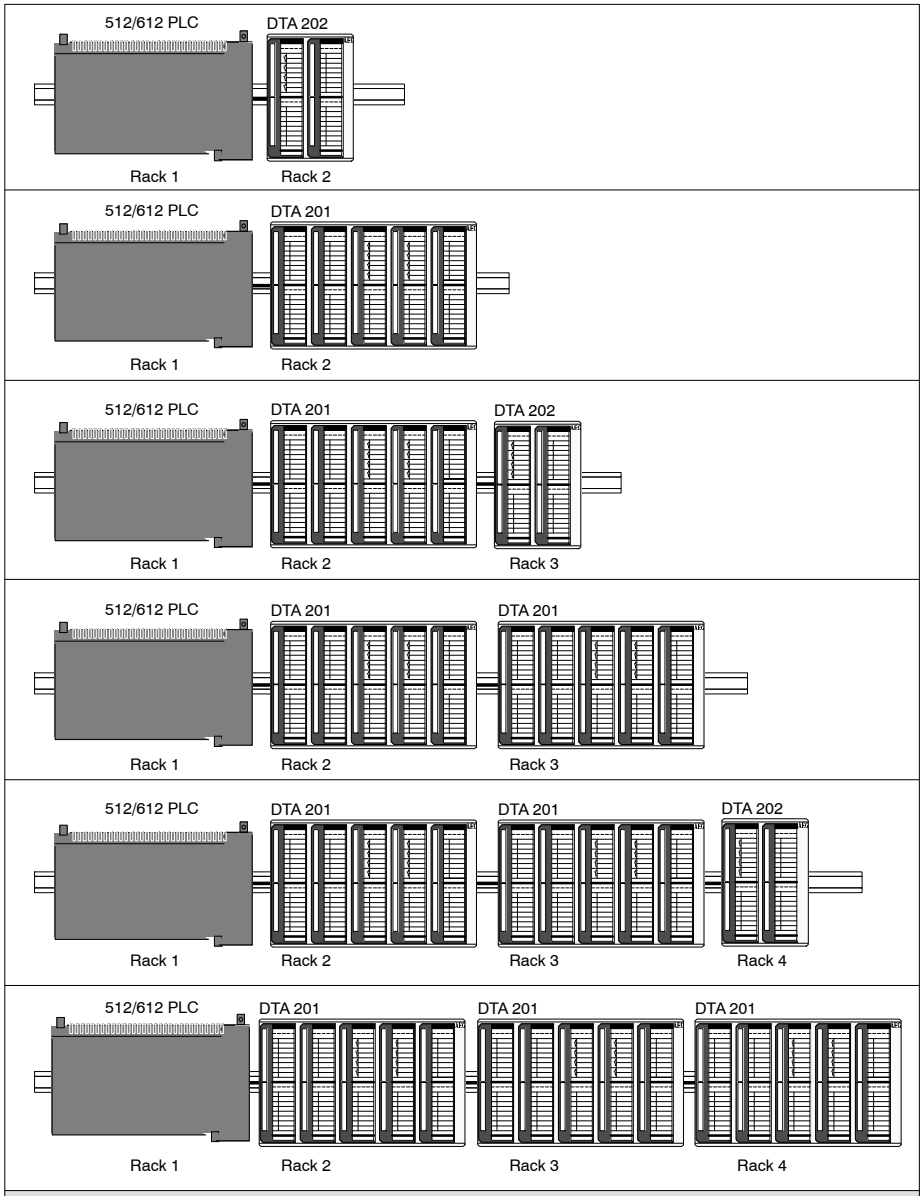
DTA 201 Five-slot A120 I/O Backplane

The DTA 202 backplane is 91.5 mm wide x 142 mm high x 31 mm deep. It also has an I/O expansion ribbon cable with 30-receptacle connector on its left side for connection to the unit prior to it. It does not have a connector on its right side—if the DTA 202 is used, it must be the last rack in the A120 I/O expansion.

If you plan to use a DTA 202, remember that no more than one can be used and that it can be used only in a linear drop layout, not in a stacked (two-high) drop layout.



DTA 202 Two-slot A120 I/O Backplane

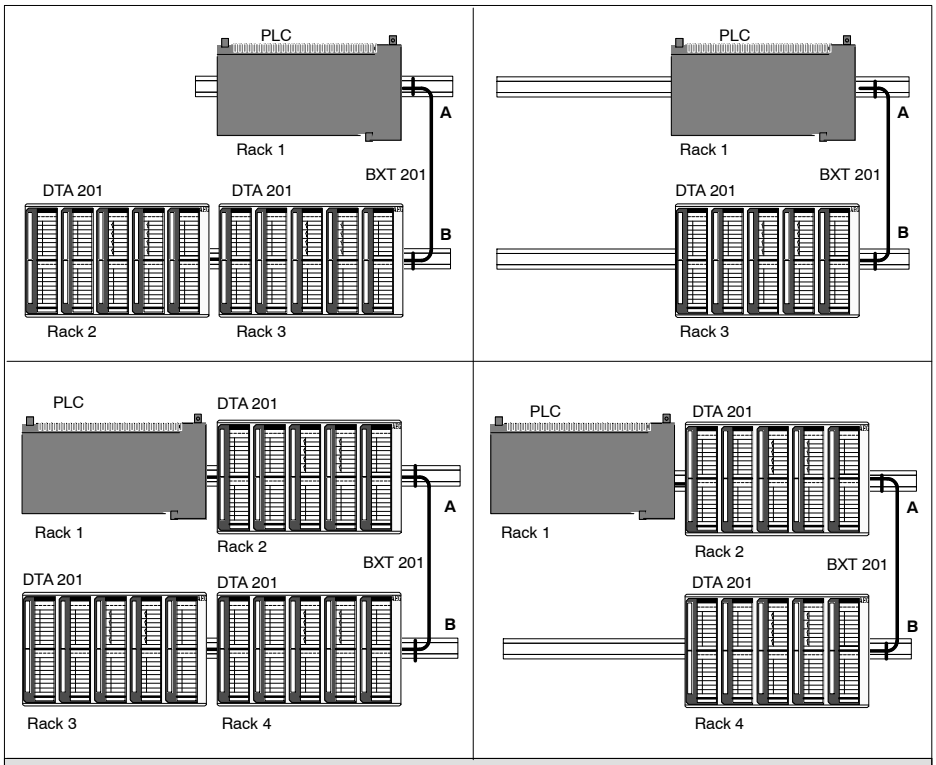


Linear A120 I/O Expansion Layouts

The racks may also be stacked on two DIN rails and connected by a BXT 201 bus extension cable. There may be either one or two racks mounted on each DIN rail.

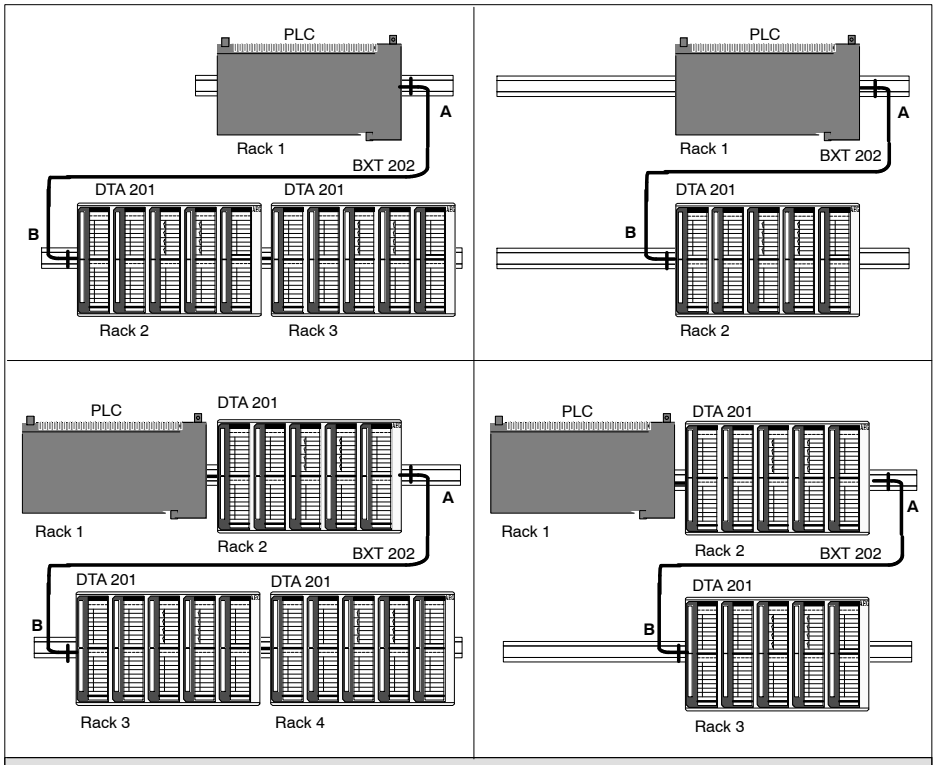
Only DTA 201 backplanes can be used for A120 I/O in a stacked layout—DTA 202 (two-slot) backplanes are not allowed.

Caution The connectors on the BXT 201 cable are polarized and must be connected properly—the A connector *must* be attached to the rightmost unit on the top DIN rail and the B connector *must* be attached to the rightmost unit on the bottom DIN rail.



Stacked A120 I/O Expansion Layouts

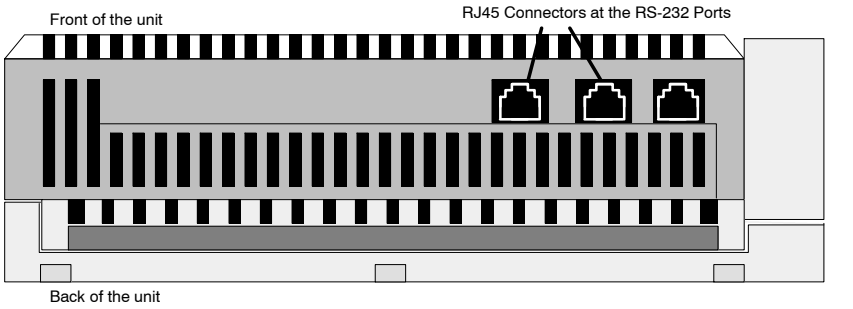
☞ **Note** The rack numbers in a stacked layout are determined by the way the rack on the right side of the lower level is connected via BXT 201 cable to the PLC or to rack 1 above.



Stacked A120 I/O Expansion Layouts

Connecting the PLC to a Programming Panel

A programming panel—for example, the 520VPU19200 Hand-held Programmer* (HHP) or a personal computer running Modsoft programming software—can be connected to the PLC at one of its two RS-232 ports, **comm 1** or **comm 2**.



RS-232 Port Locations on the Bottom of a PLC

RS-232 Cable Cables

Standard eight-position, foil-shielded, flat telephone cables with male RJ45 connectors on each end are used to connect the units. Three premade cable assemblies are available:

RS-232 Communications Cables	
Length	**Part Number**
1 m (3 ft)	110XCA28201
3 m (10 ft)	110XCA28202
6 m (20 ft)	110XCA28203

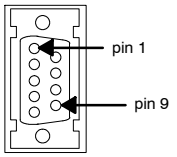
* Does not support the 61204.

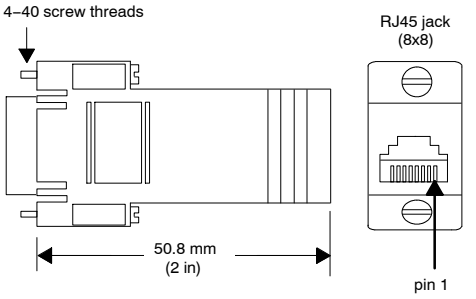
RS-232 Cable Connectors

Two female D-shell adapters are available from Modicon for PLC-to-computer connections—a (110XCA20300) 9-pin adapter for PC-AT type computers and a (110XCA20400) 25-pin adapter for PC-XT type computers.

These adapters come equipped with an RJ45 jack that allows them to clip directly onto a cable assembly. Details are shown on the following page.

110XCA20300
9-pin Female Adapter



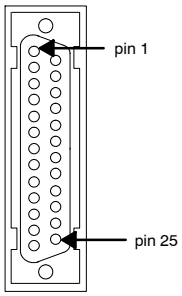


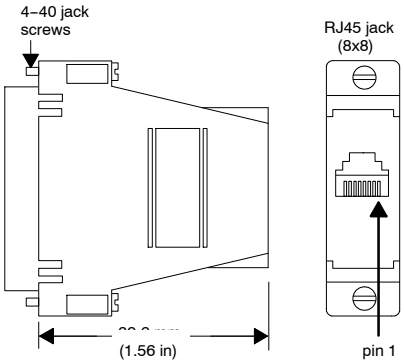
Micro ◄► PC-AT Pinouts

RJ45 Connector			9-pin D-shell	
	1*		1	DCD
TXD	3	→	2	RXD
RXD	4	→	3	TXD
DSR	2	→	4	DTR
GND	5	→	5	GND
		→	6	DSR
CTS	7	→	7	RTS
RTS	6	→	8	CTS
			9	RI
chassis ground	8	→	case of the connector	

*** CAUTION: Pin 1 receives 5 V from the Micro**

110XCA20400
25-pin Female Adapter





Micro ◄► PC-XT Pinouts

RJ45 Connector			25-pin D-shell	
	1*		1	
RXD	4	→	2	TXD
TXD	3	→	3	RXD
CTS	7	→	4	RTS
RTS	6	→	5	CTS
		→	6	DSR
GND	5	→	7	GND
			8	DCD
DSR	2	→	20	DTR
chassis ground	8	→	1	chassis ground

*** CAUTION: Pin 1 receives 5 V from the Micro**

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