

Altivar Machine ATV320, ATV340

Altivar Process ATV900

Variable Speed Drives

Application Note for Hoisting

05/2019



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All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed. Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

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Table of Contents



Safety Information	5
About the Book	9
Part I Introduction	12
Scope and Purpose of Application Note	13
General Overview of Hoisting	15
Classification of Cranes	19
Part II Requirements, rating and sizings	21
Prerequisites for Sizing	22
General Information of the Sizing of Altivar Drives	23
General Information on the Sizing of Braking Resistor	26
General Information on the Sizing of Cable Length	28
General Information on the Sizing of Associated Components	31
Part III Wiring Diagrams	33
Introduction	34
Wiring Diagrams	35
Part IV Configuration of the Drive	38
Configuration overview	39
Prerequisites for the Configuration	40
Factory Settings	41
Expert Level Access	42
System Units Customization	43
Application Selection	44
Basic Configuration	45
Motor Configuration	46
Motors in parallel Configuration	48
Configuration of the Motor Thermal Monitoring	51
Configuration of the Encoder	53
Configuration of the Reference Speed and the Preset Speed	54
Configuration of the Direction for the Vertical Movement	55
Configuration of the Direction for the Horizontal Movement	57
Optimization of the Configuration	60
After the First Movement	61
Optimization of the Brake Logic Control	62
Acceleration and Deceleration	68

Low Speed and High Speed	69
Speed Loop Optimization: Standard	70
Speed Loop Optimization: High Performance.....	73
Torque or Current Limitation Detection	75
Configuration of the Stop Limit Switches	76
Configuration of the Slowing Down Switches and the Stop Limit Switches	77
Part V Additional Information.....	79
Complement on Brake Logic Control	80
High Speed Hoisting Configuration.....	88
Rope Slack Detection configuration.....	90
Braking Resistor Monitoring.....	91
Outputs of the drive and the Control of a Brake Contactor	93
Drive SISTEMA library.....	95
Regenerative Unit.....	96
Other Types of Motors	97
Master Slave application.....	100
For additional information	101
Appendix A Parameters Table	102
Appendix B Diagnostics and Troubleshooting.....	105
Appendix C CiA402 Operating State Diagram.....	107

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 inform 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 a hazardous situation which, if not avoided, **will result in** death or serious injury.

WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

Qualification Of Personnel

Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation are authorized to work on and with this product. In addition, these persons must have received safety training to recognize and avoid hazards involved. These persons must have sufficient technical training, knowledge and experience and be able to foresee and detect potential hazards that may be caused by using the product, by changing the settings and by the mechanical, electrical and electronic equipment of the entire system in which the product is used. All persons working on and with the product must be fully familiar with all applicable standards, directives, and accident prevention regulations when performing such work.

Intended Use

This product is a drive for three-phase synchronous and asynchronous motors and intended for industrial use according to this manual. The product may only be used in compliance with all applicable safety regulations and directives, the specified requirements and the technical data. Prior to using the product, you must perform a risk assessment in view of the planned application. Based on the results, the appropriate safety measures must be implemented. Since the product is used as a component in an entire system, you must ensure the safety of persons by means of the design of this entire system (for example, machine design). Any use other than the use explicitly permitted is prohibited and can result in hazards. Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel.

Product Related Information

Read and understand these instructions before performing any procedure with this drive.



HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only appropriately trained persons who are familiar with and understand the contents of this manual and all other pertinent product documentation and who have received safety training to recognize and avoid hazards involved are authorized to work on and with this drive system. Installation, adjustment, repair and maintenance must be performed by qualified personnel.
- The system integrator is responsible for compliance with all local and national electrical code requirements as well as all other applicable regulations with respect to grounding of all equipment.
- Many components of the product, including the printed circuit boards, operate with mains voltage.
- Only use properly rated, electrically insulated tools and measuring equipment.
- Do not touch unshielded components or terminals with voltage present.
- Motors can generate voltage when the shaft is rotated. Prior to performing any type of work on the drive system, block the motor shaft to prevent rotation.
- AC voltage can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors of the motor cable.
- Do not short across the DC bus terminals or the DC bus capacitors or the braking resistor terminals.
- Before performing work on the drive system:
 - Disconnect all power, including external control power that may be present. Take into account that circuit breaker or main switch does not de-energize all circuits.
 - Place a **Do Not Turn On** label on all power switches related to the drive system.
 - Lock all power switches in the open position.
 - Wait 15 minutes to allow the DC bus capacitors to discharge.
 - Follow the instructions given in the chapter "Verifying the Absence of Voltage" in the installation manual of the product.
- Before applying voltage to the drive system:
 - Verify that the work has been completed and that the entire installation cannot cause hazards.
 - If the mains input terminals and the motor output terminals have been grounded and short-circuited, remove the ground and the short circuits on the mains input terminals and the motor output terminals.
 - Verify proper grounding of all equipment.
 - Verify that all protective equipment such as covers, doors, grids is installed and/or closed

Failure to follow these instructions will result in death or serious injury.

Damaged products or accessories may cause electric shock or unanticipated equipment operation.

 DANGER
ELECTRIC SHOCK OR UNANTICIPATED EQUIPMENT OPERATION
Do not use damaged products or accessories.
Failure to follow these instructions will result in death or serious injury.

Contact your local Schneider Electric sales office if you detect any damage whatsoever.

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of hazardous atmosphere.

 DANGER
POTENTIAL FOR EXPLOSION
Install and use this equipment in non-hazardous locations only.
Failure to follow these instructions will result in death or serious injury.

 WARNING
INSUFFICIENT PERFORMANCE LEVEL/SAFETY INTEGRITY LEVEL AND/OR UNINTENDED EQUIPMENT OPERATION
• Conduct a risk assessment according to EN ISO 12100 and all other standards that apply to your application. • Use redundant components and/or control paths for all critical control functions identified in your risk assessment. • If moving loads can result in hazards, for example, slipping or falling loads, operate the drive in closed loop mode. • Verify that the service life of all individual components used in your application is sufficient for the intended service life of your overall application. • Perform extensive commissioning tests for all potential error situations to verify the effectiveness of the safety-related functions and monitoring functions implemented, for example, but not limited to, speed monitoring by means of encoders, short circuit monitoring for all connected equipment, correct operation of brakes and guards. • Perform extensive commissioning tests for all potential error situations to verify that the load can be brought to a safe stop under all conditions
Failure to follow these instructions can result in death, serious injury, or equipment damage.

Drive systems may perform unexpected movements because of incorrect wiring, incorrect settings, incorrect data or other errors.

 WARNING
UNANTICIPATED EQUIPMENT OPERATION
• Carefully install the wiring in accordance with the EMC requirements. • Do not operate the product with unknown or unsuitable settings or data. • Perform a comprehensive commissioning test.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop, overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines (1).
- Each implementation of the product must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

(1) For USA: Additional information, refer to NEMA ICS 1.1 (latest edition), Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control and to NEMA ICS 7.1 (latest edition), Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.

Machines, controllers, and related equipment are usually integrated into networks. Unauthorized persons and malware may gain access to the machine as well as to other devices on the network/fieldbus of the machine and connected networks via insufficiently secure access to software and networks.

WARNING

UNAUTHORIZED ACCESS TO THE MACHINE VIA SOFTWARE AND NETWORKS

- In your hazard and risk analysis, consider all hazards that result from access to and operation on the network/fieldbus and develop an appropriate cyber security concept.
- Verify that the hardware infrastructure and the software infrastructure into which the machine is integrated as well as all organizational measures and rules covering access to this infrastructure consider the results of the hazard and risk analysis and are implemented according to best practices and standards covering IT security and cyber security (such as: ISO/IEC 27000 series, Common Criteria for Information Technology Security Evaluation, ISO/IEC 15408, IEC 62351, ISA/IEC 62443, NIST Cybersecurity Framework, Information Security Forum - Standard of Good Practice for Information Security).
- Verify the effectiveness of your IT security and cyber security systems using appropriate, proven methods.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

WARNING

LOSS OF CONTROL

- Perform a comprehensive commissioning test to verify that communication monitoring properly detects communication interruptions.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

About the Book



At a Glance

Document Scope

This application note describes specific aspects of the use of the following drives in hoisting applications:

Altivar Drive	Minimum software version of the drive required	Horizontal Movement in Open Loop	Horizontal Movement in Closed Loop	Vertical Movement in Closed Loop
Altivar Machine ATV320	V2.9	✓	-	-
Altivar Machine ATV340	V1.7	✓	✓	✓
Altivar Process ATV900	V2.2	✓	✓	✓

This application note only covers use cases with drives that provide closed loop operation.

This application note provides information on sizing, selecting, configuring and wiring drives for specific hoisting applications. This application note is not intended to provide exhaustive information on the complete design of a hoisting application. You must read "[Scope and Purpose of the Present Document](#)" for further details.

This application note is a complement of the programming manuals of the Altivar drives family. For more details, refer to the programming manual of the drive (see the section "[related documents](#)").

Validity Note

Original instructions and information given in the present document have been written in English (before optional translation).

This document is valid for the ATV320, ATV340 and ATV900 drives.

The technical characteristics of the devices described in this document also appear online. To access this information online:

Step	Action
1	Go to Schneider Electric home page www.schneider-electric.com
2	In the Search box type the reference of a product or the name of a product range. - Do not include blank spaces in the model number/product range. - To get information on grouping similar modules, use asterisks (*).
3	If you entered a reference, go to the Product Datasheets search results and click on the reference that interests you. If you entered the name of a product range, go to the Product Ranges search results and click on the product range that interests you
4	If more than one reference appears in the Products search results, click on the reference that interests you
5	Depending on the size of your screen, you may need to scroll down to see the data sheet.
6	To save or print a data sheet as a .pdf file, click Download XXX product datasheet .

The characteristics that are presented in this manual should be the same as those characteristics that appear online. In line with our policy of constant improvement, we may revise content over time to improve clarity and accuracy. If you see a difference between the manual and online information, use the online information as your reference.

Related Documents

Use your tablet or your PC to quickly access detailed and comprehensive information on all our products on www.schneider-electric.com.

The internet site provides the information you need for products and solutions:

- The whole catalog for detailed characteristics and selection guides,
- The CAD files to help design your installation, available in over 20 different file formats,
- All software and firmware to maintain your installation up to date,
- A large quantity of White Papers, Environment documents, Application solutions, Specifications... to gain a better understanding of our electrical systems and equipment or automation,

And finally, all the User Guides related to your drive, listed below:

Title of Documentation	Reference Number
Catalog: Altivar Machine ATV320 variable speed drives	DIA2ED2160311EN (English), DIA2ED2160311FR (French)
ATV320 Getting Started	NVE21763 (English), NVE21771 (French), NVE21772 (German), NVE21773 (Spanish), NVE21774 (Italian), NVE21776 (Chinese)
ATV320 Getting Started Annex (SCCR)	NVE21777 (English)
ATV320 Installation Manual	NVE41289 (English), NVE41290 (French), NVE41291 (German), NVE41292 (Spanish), NVE41293 (Italian), NVE41294 (Chinese)
ATV320 Programming Manual	NVE41295 (English), NVE41296 (French), NVE41297 (German), NVE41298 (Spanish), NVE41299 (Italian), NVE41300 (Chinese)
Catalog: Altivar Machine ATV340	DIA2ED2160701EN (English), DIA2ED2160701FR (French)
ATV340 Getting Started	NVE37643 (English), NVE37642 (French), NVE37644 (German), NVE37646 (Spanish), NVE37647 (Italian), NVE37648 (Chinese)
ATV340 Getting Started Annex (SCCR)	NVE37641 (English)
ATV340 Installation Manual	NVE61069 (English), NVE61071 (French), NVE61074 (German), NVE61075 (Spanish), NVE61078 (Italian), NVE61079 (Chinese)
ATV340 Programming Manual	NVE61643 (English), NVE61644 (French), NVE61645 (German), NVE61647 (Spanish), NVE61648 (Italian), NVE61649 (Chinese)
Catalog: Variable speed drives Altivar Process ATV900	DIA2ED2150601EN (English), DIA2ED2150601FR (French)
ATV900 Getting Started	NHA61578 (English), NHA61579 (French), NHA61580 (German), NHA61581 (Spanish), NHA61724 (Italian), NHA61582 (Chinese)
ATV900 Getting Started Annex (SCCR)	NHA61583 (English)
ATV930, ATV950 Installation Manual	NHA80932 (English), NHA80933 (French), NHA80934 (German), NHA80935 (Spanish), NHA80936 (Italian), NHA80937 (Chinese)
ATV900 Programming Manual	NHA80757 (English), NHA80758 (French), NHA80759 (German), NHA80760 (Spanish), NHA80761 (Italian), NHA80762 (Chinese)
Schneider Electric reliability value Libraries	Reliability values

Terminology

The technical terms, terminology, and the corresponding descriptions in this manual normally use the terms or definitions in the relevant standards.

In the area of drive systems this includes, but is not limited to, terms such as **error**, **error message**, **failure**, **fault**, **fault reset**, **protection**, **safe state**, **safety function**, **warning**, **warning message**, and so on.

Among others, these standards include:

- IEC 61800 series: Adjustable speed electrical power drive systems
- IEC 61508 Ed.2 series: Functional safety of electrical/electronic/programmable electronic safety-related
- EN 954-1 Safety of machinery - Safety related parts of control systems
- EN ISO 13849-1 & 2 Safety of machinery - Safety related parts of control systems.
- IEC 61158 series: Industrial communication networks - Fieldbus specifications
- IEC 61784 series: Industrial communication networks - Profiles
- IEC 60204-1: Safety of machinery - Electrical equipment of machines – Part 1: General requirements
- IEC 60204-32 series: Safety of machinery – Electrical equipment of machines – Part 32: Requirements for hoisting machines.

In addition, the term **zone of operation** is used in conjunction with the description of specific hazards, and is defined as it is for a **hazard zone** or **danger zone** in the EC Machinery Directive (2006/42/EC) and in ISO 12100-1.

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Part I

Introduction

What is in This Part?

This part contains the following chapters:

Scope and Purpose of Application Note.....	13
General Overview of Hoisting	15
Classification of Cranes	19

Scope and Purpose of Application Note

Scope and Purpose of Application Note

A hoisting application consists of a whole range of different interrelated mechanical, electrical, and electronic components, the drive being just one part of such an application. The drive by itself is neither intended to nor capable of providing the entire functionality to meet all safety-related requirements that apply to a hoisting application. Depending on the application and the corresponding risk assessment to be conducted by you, a whole variety of additional equipment is required such as, but not limited to, external encoders, external brakes, external monitoring devices, guards, etc.

The present document is intended to provide information relating to specific aspects of the design of your hoisting application with regard to the drive. The present document assumes that you are fully aware of all normative standards and requirements that apply to your hoisting application. The present document assists you in determining the suitability of a specific drive model to implement certain requirements of your machine design. Since the drive cannot provide all safety-related functionality for the entire hoisting application, you must ensure that the required Performance Level and/or Safety Integrity Level is reached by installing all necessary additional equipment.

Design, construction, operation, and maintenance of hoisting machines such as cranes are covered by numerous standards of type A, type B and type C.

A type A standard is a basic safety-related standard that covers basic concepts, design principles and general aspects applying to all machinery. Typical examples of Type A standards include:

- EN ISO 12100 - General principles for design - Risk assessment and risk reduction
- IEC 61508 - Functional safety of electrical/electronic/ programmable electronic safety-related systems

Type B standards are classified into Type B1 and Type B2 standards. Type B1 standards are generic standards covering particular safety-related aspects. Type B2 standards cover specific types of safeguards that can be used across a wider range of machinery. Typical examples of Type B standards include:

- EN ISO 13849-1 - Safety-related parts of control systems
- IEC 62061 - Safety of machinery: Functional safety of electrical, electronic and programmable electronic control systems
- EN ISO 13850 - Safety of machinery. Emergency stop function. Principles for design
- EN 60204-1 - Safety of machinery. Electrical equipment of machines. General requirements

Type C standards cover detailed safety-related requirements for a particular machine or group of machines. Typical examples of type C standards relating to cranes include:

- EN 60204-32 Safety of machinery. Electrical equipment of machines. Requirements for hoisting machines
- EN 15011 - Cranes. Bridge and gantry cranes
- EN 14492-1 and EN 14492-2 Cranes. Power driven winches and hoists
- EN 13135-2 - Cranes. Equipment. Non-electrotechnical equipment

As a designer/manufacturer of hoisting machines, you must be familiar with and observe all standards that apply to your machine. You must conduct a risk assessment and determine the appropriate Performance Level (PL) and/or Safety Integrity Level (SIL) and design and build your machine in compliance with all applicable standards. In doing so, you must consider the interrelation of all components of the machine. In addition, you must provide instructions for use that enable the user of your machine to perform any type of work on and with the machine such as operation and maintenance in a safe manner.

WARNING

INSUFFICIENT PERFORMANCE LEVEL/SAFETY INTEGRITY LEVEL AND/OR UNINTENDED EQUIPMENT OPERATION

- Conduct a risk assessment according to EN ISO 12100 and all other standards that apply to your application.
- Use redundant components and/or control paths for all critical control functions identified in your risk assessment.
- If moving loads can result in hazards, for example, slipping or falling loads, operate the drive in closed loop mode.
- Verify that the service life of all individual components used in your application is sufficient for the intended service life of your overall application.
- Perform extensive commissioning tests for all potential error situations to verify the effectiveness of the safety-related functions and monitoring functions implemented, for example, but not limited to, speed monitoring by means of encoders, short circuit monitoring for all connected equipment, correct operation of brakes and guards.
- Perform extensive commissioning tests for all potential error situations to verify that the load can be brought to a safe stop under all conditions

Failure to follow these instructions can result in death, serious injury or equipment damage.

General Overview of Hoisting

Glossary

Load: a heavy or bulky object carried or is about to be carried.

Hoist: Machines for lifting and lowering suspended loads over predetermined distances, with or without trolleys, using different hoist media.

Hook (or hooks): Part used to connect the material to the crane. It is suspended from the hoist rope.

Brake: Device for reducing the speed, stopping and preventing movement of the crane mechanisms.

Jib: Component of a crane which provides the necessary radius and/or height of the load-handling device. This operating arm holds and guides a piece on it.

Trolley or travel: It carries the hoist and load and can be moved from side to side between the tracks. The trolley is carried by the bridge.

Bridge or long travel: Main supporting structure of overhead type cranes over which the trolley traverses, or the structure between supports on portal and semi-portal cranes.

Crane: Cyclic action machine intended for hoisting and moving in space of a load suspended by means of a hook or other load-handling device.

Gantry: bridge-like overhead structure with a platform supporting equipment such as a crane.

Overhead Travelling crane: Crane with its load-handling device hung from a trolley with hoist mechanism capable of travelling along a bridge and with its bridge girders directly supported on rail tracks by travelling carriages.

Gantry Crane: Crane able to travel by wheels on rails, runways or roadway surfaces, or crane without wheels mounted in a stationary position, having at least one primarily horizontal girder supported by at least one leg and equipped with at least one hoisting mechanism.

Tower Crane: Crane with a load-handling device suspended from a trolley travelling along a slewing jib (or with a lowering slewing jib) which is located at the top of a vertical tower which is jointed to the crane base at the bottom.

Hoisting Segmentation and Applications

Hoisting applications can be categorized as:

- **Industrial cranes:** these are the cranes use for production. The industrial cranes can be classified in two categories: the standard cranes and the special cranes.
 - The Standard Cranes cover the block hoist, the jib cranes and part of the overhead traveling cranes and the gantry cranes.
 - The Special Cranes cover the other part of the overhead traveling cranes and the gantry cranes. These are cranes designed for specific usage requiring specific architecture (mechanical and electrical).
- **Building cranes:** these are the cranes use for construction. In this segment there are tower cranes, self-erected tower cranes and luffing jib cranes.
- **Logistic cranes:** In this segment, the cranes are not used for construction or production. These are mainly the harbor cranes like:
 - ship-to-shore gantry cranes (example: container gantry cranes and bulk load / unload cranes),
 - rubber tire gantry cranes,
 - rail mounted gantry cranes.

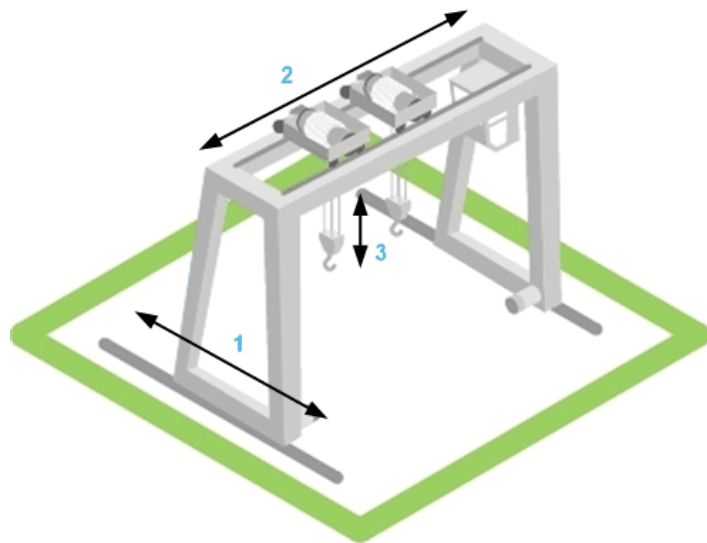
Type of Movements

There are five main hoisting movements:

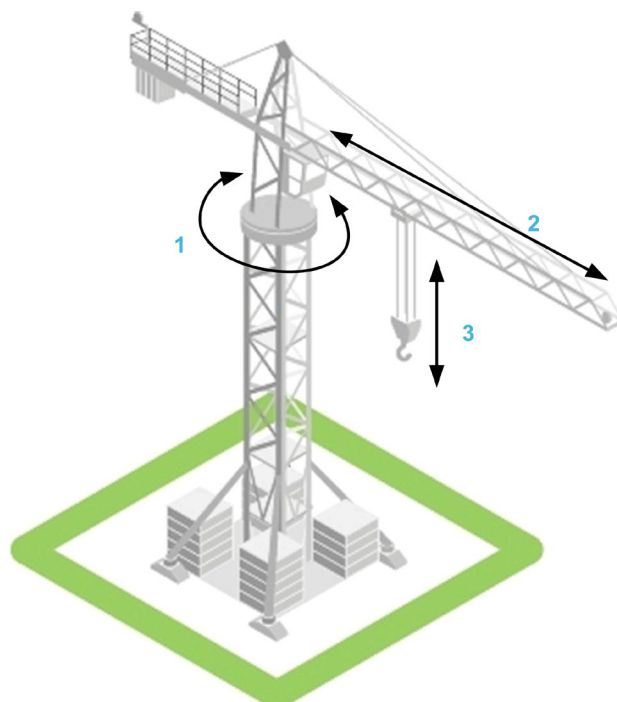
- Vertical movement (Hoisting): This movement is in charge of holding a load and moving it vertically by lifting or lowering it,
- Trolleying: the horizontal movement of the hoist along the girder or the jig,
- Travelling: the horizontal movement of the hoist along a rail,
- Slewing: the angular movement of the revolving part in the horizontal plane,
- Luffing jib: A hinged jib that can be raised or lowered towards the tower, reducing the radial reach of the crane.

The following figures show main examples of the possible movements in applications (gantry crane, tower crane).

1: Traveling
2: Trolley
3: Hoisting



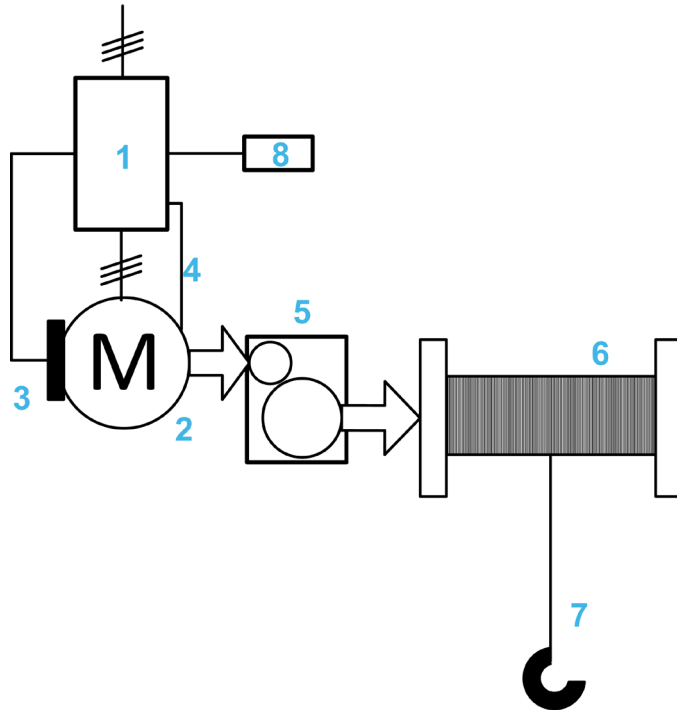
1: Slewing
2: Trolley/Traveling
3: Hoisting



Hoisting or Vertical Movement

A typical vertical movement (hoisting) is performed by a single asynchronous motor and a single drive. This application note describes this use case.

Overview:



- 1: Drive
- 2: Asynchronous Motor
- 3: Brake
- 4: Encoder feedback
- 5: Gearbox
- 6: Drum
- 7: Rope and hook
- 8: Braking resistor

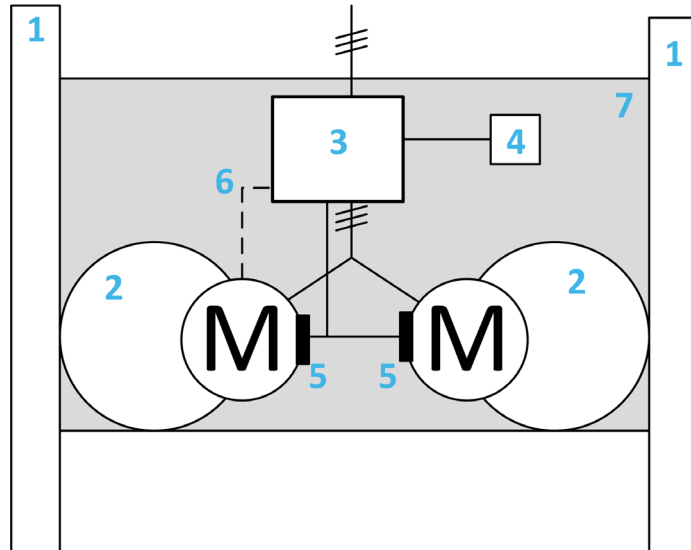
The brake shown in the graphic acts on the motor. This is a service brake. There are also use case in which an additional brake acts on the drum.

The vertical movements can be very different. With the same nominal power, a heavy load can be lifted with a low speed or a light load can be lifted with high speed. For example, with 20 kW, you can lift 20 T at 5m/min or 2 T at 50m/min. The over torque value during acceleration and deceleration is different. These two cases do not belong to the same crane category (see the following topic about crane category classification).

Trolleying or Travelling Movement

A typical horizontal movement (trolleying) is performed by multiple asynchronous motors with a single or multiples drives. This application note describes operation with two identical asynchronous motors and a single drive.

Overview:



- 1: Rail / Jib
- 2: Gearbox and wheel
- 3: Drive
- 4: Brake resistor
- 5: Brake
- 6: Encoder feedback (optional)
- 7: Bridge
- M: Motor (asynchronous)

The drive handles two brakes with one single output. The brakes are applied to the motors.

In this application note the travelling or horizontal movement will be considered as operated with two asynchronous motor in parallel with the same characteristics.

Hoisting Machine / Process

A differentiation must be made between hoisting machine and hoisting process.

It is considered as a machine when it is always available and its usage only temporary. It is not crucial if a machine is out of order.

It is considered as process when it is a full part of the process, for example if the production line depends on it: It is crucial if the process is out of order.

In application hoisting process may have similarities with hoisting machine but the constraints like design constraints are not the same.

Classification of Cranes

Overview

There are two main mechanical classifications of hoist duty rating: FEM 9.511 and ISO 4301-1. These classifications include mechanical class, load spectrum and run time class.

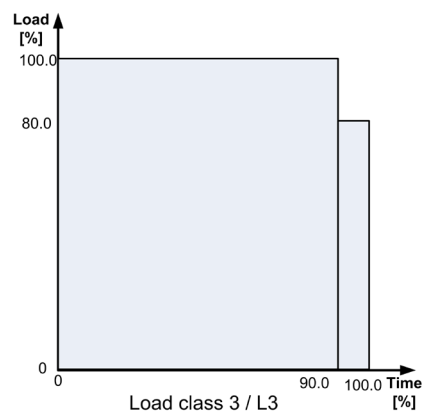
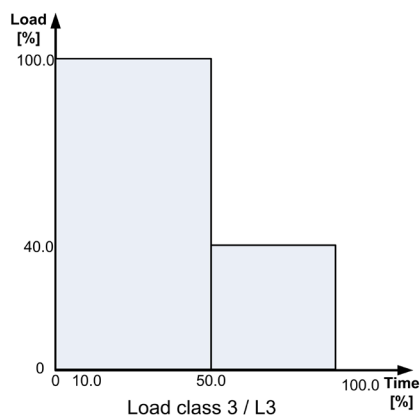
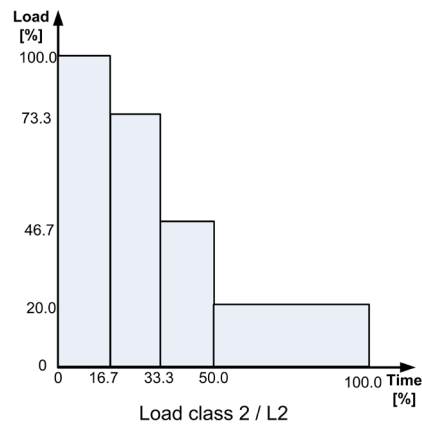
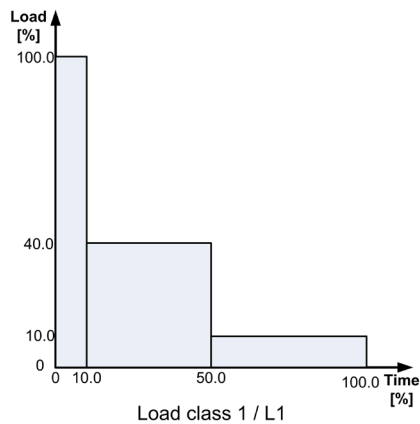
Runtime class

The following table shows the 9 run time classes depending on the mean daily run time in hours or the total duration of use:

Run time class		Mean daily run time (T in hour)	Total duration of use (in hour)
FEM	ISO		
V0.06	T 0	$T \leq 0.12$	200
V0.12	T 1	$0.12 < T \leq 0.25$	400
V0.25	T 2	$0.25 < T \leq 0.5$	800
V0.5	T 3	$0.5 < T \leq 1$	1600
V 1	T 4	$1 < T \leq 2$	3200
V 2	T 5	$2 < T \leq 4$	6300
V 3	T 6	$4 < T \leq 8$	12500
V 4	T 7	$8 < T \leq 16$	25000
V 5	T 8	$T > 16$	50000

Load spectrum

Both standards define four levels of load spectrum. These levels correspond to the distribution of load (in %) in relation to the daily runtime (in %).



Frequency of use spectrum

The following table crosses the load spectrum with the runtime class for the ISO standard:

ISO	T 0	T 1	T 2	T 3	T 4	T 5	T 6	T 7	T 8
L1	-	-	M 1	M 2	M 3	M 4	M 5	M 6	M 7
L2	-	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8
L3	M 1	M 2	M 3	M 4	M 5	M 6	M 7	M 8	-
L4	M 2	M 3	M 4	M 5	M 6	M 7	M 8	-	-

The following table crosses the load spectrum with the runtime class for the FEM standard:

FEM	V0.06	V0.12	V0.25	V0.5	V 1	V 2	V 3	V 4	V 5
1	-	-	1Dm	1Cm	1Bm	1Am	2m	3m	4m
2	-	1Dm	1Cm	1Bm	1Am	2m	3m	4m	5m
3	1Dm	1Cm	1Bm	1Am	2m	3m	4m	5m	-
4	1Cm	1Bm	1Am	2m	3m	4m	5m	-	-

Correspondence table

The following table shows the correspondence between the horizontal and the vertical movement with:

- the Service Factor (S.F.) calculated as 1/3 of low services (L.S.) and 2/3 of high services (H.S.)
- the Starting Class corresponding to the number of starts per hour.

ISO	FEM	Vertical Movement		Horizontal Movement	
		S.F. %	Starting Class	S.F. %	Starting Class
M1	1Dm	15 %	90	10 %	60
M2	1Cm	20 %	120	15 %	90
M3	1Bm	25 %	150	20 %	120
M4	1Am	30 %	180	25 %	150
M5	2m	40 %	240	30 %	180
M6	3m	50 %	300	40 %	240
M7	4m	60 %	360	50 %	300
M8	5m	60 %	360	60 %	360

Mechanical design information is mandatory for sizing.

A typical hoisting machine for vertical movement has a low service factor if it has a linear speed (speed of the load) less than 5 m/min. The corresponding categories are M3 to M5.

A typical hoisting machine for vertical movement has a high service factor if it has a linear speed (speed of the load) higher than 5 m/min. The corresponding categories are M6 to M8.

Part II

Requirements, rating and sizings

What is in This Part?

This part contains the following topics:

Prerequisites for Sizing.....	22
General Information of the Sizing of Altivar Drives	23
General Information on the Sizing of Braking Resistor	26
General Information on the Sizing of Cable Length.....	28
General Information on the Sizing of Associated Components	31

Prerequisites for Sizing

Overview

This application note does not cover the collection of the required data for hoisting machines, especially the mechanical data like the motor sizing.

Before starting the sizing, the collection of the mechanical data must be done by a mechanics specialist.

Information needed

Before starting to select the components of your hoisting machines, you must have the following information:

- The number of motors in parallel (one or two similar motors in parallel).
- All characteristics of the motors to determine its suitability,
- The type (vertical or horizontal) and speed of the movement.
- The cable length between the drive and the motor(s),
- The type of connection for mains supply (through the tracks of the trolley or cables).
- The machine cycle with its classification/category including the number of starts per hour of the machine.

General Information of the Sizing of Altivar Drives

Introduction

Refer to the ATV320, ATV340 and Altivar Process ATV900 drives catalogs to choose the most appropriate drive for your application. See the section [“related documents”](#).

Drive Rating for Vertical Movements

When choosing the drive for vertical movements with hoisting machines, you must respect the following requirements:

- The nominal power of the motor must be equal to or less than the nominal power of the drive in Heavy Duty (HD). Heavy Duty is a dedicated mode for applications requiring a significant overload current (up to 150 % of nominal output current),
- A closed loop solution is required. Encoder interface module is required (refer to the drive catalog, see the [“related documents”](#)).
- The nominal current of the drive in Heavy Duty must be higher than the nominal current of the motor.

The drive must be overrated by 1 power rating if at least one of the following conditions is fulfilled:

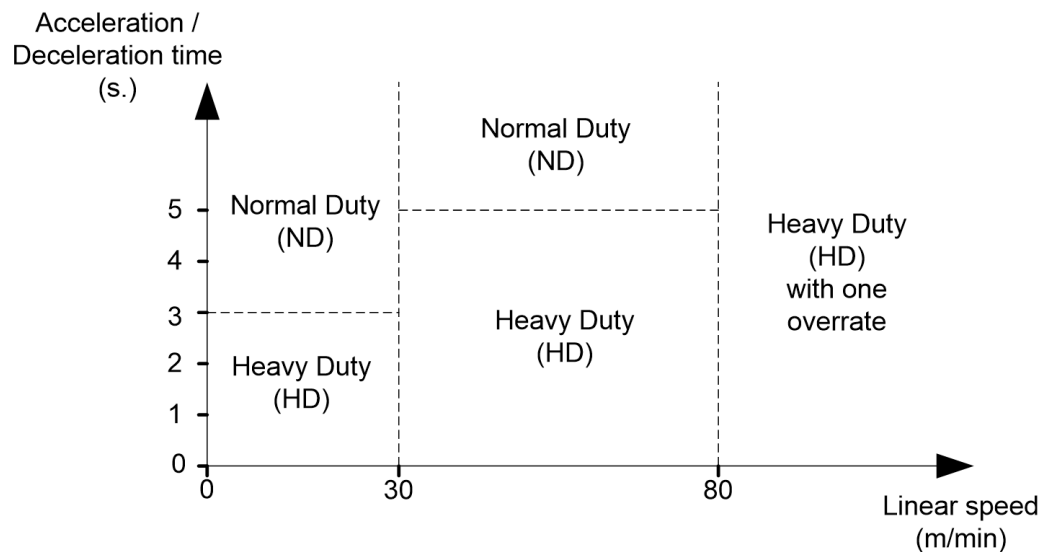
- The linear speed (speed of the load) can be higher than 20 m/min,
- The High Speed Hoisting function is used,

Note: This application note only covers use cases with drives that provide closed loop operation.

Drive Rating for Horizontal Movements

When choosing the drive for horizontal movements in open or closed loop, you must respect the following requirements:

- The sum of the nominal power of the motors must be equal to or less than the nominal power of the drive according to its duty rating (ND/HD) following the graph below.



- The nominal current of the drive, according to the selected duty rating (ND/HD) must be higher than the sum of the nominal current of the motors,
- The minimum linear speed (speed of the bridge) must be higher than the slip speed of the motor.

Both open and closed loop are possible for horizontal movements. If a speed less than the motor slip speed is required, a closed loop solution must be implemented with multiple motors. Refer to the slip speed calculation below.

Note: Ratings of ATV320 are to be considered as Heavy Duty (HD).

Slip speed calculation

The parameter **[Nominal motor slip]** n_{SL} is calculated as following (in Hz):

$$n_{SL} = FRS - \frac{NSP * NPP}{60}$$

FRS : [Nominal motor Freq]

NSP : [rated motor speed]

NPP: number of pole pairs defined by the following calculation (with the "floor" function "[...]"):

$$NPP = \left\lfloor \frac{FRS * 60}{NSP} \right\rfloor$$

Examples

In the following example, only wall-mounting drives are considered.

Vertical Movement: one motor of 55 kW (nominal power) and 81.6 A (nominal current).

The ATV340 catalog shows the following table:

Motor			Supply mains				Altivar Machine				Reference (1)	Weight
Power indicated on rating plate (2)			Input current (3)		Apparent power	Prospective line Isc	Maximum continuous current (2)	Maximum transient current for 2 s	Maximum transient current for 60 s			
HD:	Heavy duty (5)		380 V	480 V	380 V							
ND:	Normal duty (4)											
	kW	HP	A	A	kVA	kA	A	A	A		kg/lb	
Three-phase supply voltage: 380...480 V 50/60 Hz												
HD	37	50	67.1	59	49.1	50	74.5	111.75	111.75	ATV340D37N4E	28.400/ 62.611	
ND	45	60	78.9	69.1	57.4	50	88	105.6	105.6			
HD	45	60	81.4	71.8	59.7	50	88	132	132	ATV340D45N4E	56.400/ 124.341	
ND	55	75	97.2	84.2	70	50	106	127.2	127.2			
HD	55	75	98.9	86.9	72.2	50	106	159	159	ATV340D55N4E	57.900/ 127.648	
ND	75	100	131.3	112.7	93.7	50	145	174	174			
HD	75	100	134.3	118.1	98.2	50	145	217.5	217.5	ATV340D75N4E	58.400/ 128.750	
ND	90	125	156.2	135.8	112.9	50	173	207.6	207.6			

ATV340D55N4E complies with both requirements on the nominal power and the nominal current in HD.

For Altivar Process ATV900, we have many different references depending on the IP level, the integration of EMC filter or braking unit.

For example, by referring to **IP 21/UL Type 1 drives with category C2 or C3 integrated EMC filter - Wall mounting**, the table is:

IP 21/UL Type 1 drives with category C2 or C3 integrated EMC filter - Wall mounting ⁽¹⁾										
Motor			Line supply				Altivar Process			
Power indicated on rating plate ⁽²⁾			Line current ⁽³⁾		Apparent power	Prospective line Isc	Maximum continuous current ⁽²⁾	Maximum transient current for 60 s	Reference	Weight
			380 V	480 V	380 V					
ND:	Normal duty ⁽⁴⁾									
HD:	Heavy duty ⁽⁵⁾									
	kW	HP	A	A	kVA	kA	A	A		kg/lb
ND	37	50	66.2	57.3	47.6	50	74.5	89.4	ATV930D37N4	28.200/62.170
HD	30	40	54.8	48.3	40.2	50	61.5	92.3		
ND	45	60	79.8	69.1	57.4	50	88	105.6	ATV930D45N4	28.700/63.273
HD	37	50	67.1	59.0	49.1	50	74.5	111.8		
ND	55	75	97.2	84.2	70	50	106	127.2	ATV930D55N4	57.500/126.766
HD	45	60	81.4	71.8	59.7	50	88	132		
ND	75	100	131.3	112.7	93.7	50	145	174	ATV930D75N4	59.000/125.663
HD	55	75	98.9	86.9	72.2	50	106	159		
ND	90	125	156.2	135.8	112.9	50	173	207.6	ATV930D90N4	59.500/131.174
HD	75	100	134.3	118.1	98.2	50	145	217.5		

ATV930D75N4 complies with both the requirements on the nominal power and the nominal current in HD.

If the drive must be overrated, ATV340D55N4E becomes ATV340D75N4E and ATV930D75N4 becomes ATV930D90N4.

Horizontal Movement: two or four motors.

The following table shows the required characteristics of the drive following different examples of horizontal movement:

Movement	horizontal movement characteristics		Number of motors	Minimum drive characteristics			
	Acceleration / Deceleration	Maximum linear speed		Nominal power	Nominal Current	Duty of the drive ¹	Overtime
1	≤ 3 s	≤ 30 m/min	2 ²	1.5 kW	3.8 A	HD	-
2	5 s	≤ 30 m/min	2 ³	4.4 kW	9.8 A	ND	-
3	6 s	40 m/min	2 ⁴	15 kW	30.2 A	ND	-
4	4 s	40 m/min	2 ⁴	15 kW	30.2 A	HD	-
5	5 s	60 m/min	4 ⁴	30 kW	60.4 A	HD	-
6	6 s	120 m/min	4 ⁴	30 kW	60.4 A	HD	Yes
(1): not applicable for ATV320							
(2): The nominal power of each motor is 0.75 kW and the nominal current is 1.9 A.							
(3): The nominal power of each motor is 2.2 kW and the nominal current is 4.9 A.							
(4): The nominal power of each motor is 7.5 kW and the nominal current is 15.1 A.							

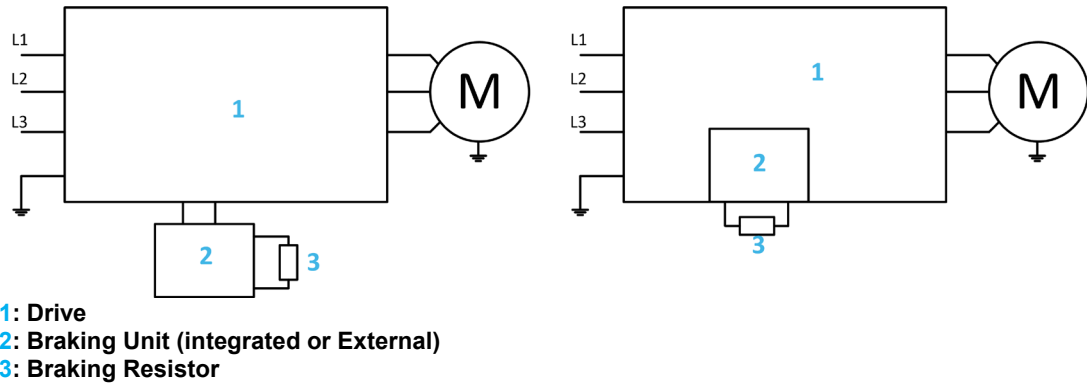
The following table shows the catalog numbers of the drive for the different examples:

Movement	Catalog Number		
	ATV320	ATV340	ATV900 ¹
1	ATV320U15N4●	ATV340U15N4●	ATV340U15N4
2	ATV320U55N4●	ATV340U40N4●	ATV340U55N4
3	ATV320D15N4B	ATV340D11N4E	ATV930D15N4
4	ATV320D15N4B	ATV340D15N4E	ATV930D18N4
5	-	ATV340D30N4E	ATV930D37N4
6	-	ATV340D37N4E	ATV930D45N4
(1): By referring to IP 21/UL Type 1 drives with category C2 or C3 integrated EMC filter - Wall mounting			

General Information on the Sizing of Braking Resistor

Braking Module

Some drives have a built-in dynamic brake transistor. If there is no built-in solution, you must add a braking unit. The sizing must be done in accordance with the machine cycling.



Refer to the drive catalog for further information (see the [“related documents”](#)).

Braking resistor Sizing for Vertical Movements

The resistor power value must be equal to or higher than 50 % of the motor power.

The resistor value must be higher, and as close as possible, than the minimum braking resistor value given in the catalog for the selected drive or braking unit.

The power value can be optimized with exact knowledge of the machine cycling and the mechanical loss.

Braking resistor Sizing for Horizontal Movements

The resistor power value must be equal to or higher than 25 % of the motor power.

The resistor value must be higher, and as close as possible, than the minimum braking resistor value given in the catalog for the selected drive or braking unit.

The power value can be optimized with exact knowledge of the machine cycling and the mechanical loss.

Minimum braking Resistor and braking Unit depending on the drive caliber

The following table shows the minimum value of resistor required depending on the ATV320 drive:

Catalog Number	Minimum Resistor Value (Ω)	Catalog Number	Minimum Resistor Value (Ω)	Catalog Number	Minimum Resistor Value (Ω)
ATV320U07M●●	40	ATV320D11M3C	5	ATV320U07N4●	80
ATV320U04M●●	40	ATV320D15M3C	5	ATV320D11N4B	16
ATV320U06M●●	40	ATV320U11N4●	54	ATV320D15N4B	16
ATV320U07M●●	40	ATV320U15N4●	54	ATV320U07S6C	96
ATV320U11M●●	27	ATV320U22N4●	54	ATV320U15S6C	64
ATV320U15M●●	27	ATV320U30N4●	54	ATV320U22S6C	64
ATV320U22M●●	25	ATV320U40N4●	36	ATV320U40S6C	44
ATV320U30M3C	16	ATV320U55N4B	27	ATV320U55S6C	34
ATV320U40M3C	16	ATV320U75N4B	27	ATV320U75S6C	23
ATV320U55M3C	8	ATV320U04N4●	80	ATV320D11S6C	24
ATV320U75M3C	8	ATV320U06N4●	80	ATV320D15S6C	24

The following table shows the minimum value of resistor required depending on the ATV340 drive:

Catalog Number	Minimum Value (Ω)	Catalog Number	Minimum Value (Ω)
ATV340U07N4●	78	ATV340D15N4●	16
ATV340U15N4●	52	ATV340D18N4●	13
ATV340U22N4●	52	ATV340D22N4●	10
ATV340U30N4●	31	ATV340D30N4E	10
ATV340U40N4●	31	ATV340D37N4E	10
ATV340U55N4●	31	ATV340D45N4E	2.5
ATV340U75N4●	28	ATV340D55N4E	2.5
ATV340D11N4●	16	ATV340D75N4E	2.5

The following table shows the minimum value of resistor required depending on the ATV900 drive:

Catalog Number	Minimum resistor Value (Ω)	Catalog Number	Minimum resistor Value (Ω)	Catalog Number	Minimum resistor Value (Ω)
ATV9●0U07N4●	56	*ATV930C25N4C	1.05	ATV930U55Y6	12
ATV9●0U15N4●	56	*ATV930C31N4C	1.05	ATV930U75Y6	12
ATV9●0U22N4●	56	ATV930U07M3	44	ATV930D11Y6	12
ATV9●0U30N4●	34	ATV930U15M3	33	ATV930D15Y6	12
ATV9●0U40N4●	34	ATV930U22M3	22	ATV930D18Y6	12
ATV9●0U55N4●	23	ATV930U30M3	22	ATV930D22Y6	12
ATV9●0U75N4●	19	ATV930U40M3	16	ATV930D30Y6	12
ATV9●0D11N4●	12	ATV930U55M3	11	ATV930D37Y6	8
ATV9●0D15N4●	15	ATV930U75M3	8	ATV930D45Y6	8
ATV9●0D18N4●	15	ATV930D11M3	5	ATV930D55Y6	8
ATV9●0D22N4●	15	ATV930D15M3	5	ATV930D75Y6	5
ATV9●0D30N4●	10	ATV930D18M3	5	ATV930D90Y6	5
ATV9●0D37N4●	10	ATV930D22M3	5	ATV930D18S6	10
ATV9●0D45N4●	10	ATV930D30M3●	2.5	ATV930D22S6	10
ATV9●0D55N4●	2.5	ATV930D37M3●	2.5	ATV930D30S6	5
ATV9●0D75N4●	2.5	ATV930D45M3●	2.5	ATV930D37S6	5
ATV9●0D90N4●	2.5	*ATV930D55M3C	1.4	ATV930D45S6	5
*ATV930C11N4C	2.5	*ATV930D75M3C	1.4	ATV930D55S6	2.5
*ATV930C13N4C	2.5	ATV930U22Y6	12	ATV930D75S6	2.5
*ATV930C16N4C	2.5	ATV930U30Y6	12		
ATV930C22N4●	1.4	ATV930U40Y6	12		

(*): a braking unit must be used on this drive.

These previous tables are extracted from the installation manual of the drives. Always verify that these values are up to date (see the "[related documents](#)").

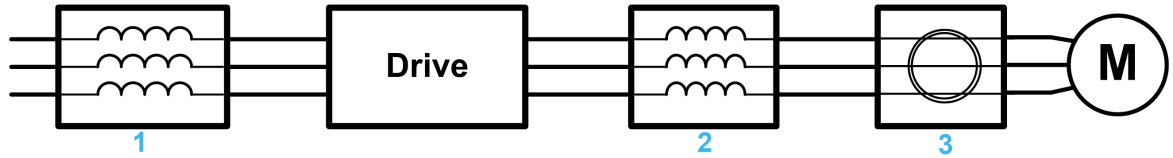
There is additional information about the compatibility of the braking unit and braking resistor with the drives in the catalog of the drives (see the "[related documents](#)").

General Information on the Sizing of Cable Length

Overview

Cables and filters:

- Upstream to the drive: Line Chokes,
- Downstream to the drive: Motor Chokes / Output Filters (Motor Chokes, sinus filter or dv/dt filter) and/or Common filter.



1: Line Chokes

2: Motor Chokes / Output Filters

3: Common Mode Filter

The following table shows the possible options available for each drive:

Drive	Line Chokes / Line inductances	Motor Chokes	Sinus filter	dv/dt filter	Common Mode Filter
ATV320	✓	✓	-	-	-
ATV340	✓	-	-	✓	✓
ATV900	✓ ¹	-	✓	✓	✓
(1): on ATV930, DC choke is embedded.					

✓ Compliant and validated use

For other combinations than the ones available in the table, contact your local Schneider Electric representative.

Refer to drive catalog to have further information and choose the adapted combination for your application (see the [“related documents”](#)).

Lines Chokes

Line chokes must be installed upstream to the drive.

It is advisable to use line chokes if there are:

- Disturbance on the mains supply like interference or overvoltage (for example if the machine is supplied through the tracks of the trolley).
- Voltage imbalance between the phases.
- Low impedance of the drive mains supply.
- Several frequency inverters on the same mains supply.
- A power factor correction module in the installation.

Lines Chokes are mandatory from ATV340U07N4 to ATV340D22N4 with Normal Duty mode (horizontal movement).

For ATV930U22Y6...D90Y6 drives (500...690 V mains supply), line chokes must be used to decrease harmonics level. Refer to the catalog for combinations (see the [“related documents”](#)).

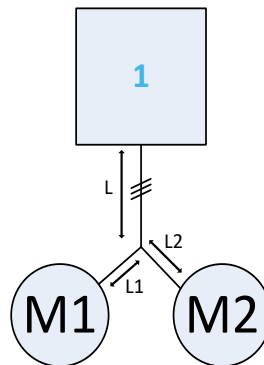
Motor Filters / Output Filters

Motor Filters, also known as load reactors, can be inserted between the drive and the motors to:

- Limit the dv/dt at the motor terminals.
- Filter interferences caused by the opening of a contactor placed between the filter and the motor.
- Reduce the motor ground leakage current.
- Smooth the motor current wave form to reduce motor noise.

The need also depends on the cable length and the type of cable (shielded or unshielded).

The cable length to consider is the total length of cables between the drive and the motors (on the following schematic, the sum is $L+L_1+L_2$).



1: Drive

M1, M2: motors

Cable Length and Motor Filter

The following table shows the maximum cable lengths to operate without motor filter:

Drive	Shielded motor cable lengths	Unshielded motor cable lengths
ATV320	50 m / 164 ft	100 m / 328 ft
ATV340	100 m / 328 ft	200 m / 656 ft
ATV930 ¹	150 m / 492 ft	300 m / 984 ft
1: For 500...690 V supply voltage, maximum motor cable length is 10 m / 32 ft for shielded cables and 20 m / 65 ft for unshielded cables.		

Refer to the catalog for additional information (see the [“related documents”](#)).

The following table shows the use of output filters depending on the drive and according to IEC60034-25:

- For ATV340:

Cable length	100 m up to 300 m (328 ft up to 984 ft)	300 m up to 500 m (984 ft up to 1640 ft)	500 m up to 1000 m (1640 ft up to 3280 ft)
Shielded motor cable	dv/dt filter	Not applicable	Not applicable
Unshielded motor cable	dv/dt filter	dv/dt filter ⁽¹⁾	Not applicable
(1): for ATV340U07N4 to ATV340U40N4: not applicable.			

- For ATV930:

Cable length	150 m up to 300 m (492 ft up to 984 ft)	300 m up to 500 m (984 ft up to 1640 ft)	500 m up to 1000 m (1640 ft up to 3280 ft)
Shielded motor cable	dv/dt filter	Sinus filter	Not applicable
Unshielded motor cable	No filter	dv/dt filter	Sinus filter

Note:

- It is advised to use shielded motor cables.
- Verify the compatibility of the motor with overvoltage up to 1500V/μs. For motor higher than 200kW the supplier must ensure the compatibility with frequency inverter control.

Motor Chokes

The association depends on the type and length of the cables. Refer to ATV320 catalog.

dv/dt Filters

For cables longer than 50 m / 164 ft, it is recommended to add an output filter.

Output filters are designed to limit dv/dt at motor terminals to 500 V/μs maximum supply voltages up to 480 V. With 400 V supply voltage, output filters are designed to limit overvoltage at the motor terminals to less than:

Maximum Voltage	Shielded cable length
800 V	0-50 m
1000 V	50-150 m
1500 V	150-300 m (up to 500 m with unshielded cable)

Note: For 500...690V supply voltage, refer to the ATV900 catalog.

Sinus Filter

Sinus filters are used for applications requiring:

- Long cable runs: Altivar Process ATV900 drives can operate with cables lengths up to 500 m with shielded cable and up to 1000 m with unshielded cable,
- Motors connected in parallel.

Note: With a sinus filter, the parameter **[Sinus Filter Activation]** αF must be set to **[Yes]** $5E5$.

NOTICE
DAMAGE TO THE SINUS FILTER Do not set the maximum output frequency [Max frequency] f_r to a value greater than 100 Hz on system with a sinus filter. Failure to follow these instructions can result in equipment damage.

The Sinus filter can only be used with closed loop control or with the 5 points U/F vector control. Otherwise, the drive can trigger an **[Overcurrent]** αF error.

Note: To use a sinus filter in open loop contact your local Schneider Electric representative.

Common Mode filter

Common mode filter reduces the interference of the motor cable and improves the efficiency of the EMC filter for conducted emissions. It also reduces the high frequency currents circulating in the bearings of the motor preventing damages.

The common mode filter can be used with or without output filters (sinus filter or dv/dt filter).

General Information on the Sizing of Associated Components

IEC 60204-32 International Standard

For hoisting application, the contactors with their associated circuit breaker must have type “2” coordination in accordance with IEC 60947-4-1, 8.2.5.1.

For UL61800-5-1 (Reference UL file E116875) combinations, refer to the annexes to the Getting Started (see the [“related documents”](#)).

ATV320 coordination table type 2

The following table shows the coordination type 2 (circuit-breaker & contactor) in accordance with the drive catalog number and the mains supply:

Mains supply in Vac	Motor power rating in kW (HP)	Catalog Number	Line Current (A)	Coordination Type 2	
				Circuit Breaker	Line Contactor
380...415	0.37 (0.5)	ATV320U04N4•	2.1 ⁽¹⁾	GV2L 07	LC1D09••
380...415	0.55 (0.75)	ATV320U06N4•	2.8 ⁽¹⁾	GV2L 08	LC1D09••
380...415	0.75 (1)	ATV320U07N4•	3.6 ⁽¹⁾	GV2L 08	LC1D09••
380...415	1.1 (1.5)	ATV320U11N4•	5 ⁽¹⁾	GV2L 10	LC1D18••
380...415	1.5 (2)	ATV320U15N4•	6.4 ⁽¹⁾	GV2L 14	LC1D18••
380...415	2.2 (3)	ATV320U22N4•	8.7 ⁽¹⁾	GV2L 14	LC1D18••
380...415	3 (4)	ATV320U30N4•	11.1 ⁽¹⁾	GV2L 16	LC1D18••
380...415	4 (5)	ATV320U40N4•	13.1 ⁽¹⁾	GV2L 16	LC1D25••
380...415	5.5 (7.5)	ATV320U55N4B	20.7 ⁽¹⁾	GV2L 22	LC1D25••
380...415	7.5 (10)	ATV320U75N4B	26.5 ⁽¹⁾	GV2L 32	LC1D25••
380...415	11 (15)	ATV320D11N4B	36.6 ⁽¹⁾	GV3L 40	LC1D40A••
380...415	15 (20)	ATV320D15N4B	47.3 ⁽¹⁾	GV3L 50	LC1D50A••

⁽¹⁾: Given for 380 V.

ATV340 coordination table type 2

The following table shows the coordination type 2 (circuit-breaker & contactor) in accordance with the drive catalog number (Heavy Duty) and the mains supply:

Mains supply in Vac	Motor power rating in kW (HP)	Catalog Number	Line Current (A)	Coordination Type 2	
				Circuit Breaker	Line Contactor
380...415	0.75 (1)	ATV340U07N4•	3.4 ⁽¹⁾	GV2L 08	LC1D18••
380...415	1.5 (2)	ATV340U15N4•	6 ⁽¹⁾	GV2L 10	LC1D18••
380...415	2.2 (3)	ATV340U22N4•	8.4 ⁽¹⁾	GV2L 14	LC1D18••
380...415	3 (4)	ATV340U30N4•	10.7 ⁽¹⁾	GV2L 16	LC1D25••
380...415	4 (5)	ATV340U40N4•	13.4 ⁽¹⁾	GV2L 16	LC1D25••
380...415	5.5 (7.5)	ATV340U55N4•	20 ⁽¹⁾	GV2L 22	LC1D25••
380...415	7.5 (10)	ATV340U75N4•	25.6 ⁽¹⁾	GV3L 32	LC1D40A••
380...415	11 (15)	ATV340D11N4•	34.7 ⁽¹⁾	GV3L 40	LC1D40A••
380...415	15 (20)	ATV340D15N4•	44.9 ⁽¹⁾	GV3L 50	LC1D50A••
380...415	18.5 (25)	ATV340D18N4•	54.7 ⁽¹⁾	GV3L 65	LC1D65A••
380...415	22 (30)	ATV340D22N4•	63.5 ⁽¹⁾	GV3L 65	LC1D65A••
380...415	30 (40)	ATV340D30N4E	54.8 ⁽¹⁾	GV4L(E)80•	LC1D65A••
380...415	37 (50)	ATV340D37N4E	67.1 ⁽¹⁾	GV4L(E)115•	LC1D115•• or LC1F115••
380...415	45 (60)	ATV340D45N4E	81.4 ⁽¹⁾	GV4L(E)115•	LC1F115•• or LC1D115••
380...415	55 (75)	ATV340D55N4E	98.9 ⁽¹⁾	NSX160 MA150	LC1F115•• or LC1D115••
380...415	75 (100)	ATV340D75N4E	134.3 ⁽¹⁾	NSX250* MA220A	LC1F185••

⁽¹⁾: Given for 380 V.

Altivar Process ATV900 coordination table type 2

The following table shows the coordination type 2 (circuit-breaker & contactor) in accordance with the drive catalog number (Heavy Duty) and the mains supply:

Mains supply in Vac	Motor power rating in kW (HP)	Catalog Number	Line Current (A)	Coordination Type 2	
				Circuit Breaker	Line Contactor
380...415	0.37 (0.5)	ATV930U07N4	0.9 ⁽¹⁾	GV2L 07	LC1D09••
380...415	0.75 (1)	ATV930U15N4	1.7 ⁽¹⁾	GV2L 08	LC1D18••
380...415	1.5 (2)	ATV930U22N4	3.1 ⁽¹⁾	GV2L 10	LC1D18••
380...415	2.2 (3)	ATV930U30N4	4.5 ⁽¹⁾	GV2L 14	LC1D18••
380...415	3 (4)	ATV930U40N4	6 ⁽¹⁾	GV2L 14	LC1D18••
380...415	4 (5)	ATV930U55N4	8 ⁽¹⁾	GV2L 16	LC1D25••
380...415	5.5 (7.5)	ATV930U75N4	10.5 ⁽¹⁾	GV2L 20	LC1D25••
380...415	7.5 (10)	ATV930D11N4	14.1 ⁽¹⁾	GV2L 22	LC1D25••
380...415	11 (15)	ATV930D15N4	20.6 ⁽¹⁾	GV3L 32	LC1D40A••
380...415	15 (20)	ATV930D18N4	27.7 ⁽¹⁾	GV3L 40	LC1D50A••
380...415	18.5 (25)	ATV930D22N4	34.1 ⁽¹⁾	GV3L 50	LC1D50A••
380...415	22 (30)	ATV930D30N4	40.5 ⁽¹⁾	GV3L 65	LC1D65A••
380...415	30 (40)	ATV930D37N4	54.6 ⁽¹⁾	GV4L(E)80•	LC1D65A••
380...415	37 (50)	ATV930D45N4	67.1 ⁽¹⁾	GV4L(E)115•	LC1D115•• or LC1F115••
380...415	45 (60)	ATV930D55N4	81.4 ⁽¹⁾	GV4L(E)115•	LC1D115•• or LC1F115••
380...415	55 (75)	ATV930D75N4	98.9 ⁽¹⁾	NSX160 MA150	LC1D115•• or LC1F115••
380...415	75 (100)	ATV930D90N4	134.3 ⁽¹⁾	NSX250* MA220A	LC1F185••
380...415	90 (125)	ATV930C11N4	134.3 ⁽¹⁾	NSX250* MA220A	LC1F185••
380...415	110 (150)	ATV930C13N4•	201 ⁽¹⁾	NSX400* Micrologic 1.3-M 320A	LC1F265••
380...415	132 (200)	ATV930C16N4•	237 ⁽¹⁾	NSX400* Micrologic 1.3-M 320A	LC1F330••
380...415	160 (250)	ATV930C22N4•	296 ⁽¹⁾	NSX630* Micrologic 1.3-M 500A	LC1F500••
380...415	200 (300)	ATV930C25N4•	365 ⁽¹⁾	NSX630* Micrologic 1.3-M 500A	LC1F500••
380...415	250 (400)	ATV930C31N4•	457 ⁽¹⁾	NS800L Micrologic 2 or 5	LC1F500••

⁽¹⁾: Given for 380 V.

Part III

Wiring Diagrams

What is in This Part?

This part contains the following topics:

Introduction.....	34
Wiring Diagrams.....	35

Introduction

Overview

Two wiring diagrams are described according to the movement (vertical or horizontal). The differences are listed in a section below.

The described wirings should be considered as a reference for basic and standard usage.

Complementary information

The wiring described in this part does not consider regenerative unit. Refer to the section "[Regenerative Unit](#)" for additional information.

In this application note, the relay R2 of the drive is used to control the brake contactor. Verify that this configuration is suitable for your application. For additional information, refer to the section "[Outputs of the drive and the Control of a Brake Contactor](#)".

There is only one brake for each motor in the described wiring. The mechanical brake is placed on the motor shaft. You must ensure that the brake used in the application is always efficient to stop a loss of the load. Other solutions exist with an additional brake, refer to your local Schneider Electric representative for additional information.

The described wiring diagram monitors:

- the relay R2,
- the brake contact or the brake contactor depending on the information available on the digital input linked to **[Brake Contact] bC**, and **[Brake Relay Fdbk] bR**.

Definition of brake contact feedback and brake contactor feedback

To release or to apply the brake, the drive controls its output relay. Then, the relay controls the brake contactor. Finally, the brake contactor controls the mechanical part of the brake. Two different feedbacks can be wired to the drive in order to be monitored:

- **The brake contact feedback:** it provides the state (applied or released) of the brake in order to know if the brake is released or applied. This feedback does not consider mechanical damage to the brake or mechanical wear of the brake. You must address this in your risk assessment and take all measures required to safely decelerate the load and hold it at standstill. To activate monitoring of the brake contact, assign the parameter **[Brake contact] bC** to a suitable digital input.
- **The brake contactor feedback (also called brake relay feedback):** it provides the state of the command to release the brake if the used contactor (such as the LC1DT20 contactor) sends its physical state (energized or deenergized) to the drive. This information does not provide the state (applied or released) of the brake. To activate monitoring of the brake contactor, assign the parameter **[Brake Relay Fdbk] bR**.

NOTE: **[Brake Relay Fdbk] bR** parameter is not available on ATV320. Instead of **[Brake Relay Fdbk] bR**, **[Brake contact] bC** can be used for the brake contactor feedback.

Wiring Diagrams

Vertical Movement Wiring Diagram (Closed loop)

When the drive transitions to operating state Fault, the mains contactor and the brake contactor must be deenergized.

 **WARNING**

UNANTICIPATED EQUIPMENT OPERATION

- Assign [Operating state fault] FLT to output relay R1.
- Connect the coil of the mains contactor to output relay R1.
- Connect the brake contactor downstream of the mains contactor.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

For vertical movement, the forward run command (Fwd) with a positive reference value must be the lifting of the load (UP) and it must be on the digital input DI1. The lowering of the load (DOWN) must be on the digital input DI2.

An encoder must be wired and configured for Closed loop.

The brake contact feedback must be wired and configured to be monitored. If the brake contact itself cannot be wired and monitored, an alternative solution using the brake contactor feedback can be applied. In this case, the full optimization of the control to release/apply the brake is not possible. See the "[Optimization of the Brake Logic Control](#)" and the "[Complement on Brake Logic Control](#)" in this document for additional information.

Refer to the installation manual for the grounding and the shielded wiring.

Note: For ATV340 drives, the number of digital inputs depends on the catalog numbers. For drives with power below 30 kW (40 HP), DI6 used as a digital input replaces DI16.

Diagram with brake contact feedback

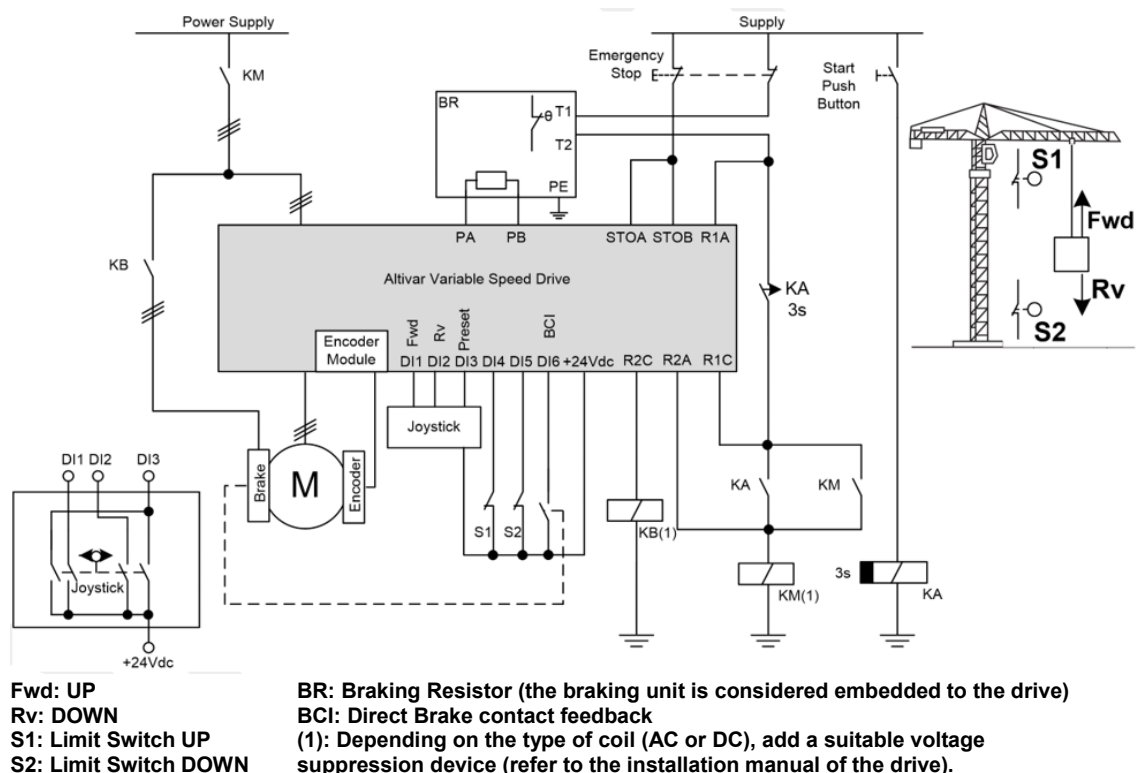
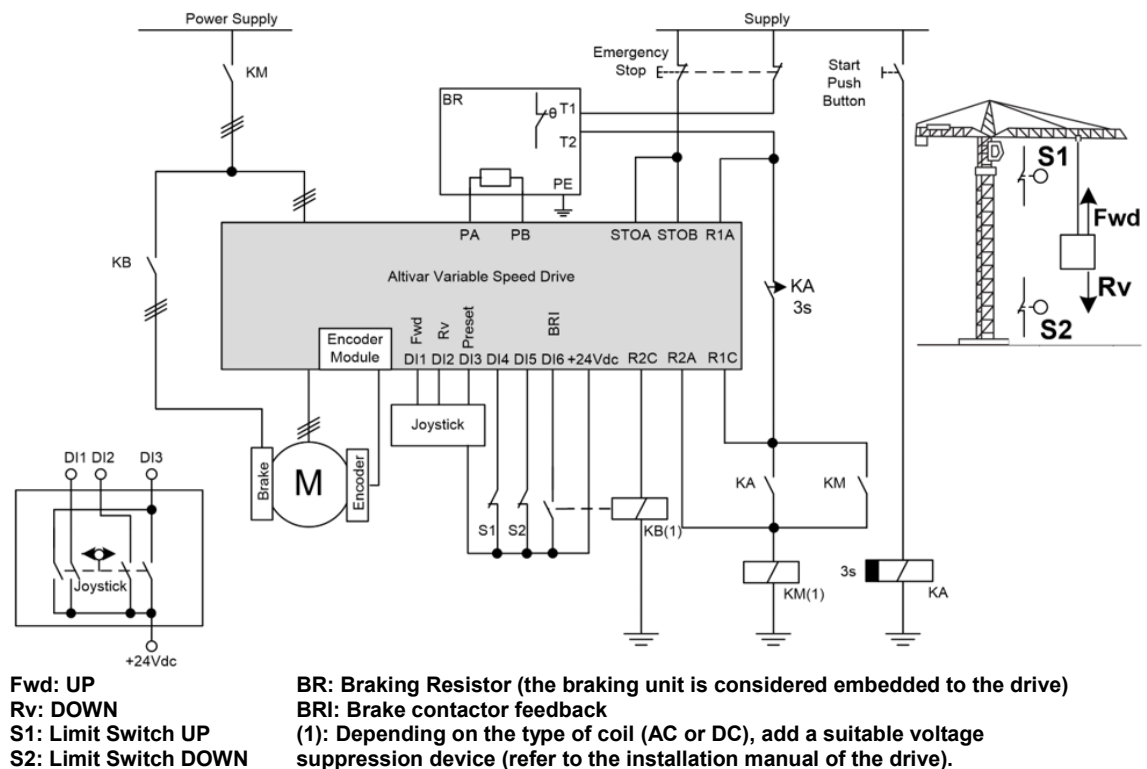


Diagram with brake contactor feedback



Horizontal Movement Wiring Diagram (Open loop and Closed loop)

When the drive transitions to operating state Fault, the mains contactor and the brake contactor must be deenergized.

 WARNING
UNANTICIPATED EQUIPMENT OPERATION - Assign [Operating state fault] FLT to output relay R1. - Connect the coil of the mains contactor to output relay R1. - Connect the brake contactor downstream of the mains contactor.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

For horizontal movement, the forward run command (Fwd) with a positive reference value must move the bridge in the direction considered as forward and the digital input DI2 (reverse) must move the bridge in the opposite direction.

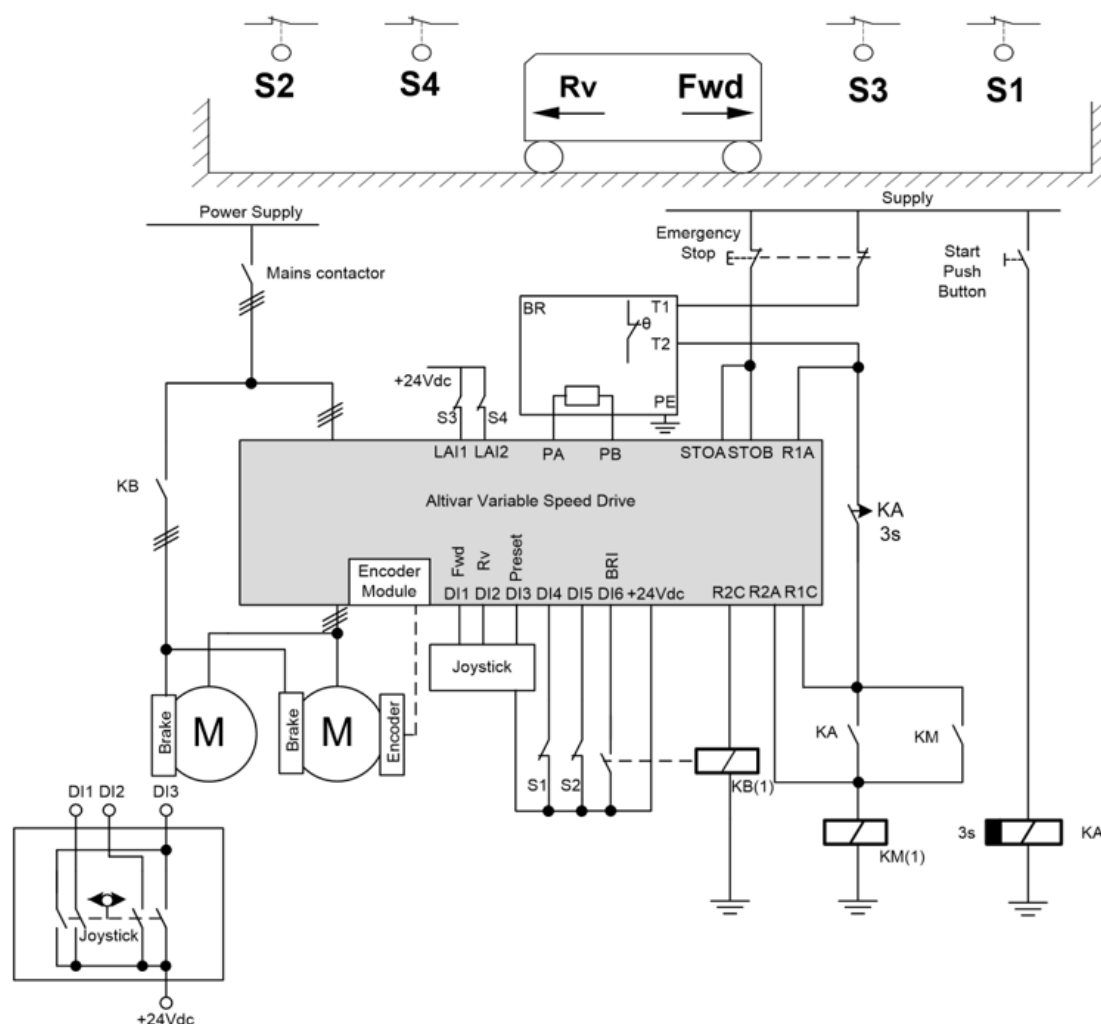
In closed loop, an encoder must be wired and configured. No encoder is used in open loop.

A brake is connected to each motor. The drive cannot monitor two brake NC contacts at the same time. Then, the brake contactor feedback common to the two brakes must be wired and configured to be monitored. In this case, the full optimization of the control to release/apply the brake is not possible. See the [“Optimization of the Brake Logic Control”](#) and the [“Complement on Brake Logic Control”](#) in this document for additional information.

Refer to the installation manual for the grounding and the shielded wiring.

Note: For ATV340 drives, the number of digital inputs depends on the catalog numbers. For drives with power below 30 kW (40 HP), DI1 used as a digital input replaces DI6.

Diagram with brake contactor feedback



Fwd: Forward

Rv: Reverse

S1: Limit Switch Forward

S2: Limit Switch Reverse

BR: Braking Resistor

S3: Slowdown switch Forward (on DI7 or LAI1)

S4: Slowdown switch Reverse (on DI8 or LAI2)

BRI: Brake contactor feedback

(1): Depending on the type of coil (AC or DC), add a suitable voltage suppression device (refer to the installation manual of the drive).

NOTE: [Brake Relay Fdbk] $\overline{BRI}$ is not available on ATV320. Instead of [Brake Relay Fdbk] $\overline{BRI}$, [Brake contact] $\overline{KB(1)}$ can be used for the brake contactor feedback.

Differences about the wiring diagrams

The following table lists the main differences in the wiring diagram depending on the application:

	Vertical movement in closed loop	Horizontal movement in open loop	Horizontal movement in closed loop
Drive	ATV340 or ATV900	ATV320, ATV340 or ATV900	ATV340 or ATV900
Encoder module	Yes	no	Yes
Number of motor connected to the drive	1 motor	2 motors in parallel	2 motors in parallel
Number of brake contactor controlled via the drive	1 brake contactor with 1 drive output	2 brakes controlled by 1 brake contactor with 1 drive output	2 brakes controlled by 1 brake contactor with 1 drive output
Digital inputs (DI) and Analog inputs (AI)	2 DI for run command 1 DI for preset speed 2 DI for limit switches	2 DI for run command 1 DI for preset speed 4 DI for slowing and limit switches	2 DI for run command 1 DI for preset speed 4 DI for slowing and limit switches

Note: The total number of inputs and outputs depends on the drive catalog numbers.

Part IV

Configuration of the Drive

What is in This Part?

This part contains the following chapters:

Configuration overview.....	39
Prerequisites for the Configuration.....	40
Basic Configuration.....	45
Optimization of the Configuration.....	60

Chapter 1

Configuration overview

How to configure the drive

The drive can be configured by means of the tools such as SoMove, Graphic Display Terminal VW3A1111 (for ATV340 and ATV900) and Remote graphic terminal VW3A1101 (for ATV320).

The step-by-step configuration is different depending on the drive:

- **ATV340 or ATV900 step-by-step configuration,**
- **ATV320 step-by-step configuration.**

If you encounter difficulties during the step-by-step configuration, contact your local Schneider Electric representative.

Overview

The following table shows the main steps to follow for the configuration of the drive depending on the type for movement:

Chapter	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
2. Prerequisites for the configuration			
Factory settings	✓	✓	✓
Expert Level Access	✓	✓	✓
System Units Customization	✓	✓	✓
Application Selection	✓	✓	✓
3. Basic configuration			
Motor Configuration	✓ ¹	✓ ¹	✓
Motors in parallel Configuration	✓	✓	–
Configuration of the Motor Thermal Monitoring	✓	✓	✓
Configuration of the Encoder	–	✓	✓
Configuration of the Reference Speed and the Preset Speed	✓	✓	✓
Configuration of the Direction for the Vertical Movement	–	–	✓ ²
Configuration of the Direction for the Horizontal Movement	✓	✓ ²	–
4. Optimization of the Configuration			
After the first movement	–	✓	✓
Optimization of the Brake Logic Control	✓	✓	✓
Acceleration and Deceleration	✓	✓	✓
Low Speed and High Speed	✓	✓	✓
Speed Loop Optimization: Standard	✓	–	–
Speed Loop Optimization: High Performance	–	✓	✓
Torque or Current Limitation Detection	✓	✓	✓
Configuration of the Stop Limit Switches	–	–	✓
Configuration of the Slowing Down Switches and the Stop Limit Switches	✓	✓	–
⁽¹⁾ : movement with a single motor			
⁽²⁾ : contains the first movements in open loop			

Chapter 2

Prerequisites for the Configuration

What is in This Chapter?

This chapter contains the following topics:

Factory Settings	41
Expert Level Access	42
System Units Customization	43
Application Selection.....	44

Factory Settings

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	✓	✓

Before starting the drive configuration, ensure that the drive is reset to the factory settings.

If the drive is not reset to the factory settings, save your configuration and proceed to the following step-by-step configuration.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the factory settings:

Step	Action
1	Go to [File Management] <i>F 7 E</i> → [Factory settings] <i>F 5</i> menu
2	Go to [Parameter group list] <i>F 7 Y</i> and select [All] <i>7 L L</i> .
3	Select [Go to Factory Settings] <i>5 F 5</i> .

ATV320 Step-by-step configuration

The following table shows the step-by-step configuration of the factory settings:

Step	Action
1	Go to [1 Drive Menu] (<i>d r i</i>) → [1.3 Configuration] (<i>C o n F</i>) → [Factory settings] (<i>F 5 -</i>) menu
2	Go to [Parameter group list] (<i>F 7 Y -</i>) and select [All] (<i>7 L L</i>).
3	Select [Go to Factory Settings] (<i>5 F 5</i>).

Expert Level Access

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	✓	✓

Some parameters for this application can only be accessed in expert mode.

The factory setting is **[Standard]** *5 L d*.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of level access:

Step	Description
1	Go to [My Preferences] <i>Π Υ Ρ</i> - menu,
2	Set [Access Level] <i>L A C</i> to [Expert] <i>E P r</i>

ATV320 Step-by-step configuration

The following table shows the step-by-step configuration of level access:

Step	Description
1	Go to [3 Interface] (<i>3 I F -</i>) menu,
2	Set [3.1 Access Level] (<i>L A C</i>) to [Expert] (<i>E P r</i>)

System Units Customization

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	✓	✓

The ATV900 and ATV340 drives offer the possibility to have customized units for your application. The customization is not possible with ATV320 drives.

This menu is used to customize the following units:

- Temperature,
- Currency.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the System units:

Step	Description
1	Go to [Complete Settings] <i>C S E</i> - menu, [Define system units] <i>S U C</i> - submenu.
2	Set the following parameters values: • [Temperature unit] <i>S U T P</i>: [0.1°C] <i>D I C</i> • [Currency unit list] <i>S U C U</i>: [Euro] <i>E U R O</i>

ATV320 Step-by-step configuration

Not Applicable for ATV320 drives.

Application Selection

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	✓	✓

In the macro-configuration menu, you can select the appropriate application functions.

This selection gives access to the dedicated functions and the associated parameters.

Additionally, for ATV320 drives, if a macro-configuration is selected, a pre-configuration of some parameters is done. The following list contains the main parameters impacted by the hoisting macro-configuration:

- The digital inputs (DI1 up to DI6),
- The relay R2,
- The brake logic control parameters,
- The low speed parameter.

For more details about the pre-configuration, refer to the ATV320 programming manual.

For ATV900 drives, the macro-configuration parameter is **[Application Selection] *APP L***. For ATV320, the macro-configuration parameter is **[Macro Configuration] *(CFG)***. There is no macro-configuration for ATV340 drives.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the application selection:

Step	Action
1	Go to [Complete Settings] <i>CS L</i> → [Macro Configuration] <i>ML r</i> menu
2	Set [Application Selection] <i>APP L</i> to [Hoisting] <i>HS L</i>

ATV320 Step-by-step configuration

The following table shows the step-by-step configuration of the applicable selection:

Step	Action
1	Go to [1 Drive Menu] <i>(dr i)</i> , [1.3 Configuration] <i>(CFG)</i> submenu
2	Set [Macro Configuration] <i>(CFG)</i> to [Hoisting] <i>(HS L)</i>

Chapter 3

Basic Configuration

What is in This Chapter?

This chapter contains the following topics:

Motor Configuration	46
Motors in parallel Configuration	48
Configuration of the Motor Thermal Monitoring	51
Configuration of the Encoder	53
Configuration of the Reference Speed and the Preset Speed	54
Configuration of the Direction for the Vertical Movement	55
Configuration of the Direction for the Horizontal Movement	57

Motor Configuration

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓ ¹	✓ ¹	✓
(1): movement with a single motor			

The motor parameters must be set to optimize the motor control performances.

The parameters must be entered according to the motor nameplate.

The following table shows an example of nameplate:

Number of motors		1
Type of motors		Asynchronous
Name plate / Characteristics	Nominal Voltage	400 V
	Nominal Current	11.2 A
	Power Factor (at full-load)	0.84
	Nominal Power	5.5 kW (7.5 HP)
	Nominal Frequency	50 Hz
	Nominal Speed	1,460 rpm

In this document, the configuration uses the power factor of the motor instead of the nominal motor power in order to consider the impact of the duty cycle.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the motor parameters:

Step	Action
1	Go to [Complete Settings] $\llcorner \llcorner \llcorner$ - menu, [Motor parameters] $\llcorner \llcorner \llcorner$ - submenu.
2	Set [Dual rating] $\llcorner \llcorner \llcorner$ to [Heavy Duty] $\llcorner \llcorner \llcorner$.
3	Verify [Motor Control Type] $\llcorner \llcorner \llcorner$ to [SVC V] $\llcorner \llcorner \llcorner$. Note: At this step, the type of control is open loop.
4	Go to [Motor data] $\llcorner \llcorner \llcorner$ - submenu.
5	On [Data] tab, set the motor parameters according to the motor nameplate. For example: • [Motor Standard] $\llcorner \llcorner \llcorner$: [50 Hz IEC] $\llcorner \llcorner \llcorner$ 50 • [Motor Param choice] $\llcorner \llcorner \llcorner$: [Mot Cosinus] $\llcorner \llcorner \llcorner$ $\llcorner \llcorner \llcorner$ • [Nom Motor Voltage] $\llcorner \llcorner \llcorner$: 400 Vac • [Nom Motor Current] $\llcorner \llcorner \llcorner$: 11.20 A • [Motor 1 Cosinus Phi] $\llcorner \llcorner \llcorner$: 0.84 • [Nominal Motor Freq] $\llcorner \llcorner \llcorner$: 50.0 Hz • [Nominal Motor Speed] $\llcorner \llcorner \llcorner$: 1,460 rpm
6	On [Tune] tab, set [Autotuning Usage] $\llcorner \llcorner \llcorner$ to [Therm mot] $\llcorner \llcorner \llcorner$. Note: The thermal estimation calculation is only optimized for a single class 1 motor usage.
7	 WARNING UNEXPECTED MOVEMENT Autotuning moves the motor in order to tune the control loops. • Only start the system if there are no persons or obstructions in the zone of operation. Failure to follow these instructions can result in death, serious injury, or equipment damage. During autotuning, noise development and oscillations of the system are normal. On [Tune] tab, set [Autotuning] $\llcorner \llcorner \llcorner$ to [Apply Autotuning] $\llcorner \llcorner \llcorner$. Note: • The autotuning must be performed with a cold motor. • The autotuning measures the motor stator resistance ([AsyncMotor R Stator] $\llcorner \llcorner \llcorner$) and the leakage inductance ([AsyncMotor Lf inductance] $\llcorner \llcorner \llcorner$). The [Rotor time const] $\llcorner \llcorner \llcorner$, the [Magnetizing current] $\llcorner \llcorner \llcorner$ and the [Nominal motor slip] $\llcorner \llcorner \llcorner$ are not measured via autotuning.
8	Wait until the status [Autotuning Status] $\llcorner \llcorner \llcorner$ is equal to [Autotuning done] $\llcorner \llcorner \llcorner$. If the status is equal to [Error] $\llcorner \llcorner \llcorner$, verify the configuration and the wiring of the drive then perform again the autotuning.

Motors in parallel Configuration

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	✓	–

The motor parameters must be set to optimize the motor control performances.

The parameters must be entered according to the motor nameplate.

The following table shows an example of nameplate:

Number of motors		2 identical motors in parallel
Type of motors		Asynchronous
Nameplate / Characteristics (1 motor)	Nominal Voltage	400 V
	Nominal Current	5.6 A
	Power Factor (at full-load)	0.84
	Nominal Power	3 kW (4 HP)
	Nominal Frequency	50 Hz
	Nominal Speed	1,460 rpm
Virtual Equivalent Motor Nameplate (2 motors)	Nominal Voltage	400 V
	Nominal Current	11.2 A
	Power Factor (at full-load)	0.84
	Nominal Power	6 kW (8 HP)
	Nominal Frequency	50 Hz
	Nominal Speed	1,460 rpm

To obtain the virtual equivalent motor nameplate from two asynchronous identical motors in parallel, you must multiply by 2 the nominal power and the nominal current. The other parameters are not impacted.

Do not use motors in parallel with different characteristics.

In this document, the configuration uses the power factor of the motor instead of the nominal motor power in order to consider the impact of the duty cycle.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the motor parameters:

Step	Action
1	Go to [Complete Settings] C S E - menu, [Motor parameters] M P R - submenu.
2	Set [Dual rating] d r E to [Heavy Duty] H i G h .
3	Verify [Motor Control Type] C E E to [SVC V] V V C . Note: At this step, the type of control is open loop.
4	Go to [Motor data] M E d - submenu.
5	On [Data] tab, set the motor parameters according to the motor nameplate. For example: • [Motor Standard] b F r: [50 Hz IEC] 50 • [Motor Param choice] M P C: [Mot Cosinus] C o S • [Nom Motor Voltage] u n S: 400 Vac • [Nom Motor Current] n C r: 11.20 A • [Motor 1 Cosinus Phi] C o S: 0.84 • [Nominal Motor Freq] F r S: 50.0 Hz • [Nominal Motor Speed] n S P: 1,460 rpm
6	On [Tune] tab, set [Autotuning Usage] E u n u to [Therm mot] E n . Note: The thermal estimation calculation is only optimized for a single class 1 motor usage. It is not optimized in case of motors in parallel.
7	 WARNING UNEXPECTED MOVEMENT Autotuning moves the motor in order to tune the control loops. • Only start the system if there are no persons or obstructions in the zone of operation. Failure to follow these instructions can result in death, serious injury, or equipment damage. During autotuning, noise development and oscillations of the system are normal. On [Tune] tab, set [Autotuning] E u n to [Apply Autotuning] Y E S . Note: • The autotuning must be performed with a cold motor. • The autotuning measures the motor stator resistance ([AsyncMotor R Stator] r S R) and the leakage inductance ([AsyncMotor Lf inductance] L F R). The [Rotor time const] E r R, the [Magnetizing current] i d R and the [Nominal motor slip] n S L are not measured via autotuning.
8	Wait until the status [Autotuning Status] E u S is equal to [Autotuning done] d o n E . If the status is equal to [Error] F R i L , verify the configuration and the wiring of the drive then perform again the autotuning.

ATV320 Step-by-step configuration

The following table shows the step-by-step configuration of the motor parameters:

Step	Action
1	Go to [1 Drive Menu] (<i>d r</i>), [1.3 configuration] (<i>C o n f</i>), [Full] (<i>F u l l</i>) menu
2	Go to [Motor Control] (<i>d r C -</i>) submenu
3	Verify [Motor Control Type] (<i>C t t</i>) to [SVC V] (<i>V v C</i>). Note: The type of control is always open loop for ATV320 drives.
4	Go back to, [Full] (<i>F u l l</i>) menu
5	Go to [Simply Start] (<i>S , n -</i>) submenu
6	Set the motor parameters according to the motor nameplate. For example: • [Standard mot. freq] (<i>b F r</i>): [50 Hz IEC] (50) • [Motor Param choice] (<i>n P C</i>): [Mot Cos] (<i>C o 5</i>) • [Rated Motor Volt.] (<i>u n 5</i>): 400 Vac • [Rated Mot. current] (<i>n C r</i>): 11.20 A • [Motor 1 Cosinus Phi] (<i>C o 5</i>): 0.84 • [Rated motor freq.] (<i>F r 5</i>): 50.0 Hz • [Rated Motor Speed] (<i>n S P</i>): 1,460 rpm
7	Go back to, [Full] (<i>F u l l</i>) menu
8	Go to [Motor Control] (<i>d r C -</i>) submenu then [ASYNC. MOTOR] (<i>A S Y -</i>) menu.
9	Verify that [Auto tuning Usage] (<i>t u n u</i>) to [therm Mot] (<i>t n</i>) Note: The thermal estimation calculation is only optimized for a single class 1 motor usage. It is not optimized in case of motor in parallel.
10	 WARNING UNEXPECTED MOVEMENT Autotuning moves the motor in order to tune the control loops. • Only start the system if there are no persons or obstructions in the zone of operation. Failure to follow these instructions can result in death, serious injury, or equipment damage. During autotuning, noise development and oscillations of the system are normal. Set [Auto tuning] (<i>t u n</i>) to [Do tune] (<i>y E 5</i>). Note: • The autotuning must be performed with a cold motor. • The autotuning measures the motor stator resistance ([Cust stator resist.] (<i>r 5 R</i>)) and the leakage inductance ([Lfw] (<i>L F R</i>)). The [Cust. Rotor t const.] (<i>t r R</i>) and the [idw] (<i>i d R</i>) are not measured via autotuning.
11	Wait until the status [Auto tuning State] (<i>t u 5</i>) is equal to [Done] (<i>d o n E</i>) If the status is equal to [Failed] (<i>F R , L</i>), verify the configuration and the wiring of the drive then perform again the autotuning.

Configuration of the Motor Thermal Monitoring

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	✓	✓

The motor thermal monitoring helps to prevent and detect an overheating of the motor via an estimation of the thermal state of the motor or via a measurement of the temperature.

The motor thermal monitoring uses the calculation of i^2t . There are two modes available:

- Self-cooled motors: the trigger curves depend on the motor frequency,
- Forced-cooled motors: only the 50 Hz trigger curve needs to be considered regardless of the motor frequency.

On ATV340 and ATV900, if the drive is switched off, the motor thermal state is stored. The power-off time is used to calculate the motor thermal state at the next startup. On ATV320, the autotuning must be done at each power-on, considering the thermal estimation.

The thermal calculation method is optimized for the use of a single class 1 motor. The estimation is not optimized for motors from other classes and for multi-motors in parallel: it is advisable to monitor the temperature by using a thermal probe (like PTC).

Note: In the case of multi-motors in parallel, the thermal monitoring by thermal calculation method is based on the virtual equivalent motor and thus the thermal monitoring is not individual. For individual monitoring, you must monitor the temperature by using a thermal probe and the associated function.

The following step-by-step configuration shows the setting for the use of the thermal calculation.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration to configure the motor thermal monitoring:

Step	Action
1	Go to [Complete Settings] $\llcorner$ S E - menu, [Motor parameters] Π P R - submenu then [Motor Monitoring] Π o P -.
2	Set [Motor Thermal Mode] $\llcorner$ H E depending on the cooling mode: • If the motor is forced-cooled: [Force-cool] $\llcorner$ L C • If the motor is self-cooled: [self-cool] $\llcorner$ C L
3	Set [Motor Th Current] $\llcorner$ E H to the same setting than [Rated Mot. current] $\llcorner$ C r .
4	Set [Current Limitation] $\llcorner$ L $\llcorner$ to the 150 % of [Rated Mot. current] $\llcorner$ C r .

ATV320 Step-by-step configuration

The following table shows the step-by-step configuration to configure the motor thermal monitoring:

Step	Action
1	Go to [1 Drive Menu] (<i>d r</i>), [1.3 configuration] (<i>C o n F</i>), [Full] (<i>F u L L</i>), [Fault Management] (<i>F L t</i>) menu.
2	Go to [Motor Thermal Prot.] (<i>t h t -</i>) menu and set [Motor protect. type] (<i>t H t</i>) to: • If the motor is forced-cooled: [Force-cool] (<i>F L C</i>) • If the motor is self-cooled: [self-cool] (<i>H C L</i>)
3	Go to [1 Drive Menu] (<i>d r</i>), [1.3 configuration] (<i>C o n F</i>), [Full] (<i>F u L L</i>), [Simple Start] (<i>S i P -</i>) menu.
4	Set [Mot. Therm. current] (<i>t e H</i>) to the same setting than [rated mot. current] (<i>n C r</i>).
5	Go to [1 Drive Menu] (<i>d r</i>), [1.3 configuration] (<i>C o n F</i>), [Full] (<i>F u L L</i>), [settings] (<i>S E t</i>) menu.
6	Set [Current Limitation] (<i>C L i</i>) to the 150 % of [Rated Mot. current] (<i>n C r</i>).

Configuration of the Encoder

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	-	✓	✓

An encoder module needs to be used for a closed loop application.

The following table shows the compatibility between the encoder modules and the drives:

Catalog Number		ATV320	ATV340	ATV900
VW3A3620	Speed monitoring module - RS422 - 5V	✓	-	-
VW3A3420	Digital encoder interface module	-	✓	✓
VW3A3422	Analog encoder interface module	-	✓	✓
VW3A3423	Resolver interface module	-	✓	✓
VW3A3424	HTL encoder interface module	-	✓	✓

For additional information on each encoder module, refer to the catalog of the drives.

For ATV320 drives, closed loop configuration is not possible.

The following configuration considers an incremental encoder 24 V, 1024 pulses per revolution. The module is a digital encoder interface module VW3A3420.

You must insert the encoder module before switching-on the drive.

The configuration of the encoder must be verified in one of the following steps depending on the movement type. In these steps, the first movement in open loop is done.

- Configuration of the Direction for the Vertical Movement,
- Configuration of the Direction for the Vertical Movement.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of a digital encoder interface module:

Step	Description
1	Go to [Complete Settings] <i>C 5 E</i> - menu, [Encoder configuration] <i>E n</i> - submenu
2	Set the encoder parameters according to the manufacturer datasheets (it depends on the encoder and the encoder module): • [Encoder Type] <i>u E C P</i> to [RS422] <i>A b</i> • [Encoder supply volt.] <i>u E C V</i> to [24 Vdc] <i>2 4 V</i> • [Number of pulses] <i>P G</i> , to 1024.
3	Adapt [AB Encoder Max Freq] <i>A b n F</i> if necessary (F.S.: [300 kHz] <i>3 0 0 K</i>)

ATV320 Step-by-step configuration

Not Applicable for ATV320 drives.

Configuration of the Reference Speed and the Preset Speed

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	✓	✓

The drive offers several channels for the command and the reference value. The menu **[Command and Reference] C r P -** (for ATV340 and ATV900) and the menu **[Command] (C E L -)** (for ATV320) are used to customize these channels according to the application needs.

The operator can set preset speeds in order to select one of them with a digital joystick or with a remote control. The drive lets you preset up to 16 speeds requiring up to 4 digital inputs to activate the different preset speeds.

The example provided in this application note use local control mode. The command is supplied via digital inputs. The reference values are supplied via a preset speed or by a Graphic Display Terminal.

In the case of a run command without preset speed activated, the drive follows the reference value coming from the Graphic Display Terminal. The preset speed is activated via the digital input DI3

This example can be extended to more preset speeds in accordance with the wiring architecture and the configuration.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the parameters for the command and the reference values:

Step	Action
1	Go to [Complete Settings] C S E - menu, [Command and Reference] C r P - submenu.
2	Set the following parameters: [Ref Freq 1 config] F r 1 to [Ref.Freq-Rmt.Term] L C L. [Control Mode] C H C F to [Separate] S E P [Cmd Channel 1] C d 1 to [Terminals] E E r
3	Go to [Preset speeds] P S S submenu
4	Set [2 preset Freq] P S 2 to [DI3] L , 3
5	Set the preset speed [Preset speed 2] S P 2 : 50 Hz

ATV320 Step-by-step configuration

The following table shows the step-by-step configuration of the parameters for the command and the reference values:

Step	Action
1	Go to [1 Drive Menu] (d r i) , [1.3 configuration] (C o n F) , [Full] (F u L L) menu
2	Go to [Command] (C E L -) menu
3	Set the following parameters: [Ref. 1 config] (F r 1) to [HMI] (L C L). [Profile] (C H C F) to [Separate] (S E P) [Cmd Channel 1] (C d 1) to [Terminals] (E E r)
4	Go back to [Full] (F u L L) then [Application Funct.] (F u n) , [Preset speeds] (P S S) menu
5	Set [2 preset Freq] (P S 2) to [LI3] (L , 3)
6	Set the preset speed [Preset speed 2] (S P 2) : 50 Hz

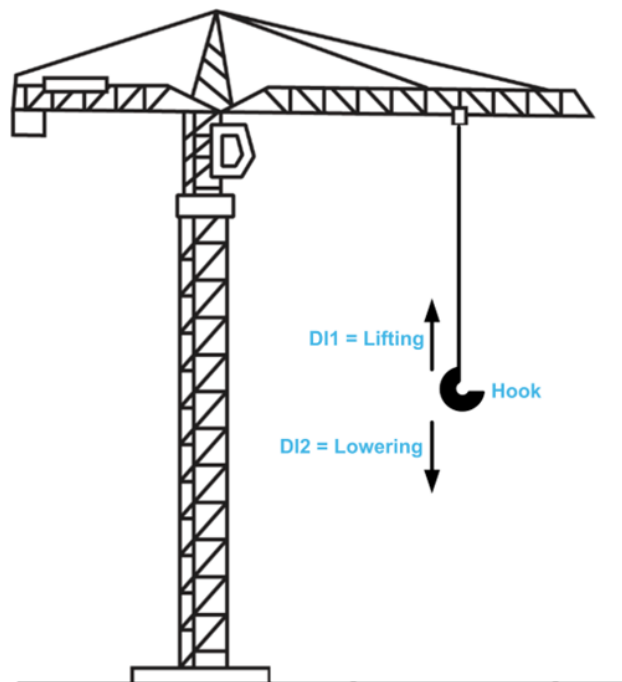
Configuration of the Direction for the Vertical Movement

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	-	-	✓

Configuration requirements:

- **Digital Inputs:** the forward command (activation of the digital input DI1) must correspond to the lifting of the load and the reverse command (activation of the digital input DI2) must correspond to the lowering of the load.
- **Encoder module:** the encoder signal feedback must be in the same direction as the motor frequency speed of the drive.



If the motor phases U, V and W are not connected properly, the direction of the motor torque and the logic with which the brake is released do not match. This means lowering logic instead of lifting logic when the brake is released.

This part of the configuration includes:

- The verification of the configuration for the 2-wire control,
- The configuration of the low speed,
- The basic configuration of the brake logic control function for the first movement,
- The first movement in open loop without load,
- The verification of the requirements and the remedies depending on the observations.

The optimization of the brake logic control function is detailed in the section “Brake Logic Control Optimization”.

Note: In open loop, no torque is applied at 0 Hz, then the **[low speed] L 5 P** must be set to a value higher than the slip speed of the motor.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration to operate in the desired direction:

Step	Action
1	Go to [Complete Settings] CSE - menu, [Command and reference] CrP - submenu.
2	Verify the setting of the following parameters: • [2/3-Wire Control] ELC to [2-wire control] 2C • [2-wire type] ELT to [Transition] ETn
3	Go to [Simply start] SY5 - menu
4	Set [Low Speed] LSP to a value higher than 10 % of the nominal speed. Note: [low speed] LSP must be set to a value higher than the slip speed of the motor.
5	Go to [Complete Settings] CSE - menu, [Hoisting Functions] HFE - submenu then, [Brake logic control] BLC - submenu.
6	Set the following parameters to configure the brake logic control for the first movement in open loop: • [Brake assignment] BLC to [R2] r2, it activates the function and the relay R2 controls the command to release/apply the brake. • [Brake contact] BC, to [DI6] L6 to handle the brake contact feedback or [Brake Relay Fdbk] br, to [DI6] L6 to handle the brake contactor feedback • [brake fdbk filter] FbC, or [brake Rly Fdbk Filter] Fbr, to 100 ms • [Brake release time] brt: value of the release time given in the brake datasheet plus [brake fdbk filter] FbC, or [brake Rly Fdbk Filter] Fbr, • [Brake engage time] bet: value of the engage time given in the brake datasheet plus [brake fdbk filter] FbC, or [brake Rly Fdbk Filter] Fbr, • [Brake release current] br to 70 % of [Nom Motor Current] nCr Verify the setting of the following parameters: • [Movement type] b5t to [Hoisting] VER • [Brake release pulse] b, P to [Yes] YES (motor torque always in the lifting direction) • [Brake release freq] br, r to [Auto] Auto • [Brake engage freq] ben to [Auto] Auto • [Jump at reversal] JdC to [Auto] Auto
7	Run the motor by activating the Digital Input DI1 with a reference value not zero to verify the direction of the motor. The movement must be done without load.
8	Do the corresponding modifications depending on the observations: • The hook has moved down and [Measured output fr.] PPF has a negative value: set [Output Ph Rotation] PHr to [ACB] ACB (factory setting: [ABC] ABC). • The hook has moved down and [Measured output fr.] PPF has a positive value: set [Output Ph Rotation] PHr to [ACB] ACB (factory setting: [ABC] ABC) and reverse the direction of the encoder signals. • The hook has moved up and [Measured output fr.] PPF has a negative value: reverse the direction of the encoder signals. • The hook has moved up and [Measured output fr.] PPF has a positive value: verify the order of magnitude of [Measured output fr.] PPF with [Motor Frequency] rFr. The configuration is correctly done. Note: • [Measured output fr.] PPF and [Motor Frequency] rFr are in [Display] PPn, [Drive Parameters] PP, menu. • [Output Ph Rotation] PHr is in [Complete settings] CSE, [Motor parameters] PPA, [Motor control] drc menu.
9	Repeat steps 7 and 8 until the configuration is correctly done.

Configuration of the Direction for the Horizontal Movement

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	✓	–

Configuration requirements:

- **Digital Inputs:** the forward command (activation of the digital input DI1) must correspond to a bridge movement in the forward direction of your application. The reverse command (activation of the digital input DI2) must correspond to a bridge movement in the opposite direction.
- **Encoder module:** the encoder signal feedback must be in the same direction as the motor frequency speed of the drive.

This part of the configuration includes:

- The verification of the configuration for the 2-wire control,
- The basic configuration of the brake logic control function for the first movement,
- The first movement in open loop without load,
- The verification of the requirements and the remedies depending on the observations.

The optimization of the brake logic control function is detailed in the section “Brake Logic Control Optimization”.

In this application note with two motors, if the motors are not wired or configured properly, both extremities of the bridge move in opposite directions, the wiring of one motor must be modified in order to correct the direction for one of the extremities.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration to operate in the desired direction:

Step	Action
1	Go to [Complete Settings] $\mathcal{L}5\mathcal{E}$ - menu, [Command and reference] $\mathcal{C}rP$ - submenu.
2	Verify the setting of the following parameters: • [2/3-Wire Control] $\mathcal{E}\mathcal{C}\mathcal{C}$ to [2-wire control] $\mathcal{Z}\mathcal{C}$ • [2-wire type] $\mathcal{E}\mathcal{C}\mathcal{E}$ to [Transition] $\mathcal{E}r\mathcal{n}$
3	Go to [Complete Settings] $\mathcal{L}5\mathcal{E}$ - menu, [Hoisting Functions] $H\mathcal{F}\mathcal{E}$ - submenu then, [Brake logic control] $b\mathcal{L}\mathcal{C}$ - submenu.
4	Set the following parameters to configure the brake logic control for the first movement in open loop: • [Brake assignment] $b\mathcal{L}\mathcal{C}$ to [R2] $r\mathcal{Z}$ it activates the function and the relay R2 controls the command to release/apply the brake. • [Movement type] $b\mathcal{S}\mathcal{E}$ to [Traveling] $H\mathcal{O}r$ • [Brake Relay Fdbk] $b\mathcal{r}\mathcal{r}$ to [DI6] $\mathcal{L}\mathcal{r}\mathcal{S}$ to handle the brake contactor feedback. • [Brake Rly Fdbk Filter] $Fb\mathcal{r}\mathcal{r}$ to 100 ms • [Brake release current] $\mathcal{r}b\mathcal{r}$ to 0 A • [Brake release time] $b\mathcal{r}\mathcal{E}$: value of the release time given in the brake datasheet plus [Brake Rly Fdbk Filter] $Fb\mathcal{r}\mathcal{r}$ • [Brake engage time] $b\mathcal{E}\mathcal{E}$: value of the engage time given in the brake datasheet plus [Brake Rly Fdbk Filter] $Fb\mathcal{r}\mathcal{r}$ • [Brake engage freq] $b\mathcal{E}n$ to 0 Hz • [Auto DC inj Level 1] $\mathcal{S}d\mathcal{C}\mathcal{I}$ to 70 % of [Nom Motor Current] $n\mathcal{C}r$ Verify the setting of the following parameters: • [Brake release pulse] $b\mathcal{r}P$ to [No] $n\mathcal{O}$ (motor torque always in the requested operating direction) • [Brake release freq] $b\mathcal{r}r$ to 0 Hz
5	Run the motor by activating the Digital Input DI1 with a reference value not zero to verify the direction of the motor. The movement must be done without load.
6	If your application will remain in open loop (no encoder module), do the corresponding modifications depending on the following observations else go to step 7: • The bridge has moved in the considered reverse direction: set [Output Ph Rotation] $P\mathcal{H}r$ to [ACB] $\mathcal{H}\mathcal{C}b$ (factory setting: [ABC] $\mathcal{H}b\mathcal{C}$) • The bridge has moved in the considered forward direction: the configuration is correctly done. Note: [Output Ph Rotation] $P\mathcal{H}r$ is in [Complete settings] $\mathcal{L}5\mathcal{E}$, [Motor parameters] $\mathcal{M}P\mathcal{H}$, [Motor control] $d\mathcal{r}\mathcal{C}$ menu.
7	If your application will be modified to be in closed loop (encoder module), do the corresponding modifications depending on the following observations else go to step 8: • The bridge has moved in the considered reverse direction and [Measured output fr.] $\mathcal{M}\mathcal{M}F$ has a negative value: set [Output Ph Rotation] $P\mathcal{H}r$ to [ACB] $\mathcal{H}\mathcal{C}b$ (factory setting: [ABC] $\mathcal{H}b\mathcal{C}$) • The bridge has moved in the considered reverse direction and [Measured output fr.] $\mathcal{M}\mathcal{M}F$ has a positive value: set [Output Ph Rotation] $P\mathcal{H}r$ to [ACB] $\mathcal{H}\mathcal{C}b$ (F.S.: [ABC] $\mathcal{H}b\mathcal{C}$) and [Encoder rotation inv.] $E\mathcal{n}r\mathcal{r}$ to [Yes] $\mathcal{Y}E\mathcal{S}$. • The bridge has moved in the considered forward direction and [Measured output fr.] $\mathcal{M}\mathcal{M}F$ has a negative value: set [Encoder rotation inv.] $E\mathcal{n}r\mathcal{r}$ to [Yes] $\mathcal{Y}E\mathcal{S}$. • The bridge has moved in the considered forward direction and [Measured output fr.] $\mathcal{M}\mathcal{M}F$ has a positive value: verify the order of magnitude of [Measured output fr.] $\mathcal{M}\mathcal{M}F$ with [Motor Frequency] $r\mathcal{F}r$. The configuration is correctly done.

Step	Action
	Note: • [Measured output fr.] $\Pi \Pi F$ and [Motor Frequency] $r F r$ are in [Display] $\Pi \Pi n$, [Drive Parameters] ΠP, menu • [Output Ph Rotation] $P H r$ is in [Complete settings] $L 5 E$, [Motor parameters] $\Pi P H$, [Motor control] $d r L$ menu.
8	Repeat from step 5 until the configuration is correctly done.

ATV320 Step-by-step configuration

The following table shows the step-by-step configuration to operate in the desired direction:

Step	Action
1	Go to [1 Drive Menu] ($d r$), [1.3 configuration] ($L \Pi n F$), [Full] ($F u L L$), [Inputs / Outputs Cfg] ($i - o -$) menu
2	Verify the setting of the following parameters: • [2/3-Wire Control] ($E L L$) to [2 wire] ($2 L$) • [2-wire type] ($E L E$) to [Level] ($E r n$)
3	Go to [1 Drive Menu] ($d r$), [1.3 configuration] ($L \Pi n F$), [Full] ($F u L L$), [Application Funct.] ($F u n$), then [Brake Logic Control] ($b L L$) menu
4	Set the following parameters to configure the brake logic control for first movement. • [Movement type] ($b 5 E$) to [Traveling] ($H \Pi r$) • [Brake contact] ($b L i$) to [LI6] ($L i 6$) for brake contactor state handling • [Brake release I FW] ($i b r$) to 0 A • [Brake release time] ($b r E$) in accordance with the brake datasheet • [Brake engage time] ($b E E$) in accordance with the brake datasheet • [Brake engage freq] ($b E n$) to 0 Hz • [Auto DC inj Level 1] ($5 d L i$) to 70 % of [Rated Mot. current] ($n L r$) Verify the setting of the following parameters: • [Brake assignment] ($b L L$) to [R2] ($r 2$), it activates the function and the relay R2 controls the command to release/apply the brake. • [Brake impulse] ($b i P$) to [No] ($n o$) (motor torque always in the requested operating direction). • [Brake release freq] ($b i r$) to 0 Hz.
5	Run the motor by activating the Digital Input DI1 with a reference value not zero to verify the direction of the motor. The movement must be done without load.
6	Do the corresponding modifications depending on the following observations: • The bridge has moved in the considered reverse direction: modify the phase wiring of the motor and repeat from step 5 to verify the modification of direction. • The bridge has moved in the considered forward direction: the configuration is correctly done.

Chapter 4

Optimization of the Configuration

What is in This Chapter?

This chapter contains the following topics:

After the First Movement.....	61
Optimization of the Brake Logic Control.....	62
Acceleration and Deceleration	68
Low Speed and High Speed	69
Speed Loop Optimization: Standard	70
Speed Loop Optimization: High Performance	73
Torque or Current Limitation Detection	75
Configuration of the Stop Limit Switches.....	76
Configuration of the Slowing Down Switches and the Stop Limit Switches.....	77

After the First Movement

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	–	✓	✓

At this step of the configuration, the application is configured in open loop for both movements (vertical and horizontal). No optimization of the settings has been done.

For vertical movement, before any other movement, the type of control must be modified to closed loop. For the horizontal movement, the type of control must also be modified if your application is meant to be in closed loop.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration to modify the type of control:

Step	Description
1	Go to [Complete Settings] <i>C S E</i> - menu, [Motor parameters] <i>MPR</i> - submenu
2	Set [Motor Control Type] <i>C E E</i> to [FVC] <i>F V C</i> to be in closed loop. Note: - The following parameter are no more accessible and are considered set to 0: [Brake release freq] <i>b r r</i> [Brake engage freq] <i>b E n</i> [Jump at reversal] <i>J d C</i> [Encoder Usage] <i>E n u</i> is set to [Speed Regulation] <i>r E G</i>, and thus: [Load slip detection] <i>S d d</i> is set to [Yes] <i>Y E S</i>¹, [Encoder Coupling Monit] <i>E C C</i> is set to [Yes] <i>Y E S</i>². (1): the [Load slipping] <i>R n F</i> error is triggered by comparing the ramp output with the speed feedback. The monitoring is effective for speeds greater than 10% of the [Nominal Motor Freq] <i>F r S</i>. If the error is triggered, the drive stops in freewheel, and if the brake logic control function is configured, the command of the brake is set to 0 (command to apply the brake). (2): The mechanical coupling of the encoder is monitored. If an error is triggered, the drive stops in freewheel, and if the brake logic control function is configured, the command of the brake is set to 0 (command to apply the brake).

Optimization of the Brake Logic Control

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	✓	✓

The brake logic control function is a main function for hoisting applications. This function is used to control one or several electromagnetic brake(s) via a single output of the drive.

For vertical movements, the objective is to maintain motor torque in the lifting direction during the release and the application of the brake, in order to hold the load. Start smoothly when the brake is released and stop smoothly when the brake is applied.

For horizontal movements, the objective is to synchronize during the beginning of the movement the release of the brake with the built-up of torque and during stopping the application of the brake with the zero speed, in order to help prevent jerking.

In this application note, the relay R2 of the drive is used to control the brake contactor. Each time the brake sequence is executed, this relay is activated/deactivated in order to release/apply the brake. This corresponds to one operation of the relay.

NOTE: You must ensure that the service life of the relay R2 is suitable for your application. For information on the service life, refer to the section [“Outputs of the drive and the Control of a Brake Contactor”](#).

In this document, three different uses of the brake logic control are presented:

- Vertical movements with closed loop control,
- Horizontal movements with closed loop control,
- Horizontal movements with open loop control.

NOTE: In case of closed loop control, the brake logic sequence for horizontal movements is similar to the brake logic sequence for vertical movements. The only difference is the sign inversion of the torque-generating current for horizontal movements when the direction is reversed.

The following figures describe examples of the brake logic sequence giving the information below:

- The direction of movement given by the run command.
- The flux current.
- The torque-generating current.
- The relay R2 state.
- The brake contactor feedback.
- **[Brake Relay fdbk] b r** , filtered.
- The brake contact feedback (the state of the brake).
- **[Brake Contact] b c** , filtered.
- The motor speed.
- The following phase name:

A: Waiting for run command

B: Motor fluxing

C: Injection of the torque-generating current

D: Release of the brake

E: Acceleration/deceleration

F: Reference value attained

G: Deceleration due to stop command

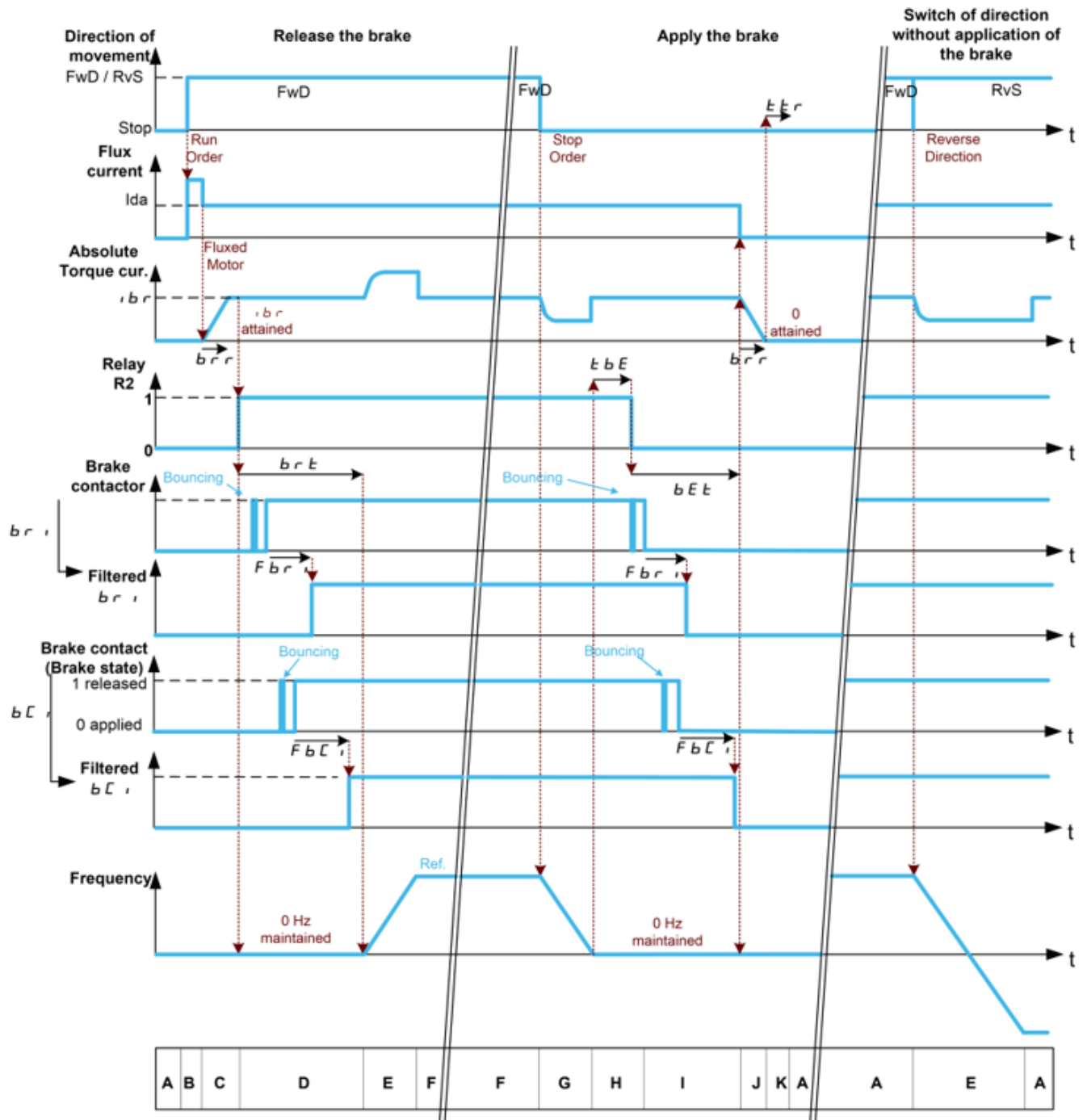
H: Delay before command to apply the brake

I: Application of the brake

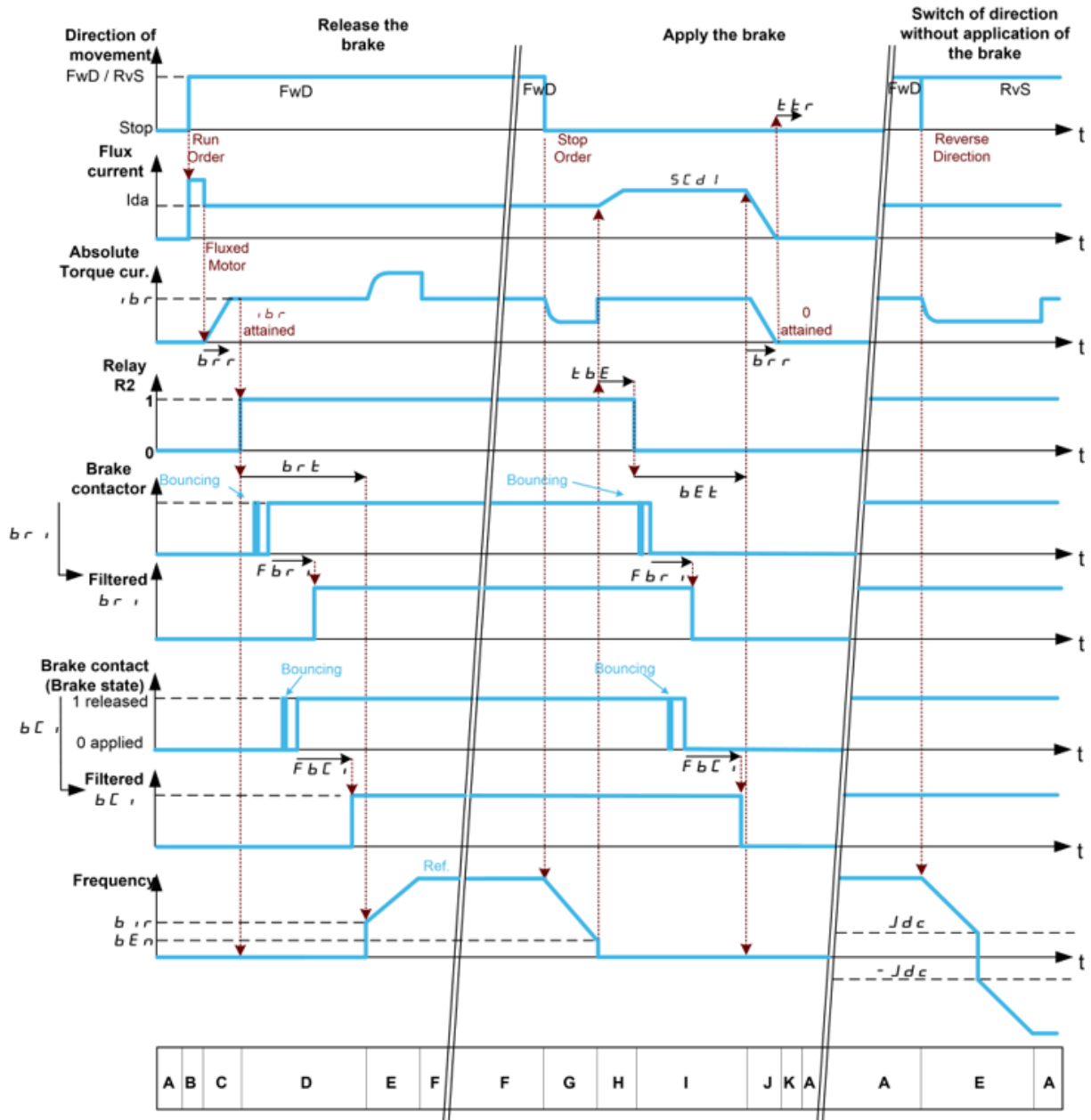
J: Removal of current

K: Restart delay

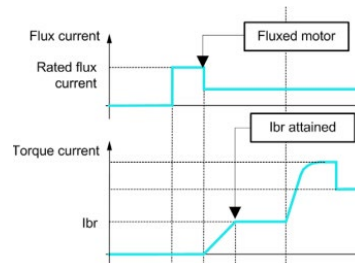
Example of Brake Logic Sequence for both Vertical and Horizontal Movements in Closed Loop



Example of Brake Logic Sequence for Horizontal Movements in Open Loop



Behavior at run command



When run command is given, the drive over-fluxes the motor during a short time in order to generate a sufficient motor torque. The level of the torque is set with the parameter **[Brk Release Current]** I_{br} . This torque is required to maintain the load during the release of the brake and before starting frequency control.

The parameter **[Rotor Time Const]** t_{rH} is the time needed by the motor to be fluxed. This parameter is computed by the drive using the values of the parameters **[Nom Motor Current]** n_{Lr} , **[Motor 1**

Cosinus Phi] $C \phi 5$, **[Nom Motor Voltage]** $u n 5$ and **[Nominal Motor Speed]** $n 5 P$ which have to be set properly according to the motor specification.

Before releasing the brake by means of the relay output R2 set with the parameter **[Brake assignment]** $b L C$, the drive verifies the two following conditions:

- The fluxing current is stable.
- The torque-generating current has been reached.

If one of the two conditions is not fulfilled, the drive does not release the brake and triggers the error **[Brake Control]** $b L F$. This error code can be triggered, for example, if a phase of the motor is not properly connected to the motor output of the drive.

Monitoring of the brake contact feedback or the brake contactor feedback

The assignment of **[Brake contact]** $b C$, enables the monitoring of the assigned input (brake contact feedback). Likewise, the assignment of **[Brake Relay Fdbk]** $b r$, enables the monitoring of the assigned input (brake contactor feedback). This monitoring function compares the state of the digital input with the state of the brake logic sequence. If an inconsistency is detected, the error **[Brake Feedback]** $b r F$ is triggered. For example:

- At the end of **[Brake release time]** $b r t$, if the brake contact feedback or the brake contactor feedback remain at 0.
- At the end of **[Brake engage time]** $b E t$, if the brake contact feedback or the brake contactor feedback remain at 1.

If **[Brake Fdbk Filter]** $F b C$, is not 0, the monitoring uses this filtered input (likewise with **[Brake Rly Fdbk Filter]** $F b r$, and the brake contactor).

NOTE:

- Both **[Brake release time]** $b r t$ and **[Brake engage time]** $b E t$ must take into account the maximum of **[Brake Fdbk Filter]** $F b C$, and **[Brake Rly Fdbk Filter]** $F b r$.
- **[Brake Fdbk Filter]** $F b C$, is used to consider the potential signal bouncing of the brake contact feedback. Likewise **[Brake Rly Fdbk Filter]** $F b r$, is used to consider the potential signal bouncing of the brake contactor feedback.

Parameters not used for the standard optimization

For the standard optimization, the following parameters do not need to be modified. They may have been modified when the type of control was selected (refer to the section [“After the First Movement”](#)):

- | | |
|--|--|
| • [Brake assignment] $b L C$ | • [Current ramp time] $b r r$ |
| • [Movement type] $b 5 t$ | • [Time to restart] $t t r$ |
| • [Brake contact] $b C$ | • [Brake engage at 0] $b E C d$ |
| • [Brake release pulse] b , P | • [Brake Fdbk Filter] $F b C$, (for ATV340 and ATV900) |
| • [Brake release freq] b , r | • [Brake Relay Fdbk] $b r$, (for ATV340 and ATV900) |
| • [Jump at reversal] $J d C$ | • [Brake Rly Fdbk Filter] $F b r$, (for ATV340 and ATV900) |
| • [Engage at reversal] $b E d$ | |

NOTE:

- **[Brake release freq]** b , r , **[Brake engage freq]** $b E n$ and **[Jump at reversal]** $J d C$ are not available in closed loop.
- **[Jump at reversal]** $J d C$, **[Engage at reversal]** $b E d$, **[current ramp time]** $b r r$, **[time to restart]** $t t r$ and **[Brake engage at 0]** $b E C d$ are designed for specific applications. In this application note, they are not modified.
- The brake parameters $b r H d$ to $b r H b$ are used for specific optimization and monitoring. Refer to the section [“Complement on Brake Logic Control”](#).

Parameters modified for the standard optimization

The following table shows criteria to adjust some parameters related to the brake logic control:

Parameter	Description	Horizontal		Vertical
		Open loop	Closed loop	
[Brk Release Current] i_{br}	The value can be adapted to hold the load during [Brake release time] t_{brt}. To optimize the value, determine the torque required by the motor to hold the full load (below this value, the load slips). Then, add 10 % of the determined value. Jerks may still be present. NOTE: - With the optimized value, without load, a movement (up direction) may occur during [Brake release time] t_{brt}. - The optimization of [Brk Release Current] i_{br} must be done before the optimization of [Brake release time] t_{brt}.	-	-	✓
[Brake release time] t_{brt}	Gradually reduce the value until the brake releases without allowing the motor to drift before the acceleration begins. Increase the value if the torque increases and the motor speeds stays at 0 Hz with a reference value not zero. The motor acts against the still applied brake. Noise and jerks may be generated when the motor breaks free from the brake. This leads to premature wear of the brake. Decrease the value if the brake is released with a speed staying a long time to [Low Speed] LSP value.	✓	✓	✓
[Brake engage time] t_{bet}	Gradually reduce the value until the current is zero when the brake is fully applied. Increase the value if the brake is not applied when the power to the motor is removed. For a vertical movement, this means that the load slips down. Without load, the brake is applied and a jerk can be felt.	✓	✓	✓
[Brake engage freq] f_{ben}	If the machine is subject to wind, set this parameter to a value up to 0.5 Hz to reduce its impact at application of the brake. Otherwise, the value can be let to 0 Hz.	✓	-	-
[Auto DC inj Level 1] S_{dcl}	Anti-sway: This parameter can be set to 70 % of [Nom Motor Current] i_{nr} . Depending on the mechanical result, increase or decrease this value to reduce the swaying of the machine.	✓	-	-
[Brake engage delay] t_{bed}	Set this parameter to smooth the application of the brake by stabilizing the motor speed before the brake is applied. For horizontal movements in open loop, modify this parameter in combination with [Auto DC inj Level 1] S_{dcl} to reduce mechanical jerking and to smooth the application of the brake. NOTE: For closed-loop applications, refer to the section "Complement on Brake Logic Control" for additional information on the use of this parameter.	✓	✓	✓

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration to optimize the brake logic control:

Step	Description
1	Run the motor and observe the behavior of the system.
2	Go to [Complete Settings] <i>C S E</i> - menu, [Hoisting Functions] <i>H F E</i> - submenu then, [Brake logic control] <i>b L E</i> - submenu.
3	Modify the value of the parameters according to criteria presented in the previous table then repeat step 1 to observe the modifications.

ATV320 Step-by-step configuration

The following table shows the step-by-step configuration to optimize the brake logic control:

Step	Description
1	Run the motor and observe the behavior of the system.
2	Go to [1 Drive Menu] (<i>d r i</i> -), [1.3 configuration] (<i>C o n F</i> -), [Full] (<i>F u L L</i> -), [Application Funct.] (<i>F u n</i> -), then [Brake Logic Control] (<i>b L C</i> -) menu
3	Modify the value of the parameters according to criteria presented in the previous table then repeat step 1 to observe the modifications.

Acceleration and Deceleration

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	✓	✓

Both the **[Acceleration] ACC** and the **[Deceleration] DEC** of the motor are defined by the system operation to be compatible with the technical requirements of the hoisting machine. For example, but not limited to, the current limitation must not be reached.

The unit of these parameters is the second.

Factory settings for **[Acceleration] ACC** and **[Deceleration] DEC** are 3 seconds.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the acceleration and the deceleration:

Step	Action
1	Go to [Simply start] SS - menu, [Simply start] SS , Π tab
2	Set [Acceleration] ACC to the required acceleration (in seconds)
3	Set [Deceleration] DEC to the required deceleration (in seconds)

ATV320 Step-by-step configuration

The following table shows the step-by-step configuration of the acceleration and the deceleration:

Step	Action
1	Go to [1 Drive Menu] Dr , [1.3 configuration] $CONF$, [Full] $FULL$, [Simply Start] SS , Π menu
2	Set [Acceleration] ACC to the required acceleration (in seconds)
3	Set [Deceleration] DEC to the required deceleration (in seconds)

Low Speed and High Speed

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	✓	✓

Both the **[Low speed] L S P** and the **[High Speed] H S P** of the motor are defined by the system operation to be compatible with the technical requirements of the hoisting machine.

NOTE: The system operation can also list required preset speeds; refer to section [“Configuration of the Reference Speed and the Preset Speed”](#) for additional information.

In closed loop, the low speed can be set to 0 Hz for both movements (vertical and horizontal). For the vertical movement, when the brake is released, the drive applies a torque not zero to maintain the load. For the horizontal movement, when the brake is released, the drive maintains the position of the bridge.

The unit of these parameters is the hertz.

The conversion in “meter by minutes” unit depends on the mechanical sizing and the moving mass. The moving mass is defined as:

- The lifted load for the vertical movement,
- The bridge plus the load for the horizontal movement.

NOTE:

- If **[High Speed] H S P** is higher than **[Nominal Motor Freq] F r S**, the high speed hoisting function needs to be configured.
- The threshold overspeed is 110 % of **[Max frequency] L F r**. The factory setting of **[Max frequency] L F r** is 60 Hz.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the high speed and the low speed:

Step	Action
1	Go to [Simply start] S Y S - menu
2	Set [Low Speed] L S P to the required low speed (in Hz)
3	Set [High Speed] H S P to the required high speed (in Hz)

ATV320 Step-by-step configuration

The following table shows the step-by-step configuration of the high speed and the low speed:

Step	Action
1	Go to [1 Drive Menu] (d r i) , [1.3 configuration] (C o n F) , [Full] (F u l L) , [Simply Start] (S i n) menu
2	Set [Low Speed] (L S P) to the required low speed (in Hz)
3	Set [High Speed] (H S P) to the required high speed (in Hz)

Speed Loop Optimization: Standard

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	–	–

The speed loop optimization function limits the vibration, the overshoot and the undershoot.

On ATV340 and ATV900, there are two different types of speed loop optimization:

- The high-performance speed loop optimization which requires the knowledge of the application inertia.
- The standard speed loop optimization which do not use the inertia of the application.

On ATV320, only the standard speed loop optimization is available.

In this step, the standard speed loop optimization is used. 3 parameters are used:

- **[K speed loop filter] $S F C$** to filter the reference value.
- **[Speed prop. gain] $S P G$** and **[Speed time integral] S , L** to adjust the speed loop (response time, overshoot of the speed, etc.).

Speed reference value filter

The speed reference value is filtered upstream to the speed loop. The filter can be adjusted with **[K speed loop filter] $S F C$** . If **[K speed loop filter] $S F C$** is set to:

- 0 (e.g. 0 %), the speed reference value is completely filtered: for applications requiring flexibility and stability.
- 100 (e.g. 100 %), the speed reference value is not filtered: for applications requiring short time response.
- 65 (default value), the speed reference value is filtered at 65 %.

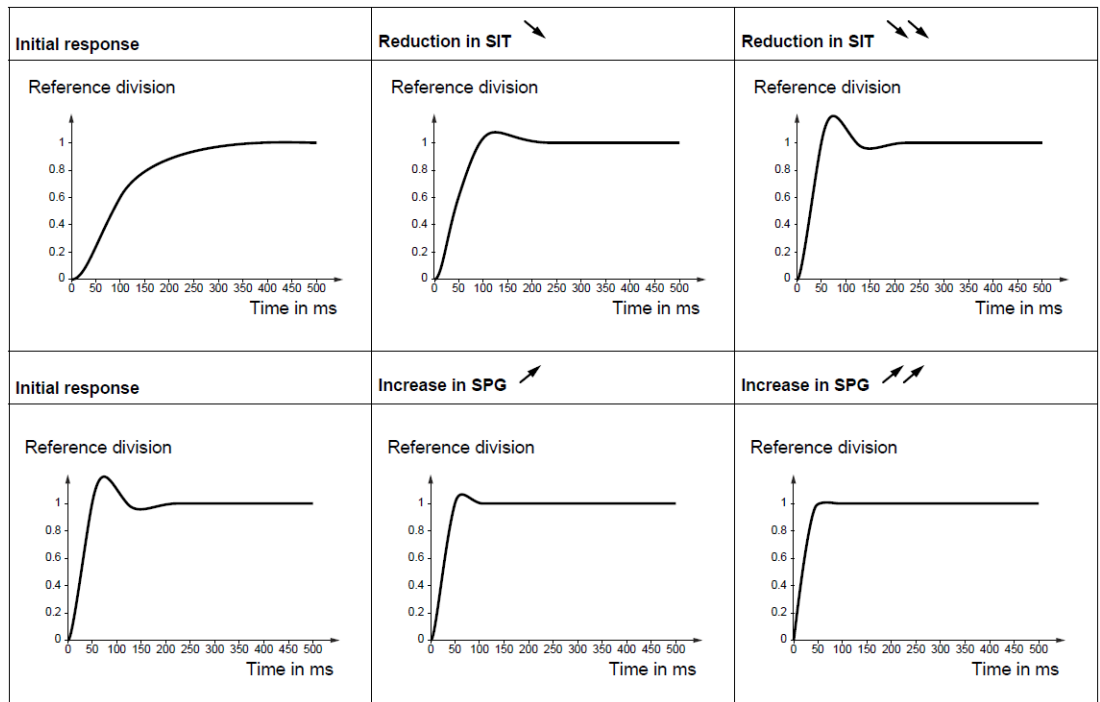
For the standard speed loop optimization, the time constant value of this filter is equal to $1 / S , L$.

Standard speed loop optimization

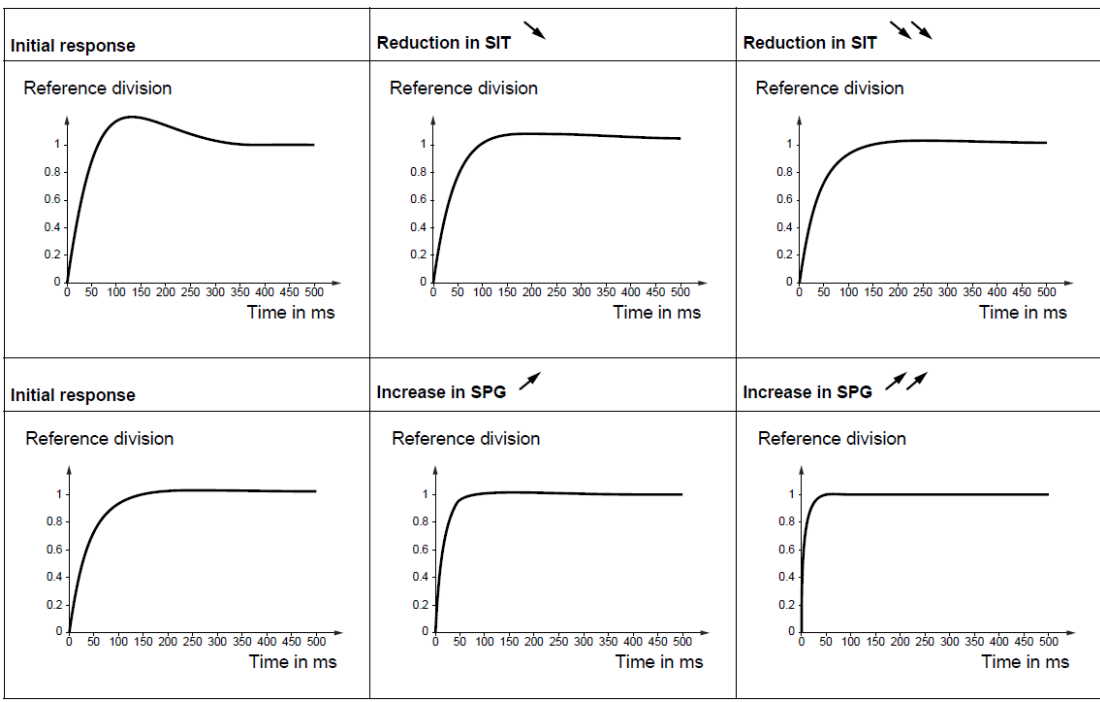
[Speed prop. gain] $S P G$ and **[Speed time integral] S , L** are used to adjust the standard speed loop. These two parameters modify the overshoot of the speed, the bandwidth and the response time. The following table shows the influence of these parameters according to the value of **[K speed loop filter] $S F C$** :

Value of [K speed loop filter] $S F C$	0	50	100
Influence of [Speed prop. gain] $S P G$	overshoot of the speed	Overshoot of the speed Bandwidth and response time	Bandwidth and response time
Influence of [Speed time integral] S , L	Bandwidth and response time		Overshoot of the speed

The following graphs show the influence of **[Speed prop. gain] SPG** and **[Speed time integral] SIT** with **[K speed loop filter] $SFC = 0$** .



The following graphs show the influence of **[Speed prop. gain] SPG** and **[Speed time integral] SIT** with **[K speed loop filter] $SFC = 100$** .



ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the standard speed loop optimization:

Step	Action
1	Go to [Complete settings] <i>C S E -</i> , [Motor parameters] <i>MPR -</i> , [Motor control] <i>dr C -</i> menu.
2	Set [Slip compensation] <i>SLP</i> to 0 %.
3	Go to [Spd Loop Optimization] <i>PLL -</i> menu.
4	Set [K speed loop filter] <i>SFL</i> to 65 %.
5	If necessary adjust the speed loop with [Speed prop. gain] <i>SPG</i> and [Speed time integral] <i>SI</i> . The influence of these parameters depends on [K speed loop filter] <i>SFL</i> value.

ATV320 Step-by-step configuration

The following table shows the step-by-step configuration of the standard speed loop optimization:

Step	Action
1	Go to [1 Drive Menu] (<i>dr i</i>), [1.3 configuration] (<i>CONF</i>), [Full] (<i>FULL</i>), [Settings] (<i>SE E -</i>) menu.
2	Set [Slip compensation] (<i>SLP</i>) to 0 %.
3	Set [K speed loop filter] (<i>SFL</i>) to 65 %.
4	If necessary, adjust the speed loop with [Speed prop. gain] (<i>SPG</i>) and [Speed time integral] (<i>SI</i>). The influence of these parameters depends on [K speed loop filter] (<i>SFL</i>) value.

Speed Loop Optimization: High Performance

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	–	✓	✓

The speed loop optimization function limits the vibration, the overshoot and the undershoot.

On ATV340 and ATV900, there are two different types of speed loop optimization:

- The standard speed loop optimization which are not using the inertia of the application.
- The high-performance speed loop optimization which requires the knowledge of the application inertia.

In case of closed loop, it is advisable to configure the speed loop optimization via the application inertia. In this step, the high-performance speed loop optimization is configured. 4 parameters are used:

- **S F C** to filter the reference value,
- **J A P L** : the inertia seen by the drive (the entire application),
- **S E R** to adjust the return to steady state after a speed transient, according to the dynamics of the machine,
- **F L G** to adjust the response of the machine speed transients according to the dynamics of the machine.

Note: In this document, the feedforward filter is not used: **[Feed forward] F F P** is set to 0%.

Speed reference value filter

The speed reference value is filtered upstream to the speed loop. The filter can be adjusted with **[K speed loop filter] S F C**. If **[K speed loop filter] S F C** is set to:

- 0 (e.g. 0 %), the speed reference value is completely filtered: for applications requiring flexibility and stability.
- 100 (e.g. 100 %), the speed reference value is not filtered: for applications requiring short time response.
- 65 (default value), the speed reference value is filtered at 65 %.

For the high-performance speed loop optimization, the time constant value of this filter is equal to **F L G / S E R**.

Estimation of the application inertia

The parameter **[Application Inertia] J A P L** represents the inertia of the application system (including the motor inertia).

By default, the **[Application Inertia] J A P L** is set to **[Estim. app. inertia] J E S E** value. **[Estim. app. inertia] J E S E** is estimated from the motor parameters.

NOTE:

- If the motor parameters are modified, the **[Estim. app. inertia] J E S E** is recalculated and updated. **[Application Inertia] J A P L** returns to its default value according to the new value of **[Estim. app. inertia] J E S E**.
- The unit is given by **[Inertia Mult. Coef.] J N L**.

The following calculations show an estimation of the application inertia (**[Application Inertia] J_{APL}**):

- For the vertical movement (with J_{Mot} the motor inertia):

$$J_{APL} = J_{Mot} + 2 \%$$

This is the approximation of $J_{APL} = J_{Mot} + J_{Gearbox} + J_{Hoisting} * K^2$ with:

Notation	J_{APL}	J_{Mot}	$J_{Gearbox}$	$J_{Hoisting}$	K
Description	Application inertia	Motor inertia	Gearbox inertia	Hoisting inertia: inertia of drum mass	Gearbox ratio
Example	2.432 Kg.m ²	2.41 kg.m ²	0.002 kg.m ²	Around 100 kg.m ² (for a 600kg)	0.014

- For the horizontal movement (with $J_{load\&bridge}$ the moving mass inertia and K the gearbox ratio):

$$J_{APL} = J_{load\&bridge} * K^2 + 2 \%$$

This is the approximation of $J_{APL} = J_{Mot} * N_{Motors} + J_{Gearbox} + J_{Hoisting} * K^2$ with $J_{Hoisting} = J_{Wheel} * N_{Wheels} + J_{load\&bridge}$:

Notation	J_{APL}	J_{Mot}	N_{Motors}	$J_{Gearbox}$	K	J_{Wheel}	N_{Wheels}	$J_{load\&bridge}$
Description	Application inertia	Motor inertia	Number of motors	Gearbox inertia	Gearbox ratio	Inertia of one wheel	Number of wheels	Inertia of the moving mass (load and bridge)
Example	0.357 kg.m ²	0.015 kg.m ²	2	0.002 kg.m ²	0.017	0.125 kg.m ²	4	1125 kg.m ² (for 16,000 kg)

Refer to the motor and gearbox datasheets.

High-performance speed loop optimization

The two following parameters are used to adjust the high-performance speed loop:

- [FreqLoop Stab] 5 L R** to modify the return to steady state after a speed transient, according to the dynamics of the machine. Gradually increase the stability in order to increase control loop attenuation and thus reduce speed overshoot.
- [FreqLoopGain] F L G** to modify the response of the machine speed transients according to the dynamics of the machine. For machines with high resistive torque, high inertia of fast cycles, increase the gain gradually.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the high-performance speed loop optimization:

Step	Action
1	Go to [Complete settings] C 5 L - , [Motor parameters] M P R - , [Motor control] d r C - and [Spd Loop Optimization] M C L - menu
2	Set [Speed loop type] 5 5 L to [High Perf] H P F .
3	Set [K speed loop filter] 5 F C to 100 %.
4	If you know the exact application inertia (including the motor inertia), set [Application Inertia] J A P L to its value and go directly to the step 6. Otherwise go to the step 5.
5	If you don't know the exact application inertia, increase [Application Inertia] J A P L (by maximum step of 10%) until there is speed oscillation. Then set [Application Inertia] J A P L to 80 % of this value.
6	If necessary, modify the bandwidth with [FreqLoopGain] F L G
7	If necessary, modify the stability with [FreqLoop Stab] 5 L R

Torque or Current Limitation Detection

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	✓	✓	✓

This function can be used to manage the torque value or the current value to limit mechanical damages due to mechanical hazards of the motor.

If the torque limitation or the current limitation is reached during a settable time, the drive triggers:

- the **[Torque Limit Reached]** 5 5 *H* warning. This warning must be monitored by the application in order to analyze the cause. Or,
- the **[Torque Limitation Error]** 5 5 *F* error and the drive stops. The type of stop depends on the value of **[Trq/l limit. stop]** 5 5 *b*.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the function:

Step	Description
1	Go to [Complete Settings] <i>C 5 E</i> - menu, [Error/Warning handling] <i>C 5 W 11</i> - submenu, [Torque or i lim. detect] <i>E 1 d</i> - menu.
2	Set [Trq/l limit. stop] 5 5 <i>b</i> to [Freewheel Stop] <i>5 E 5</i> .
3	Set the delay [Trq/l limit. Time out] 5 <i>E a</i> to a value corresponding to your application (the factory setting of this parameter is 1,000 ms).

ATV320 Step-by-step configuration

The following table shows the step-by-step configuration of the function:

Step	Description
1	Go to [1 Drive Menu] (<i>d r 1</i>), [1.3 configuration] (<i>C a n F</i>), [Full] (<i>F u L L</i>), [Fault Management] (<i>F L E</i>), [Torque or i lim. detect] (<i>E 1 d</i>) menu
2	Set [Trq/l limit. stop] (5 5 <i>b</i>) to [Freewheel] (<i>5 E 5</i>).
3	Set [Trq/l limit. Time out] (5 <i>E a</i>) to a value corresponding to your application (the factory setting of this parameter is 1,000 ms).

Configuration of the Stop Limit Switches

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	–	–	✓

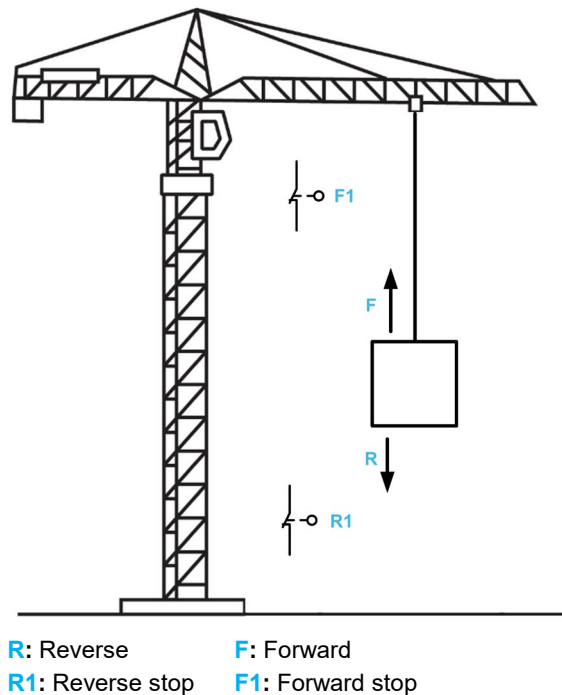
This function can be used to manage trajectory limits via limit switches.

If the stop contact is activated, the load is stopped depending on the configurable stop mode and only the startup in the opposite direction is authorized.

In this application note, the type of stop is set to fast stop. The type of stop must differ from freewheel in hoisting application.

To have a correct position of the switches and avoid collision, you must consider:

- For the lowering movement, the distance traveled by the maximum load at maximum speed after activation of the stop contact.
- For the lifting movement, the distance traveled by the minimum load at maximum speed after activation of the stop contact.



The stop is activated when the digital input is at low level 0 (contact open).

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the limit switch function:

Step	Description
1	Go to [Complete Settings] L 5 E - menu, [Generic functions] L 5 G F - submenu, [Limit switches] L 5 L - submenu.
2	Set [Stop FW assign] L R F to [DI4 (Low level)] L 4 L , the upper limit switch
3	Set [Stop RV assign] L R r to [DI5 (Low level)] L 5 L , the lower limit switch.
4	Set [Stop type] L R 5 to [Fast stop] F 5 E , the type of motor stop.

Adapting the previous description, the reverse slowdown, forward stop and reverse stop have similar behavior.

Note:

- At first power-up, the mechanical position must be in the standard area (between R1 and F1).
- In this application note, the configured logic for the slowdown and the stop is contact open (low level: activated when the input is at 0).

ATV320, ATV340 and ATV900 do not have the same number of digital inputs. In ATV340 drives, the number of inputs may differ from a catalog number to another. Refer to the drives catalog for additional information on the number of digital inputs.

In the following step-by-step configuration, 8 digital inputs are considered for ATV900 and ATV340 drives and 6 digital inputs plus 2 analog inputs used as digital inputs for ATV320 drives.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the slow down and limit switch function:

Step	Description
1	Go to [Complete Settings] <i>C S E</i> - menu, [Generic functions] <i>C S G F</i> - submenu, [Positioning by Sensors] <i>L P a</i> - submenu.
2	Set the limit switches on the corresponding inputs: • [Stop FW limit sw.] <i>S R F</i>: [DI4 (Low Level)] <i>L 4 L</i> • [Stop RV limit sw.] <i>S R r</i>: [DI5 (Low Level)] <i>L 5 L</i> • [Forward Slowdown] <i>d R F</i>: [DI7 (Low Level)] <i>L 7 L</i> • [Reverse Slowdown] <i>d R r</i>: [DI8 (Low Level)] <i>L 8 L</i>
3	Set the type of stop and type of deceleration: • [Stop type] <i>P R S</i> to a value corresponding to the application (the factory setting is [On Ramp] <i>r P P</i>) • [Deceleration type] <i>d S F</i> to a value corresponding to the application (the factory setting is [Standard] <i>S E d</i>)

ATV320 step-by-step configuration

The following table shows the step-by-step configuration of the slow down and limit switch function:

Step	Description
1	Go to [1 Drive Menu] (<i>d r i</i>), [1.3 configuration] (<i>C a n F</i>), [Full] (<i>F u L L</i>) and [Application Funct.] (<i>F u n -</i>) and [Positioning by Sensors] (<i>L P a -</i>) submenu
2	Set the limit switches on the corresponding inputs: • [Stop FW limit sw.] (<i>S R F</i>): [LI4] (<i>L 4 L</i>) • [Stop RV limit sw.] (<i>S R r</i>): [LI5] (<i>L 5 L</i>) • [Slowdown Forward] (<i>d R F</i>): [LAI1] (<i>L R i 1</i>) analog input AI1 used as digital input • [Slowdown Reverse] (<i>d R r</i>): [LAI2] (<i>L R i 2</i>) analog input AI2 used as digital input
3	Set the logic level configuration: • [Stop limit config.] (<i>S R L</i>): [Active low] (<i>L a</i>) • [Slowdown limit cfg.] (<i>d R L</i>): [Active low] (<i>L a</i>)
4	Set the type of stop and type of deceleration: • [Stop type] (<i>P R S</i>) to a value corresponding to the application (the factory setting is [On Ramp] (<i>r P P</i>)) • [Deceleration type] (<i>d S F</i>) to a value corresponding to the application (the factory setting is [Standard] (<i>S E d</i>))

Part V

Additional Information

What is in This Part?

This part contains the following chapters:

Complement on Brake Logic Control.....	80
High Speed Hoisting Configuration	88
Rope Slack Detection configuration	90
Braking Resistor Monitoring	91
Outputs of the drive and the Control of a Brake Contactor	93
Drive SISTEMA library.....	95
Regenerative Unit.....	96
Other Types of Motors.....	97
Master Slave application	100
For additional information	101

Complement on Brake Logic Control

Overview

The following table shows the context to set the brake expert parameters:

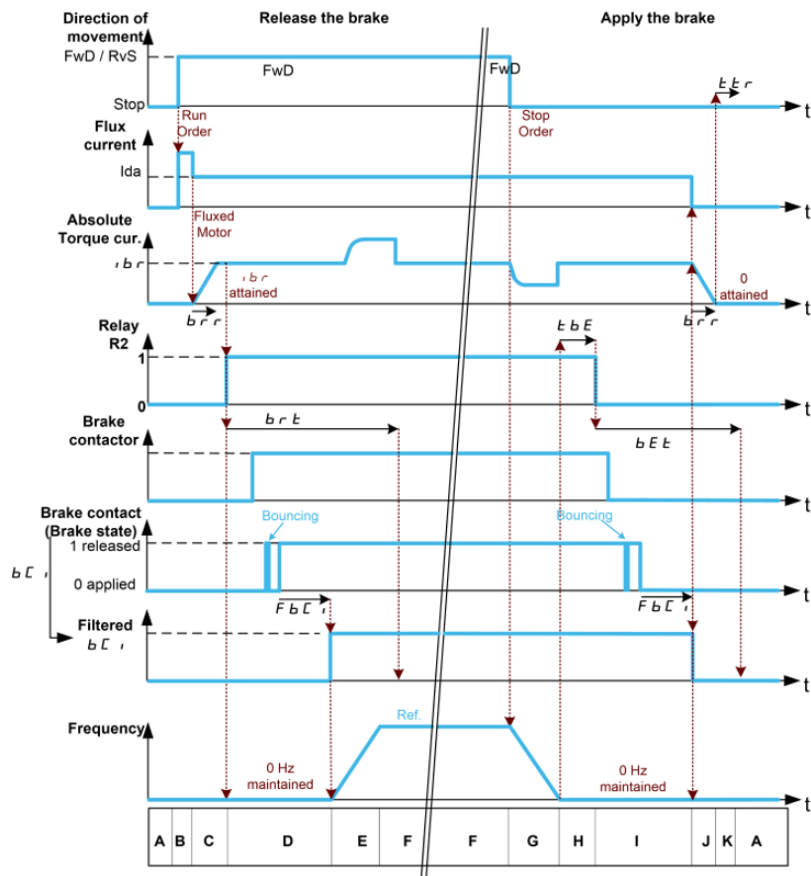
Usage	Drive	Prerequisites	Parameter(s) used
Reduce the sequence to release/apply the brake	ATV320 ATV340 ATV900	[Brake contact] <i>b C</i> , set	[BRH b2] <i>b r h 2</i>
Improve reaction time on premature⁽¹⁾ run command	ATV320 ATV340 ATV900	—	[BRH b0] <i>b r h 0</i> [Brake engage delay] <i>b E E</i>
Behavior of the drive at zero speed reference value	ATV340 ATV900	Closed loop	[Brake engage at 0] <i>b E C d</i> [BRH b6] <i>b r h 6</i>
[Brake Feedback] BRF error is untimely triggered in steady state	ATV320 ATV340 ATV900	[Brake contact] <i>b C</i> , set	[Brake Fdbk Filter] <i>F b C</i> , or [BRH b1] <i>b r h 1</i>
Maintain zero speed at application of the brake if brake feedback is inconsistent	ATV340 ATV900	Closed loop [Brake contact] <i>b C</i> , set or [Brake Relay Fdbk] <i>b r</i> , set	[BRH b3] <i>b r h 3</i>
Maintain zero speed if a movement is detected without run command	ATV340 ATV900	Closed loop	[BRH b4] <i>b r h 4</i> [BRH_b4_freq] <i>b F E d</i>
Behavior of the “maintain at zero speed”	ATV340 ATV900	[BRH b3] <i>b r h 3</i> set to [1] 1 and/or [BRH b4] <i>b r h 4</i> set to [1] 1	[BRH b5] <i>b r h 5</i> [Load Maintain Time] <i>l d F E</i>
(1): run command is applied before the completion of the command to apply the brake.			

Reduce the Sequence to Release/Apply the Brake

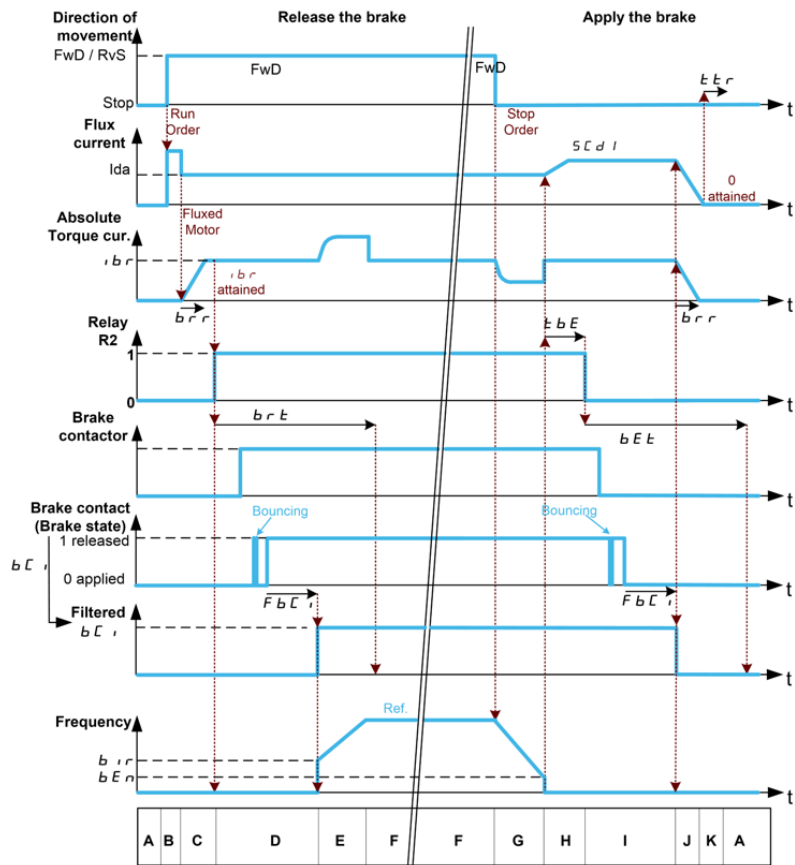
[BRH b2] <i>b r h 2</i>	Behavior of the drive
[0] 0 (Factory Setting)	The sequence to release/apply the brake is fully executed. All the delays are considered: - During the sequence to release the brake, the reference value is enabled at the end of the time [Brake release time] <i>b r E</i> . - During the sequence to apply the brake, the current decreases to 0 at the end of [Brake engage time] <i>b E E</i> .
[1] 1	The sequence to release/apply the brake is reduced with the information of the (filtered) brake contact feedback: - During the sequence to release the brake, the reference value is enabled when the (filtered) brake contact feedback switches to 1. - During the sequence to apply the brake, the current decreases to 0 when the (filtered) brake contact feedback switches to 0.

The following graphs show the reduced cycles. Refer to “[Optimization of the Brake Logic Control](#)” for the graphs of the standard cycle.

Reduced Sequence for both Vertical and Horizontal Movements in Closed Loop



Reduced Sequence for Horizontal Movements in Open Loop



NOTE:

- Irrespective of **[BRH b2] b r h 2** value, the current still decreases following the ramp **[Current ramp time] b r r**.
- This reduction of cycle is only possible with **[Brake contact] b c**, corresponding to the brake contact feedback (the state of the brake) otherwise the motor can force on the brake or can stop before the brake is applied.
- Irrespective of **[BRH b2] b r h 2** value, the monitoring of the brake feedback still considers **[Brake engage time] b e t** and **[Brake release time] b r t** (refer to the "[Monitoring of the brake contact feedback or the brake contactor feedback](#)").

Improve reaction time on premature run command

[BRH b0] b r h 0	Behavior of the drive
[0] 0 (Factory setting)	If a run command is requested during the application of the brake, the run command is considered after the brake is applied..
[1] 1	Improvement of the reaction time depending on the moment the run command is requested. When a run command is requested: • Before the end of [Brake engage delay] t b e, the run command is immediately considered: the sequence to apply the brake is aborted and the drive continues to run, • During [Brake engage time] b e t, the sequence to apply the brake is aborted and the run command is considered with the handling of [Brake release time] b r t, • After [Brake engage time] b e t, the sequence to apply the brake is fully completed then the run command is considered and thus, the sequence to release the brake is fully executed. For example, the use of this function with a joystick allows small jolt movements and inching command for positioning. NOTE: To increase the time window to accept a new run command without temporization, increase [Brake engage delay] t b e.

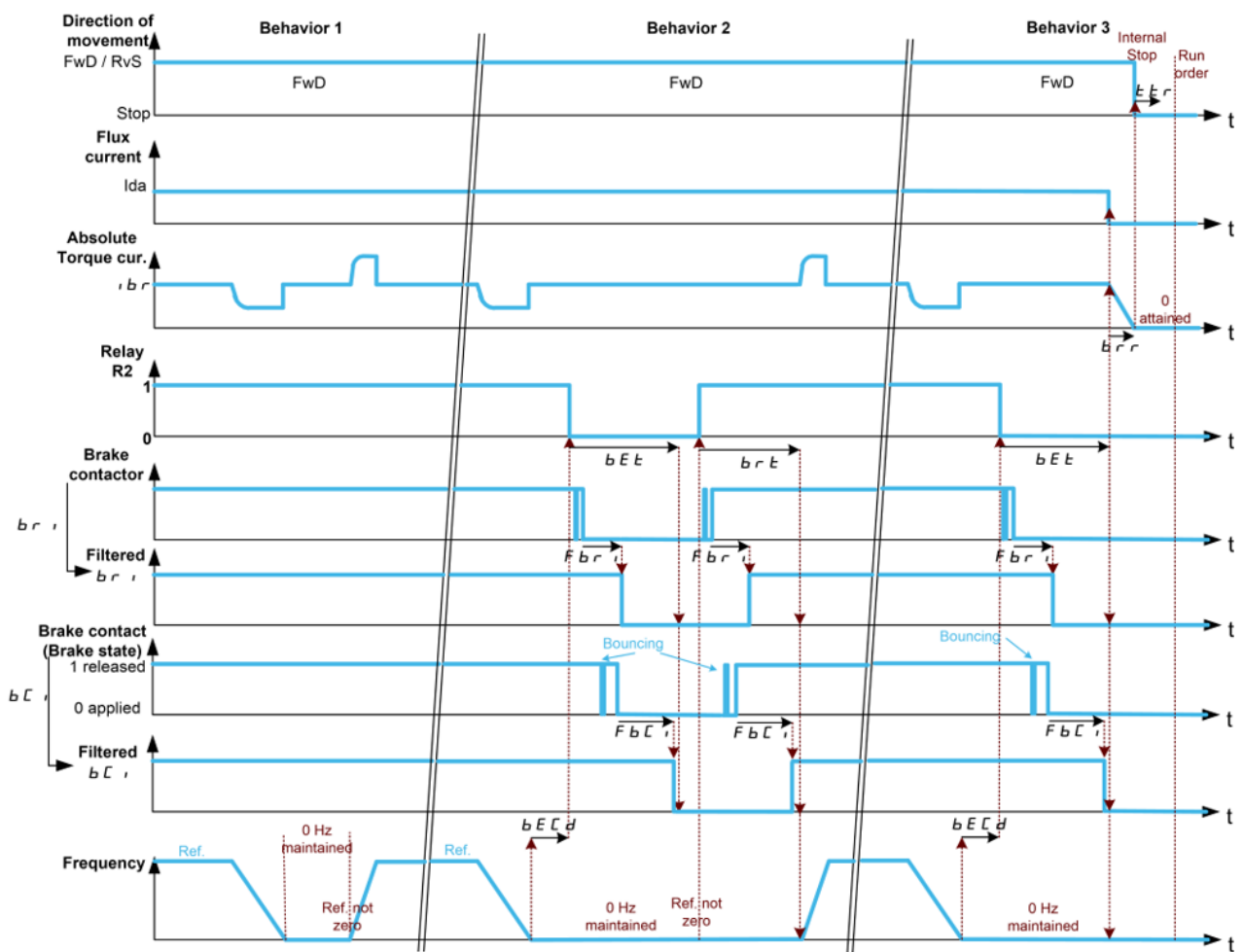
NOTE:

- If the run command is requested during **[Brake engage at 0] b e c d**, the run command is immediately considered.
- If the run command is requested with **[Engage at reversal] b e d** activated, the brake logic sequence is fully completed irrespective of the configuration of **[BRH b0] b r h 0**.
- If the run command is requested during **[Time to Restart] t t r**, the run command is considered at the end of this time.

Behavior of the drive at zero speed reference value

The following table shows the different behaviors of the drive at zero speed reference value with closed loop control:

[Brake engage at 0] <i>b E C d</i>	[BRH b6] <i>b r H b</i>	Behavior of the drive at zero speed reference value
[No] <i>n o</i> (Factory setting)	—	The drive regulates the motor torque to maintain the zero speed. The drive keeps running and the brake remains released. The sequence to apply the brake is executed with a stop command.
Numeric value (0.4 s for example)	[0] <i>0</i>	The drive maintains the zero speed. After [Brake engage at 0] <i>b E C d</i>, the brake is applied (with the handling of [Brake Engage Time] <i>b E t</i>) and the zero speed is still maintained (the drive keeps running). Then: - If a reference frequency other than zero is requested, the command to release the brake is applied following the torque application with the handling of [Brake Release Time] <i>b r t</i>. - If a stop command (external to the drive) is requested, the sequence to apply the brake is completed. This behavior can be used in specific application with a PLC waiting for the application of the brake to command a stop of the drive. NOTE: A stop command is only considered after [Brake Engage Time] <i>b E t</i>.
Numeric value (0.4 s for example)	[1] <i>1</i>	The drive regulates the speed at zero. After [Brake engage at 0] <i>b E C d</i> , a stop command is executed by the drive itself, the sequence to apply the brake is fully executed.



[Brake Feedback] $b_r F$ error is untimely triggered in steady state

Some applications show untimely bouncing of the brake (or the brake contactor). This introduces noise on the brake contact feedback or the brake contactor feedback during operation. Therefore, the brake feedback monitoring triggers the **[Brake Feedback] $b_r F$** error.

To help prevent the noise consideration,

- Set the parameter **[Brake Fdbk Filter] $F b C$** to filter the brake contact feedback (**[Brake Contact] $b C$**).
- Set the parameter **[Brake Rly Fdbk Filter] $F b r$** to filter the brake contactor feedback (**[Brake Relay Fdbk] $b r$**).

On ATV320 drive, the parameter **[Brake Fdbk Filter] $F b C$** is not available. An external filter can be used to help prevent the noise consideration. Otherwise, the monitoring of the brake contact can be deactivated in steady state by setting **[BRH b1] $b r h 1$** to **[1] 1**.

Maintain zero speed at application of the brake if brake feedback is inconsistent

The assignment of **[Brake contact] $b C$** enables the monitoring of the assigned input (brake contact feedback). Likewise, the assignment of **[Brake Relay Fdbk] $b r$** enables the monitoring of the assigned input (brake contactor feedback). Refer to the [“Monitoring of the brake contact feedback or the brake contactor feedback”](#).

These feedbacks are also monitored during the sequence to apply the brake: at the end of **[Brake engage time] $b E t$** , the (filtered) feedbacks must be equal to 0 (signifying that the brake is applied and the command to release the brake is removed). If one of the feedbacks is inconsistent with the brake logic control, the drive triggers a reaction depending on **[BRH b3] $b r h 3$** :

[BRH b3] $b r h 3$	Behavior of the drive
[0] 0 (Factory setting)	The drive triggers a [Brake Feedback] $b_r F$ error. Due to the specified wiring, if the error is triggered, the power of the brake is removed, and the command to apply the brake remains active.
[1] 1	With closed loop control, the drive triggers a [Brake Contact Warn] $b C A$ warning and maintains zero speed. The command to apply the brake remains active. If this setting is used, the behavior of the drive also depends on the setting of [BRH b5] $b r h 5$. Refer to section Behavior of the “Maintain at zero speed” for appropriate settings depending on your needs.

WARNING

LOSS OF CONTROL

- Only set **[BRH b3] $b r h 3$** to **[1] 1** if your application monitors the associated warning **[Brake contact Warn] $b C A$** , for example, by assigning the warning **$b C A$** to an output.
- If the warning **$b C A$** is triggered, the following action must be taken by the user.
 1. Move the load to a safe position.
 2. Power off the drive.
 3. Identify and remove the cause of the warning.
 4. Verify correct operation of all electrical and mechanical components of the brake before resuming regular operation.

Failure to follow these instructions can result in death, serious injury or equipment damage.

NOTE:

- Irrespective of **[BRH B3] $b r h 3$** value, the command to apply the brake remains active.
- If no feedbacks are configured, an external monitoring of the brake must be ensured.

Maintain zero speed if a movement is detected without run command

In case of closed loop control, without run command active and out of the brake sequence (i.e. after the time **[Time to restart] b t r**), if a movement, greater than the fixed threshold value determined by **[BRH_b4_freq] b F t d**, is detected, the drive triggers a reaction depending on **[BRH b4] b r H 4**:

[BRH b4] b r H 4	[BRH_b4_freq] b F t d	Behavior of the drive
[0] 0 (Factory setting)	Numeric value Factory setting: 10% of F r 5	The drive triggers a [Load Mvt Err] n d C F error. Due to the specified wiring, if the error is triggered, the power of the brake is removed, and the command to apply the brake remains active. NOTE: This is irrespective of the command profile and in all drive operating state except 2- Switch on disabled, 7- Fault Reaction Active and 8 - Fault states.
[0] 0	[NO] n o	There is no drive reaction, the load movement monitoring function is deactivated.
[1] 1	Numeric value Factory setting: 10 % of F r 5	The drive triggers a [Load Mvt Warn] b 5 A warning and maintains zero speed. The command to apply the brake remains active. If this setting is used, the behavior of the drive depends on the setting of [BRH b5] b r H 5 . Refer to section Behavior of the "Maintain at zero speed" for appropriate settings depending on your needs.

WARNING

LOSS OF CONTROL

- Only set the parameter **[BRH b4] b r H 4** to **[1] 1** if your application monitors the associated warning **[Load Mvt Warn] b 5 A**, for example, by assigning the warning **b 5 A** to an output.
- If the warning **b 5 A** is triggered, the following action must be taken by the user.
 1. Move the load to a safe position.
 2. Power off the drive.
 3. Identify and remove the cause of the warning.
 4. Verify correct operation of all electrical and mechanical components of the brake before resuming regular operation.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Setting **[BRH_b4_freq] b F t d** to **[NO] n o** disables load movement monitoring. Unintended movements and falling of the load are not detected with this setting.

WARNING

FALLING LOAD

Verify that the setting of this parameter does not result in unsafe conditions.

Failure to follow these instructions can result in death, serious injury or equipment damage.

If the value of the parameter **[BRH_b4_freq] b F t d** is too low, this may lead to unwanted triggering of load movement monitoring.

If the value of the parameter **[BRH_b4_freq] b F t d** is too high, the load movement monitoring may not trigger when required.

WARNING

LOSS OF CONTROL

Verify that the setting of this parameter is suitable for the application by performing comprehensive commissioning tests for all load conditions and all potential error conditions.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Behavior of the “Maintain at zero speed”

“Maintain at zero speed” activation comes from one of the two following events:

- Activation via BRH3 function: an inconsistency of the brake contact feedback and/or the brake contactor feedback at application of the brake (see page 84).
- Activation via BRH4 function: the detection of a movement without run command (see page 85) depending on the drive operating state (see the table below).

When “maintain at zero speed” is active, a warning is triggered (**b 5 R** or **b C R**). The command to apply the brake remains active and the drive runs in order to maintain zero speed. The “maintain at zero speed” has no priority compared to the following event:

- A new run command in order to control the drive and move the load.
- A stop command coming from a channel other than the active command channel if **[BRH b5] b r H 5** is set to **[0] 0** (see the table below).
- A triggered error if **[BRH b5] b r H 5** is set to **[0] 0** (see the table below).
- An active STO.
- A lock of the drive with the function linked to the parameter **[drive lock] L E 5**.

If one of these events occurs, the “maintain at zero speed” is interrupted.

[BRH b5] b r H 5	[Load Maintain Time] 0 d F t	Behavior of the drive
[0] 0 (Factory setting)	[Deactivated] n a	Load movement monitoring function is active only in the following drive operating states: • CIA402 command profile: 5-Operation Enabled, 6-Quick Stop Active • Other command profiles (Graphic Display Terminal, I/O, etc): 3-Ready to switch on, 4-Switched-on, 5-Operation enabled For example, when the product is controlled under Cia402 profile: • in Freewheel stop (NST) or in Operating State Fault (FLT), the load movement detection is not monitored. • if the drive is stopped by a halt command (bit 8 of the command word CMD), the drive remains in operation enabled then, the load movement detection is monitored. The “maintain at zero speed” has no priority compared to a triggered error.
[1] 1	[Deactivated] n a	Irrespective of the command profile, in all drive operating state except 7- Fault Reaction Active and 8 - Fault states, the load movement monitoring function is active. The “maintain at zero speed” has priority compared to a triggered error that can be disabled (see the list of errors that can be disabled below).
[1] 1	Numeric value (for example 2 minutes)	Same as above, however, the drive maintains zero speed during [Load Maintain Time] 0 d F t time. At the end of this time, [Load Mvt Err] 0 d C F error is triggered. When “Maintain at zero speed” is active, the remaining time before triggering [Load Mvt Error] 0 d C F error is displayed with the parameter [Load Maintain Delay] 0 t b F. If a new run command is applied, the load movement monitoring function is temporary inactive and the remaining time [Load Maintain Delay] 0 t b F is frozen. Reset of [Load Maintain Delay] 0 t b F requires a power cycle or a product restart.

NOTE:

- **b S A** and **b C A** warnings can only be cleared at next power on.

Errors that can be disabled: ACF1, ANF, BOF, BSQF, BUHF, CFA, CFB, CFC, CHF, CNF, COF, DLF, ENF, EPF1, EPF2, ETHF, FCF1, FCF2, FDR1, FDR2, FWER, IFA, IFB, IFC, IFD, IHF, INFB, INFD, INFJ, INFK, INFN, INFP, INFR, INFS, INFT, INFU, INFV, LFF1, LFF3, LFF4, LFF5, MDF, MDLF, MFF, MSDF, OBF, OHF, OLC, OLF, OPF1, OPF2, OSF, P24C, PCPF, PFMF, PGLF, PHF, SLF1, SLF2, SLF3, SOF, SPF, SRF, SSF, STF, T1CF, T3CF, T4CF, T5CF, TECF, TFA, TFB, TFC, TFD, TH1F, TH3F, TH4F, TH5F, THEF, TJF, TJF2, TLOF, TNF, ULF, URF, USF.

High Speed Hoisting Configuration

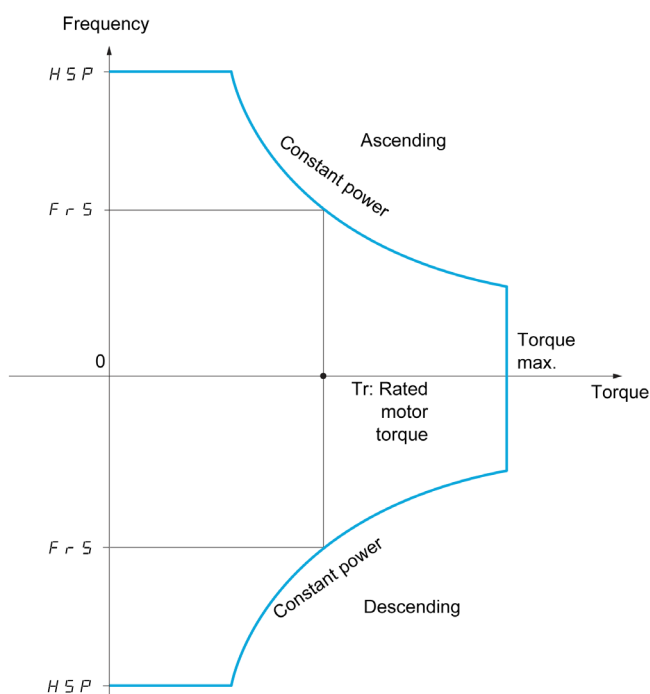
Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	–	–	✓

For vertical movements, the high speed hoisting function can be used to optimize the cycle times of the machine for zero or lightweight loads. It authorizes operation at "constant power" in order to reach a speed greater than the rated speed without exceeding the rated motor current and without overheating of the motor.

This function increases the hoisting speed when the load is lighter than the nominal load, without triggering **[Motor Overload]** $\Delta L F$ error. This increased speed can be higher than the nominal motor speed.

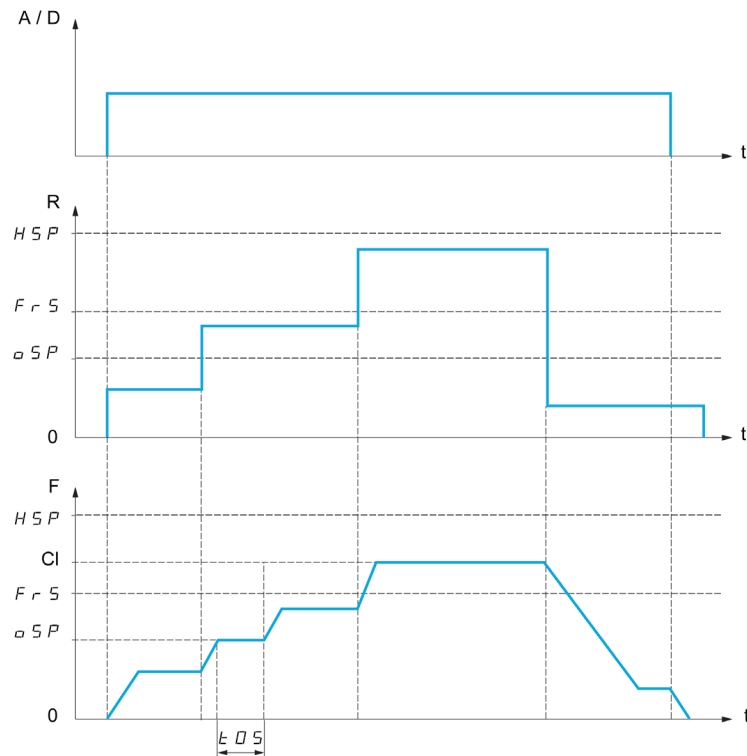
The speed remains limited by the **[High speed]** $H S P$.



Two possible operating modes are available:

- Speed reference mode: During a speed step, the drive estimates the load to adapt the maximum permissible speed.
- Current limitation mode: the maximum permissible speed is the speed that supports current limitation in motor mode, in the lifting direction only. For the lowering direction, it operates in speed reference mode.

In the case of this application note, the speed reference mode is used. The schematic below shows an example of representation of this mode.



A / D Ascend or descend command
R Reference Frequency
F Motor Frequency
CI Calculated limit
50P Adjustable speed step for load measurement
LMS Load measuring time

Note: During the configuration of this function, verify that the **[Motor current] LCL** is always less than the **[nominal motor current] nCL** for each operating point. otherwise the drive switches in **[Current limitation] LCL**.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the High Speed Hoisting function:

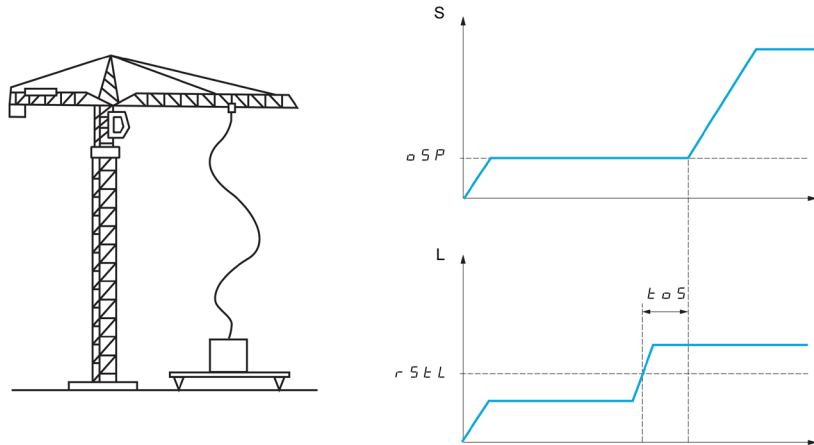
Step	Description
1	Go to [Complete Settings] LSE - menu, [Hoisting Functions] HFL - submenu, [High Speed Hoisting] H5H - submenu.
2	Set [High speed hoisting] H55 to [Reference Frequency] 555
3	Set [Measurement spd] 50P to a value less than [nominal motor freq] Fr5
4	Set [Load measuring tm.] LMS to 500 ms (or higher).
5	Run the machine in lifting direction with 4 different operating points (1 without load and 1 at full load and 2 intermediate points).
6	If the drive was in [Current limitation] LCL , during one of the previous movements, [Motor speed coeff.] L5F is too high. Reduce the value of this parameter and go back to the step 5. Otherwise, go to the next step.
7	The setting of [Motor speed coeff.] L5F is valid: - Keep this value and go the next step, or - Increase the value of [Motor speed coeff.] L5F and go back to the step 5.
8	Set [Gen. speed Coeff] L5r to [Motor speed coeff.] L5F value to limit speed difference between up and down movement.

Rope Slack Detection configuration

Overview

Movement	Horizontal movement (in open loop)	Horizontal movement (in closed loop)	Vertical movement (in closed loop)
Applicable	–	–	✓

For vertical movements, the rope slack monitoring function can be used to prevent starting up at high speed when a load has been set down ready for lifting but the rope is still slack (as illustrated below). This function required the activation of High Speed Hoisting function.



S Motor Frequency (in Hz) **L** Torque (in %)

The speed step (OSP parameter) is used to measure the load. The effective measurement cycle will not be triggered until the load reaches the adjustable threshold **[Rope slack trq level] r 5 t L**, which corresponds to the torque required (in %) to lift the hook (the value must be higher than 10 %).

Note: The speed reached for a given current level will be lower in case of mains undervoltage compared to nominal mains voltage.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the rope slack monitoring function:

Step	Description
1	Go to [Complete Settings] C 5 t - menu, [Hoisting Functions] H F t - submenu, [High Speed Hoisting] H 5 H - submenu.
2	Deactivate the High Speed Hoisting by setting [High speed hoisting] H 5 o to [No] n o .
3	Run the machine in up direction without load from the ground (only with hook).
4	Observe the value of [Motor Torque] o t r during the movement. This corresponds to the torque (in %) required to lift the hook with the cable.
5	Go to [Complete Settings] C 5 t - menu, [Hoisting Functions] H F t - submenu, [High Speed Hoisting] H 5 H - submenu.
6	Set [High speed hoisting] H 5 o to [Reference Frequency] 5 5 o .
7	Go to [Complete Settings] C 5 t - menu, [Hoisting Functions] H F t - submenu, [Rope Slack Handling] 5 d r - submenu.
8	Set [Rope Slack config.] r 5 d to [Weight Estimation] d r i .
9	Set [Rope Slack trq level] r 5 t L to the observed value of [Motor Torque] o t r plus 2 %.

Braking Resistor Monitoring

Overview

On Altivar Process ATV900 and Altivar Machine ATV340, the braking resistor can be monitored.

For vertical movements, the motor is in “generator” mode if the load moves down and in “motor” mode if the load moves up. In “generator” mode, the dissipation of the generated energy must be done through a resistor (or network braking unit in specific cases). The braking resistor must be monitored.

The calculation estimates the overall thermal state of all the brake resistors. The brake resistor monitoring function does not replace the thermal contact monitoring of each managed braking resistor. This function does not monitor the IGBT and the short circuit.

The internal calculation uses the characteristics of the equivalent braking resistor such as the time constant. Refer to the braking resistor supplier to gather the information. See for example the following table:

catalog number	time constant (in s)	catalog number	time constant (in s)	catalog number	time constant (in s)
VW3A7730	23	VW3A7740	39	VW3A7750	74
VW3A7731	39	VW3A7741	50	VW3A7751	116
VW3A7732	36	VW3A7742	161	VW3A7752	94
VW3A7733	74	VW3A7743	140	VW3A7753	179
VW3A7734	94	VW3A7744	131	VW3A7754	227
VW3A7735	140	VW3A7745	167	VW3A7755	235
VW3A7736	104	VW3A7746	202	VW3A7756	271
VW3A7737	217	VW3A7747	236	VW3A7757	289
VW3A7738	283	VW3A7748	234		

Additional information is also available in the Braking Resistors Instruction Sheet ([NHA87388](#)).

Note:

- If **[Brake assignment] b L C** is assigned, the function that tests the connection of braking resistor is automatically activated (**[Braking Resistor] b r C = [Yes] Y E 5**). If the braking resistors are not detected, it triggers the **[DB unit op. circuit] b u F a** error.
- **[Braking Resistor] b r C** must be set to **[No] n a** if the solution does not use braking resistors but Altivar Regenerative Unit.

ATV340 and ATV900 Step-by-step configuration

The following table shows the step-by-step configuration of the braking resistor monitoring:

Step	Description
1	Go to [Complete Settings] C 5 E - , [Generic functions] C 5 G F - , [Ramp] r A P P - menu.
2	Verify [Braking Resistor] b r C is set to [Yes] Y E 5 .
3	Go to [Complete Settings] C 5 E - menu, [Error/Warning handling] C 5 W P - submenu, [Braking Resistor Monit] b r C - submenu.
4	Set [Braking Resistor Monit] b r a to [Warning] Y E 5 .

Step	Description
5	Set the following parameters: • [Braking Resistor Power] brP to the total power of all installed braking resistors (in kW). • [Braking Resistor Value] brV to the rated value of the braking resistor (in Ohms). • [Braking Resist T Constant] $brTC$ to the time constant of the braking resistor (in seconds)
6	Assign a digital output or a relay to the warning [BR Thermal Warning] brA to handle the corresponding event. Note: • The warning occurs when [DBR thermal state] dbb exceeds 100%. • The warning event can be stored in the warning log file.

Outputs of the drive and the Control of a Brake Contactor

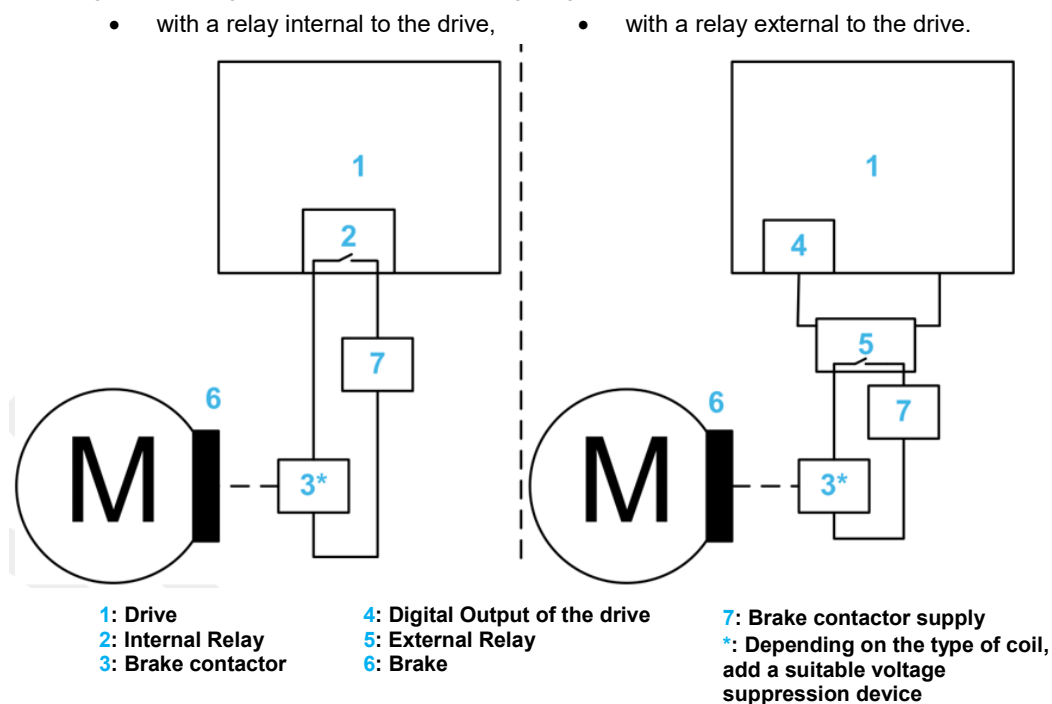
Overview

By default, a relay of the drive is used to control the brake contactor (for example, the relay R2). The following table shows the service life of the relay R2 depending on the drive. Always verify that these values are still up to date by referring to the installation manual of the drive.

ATV320	ATV340	ATV900
- Up to 100,000 operations at maximum switching current. - Up to 1,000,000 operations at 0.5 A	- Up to 100,000 operations at maximum switching current. - Up to 1,000,000 operations at 0.5 A	- Up to 100,000 operations at maximum switching current. - Up to 1,000,000 operations at 0.5 A

Instead of using an internal relay, you can also use an external relay that is controlled by a digital output of the drive. Such an external relay may offer a greater number of operations than the internal relay of the drive. Verify that the service life / the maximum number of operations of the relay used is suitable for your application. Consider the service life of the relay in the maintenance plan for your application.

The following schematic gives the two corresponding diagrams:



On the output relays of the drive, an inductive load must be equipped with a voltage suppression device according to AC or DC operation with total energy dissipation greater than the inductive energy stored in the load. Refer to sections “Output Relay with Inductive AC Loads” and “Output Relay with Inductive DC Loads” of the drive installation manual (see the [related documents](#)). For relays external to the drive, refer to the datasheets of the relays.

NOTE: You must ensure a preventive maintenance to replace the control board or the output used to control the brake contactor.

The following table shows the possible combinations depending on the drive:

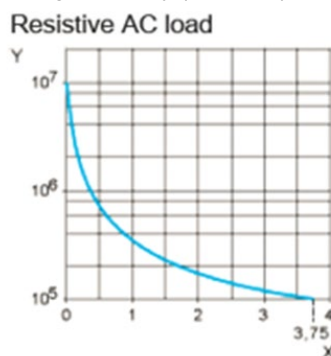
	relay of the drive	Digital output of the drive	Analog output of the drive used as digital output	Optional relay (option module)	Optional digital output (option module)
ATV320	✓	✓	✓*	-	-
ATV340	✓	✓	-	✓*	✓
ATV900	✓	✓	-	✓*	✓

(*): Combination not suitable for hoisting applications.

Example of estimation

In this example, an estimation of the service life is calculated in order to compare the use of the relay of the drive with the use of an external relay to control the brake contactor. Both combinations are equipped with a suitable voltage suppression device. Consequently, the load of the relay is regarded as a resistive load.

The external relay considered in this example is a RPM12BD. The following graph shows the number of operations (Y) depending on the switching capability (X in kVA):



NOTE: This is a typical curve, actual durability depends on load, environment, duty cycle, etc.

The brake contactor is the load of the relay. In this example, Tesys LC1DT20 is used.

Reference	Tesys LC1DT20F7	Tesys LC1DT20BD
Type of contactor	AC contactor	DC contactor
Supply Voltage	110 Vac 50/60 Hz	24 Vdc
Inrush power	70 VA at 20 °C	5.4 W at 20 °C
Hold-in power consumption	7.5 VA at 20 °C 60 Hz 7 VA at 20 °C 50 Hz	5.4 W at 20 °C
Inrush current consumption	1.5 A	0.25 A
Hold-in current consumption	0.2 A	0.25 A

The following table shows results of estimated service life depending on the combination and according to the characteristics of the relay and the brake contactor:

Relay	Relay of the drive	Relay of the drive	Digital output of the drive with an external relay (RPM12BD)
Brake contactor	LC1DT20BD	LC1DT20F7	LC1DT20F7
Number of cycles (inrush)	1,000,000	400,000	2,000,000
Number of cycles (hold-in)	1,000,000	1,000,000	9,000,000
Number of cycles (mixed)	1,000,000	750,000	5,000,000

Three number of cycles are shown: hold-in (normal cases), and inrush (worst cases) and mixed. The mixed value is the result of a calculation with the following consideration: 20 % of inrush and 80 % of hold-in.

The formula is the following:

$$\frac{1}{L_{mixed}} = 0.2 * \frac{1}{L_{WC}} + 0.8 * \frac{1}{L_{NC}}$$

L_{mixed}: Mixed number of cycles

L_{inrush}: Inrush number of cycles

L_{hold-in}: Hold-in number of cycles

Drive SISTEMA library

Overview

Schneider Electric provides scalable SISTEMA and VDMA libraries covering a large range of safety-related functions for machine applications (refer to Schneider Electric reliability value Libraries in the ["related documents"](#)).

*"The **SISTEMA** software utility provides developers and testers of safety-related machine controls with comprehensive support in the evaluation of safety in the context of **EN ISO 13849-1**. **SISTEMA** stands for "Safety Integrity Software Tool for the Evaluation of Machine Applications". The tool enables you to model the structure of the safety-related control components based upon the designated architectures, thereby permitting automated calculation of the reliability values with various levels of detail, including that of the attained Performance Level (PL)". (Extract from ["Brief description of SISTEMA"](#)).*

The SISTEMA library shows sub-systems ready to be used for automated calculation, such as:

Altivar Machine ATV320

- ATV320 - Motion by digital input
- ATV320 - Motion by fieldbus
- ATV320 - Braking by digital input command with brake feedback monitoring
- ATV320 - Braking by fieldbus command with brake feedback monitoring

Altivar Machine ATV340 and Altivar Process ATV900

- ATV6xx/9xx/340 - Motion by digital input
- ATV6xx/9xx/340 - Motion by fieldbus
- ATV6xx/9xx/340 - Braking by digital input command with brake feedback monitoring
- ATV6xx/9xx/340 - Braking by fieldbus command with brake feedback monitoring
- ATV6xx/9xx/340 - Overspeed monitoring

To meet the requested standards, the machine must be compliant with the performance level c category 2 for drive switching on and switching off and for the brake control. In addition, for a vertical movement in closed loop, performance level c category 2 must be reached for the overspeed monitoring.

The diagrams described in ["Wiring diagrams"](#) provide the capability to reach the performance level c category 2.

Application use case

For example, to deliver or to use overhead or gantry cranes, standards specify mandatory requirements in order to apply for CE marking. One of these requirements specifies to have a minimum performance level for safety-related functions. See the following extract of EN15011 (2014) chapter 5.3.4.1:

"The provisions of EN 60204-32:2008, Clause 9 shall apply as amended by 5.3.4.2 and 5.3.4.3 of this standard.

*All safety-related parts of control systems shall fulfil at least **Performance Level c** of EN ISO 13849-1:2008:*

- *control circuits built with electromechanical, hydraulic and pneumatic components shall fulfil at least **Performance Level c and category 1**;*
- *control circuits built with electronic or programmable components, respectively, shall fulfil at least **Performance Level c and category 2**.*

In high-risk applications, as specified EN 13135, a risk assessment shall be undertaken to establish a higher performance level requirement than described above".

SISTEMA is a tool used to design and verify that the performance level required for a safety-related function is reached.

"Relevant parameters such as the risk parameters for determining the required performance level (PL_r), the category of the SRP/CS, measures against common-cause failures (CCF) on multi-channel systems, the average component quality (MTTF_d) and the average test quality (DC_{avg}) of components and blocks, are entered step by step in input dialogs. [...] each parameter change is reflected immediately on the user interface with its impact upon the entire system. [...] The final results can be printed out in a summary document". (Extract from ["Brief description of SISTEMA"](#).)

The drive SISTEMA library helps you to design your own system to be compliant with the required performance level. You must ensure that the performance level reached by using Altivar drives and the wiring diagram presented in this application note is compatible with the performance level required.

Regenerative Unit

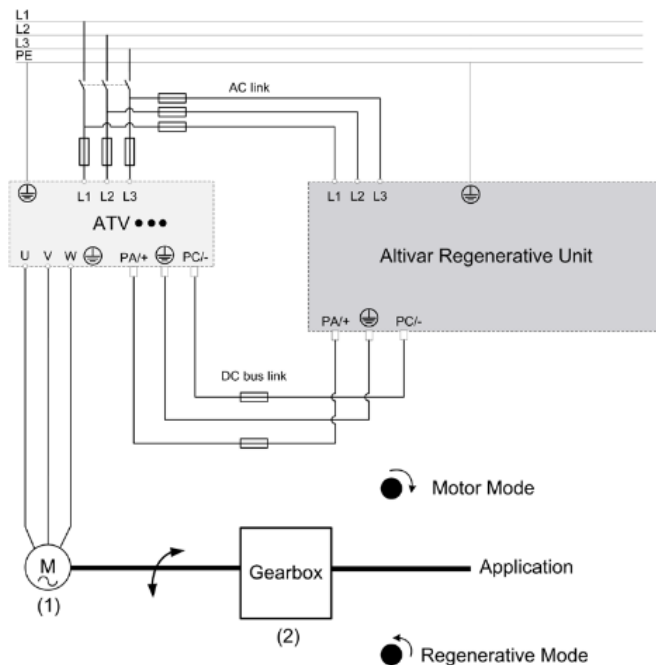
Overview

Altivar Regenerative unit is a solution replacing braking resistors. The use of Altivar Regenerative unit shows several benefits:

- **Energy Efficiency / Energy saving:** in generator mode, the brake resistors dissipate energy in the form of heat. To limit this waste of energy, the Altivar regenerative unit delivers it back to the power supply. For hoisting application where generator mode is fully a part of the operating cycle, this operation can save a significant amount of energy.
- **No heat constraint:** due to the heat dissipation by the brake resistors, a significant constraint exists on the implementation of the machine. By replacing braking resistors by Altivar regenerative units, this constraint is lightened significantly.
- A solution based on Altivar Regenerative unit is as expensive as a solution based on braking resistor. However, the return of investment is optimized with Altivar Regenerative Units.

Altivar regenerative unit is available for ATV320 drives, ATV340 drives and ATV900 drives.

Generic diagram for Altivar regenerative unit used with Altivar drives:



(1): Motor characteristics:

Motor rated power and Motor efficiency

(2): Gearbox efficiency

Note:

- Set **[Braking Resistor] b r L** to **[No] n o** on ATV340 and ATV900 if Altivar Regenerative Unit is used.
- Additionally, if AFE unit is used with drives different from ATV980, set **[DC Bus Source Type] d C b S** to **[Supply Unit REC] S u r E L**.

Sizing of Altivar Regenerative Unit is provided in the Altivar Regenerative Unit Sizing tool ([NVE94856](#)).

For additional information, refer to the user manual of Altivar Regenerative Unit ([NVE88423](#)).

Other Types of Motors

Overview

In this document, the configuration is described for asynchronous motor; it represents the common use cases. This section shows additional information for other types of motor.

Synchronous motor and reluctant motor

A single permanent magnet motor can be used for vertical movement in closed loop.

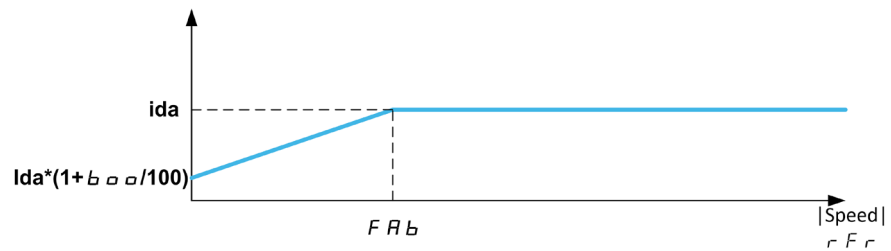
However, this document is not applicable for synchronous motor and reluctant motor. For additional information contact your local Schneider Electric representative.

Conical (rotor brake) motor

By design, conical motors integrate a brake. The use of a conical motor does not require the brake logic sequence configuration. However, the boost function must be configured in accordance with the conical motor. This function modifies the flux or the torque-generating current at low speed improving torque capability.

Conical motors can be used for horizontal movements in open loop.

The following graph shows the profile of the flux current depending on the **[motor frequency]** $r F r$ with a negative value of $b o o$. I_{da} is the magnetizing current.



Note: **[Motor Control Type]** $C L E$ must be set to an open loop asynchronous control (for example: **[SVC V]** $V V C$).

For ATV340 and ATV900, the following table shows the step-by-step configuration of the boost function with conical motor:

Step	Action
1	Go to [Complete Settings] $C S E$ -, [Motor parameters] $\Pi P R$ -, [Motor control] $d r C$ - submenu.
2	Set [Boost Activation] $b o R$ to [Static] $S E R E$
3	Set [Boost] $b o o$ to -80 % and [Freq Boost] $F R b$ to 3 Hz

For ATV320, the following table shows the step-by-step configuration of the boost function with conical motor:

Step	Action
1	Go to [1 Drive Menu] ($d r$), [1.3 configuration] ($C o n F$), [Full] ($F u L L$), [Motor Control] ($d r C$ -), [Asynchronous Motor] ($R S Y$ -) submenu
2	Set [Boost Activation] ($b o R$) to [Static] ($S E R E$)
3	Set [Boost] ($b o o$) to -80 % and [Action Boost] ($F R b$) to 3 Hz

Slip Ring Motor (for Resistor Calculation)

In order to obtain a required slip, modify the additional external resistance. The following formula gives this resistance R_a (in Ohm):

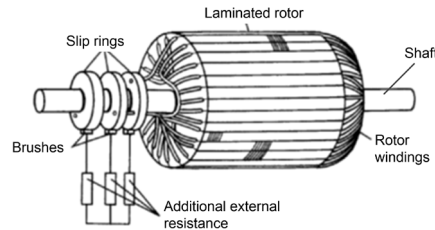
$$R_a = 333 * \frac{P}{I^2} (S - S_i)$$

P: the rated power (in kW)

I: the rated current (in A)

S: the required slip (in % of the nominal motor speed)

S_i: the internal slip (in % of the nominal motor speed)



The required slip (S) must have a higher value than the internal slip. In hoisting application, this required slip (S) must be set between 3 and 5 % to avoid peak current.

For example, considering a motor of 5.5 kW, 11.2 A and with an internal slip of 2 %, with a required slip equal to 4 %, the resistance R_a must be equal to 29.20 Ω.

Working at Constant Torque up to 87 Hz

Depending on the motor insulation class, it is possible to supply motor with a voltage greater than one specified for its coupling.

For example, a 230/400 Vac motor wired and coupled (in delta) to operate at 230 Vac / 50 Hz can be supplied at 400 V to operate with constant torque up to 87 Hz.

Some motors have information on nameplate to operate at 400 Vac / 87 Hz.

Otherwise, the following table shows the step-by-step configuration of ATV340 drives and ATV900 drives to operate at maximum speed 87 Hz:

Step	Action
1	Go to [Complete Settings] $\mathcal{L} \ 5 \ \mathcal{E} \ -$, [Motor parameters] $\Pi \ P \ \mathcal{R} \ -$, [Motor data] $\Pi \ \mathcal{O} \ \mathcal{R} \ -$, [data] $\Pi \ \mathcal{E} \ \mathcal{A} \ -$, submenu.
2	Set [Motor param choice] $\Pi \ P \ \mathcal{C}$ to [Mot Cosinus] $\mathcal{C} \ \mathcal{O} \ 5$
3	Go to [Simply start] $5 \ \mathcal{Y} \ 5 \ -$ menu, [Simply start] $5 \ , \ \Pi$ tab
4	Set [Max frequency] $\mathcal{E} \ F \ r$ to 87 Hz.
5	Set [High Speed] $H \ 5 \ P$ to 87 Hz.
6	Set [Nom Motor Current] $n \ \mathcal{C} \ r$ with the nominal current for delta coupling written on motor nameplate.
7	Set [Nominal Motor Freq] $F \ r \ 5$ to 87 Hz.
8	Configure [Nom Motor Voltage] $u \ n \ 5$ at 87 Hz from [Nom Motor Voltage] $u \ n \ 5$ at 50 Hz by performing the following calculation: $UNS_{50Hz} * \frac{FRS_{87Hz}}{FRS_{50Hz}}$
9	Configure [Nom Motor Speed] $n \ 5 \ P$ at 87 Hz to: $\frac{60}{\left[\frac{FRS_{50Hz} * 60}{NSP_{50Hz}} \right] * 37 + NSP_{50Hz}}$ with the floor function "[...]"
10	Configure [Motor 1 Cosinus Phi] $\mathcal{C} \ \mathcal{O} \ 5$ to the power factor written on motor nameplate.
11	Set [Autotuning Usage] $\mathcal{E} \ u \ n \ u$ to [Therm mot] $\mathcal{E} \ \Pi$. Note: The thermal estimation calculation is only optimized for a single class 1 motor usage. It is not optimized in case of motors in parallel.
12	Perform an autotuning by setting [Autotuning] $\mathcal{E} \ u \ n$ to [Yes] $\mathcal{Y} \ \mathcal{E} \ 5$.

For ATV320, this is the following table:

Step	Action
1	Go to [1 Drive Menu] (d r i), [1.3 configuration] (C o n f), [Full] (F u l l), [Motor Control] (d r C -), [Asynchronous Motor] (A S Y -) submenu
2	Set [Motor param choice] (M P C) to [Mot Cosinus] (C o s)
3	Go to [1 Drive Menu] (d r i), [1.3 configuration] (C o n f), [Full] (F u l l), [Simply start] (S Y S -) menu
4	Set [Max frequency] (E F r) to 87 Hz.
5	Set [High Speed] (H S P) to 87 Hz.
6	Set [Rated Mot. current] (n C r) with the nominal current for delta coupling written on motor nameplate.
7	Set [Rated motor freq.] (F r 5) to 87 Hz.
8	Configure [Rated Motor Volt.] (u n 5) at 87 Hz from [Rated Motor Volt.] (u n 5) at 50 Hz by performing the following calculation: $UNS_{50Hz} * \frac{FRS_{87Hz}}{FRS_{50Hz}}$
9	Configure [Nom Motor Speed] (n 5 P) at 87 Hz to: $\frac{60}{\left[\frac{FRS_{50Hz} * 60}{NSP_{50Hz}} \right]} * 37 + NSP_{50Hz}$ with the floor function "[...]"
10	Configure [Motor 1 Cosinus Phi] (C o s) to the power factor written on motor nameplate.
11	Verify that [Auto tuning Usage] (E u n u) to [therm Mot] (E n). Note: The thermal estimation calculation is only optimized for a single class 1 motor usage. It is not optimized in case of motors in parallel.
12	Perform an autotuning by setting [Auto tuning] (E u n) to [Do tune] (Y E 5).

Example of nameplate

PW	Hz	V	A	rpm	η %	cos φ
75	50	230V	222.0	1488	94.2	0.90
75	50	400V	28.0	1488	94.2	0.90
130	87	400V	221.0	2598	95.2	0.89

Parameters	Values by calculation (red line)	Nameplate values (blue line)
[Nom Motor Current] n C r	222.0 A	221.0 A
[Nom Motor Voltage] u n 5	87/50*230= 400.2 V	400 V
[Nom Motor Speed] n 5 P	[50*60/1488]=[2.02]=2 (floor value) (60*37/2)+1488 = 2598 rpm	2598 rpm
[Motor 1 Cosinus Phi] C o s	0.9	0.89

Master Slave application

Overview

On ATV340 and ATV900, for complex architectures with several drives (up to 10), it is possible to configure a direct communication between a drives group with MultiDrive Link function.

This communication is done through an Ethernet link.

With Master/Slave communication, additional functions such as torque control or load sharing are available.

Refer to the Master/Slave section in the ATV900 Programming Manual and ATV340 programming manual for additional information (see the [“related documents”](#)).

For additional information

For additional information

Contact your local Schneider Electric representative for additional information on:

- Motor thermal monitoring with thermal probes.
- Motor thermal monitoring with a motor different of class 1 motor.
- Motor thermal monitoring with several motors in parallel.
- DC bus sharing.

Appendix A.

Parameters Table

Parameters List Used in this Note

The following table recaps the parameters used in this application note.

You can write the value for your application on the **Customer value** column.

To store the configuration, you can use the [SoMove](#) with:

- *Altivar Process ATV900: DTM*
- *Altivar Machine ATV340: DTM*
- *Altivar Machine ATV320: DTM*

Select the movement of your application with the corresponding drive:

	Horizontal Movement in Open Loop	Horizontal Movement in Closed Loop	Vertical Movement in Closed Loop
Altivar Machine ATV320			
Altivar Machine ATV340			
Altivar Process ATV900			

Code	Label	Factory Settings	Customer Value
<i>L A C</i>	[Access Level]	[Standard] <i>S E d</i>	
<i>S u E P</i>	[Temperature unit] ¹	[0.1°C] <i>D I C</i>	
<i>S u C u</i>	[Currency unit list] ¹	[Euro] <i>E u r o</i>	
<i>C F G</i>	[Macro Configuration] ²	[Hoisting] <i>H S E</i>	
<i>A P P E</i>	[Application Selection]	[All Applications] <i>A L L</i>	
<i>d r E</i>	[Dual rating] ¹	[Norman Duty] <i>n o r M A L</i> ³	
<i>C E E</i>	[Motor Control Type]	[SVC V] <i>V V C</i>	
<i>b F r</i>	[Motor Standard] ⁴	[50 Hz IEC] <i>S D</i>	
<i>M P c</i>	[Motor Param choice] ⁴	[Mot Power] <i>n P r</i>	
<i>u n S</i>	[Nom Motor Voltage] ⁴	according to the drive rating	
<i>n C r</i>	[Nom Motor Current] ⁴	according to the drive rating	
<i>C o S</i>	[Motor 1 Cosinus Phi]	according to the drive rating	
<i>F r S</i>	[Nominal Motor Freq] ⁴	according to the drive rating	
<i>n S P</i>	[Nominal Motor Speed] ⁴	according to the drive rating	
<i>t u n u</i>	[Autotuning Usage]	[No] <i>n o</i> ⁵	
<i>t u S</i>	[Autotuning State]	[Not Done] <i>t A b</i>	
<i>t H E</i>	[Motor Thermal Mode] ⁴	[Self cooled] <i>A C L</i>	
<i>i E H</i>	[Motor Th Current] ⁴	according to the drive rating	
<i>C L i</i>	[Current limitation]	according to the drive rating	
<i>u E C P</i>	[Encore Type] ⁶	[Undefined] <i>u n d</i>	
<i>u E C V</i>	[Encoder supply volt.] ⁶	[Encoder supply volt.] <i>u E C V</i>	
<i>P G i</i>	[Number of pulses] ⁶	1024	
<i>A b M F</i>	[AB Encoder Max Freq] ⁶	[300 kHz] <i>3 0 0 K</i>	
<i>F r I</i>	[Ref Freq 1 config] ⁴	[AI1] <i>A i I</i>	

C H C F	[Control Mode]⁴	[Not Separ.] S , Π	
C d l	[Cmd Channel 1]	[Terminals] E r	
P S 2	[2 preset freq]	[No] n o	
S P 2	[Preset speed 2]	10 Hz	
E C C	[2/3-Wire Control]	[2 wire] 2 C	
E C E	[2-wire type]	[Level] (E r n)	
L S P	[Low Speed]	0 Hz	
b L C	[Brake assignment]	[No] n o	
b S E	[Movement type]	[Hoisting] V E r	
b C ,	[Brake contact]	[No] n o	
F b C ,	[brake fdbk filter]¹	100 ms	
b r ,	[brake Relay Fdbk]¹	[No] n o	
F b r ,	[Brake Rly Fdbk Filter]¹	100 ms	
, b r	[Brake release current]	according to the drive rating	
b r E	[Brake release time]	0.5 s	
b E E	[Brake engage time]	0.5 s	
S d C l	[Auto DC inj Level 1]	0.7 In	
b , P	[Brake release pulse]	[Yes] Y E S	
b , r	[Brake release freq]	[Auto] R u E o	
b E n	[Brake engage freq]	[Auto] R u E o	
J d C	[Jump at reversal]	[Auto] R u E o	
P H r	[Output Ph Rotation]	[ABC] R b C	
E b E	[Brake engage delay]	0.00 s	
A C C	[Acceleration]	3.0 s	
d E C	[Deceleration]	3.0 s	
H S P	[High Speed]	50 Hz	
E F r	[Max frequency]	60 Hz	
S S L	[Speed loop type]¹	[Standard] S E d	
S L P	[Slip compensation]	100 %	
S F C	[K speed loop filter]	65	
S , E	[Speed time integral]	according to the drive rating	
S P G	[Speed prop. gain]	40 %	
J A P L	[Application Inertia]¹	0 ⁷	
F L G	[FreqLoopGain]¹	20 %	
S E R	[FreqLoop Stab]¹	20 %	
S S b	[Trq/l limit. stop]	[Ignore] n o	
S E o	[Trq/l limit. Time out]	1000 ms	
L A F	[Stop FW assign]¹	[Not assigned] n o	
L A r	[Stop RV assign]¹	[Not assigned] n o	
L A S	[Stop type]¹	[Freewheel stop] n S E	
S A F	[Stop FW limit sw.]	[Not assigned] n o	
S A r	[Stop RV limit sw.]	[Not assigned] n o	
d A F	[Forward Slowdown]	[Not assigned] n o	
d A r	[Reverse Slowdown]	[Not assigned] n o	
P A S	[Stop type]	[Ramp stop] r Π P	
d S F	[Deceleration type]	[Standard] S E d	
S A L	[Stop limit config.]⁸	[Active low] L o	
d A L	[Slowdown limit cfg.]⁸	[Active low] L o	

<i>b r C</i>	[Braking Resistor]¹	[No] <i>n o</i>	
<i>b r o</i>	[Braking Resistor Monit]¹	[Ignore] <i>n o</i>	
<i>b r P</i>	[Braking Resistor Power]¹	0.1 kW	
<i>b r V</i>	[Braking Resistor Value]¹	0.1 Ohm	
<i>b r t C</i>	[Braking Resist T Constant]¹	45 s	
<i>b r H 0</i>	[BRH b0]	0	
<i>b r H 1</i>	[BRH b1]	0	
<i>b r H 2</i>	[BRH b2]	0	
<i>b r H 3</i>	[BRH b3]¹	0	
<i>b r H 4</i>	[BRH b4]¹	0	
<i>b r H 5</i>	[BRH b5]¹	0	
<i>Π d F t</i>	[Load Maintain Time]¹	[Deactivated] <i>n o</i>	
<i>b F t d</i>	[BRH_b4_freq]¹	10% of [Nominal Motor Freq] <i>F r 5</i>	
<i>b r H 6</i>	[BRH b6]¹	0	
<i>H 5 o</i>	[High speed hoisting]⁹	[No] <i>n o</i>	
<i>o 5 P</i>	[Measurement spd]⁹	40.0 Hz	
<i>t o 5</i>	[Load measuring tm.]⁹	0.5 s	
<i>C o F</i>	[Motor speed coeff.]⁹	100 %	
<i>C o r</i>	[Gen. speed coeff]⁹	50 %	
<i>r 5 d</i>	[Rope slack config.]⁹	[No] <i>n o</i>	
<i>r 5 t L</i>	[Rope slack trq level]⁹	0 %	

(1): Parameter not available on ATV320

(2): For ATV320, the parameter is **[Macro Configuration] *C F G*** (Factory setting: **[Start/Stop] *5 t 5***). There is no parameter for ATV340.

(3): For ATV340, the factory setting is **[Heavy Duty] *H , G H***.

(4): For ATV320, the parameter label is different.

(5): For ATV340, the factory setting is **[Therm mot] *t Π***.

(6): Parameter not used in open loop.

(7): The unit is provided by **[Inertia Mult. Coef.] *J Π u L***.

(8): Parameter not available on ATV340 and ATV900.

(9): Parameter only used for vertical movement.

Appendix B.

Diagnostics and Troubleshooting

Overview

In this appendix the main errors encountered in hoisting applications are listed. For additional information refer to the section "diagnostics and troubleshooting" in the programming manual.

Main Errors

The following table shows the main errors encountered in hoisting applications:

Error code	Probable cause	Remedy
[DB unit sh. circuit] <i>b u F</i>	- Short-circuit from braking unit. - Braking unit not connected. (not applicable for drive system braking unit option).	- Verify the wiring of the braking unit. - Verify that the braking unit value is not too low.
[DB unit op. circuit] <i>b u F a</i>	- Open-circuit from braking unit and/or braking resistor. - Low current from braking unit and/or braking resistor. - Braking unit not connected and/or braking resistor.	- Verify the wiring of the braking unit and braking resistor. - Verify that the total resistance value of the braking resistor is not too high.
[BUO Overcurrent error] <i>b u o C</i>	- Parameters in the [Braking Resistor monit] <i>b r P</i>- menu are not correct. - Braking load too high.	- Verify the braking unit parameters. - Check the braking resistor.
[Load slipping] <i>A n F</i>	The difference between the output frequency and the speed feedback is not correct.	- Confirm the drive rating according to the application (motor, load, and so on.) - Verify the motor, gain, and stability parameters. - Add a braking resistor. - Verify the mechanical coupling and wiring of the encoder. If the torque control function is used and if the encoder is assigned to speed feedback: set <i>S d d</i> to [No] <i>n a</i> and set both <i>d b P</i> and <i>d b n</i> to a value less than 10% of the nominal motor frequency.
[Encoder Feedback Loss] <i>S P F</i>	- Encoder feedback signal missing. - Noise on the encoder feedback signal - No signal on the pulse input, if the input is used for speed measurement. - Encoder consumption exceeds power supply maximum current.	- Verify the error code value [Encoder Fdbck Error] <i>E n C E</i>. - Verify the wiring between the encoder and the drive. Verify the encoder and its settings. - Verify the wiring of the pulse input and the sensor used. - Use a shielded cable and ground both ends. - Verify the encoder power supply. Reduce [Encoder Supply Voltage] <i>u E C V</i> value.
[Brake Feedback] <i>b r F</i>	- The state of the brake feedback contact is not correct compared to the brake logic control. - The brake does not stop the motor quickly enough (detected by measuring the speed on the "Pulse input" input).	- Verify the brake feedback circuit. - Verify the brake logic control circuit. - Verify the brake behavior.
[Overcurrent] <i>a C F</i>	- Parameters in the [Motor data] <i>M a A</i> - menu are not correct. - Inertia or load too high. - Mechanical locking.	- Verify the motor parameters. - Verify the size of the drive/load. - Verify the state of the mechanism. - Decrease [Current limitation] <i>C L</i> . - Increase the switching frequency.

Error code	Probable cause	Remedy
[Motor short circuit] 5 C F I	Short-circuit or grounding at the drive output.	- Verify the cables connecting the drive to the motor, and the motor insulation. - Adjust the switching frequency. - Connect chokes in series with the motor. - Verify the adjustment of speed loop and brake. - Increase the [Time to restart] t t r
[Ground Short Circuit] 5 C F 3	Significant ground leakage current at the drive output if several motors are connected in parallel.	
[Internal Error 19] i n F J	An error on the encoder module has been detected.	- Verify the compatibility of the encoder. - Contact your local Schneider Electric representative.
[Brake Control] b L F	- The torque-generating current is not reached. - The fluxing current is not stable.	- Verify the drive/motor connection. - Verify the motor windings. - Verify the i b r and i r d settings.
[Brake Feedback] b r F	- The state of the brake feedback contact or the state of the brake contactor feedback is not correct compared to the brake logic control. - The brake does not stop the motor quickly enough (detected by measuring the speed on the "Pulse input" input).	- Verify the brake feedback circuit. - Verify the brake logic control circuit. - Verify the brake behavior. - Verify that the setting of b r t and b e t take into account the brake response time, F b C i and F b r i.
[IGBT Overheating] t J F	- Drive power stage overheating. - On AFE drives: the thermal model of the AFE IGBT thermal monitoring has detected an overheat.	- Verify the size of the load/motor/drive according to environment conditions. - Reduce the switching frequency.
[Motor Overload] o L F	Triggered by excessive motor current.	- Verify the setting of the motor thermal monitoring - Verify the motor load. Wait for the motor to cool down before restarting - Verify the setting of the following parameters: i t H, t H t, t t d, o L L.
[Motor Overspeed] 5 o F	- Instability or driving load too high. - If a downstream contactor is used, the contacts between the motor and the drive have not been closed before applying a Run command.	- Verify the motor parameter settings. - Verify the size of the motor/drive/load. - Verify and close the contacts between the motor and the drive before applying a Run command.

The following detected errors require a power reset:

- [DB unit sh. circuit] b u F**
- [DB unit op. circuit] b u F o**
- [BUO Overcurrent error] b u o C**
- [Overcurrent] o C F**
- [Motor short circuit] 5 C F I**
- [Ground Short Circuit] 5 C F 3**
- [Internal Error 19] i n F J**
- [Motor Overspeed] 5 o F**

The following detected errors can be cleared with the **[Auto Fault Reset] A t r** or manually with the **[Fault Reset Assign] r 5 F** parameter after the cause has been removed:

- [Load slipping] A n F**
- [Encoder Feedback Loss] 5 P F**
- [Brake Feedback] b r F**
- [Brake Control] b L F**
- [IGBT Overheating] t J F**
- [Motor Overload] o L F**

Status of the drive

[Current limitation] C L i drive status may be a consequence of a difference between the reference value and the motor speed. The possible remedies are the following:

- Increase the acceleration/deceleration ramp time if **C L i** is observed during these phases,
- Decrease the maximum speed,
- Reduce the maximum load.

When a run command is active, if the drive is in blocking state and displays **[Freewheel] n 5 t**, verify that:

- the digital input assigned to freewheel stop in negative logic is not active,
- depending on the terminals configuration (**[2/3-Wire Control] t C C** and **[2-wire type] t C t**), the run command is not active at drive power-on.
- the control by fieldbus is correct, especially the channels priority.

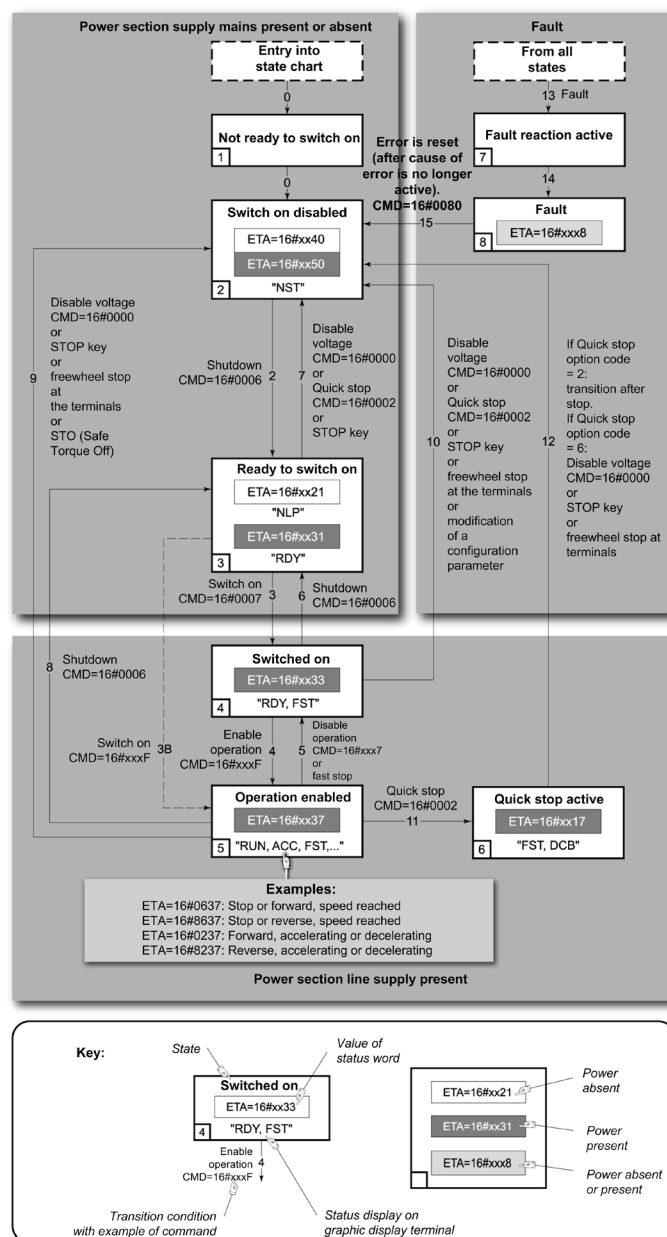
Appendix C.

CiA402 Operating State Diagram

State diagram

After switching on, the product goes through a number of operating states. The state diagram (state machine) shows the relationships between the operating states and the state transitions. The operating states are internally monitored and influenced by monitoring functions.

The following figure shows the CIA402 state diagram:



For additional information on the drive operating states and state transitions refer to the fieldbus manuals.



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