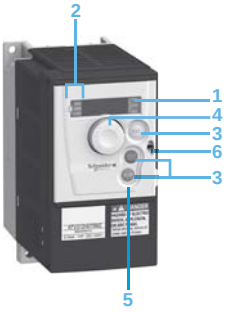
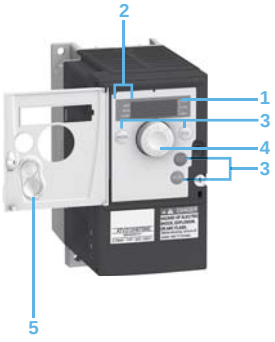
Variable speed drives
Altivar 312

Summary of functions

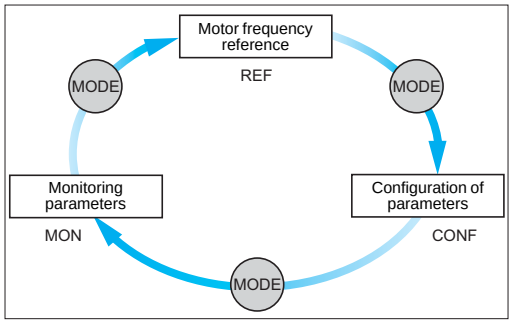
ATV 312H075M2 with front panel door closed, with cover 5: STOP/RESET and RUN keys not accessible



ATV 312H075M2 with front panel door closed, without cover 5: STOP/RESET and RUN keys accessible



ATV 312H075M2 with front panel door open



3 operating modes: REF, MON and CONF

Drive factory configuration

The Altivar 312 drive is configured to allow a quick start-up for most applications.
Factory configuration:
- Nominal motor frequency: 50 Hz
- Motor voltage: 230 V (ATV 312H●●●M2, ATV 312H●●●M3), 400 V (ATV 312H●●●N4) or 600 V (ATV 312H●●●S6)
- Linear ramp times: 3 seconds
- Low speed (LSP): 0 Hz/High speed (HSP): 50 Hz
- Normal stop mode on deceleration ramp
- Stop mode in the event of a fault: freewheel
- Motor thermal current = nominal drive current
- Standstill injection braking current = 0.7 x nominal drive current, for 0.5 seconds
- Constant torque operation with sensorless flux vector control
- Logic inputs:
  - 2 directions of operation (LI1, LI2), 2-wire control
  - 4 preset speeds (LI3, LI4): LSP (low speed), 10 Hz, 15 Hz, 20 Hz
- Analog inputs:
  - AI1 speed reference (0 +10 V)
  - AI2 (0 ± 10 V) summing of AI1
  - AI3 (4-20 mA) not configured
- Relay R1: fault relay
- Relay R2: not assigned
- Analog output AOC: 0-20 mA, image of the motor frequency
- Automatic adaptation of the deceleration ramp in the event of overbraking
- Switching frequency 4 kHz, random frequency

Human-Machine Interface (HMI)

Description

1 Display:
- 4-digit display
- Display of numeric values and codes
- Indication of the unit of the displayed value

2 Display of the drive status:
- **REF**: Reference mode. This mode is used to display the motor frequency reference of the active reference channel (terminals, local mode, remote display terminal or Modbus serial link). In local mode, the reference can be modified using the navigation button 4, if the function is configured.
- **MON**: Monitoring mode. This mode is used to display the monitoring parameters when the drive is running.
- **CONF**: Configuration mode. This mode is used to configure the drive parameters. These parameters can be modified using the SoMove setup software.

3 Use of the keys:
- **MODE** is used to access one of the following modes:
  - Reference mode REF
  - Monitoring mode MON
  - Configuration mode CONF

***Note**: This key cannot be accessed if the front panel door is closed.*
- **ESC**: Aborts a value, a parameter or a menu to return to the previous selections
- **STOP/RESET**: Local motor stop command, clears drive faults (key active in factory configuration)
- **RUN**: Local motor run command, if its activation is programmed

4 Use of the navigation button:
- Rotate: Increases or decreases the value, or goes to the next value
- Press: Saves the current value or selects the value
- The button can be used as a potentiometer in local mode

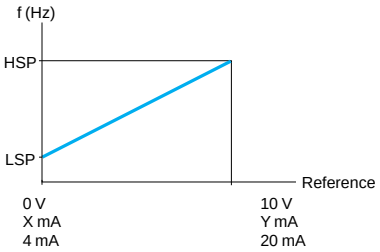
5 Cover that can be removed for access to the RUN and STOP/RESET keys.

6 It is possible to lock the front panel door with a lead seal.

Application functions

■ Operating speed range

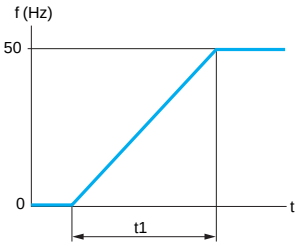
This function is used to determine the 2 frequency limits which define the speed range permitted by the machine under actual operating conditions for all applications with or without overspeed.



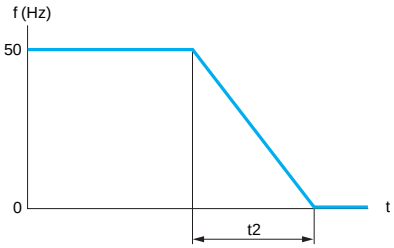
LSP: low speed, from 0 to HSP, factory setting 0
HSP: high speed, from LSP to f max., factory setting 50 Hz
X: configurable between 0 and 20 mA, factory setting 4 mA
Y: configurable between 4 and 20 mA, factory setting 20 mA

■ Acceleration and deceleration ramp times

This function is used to define acceleration and deceleration ramp times according to the application and the machine dynamics.



Linear acceleration ramp



Linear deceleration ramp

t1: acceleration time
t2: deceleration time
t1 and t2 can be set independently between 0.1 and 999.9 s, factory setting: 3 s

■ Acceleration and deceleration ramp profiles

These enable a gradual change in the output frequency starting from a speed reference, following a linear profile or a preset profile.

□ S ramps

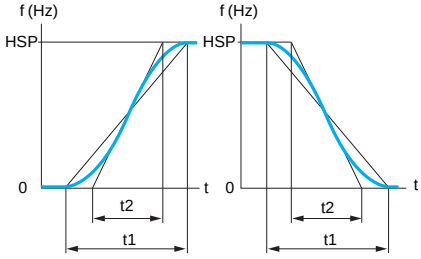
For applications such as material handling, packaging and passenger transport, the use of S ramps takes up mechanical backlash, eliminates jolts, and limits “non-following” of speed during rapid transient operation of high-inertia machines.

□ U ramps

U ramps are specifically for pumping applications, for example an installation with centrifugal pump and non-return valve. They provide better control of closing of the non-return valve.

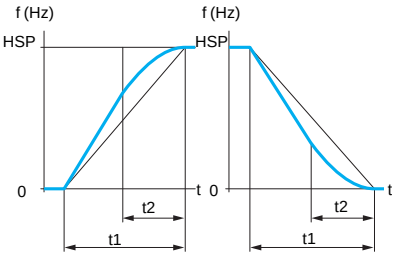
Selecting linear, S, U or customized profiles assigns both the acceleration and deceleration ramps.

S ramps



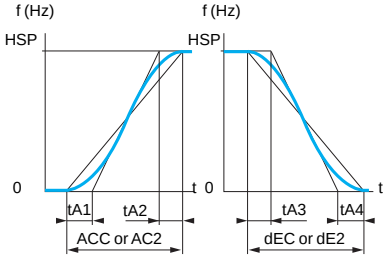
HSP: high speed
t1: ramp time set
t2 = 0.6 x t1
The rounding coefficient is fixed.

U ramps



HSP: high speed
t1: ramp time set
t2 = 0.5 x t1
The rounding coefficient is fixed.

Customized ramps



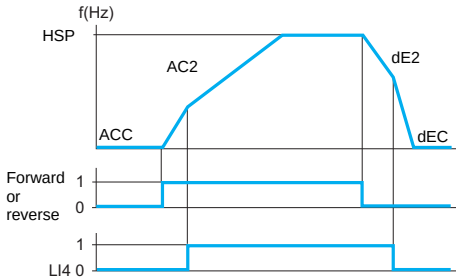
HSP: high speed
tA1: adjustable between 0 and 100% (of ACC or AC2)
tA2: can be set between 0 and (100% - tA1) (of ACC or AC2)
tA3: can be set between 0 and 100% (of dEC or dE2)
tA4: can be set between 0 and (100% - tA3) (of dEC or dE2)
ACC: acceleration ramp 1 time
AC2: acceleration ramp 2 time
dEC: deceleration ramp 1 time
dE2: deceleration ramp 2 time

Presentation: page 60420/2 | Characteristics: page 60421/2 | References: page 60422/2 | Dimensions: page 60429/2 | Schemes: page 60430/2

■ **Ramp switching**

This function is used to switch two acceleration and deceleration ramp times, which can be adjusted separately.
Ramp switching can be enabled by:
- A logic input
- A frequency threshold
- A combination of logic input and frequency threshold

This function is suitable for:
- Material handling with smooth starting and approach
- Machines with fast steady state speed correction



Acceleration 1 (ACC) and deceleration 1 (dEC):
- Adjustment 0.1 to 999.9 s
- Factory setting 3 s
Acceleration 2 (AC2) and deceleration 2 (dE2):
- Adjustment 0.1 to 999.9 s
- Factory setting 5 s
HSP: high speed

Example of switching using logic input LI4

■ **Automatic adaptation of deceleration ramp**

This function is used to automatically adapt the deceleration ramp if the initial setting is too low for the inertia of the load. It avoids the drive locking in the event of an **overbraking** fault.
The function is suitable for all applications which do require precise stopping and do not use braking resistors.
Automatic adaptation must be cancelled if the machine has position control with stopping on a ramp and a braking resistor installed. It is automatically disabled if the brake sequence is configured.

■ **Voltage/frequency ratio**

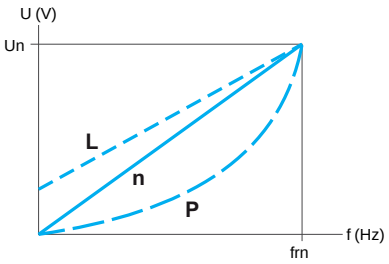
□ Motor and power supply characteristics

This function is used to determine the limit values for the voltage/frequency ratio according to the characteristics of the line supply, motor and application.
The following values should be set for constant or variable torque applications with or without overspeed:
- The base frequency corresponding to the line supply
- The nominal motor frequency (in Hz) given on the motor rating plate
- The nominal motor voltage (in V) given on the motor rating plate
- The maximum output frequency of the drive (in Hz)

□ Type of voltage/frequency ratio

This is used to adapt the voltage/frequency ratio to the application in order to optimize performance for the following applications:
- Constant torque applications (machines with average loads operating at low speed) with motors connected in parallel or special motors (e.g. resistive cage motor): ratio **L**
- Variable torque applications (pumps, fans): ratio **P**
- Machines with heavy loads operating at low speed, machines with fast cycles, with (sensorless) flux vector control: ratio **n**
- Energy saving, for machines with slow torque and speed variations: ratio **nLd**.

The voltage is automatically reduced to minimum according to the necessary torque.



Un: nominal motor voltage
frn: nominal motor frequency

■ **Auto-tuning**

Auto-tuning can be performed:
□ Voluntarily by the operator using dialogue tools via local control or the serial link
□ Each time the drive is switched on
□ On each run command
□ By enabling a logic input

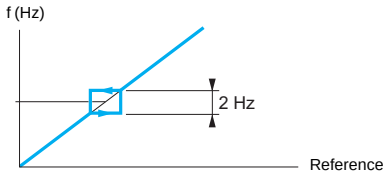
Auto-tuning is used to optimize application performance.

■ **Switching frequency, noise reduction**

Adjusting the switching frequency setting reduces the noise generated by the motor. The switching frequency is modulated randomly in order to avoid resonance. This function can be disabled if it causes instability.
High frequency switching of the intermediate DC voltage can be used to supply the motor with a current wave that has little harmonic distortion. The switching frequency can be adjusted during operation to reduce the noise generated by the motor.
Value: 2 to 16 kHz. Factory setting 4 kHz
For all applications which require low motor noise.

■ Skip frequencies

This function suppresses one or two critical speeds that may cause mechanical resonance.
It is possible to prohibit prolonged operation of the motor on 1 or 2 frequency bands (± 1 Hz), around an adjustable frequency on the speed range.
This function is suitable for lightweight machines, bulk product conveyors with an unbalanced motor, fans and centrifugal pumps.



Motor speed change depending on the skip frequency reference

■ Speed reference

The speed reference can come from different sources, depending on the drive configuration:
□ References provided by 3 analog inputs
□ The navigation button reference
□ The +/- speed function via logic input, using the keypad or remote display terminal keys
□ The remote display terminal reference
□ Speed references provided by the communication bus or networks
These sources are managed by programming the reference functions and channels.

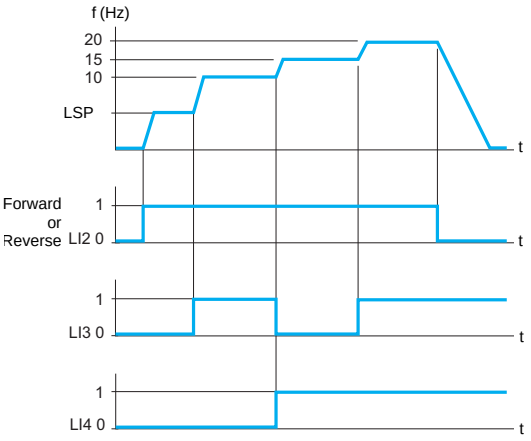
■ Analog inputs

There are 3 analog inputs:
□ 2 voltage inputs:
- 0-10 V (AI1)
- ± 10 V (AI2)

□ 1 current input:
- X-Y mA (AI3), where X is configurable between 0 and 20 mA, and Y is configurable between 4 and 20 mA

■ Preset speeds

This function is used to switch preset speed references.
Choose between 2, 4, 8 or 16 preset speeds.
Enabled by means of 1, 2, 3 or 4 logic inputs.
The preset speeds are adjustable in increments of 0.1 Hz from 0 Hz to 500 Hz.
This function is suitable for material handling and machines with several operating speeds.



The speed obtained with inputs LI3 and LI4 at state 0 is LSP or the speed reference, depending on the level of analog inputs AI1, AI2 and AI3.

Factory settings:

1st speed: LSP (low speed or speed reference)

2nd speed: 10 Hz

3rd speed: 15 Hz

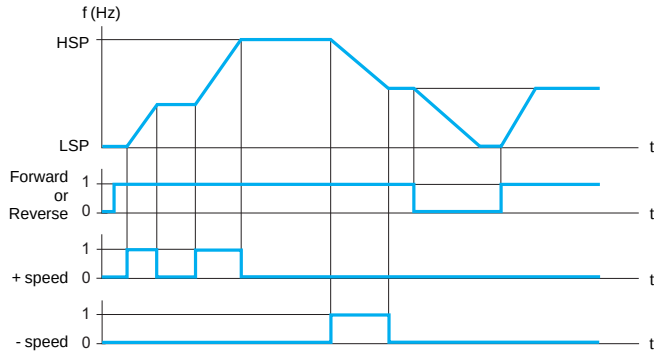
4th speed: 20 Hz (high speed)

Example of operation with 4 preset speeds and 2 logic inputs

■ +/- speed

This function is used to increase or decrease a speed reference by means of 1 or 2 logic inputs, with or without the last reference being saved (motorized potentiometer function).
This function is suitable for centralized control of a machine with several sections operating in one direction or for control by a pendant control station of a material handling crane with two operating directions.

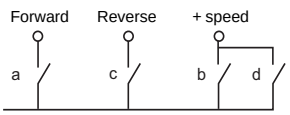
Two types of operation are available:
□ Use of single-action buttons: two logic inputs are required in addition to the operating direction(s).
The input assigned to the + speed command increases the speed, the input assigned to the - speed command decreases the speed.



Example of +/- speed with 2 logic inputs, single-action buttons and reference saving

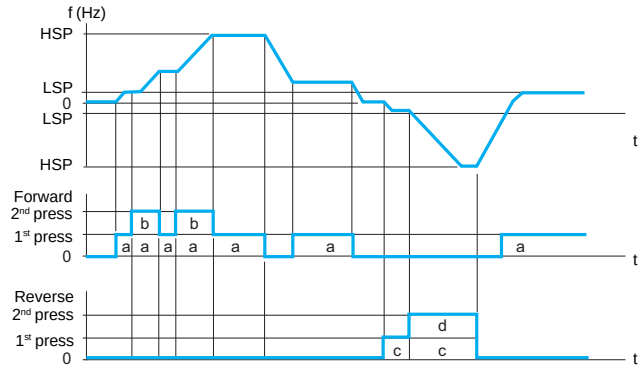
□ Use of double-action buttons (only one logic input assigned to + speed is necessary).

Logic inputs:



a and c: 1st press
b and d: 2nd press

	Released (- speed)	1st press (speed maintained)	2nd press (+ speed)
Forward button	–	a	a and b
Reverse button	–	c	c and d

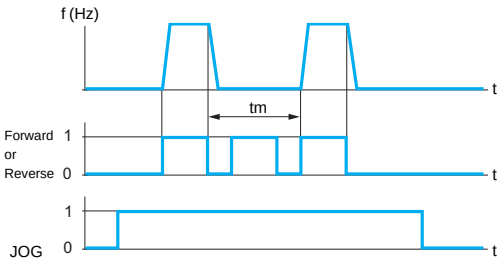


LSP: low speed; HSP: high speed

Example with double-action buttons and 1 logic input
***Note:** This type of +/- speed control is incompatible with 3-wire control.*

■ Save reference

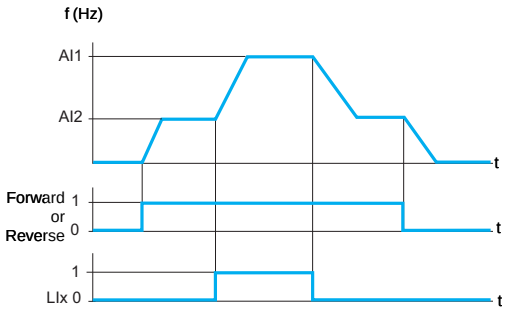
This function is associated with +/- speed control.
It enables the last speed reference prior to the loss of the run command or line supply to be read and saved. The saved reference is applied to the next run command.



Speed reference: adjustable from 0 to 10 Hz, factory setting 10 Hz

tm: fixed time of 0.5 s, minimum time between 2 pulses

Example of jog operation



Example of reference switching

■ Jog operation

This function is used for pulse operation with minimum ramp times (0.1 s), a limited speed reference and minimum time between 2 pulses.
It is enabled by 1 logic input and pulses given by the operating direction command.

This function is suitable for machines with product insertion in manual mode (e.g. gradual movement of the mechanism during maintenance operations).

■ Command and reference channels

There are several command and reference channels, which can be independent. Commands (forward, reverse, etc.) and speed references can be given via the following channels:

- Terminals (logic inputs and analog I/O)
- Local mode (STOP/RESET and RUN keys and navigation button)
- Remote display terminal
- Serial link:
  - Remote display terminal
  - Modbus control word
  - CANopen control word

The command channels and speed reference channels can be separate.
E.g. speed reference issued by CANopen and command issued by the remote display terminal.

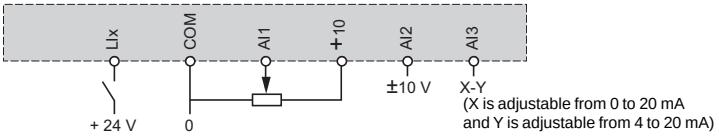
Note: *The STOP/RESET keys on the Human-Machine interface keypad and the remote display terminal can retain their priority.*
The Summing inputs and PI regulator functions only apply to one reference channel.

■ Reference switching

Switching between 2 speed references can be enabled via:

- A logic input
- A bit in a Modbus or CANopen control word

Reference 1 is active if the logic input (or control word bit) is at 0. Reference 2 is active if the logic input (or control word bit) is at 1.
The reference can be switched with the motor running.



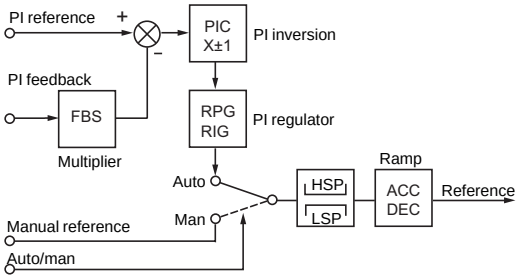
Connection diagram for reference switching

■ Summing inputs

This function is used to add together 2 to 3 speed references from different sources. The references to be added together are selected from all the possible types of speed reference.
E.g.

- Reference 1 from AI1
- Reference 2 from AI2
- Reference 3 from AIP

Drive speed reference = reference 1 + reference 2 + reference 3.



ACC: Acceleration
DEC: Deceleration
FBS: PI feedback multiplication coefficient
HSP: High speed
PIC: Reversal of the direction of correction of the PI regulator
LSP: Low speed
RIG: PI regulator integral gain
RPG: PI regulator proportional gain

PI feedback

■ **PI regulator**
This function is used for simple control of a flow rate or a pressure with a sensor supplying a feedback signal adapted to the drive.
It is suitable for pumping and ventilation applications.

□ **PI reference:**
- Internal regulator reference, adjustable from 0 to 100
- Regulation reference selected from all the possible types of regulation reference
- Preset PI references

□ **2 or 4 preset PI references** adjustable from 0 to 100, require the use of 1 or 2 logic inputs respectively
□ **Manual reference**
- Speed reference selected from all the possible types of speed reference

□ **PI feedback:**
- Analog input AI1, AI2 or AI3

□ **Auto/Man:**
- Logic input LI for switching operation to speed reference (Man) or PI regulation (Auto)

During operation in automatic mode, the process feedback can be adapted to correct inverse PI, adjust the proportional and integral gain, or apply a ramp (time = ACC - DEC) for establishing the PI action on starting and stopping.
The motor speed is limited to between LSP and HSP.

Note: *The PI function is incompatible with the Preset speeds and JOG functions. The PI reference can also be transmitted on line via the Modbus RS 485 serial link or via the CANopen bus.*

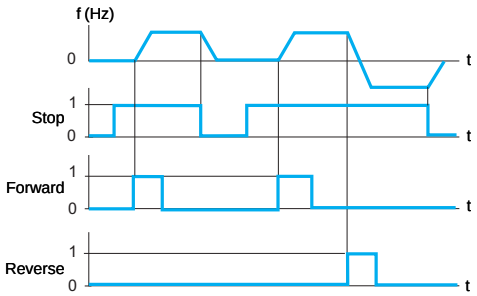
■ **Current limit switching**
A second current limit can be configured between 0.25 and 1.5 times the nominal drive current.
This function limits the torque and the temperature rise of the motor.
Switching between the two current limits can be enabled via:
□ A logic input
□ A bit in a Modbus or CANopen control word

■ **Limiting low speed operating time**
The motor is stopped automatically after a period of operation at low speed (LSP) with a zero reference and a run command present.
This time can be set between 0.1 and 999.9 seconds (0 corresponds to an unlimited time). Factory setting: 0 s. The motor restarts automatically on the ramp when the reference reappears or if the run command is interrupted and then re-established.
This function is suitable for automatic stopping/starting of pressure-regulated pumps.

■ **Motor switching**
This function allows two motors with different powers to be supplied alternately by the same drive. Switching must take place with the drive stopped and locked, using an appropriate sequence at the drive output.
The function can be used to adapt the motor parameters. The following parameters are switched automatically:
□ Nominal motor voltage
□ Nominal motor frequency
□ Nominal motor current
□ Nominal motor speed
□ Motor cosine Phi (power factor)
□ Selection of the type of voltage/frequency ratio for motor 2
□ IR compensation, motor 2
□ Motor frequency loop gain
□ Motor stability
□ Motor slip compensation

Motor thermal protection is disabled by this function.
Motor switching can be enabled by:
□ A logic input
□ A bit in a Modbus or CANopen control word

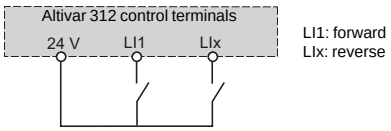
With hoisting applications, this function enables a single drive to be used for vertical and horizontal movements.



Example of 3-wire control operation

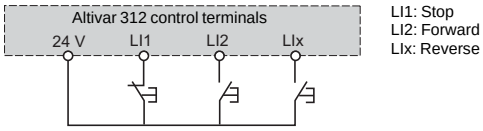
■ **Control mode switching**
Switching the command channel provides a choice of 2 control modes. Switching is enabled by:
□ A logic input
□ A bit in a Modbus or CANopen control word

■ **2-wire control**
This function is used to control the direction of operation by means of a stay-put contact.
It is enabled by means of 1 or 2 logic inputs (one or two directions of operation).
This function is suitable for all non-reversing and reversing applications.
Three operating modes are possible:
□ Detection of the state of the logic inputs
□ Detection of a change of state of the logic inputs
□ Detection of the state of the logic inputs with forward operation having priority over reverse



Wiring diagram for 2-wire control

■ **3-wire control**
This function is used to control the operating direction and stopping by means of pulsed contacts.
It is enabled by means of 2 or 3 logic inputs (1 or 2 directions of operation).
It is suitable for all non-reversing and reversing applications.



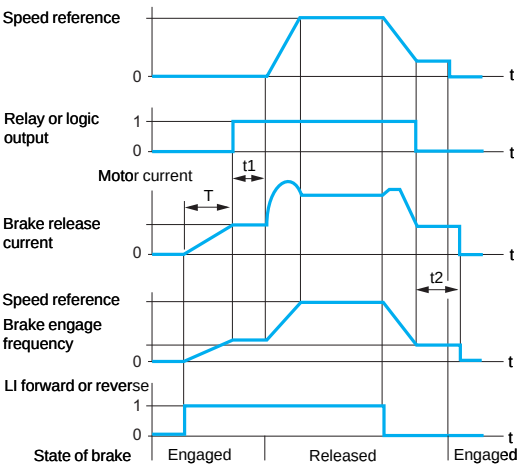
Wiring diagram for 3-wire control

■ **Forced local mode**
Forced local mode imposes control via the terminals or display terminal and disables all other control modes.
The following references and commands are available for forced local mode:
□ References AI1, or AI2, or AI3 and command via logic inputs
□ Reference and command via RUN and STOP/RESET keys and the navigation button
□ Reference and command via the remote display terminal
The changeover to forced local mode is enabled by a logic input.

■ **Freewheel stop**
This stops the motor by resistive torque if the motor power supply is cut.
A freewheel stop is achieved by:
□ Configuring a normal stop command as a freewheel stop (on disappearance of a run command or appearance of a stop command)
□ Enabling a logic input

■ **Fast stop**
This is used to achieve a braked stop with a deceleration ramp time (divided by 2 to 10) that is acceptable for the drive/motor unit without locking on an overbraking fault.
It is used for conveyors with electrical emergency stop braking.
A fast stop is achieved by:
□ Configuring a normal stop as a fast stop (on disappearance of a run command or appearance of a stop command)
□ By enabling a logic input

■ **DC injection stop**
This function is used for low speed braking of high-inertia fans, or for maintaining torque when stopping fans located in an airflow.
A DC injection stop is achieved by:
□ Configuring a normal stop as a DC injection stop (on disappearance of a run command or appearance of a stop command)
□ Enabling a logic input
The DC value and the standstill braking time are adjustable.



Accessible settings:
t1: brake release time delay
t2: brake engage time delay

Brake control

■ **Brake control**
This function is used to manage control of an electromagnetic brake in synchronization with starting and stopping the motor to avoid jolts and speed errors. The brake control sequence is managed by the drive.
Adjustable values for releasing the brake: current threshold and time delay
Adjustable values for engaging the brake: frequency threshold and time delay
Enabled by: relay logic output R2 or logic output AOC assigned to brake control.
This function is suitable for material handling applications with movements equipped with electromagnetic brakes (hoisting) and machines requiring holding brake control (unbalanced machines).

□ **Principle:**
- Vertical hoisting movement:

Maintains motor torque in an upward direction when the brake is being released and engaged, in order to hold the load and start smoothly as soon as the brake is released.
- Horizontal hoisting movement:

Synchronizes brake release with the build-up of torque during starting and brake engage at zero speed on stopping, to prevent jolting.
The recommended brake control settings for vertical hoisting applications are as follows (for horizontal hoisting applications, set the current threshold to zero):
- Brake release current: Set the brake release current to the nominal current indicated on the motor. If, during testing, the torque is insufficient, increase the brake release current (the maximum value is imposed by the drive).
- Acceleration time: For hoisting applications it is advisable to set the acceleration ramps to more than 0.5 seconds. Ensure that the drive does not change to current limiting.

The same recommendation applies for deceleration.
Note: For a hoisting movement, a braking resistor should be used. Ensure that the selected settings and configurations will not result in dropping or loss of control of the load being lifted.
- Brake release time delay t1: Adjust according to the type of brake. It is the time required for the mechanical brake to release.
- Brake engage frequency: Set to twice the nominal slip, then adjust according to the result.
- Brake engage time delay t2: Adjust according to the type of brake. It is the time required for the mechanical brake to engage.

■ **Limit switch management**
This function is used to manage the operation of one or two limit switches (with 1 or 2 operating directions).
Each limit (forward, reverse) is associated with a logic input. The type of stop that occurs on detection of a limit is configurable as normal, freewheel or fast stop.
Following a stop, the motor is permitted to restart in the opposite direction only.

■ **Monitoring**
The following data can be displayed:
□ Frequency reference
□ Internal PI reference
□ Frequency reference (absolute value)
□ Output frequency applied to the motor (value signed in two's complement)
□ Output frequency in customer units
□ Current in the motor
□ Motor power: 100% = nominal power
□ Line voltage
□ Motor thermal state:
- 100%: nominal thermal state, 118%: motor overload threshold

□ Drive thermal state:
- 100%: nominal thermal state, 118%: drive overload threshold

□ Motor torque: 100% = nominal torque
□ Last detected fault
□ Operating time
□ Auto-tuning status
□ Configuration and state of logic inputs
□ Configuration of analog inputs

■ **Fault management**
There are various operating modes in the event of resettable faults:
□ Freewheel stop
□ The drive switches to the fallback speed
□ The drive maintains the speed at which it was operating when the fault occurred, until the fault disappears
□ Stop on ramp
□ Fast stop
The following resettable faults are detected:
□ Drive overheating
□ Motor overheating
□ CANopen bus fault
□ Modbus serial link failure
□ External faults
□ Loss of 4-20 mA signal

■ **Fault reset**
This function is used to clear the last fault by means of a logic input.
The restart conditions after a reset are the same as those for a normal power-up.
Resets the following faults: overvoltage, overspeed, external fault, drive overheating, output phase loss, DC bus overvoltage, loss of 4-20 mA reference, load slipping, motor overload if the thermal state is less than 100%, serial link fault.
Line supply undervoltage and input phase loss faults are reset automatically when the line supply is restored.
This function is suitable for applications where the drives are difficult to access, for example on moving parts or in material handling systems.

■ **General reset (disables all faults)**
This function disables all faults, including thermal protection (forced operation), and can result in irreparable damage to the drive.
This invalidates the warranty.

This function is suitable for applications where restarting may be crucial (conveyor in an oven, smoke extraction system, machines with solidifying products that need to be removed).
The function is enabled by a logic input.
Fault monitoring is active if the logic input is at state 1.
All faults are reset on a change of state ⤒ of the logic input.

■ **Controlled stop on loss of line supply**
This function is used to control motor stopping on a loss of line supply.
It is suitable for material handling, machines with high inertia, continuous product processing machines.
Possible types of stop:
□ Locking of the drive and freewheel stop
□ Stop which uses the mechanical inertia to maintain the drive power supply as long as possible
□ Stop on ramp
□ Fast stop (depends on the inertia and the braking ability of the drive)

■ **Stop mode in the event of a fault**
The type of stop that occurs on detection of a fault is configurable as normal, freewheel or fast for the following faults:
□ External fault (detection enabled by a logic input or a bit in a Modbus or CANopen control word)
□ Motor phase loss fault
If an output contactor is being used between the drive and the motor, the motor phase loss fault should be disabled.

■ **Automatic catching of a spinning load with speed detection** (“catch on the fly”)
This function is used to restart the motor smoothly after one of the following events, provided the run command is still present:
□ Loss of line supply or power off
□ Fault reset or automatic restart
□ Freewheel stop

On disappearance of the event, the rms speed of the motor is detected in order to restart on a ramp from this speed and return to the reference speed. Speed detection can take up to 1 s depending on the initial deviation.
This function is automatically disabled if the brake sequence is configured.
It is suitable for machines for which the motor speed loss is negligible during the loss of line supply (such as machines with high inertia, fans and pumps driven by a residual flow, etc.).

■ **Automatic restart**
This function enables the drive to be restarted automatically after it has locked in fault mode, provided the fault has disappeared and the other operating conditions permit a restart.
This restart is performed by a series of automatic attempts separated by increasingly longer waiting periods of 1 s, 5 s, 10 s, then 1 minute for subsequent periods.
The restart procedure can last between 5 minutes and an unlimited time.
If the drive has not restarted after the configured time, it will lock and the procedure is abandoned until it has been powered off and on again.

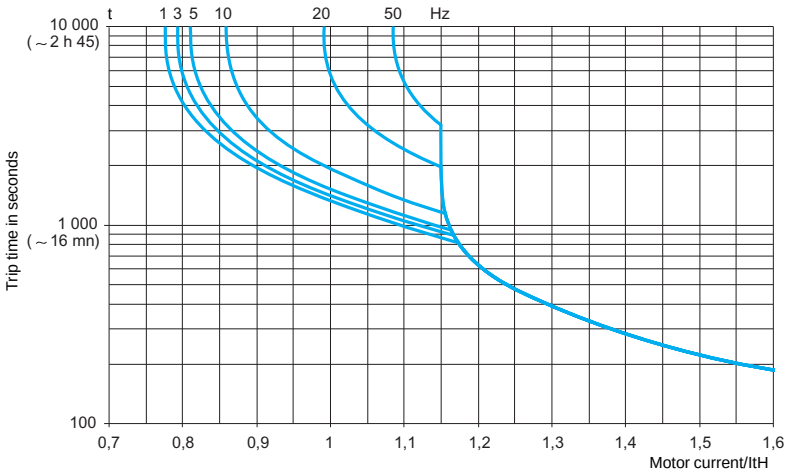
The faults which permit this type of restart are:
□ Line overvoltage
□ Motor thermal overload
□ Drive thermal overload
□ DC bus overvoltage
□ Loss of one input phase
□ External fault
□ Loss of 4-20 mA reference
□ CANopen bus fault
□ Modbus serial link fault
□ Line voltage too low. For this fault, the function is always active, even if it is not configured.
For these faults, the relay configured as a fault relay remains activated if the function is configured. The speed reference and direction of operation must be maintained for this function.
This function is suitable for machines or installations which are in continuous operation or are not monitored, and where a restart will not endanger equipment or personnel in any way.

■ **Derated operation in the event of an undervoltage**
The line voltage monitoring threshold is lowered to 50% of the motor voltage.
In this case, a line choke must be used and the performance of the drive cannot be guaranteed.

■ **Fault relay, unlocking**
The fault relay is energized when the drive is powered up and is not faulty.
It contains an N/C contact and an N/O contact with common point.
The drive is unlocked after a fault in one of the following ways:
□ By powering down until the ON LED goes out, then switching the drive back on
□ By assigning a logic input to the External faults function
□ By the Automatic restart function, if it has been configured

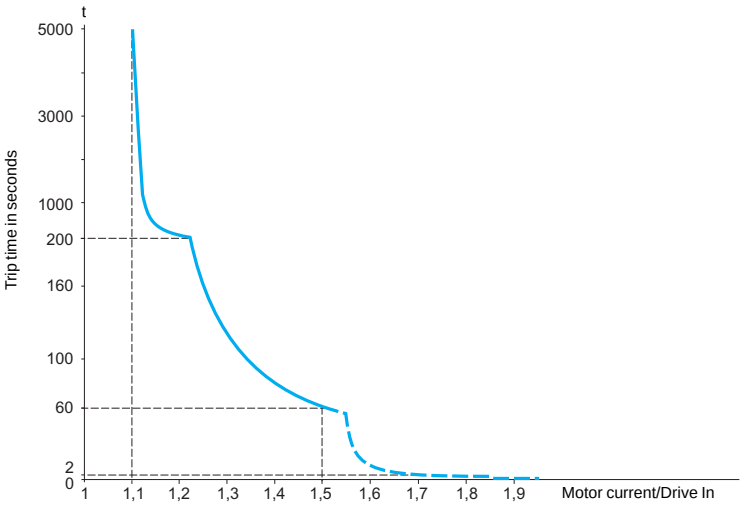
■ **Resetting operating time to zero**
The drive operating time can be reset to zero.

■ **Motor thermal protection**
The theoretical temperature rise of the motor is continuously calculated to provide indirect thermal protection.
Thermal protection is adjustable from 0.2 to 1.5 times the nominal drive current.
This function is suitable for all applications with self-cooled motors.



Motor thermal protection curves

■ **Drive thermal protection**
Thermal protection, by a PTC probe mounted on the heatsink or integrated in the power module, ensures that the drive is protected in the event of poor ventilation or excessive ambient temperatures.
Locks the drive in the event of a fault.



Drive thermal protection curves

■ **R1/R2 relay configuration**
The following states are signalled when the relay is powered on:
- □ Drive fault
- □ Drive running
- □ Frequency threshold reached
- □ High speed reached
- □ Current threshold reached
- □ Frequency reference reached
- □ Motor thermal threshold reached
- □ Brake sequence (R2 only)

■ **AOC/AOV analog outputs**
The same data is available on analog outputs AOC and AOV.
The following assignments are possible:
- □ Motor current
- □ Motor frequency
- □ Motor torque
- □ Power supplied by the drive
- □ Drive fault
- □ Frequency threshold reached
- □ High speed reached
- □ Current threshold reached
- □ Frequency reference reached
- □ Motor thermal threshold reached
- □ Brake sequence

Adjusting analog outputs AOC/AOV modifies the characteristics of the current analog output AOC or the voltage analog output AOV.
AOC: can be set as 0-20 mA or 4-20 mA
AOV: can be set as 0-10 V

■ **Saving and retrieving the configuration**
It is possible to save a configuration. This function is used to store a drive configuration in addition to the current configuration.
Retrieving this configuration clears the current configuration.

Function compatibility table

■ **Configurable I/O**
Functions which are not listed in this table are fully compatible.
Stop functions have priority over run commands.
The selection of functions is limited by:
- The number of drive I/O
- The incompatibility of certain functions with one another

Functions	Summing inputs	+/- speed	Limit switch management	Preset speeds	PI regulator	Jog operation	Brake sequence	DC injection stop	Fast stop	Freewheel stop
Summing inputs		⊖		↑	⊖	↑				
+/- speed	⊖			⊖	⊖	⊖				
Limit switch management					⊖					
Preset speeds	←	⊖			⊖	↑				
PI regulator	⊖	⊖	⊖	⊖		⊖	⊖			
Jog operation	←	⊖		←	⊖		⊖			
Brake sequence					⊖	⊖		⊖		
DC injection stop							⊖			↑
Fast stop										↑
Freewheel stop								←	←	

⊖ Incompatible functions
Compatible functions
Not applicable

Priority functions (functions which cannot be active at the same time)
← The arrow indicates which function has priority
↑ Example: the Freewheel stop function has priority over the Fast stop function