

Variable speed drives for asynchronous motors Altivar 31



Presentation (continued)

Variable speed drives for asynchronous motors Altivar 31

Applications

The Altivar 31 drive is a frequency inverter for 3-phase squirrel cage asynchronous motors. The Altivar 31 is robust, compact, easy to use and conforms to EN 50178, IEC/EN 61800-2, IEC/EN 61800-3 standards, UL/CSA certification and to C € marking.

It incorporates functions that are suitable for the most common applications, including:

- Materials handling (small conveyors, hoists, etc.),
- Packing and packaging machines,
- Specialist machines (mixers, kneaders, textile machines, etc.),
- Pumps, compressors, fans.

Altivar 31 drives communicate on Modbus and CANopen industrial buses. These two protocols are integrated as standard into the drive.

Altivar 31 drives are supplied with a heatsink for normal environments and ventilated enclosures. Multiple units can be mounted side by side 3 to save space.

Drives are available for motor ratings between 0.18 kW and 15 kW, with four types of power supply:

- 200 V to 240 V single phase, 0.18 kW to 2.2 kW
- 200 V to 240 V 3-phase, 0.18 kW to 15 kW
- 380 V to 500 V 3-phase, 0.37 kW to 15 kW
- 525 V to 600 V 3-phase, 0.75 kW to 15 kW

Altivar 31 drives are available with a choice of two different human-machine interfaces:

■ 1 ATV 31Heeee with displays and menu navigation keys

■ 2 ATV 31HeeeeA with displays, menu navigation keys and local control (Run/Stop and speed reference set by a potentiometer).

Electromagnetic compatibility EMC

The incorporation of level A EMC filters (conducted and radiated) in **ATV 31HeeM2** and **ATV 31HeeN4** drives simplifies the installation of machines and provides an economical means of meeting $C \in$ marking requirements.

ATV 31HeeM3X and ATV 31HeeS6X drives are available without EMC filter. Filters are available as an option for customer assembly, if conformity to EMC standards is required.

Functions

The Altivar 31 drive has six logic inputs, three analog inputs, one logic/analog output and two relay outputs.

- The main functions integrated in the drive are as follows:
- Motor and drive protection
- Linear, S, U and customised acceleration and deceleration ramps
- +/- speed
- 16 preset speeds
- PI references and regulator
- 2-wire/3-wire control
- Brake sequence
- Automatic catching a spinning load with speed detection and automatic restart
- Fault configuration and stop type configuration
- Saving the configuration in the drive

Several functions can be assigned to one logic input.

Options and accessories

The following options and accessories can be used with the Altivar 31 drive:

- Braking resistors
- Line chokes
- EMC radio interference input filters and output filters
- Plates for mounting on ¬___ rail
- UL Type 1 conformity kit
- Adaptor plate for replacing an Altivar 28 drive

Various dialogue and communication options 4, 5, 6, 7 can be used with the drive, see pages 7 and 8.

Characteristics:	References:	Dimensions:	Schemes:	Functions:	
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Variable speed drives for asynchronous motors Altivar 31 Enclosed drive



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Enclosed drive

Applications

- The enclosed Altivar 31 drive is suitable for applications requiring:
 - IP 55 degree of protection in a hostile environment
 - a drive that is ready for use in a motor starter

Once it has been customised, the enclosure can be installed next to the motor. Enclosed drives are available in power ratings from 0.18 kW to 4 kW. There are two types of power supply:

- 200 V to 240 V single phase, 0.18 kW and 2.2 kW
- 380 V to 500 V 3-phase, 0.37 kW and 4 kW

Customisable enclosed drive

This range allows full customisation of the human-machine interface of an enclosure. The IP 55 enclosure includes:

- a drive with external heatsink
- removable covers for installation of the following components:
- 7 Vario switch disconnector or GV2 circuit-breaker

 ${\color{black}8}$ 3 buttons and/or LEDs with plastic flange Ø 22, and 1 speed reference potentiometer

- 9 button for the RJ45 connector with IP 55 cable
- 10 cable glands for cable routing

The combinations (drive, circuit-breaker, contactor) required for the motor starter function can be found on pages 40 and 41.

- Example references:
 - 3-pole Vario switch disconnector (Vee + KCe 1eZ)
 - Selector switch with 3 fixed positions XB5 D33
- LED XB5 AV •
- 2.2 kOhm potentiometer

These references can be found in our specialist catalogues.

All components must be ordered separately and wired by the customer.

Electromagnetic compatibility EMC

The incorporation of level A EMC filters (conducted and radiated) in **ATV 31CeeM2** and **ATV 31CeeM4** drives simplifies the installation of machines and provides an economical means of meeting $C \in$ marking requirements.

Options and accessories

The following options and accessories can be used with the enclosed Altivar 31 drive:

- Braking resistors
- Line chokes
- RJ45 connector with IP 55 cable

Various dialogue and communication options 2, 3, 4, 5 can be used with the drive, see pages 7 and 8.



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Variable speed drives for asynchronous motors Altivar 31 Drive kit



Presentation (continued)

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Drive kit

Applications

The drive kit is a new addition to the Altivar 31 drives range.

- The drive kit comprises:
- Altivar 31 drive elements (heatsink, power and control subassemblies)
- EMC filter
- Mechanical fittings

■ Seals required for use in difficult environments (IP 55)

The kit is mounted on a metal fixing support with no flange or protective cover. The Altivar 31 drive kit can be built into a floor-standing or wall-mounted enclosure or a machine frame.

The drive kit is available for power ratings from 0.18 kW to 15 kW.

There are two types of power supply:

- 200 V to 240 V single phase, 0.18 kW to 2.2 kW
- 380 V to 500 V 3-phase, 0.37 kW to 15 kW

Electromagnetic compatibility EMC

The incorporation of level A EMC filters (conducted and radiated) in **ATV 31KeeM2** and **ATV 31KeeM4** drives simplifies the installation of machines and provides an economical means of meeting CC marking requirements. The drives have been sized to conform to the following standards: IEC/EN61800-3, domestic and industrial environments.

Description

■ Drive kit for power ratings ≤ 4 kW 1

The Altivar 31 drive components (heatsink, power and control subassemblies) are fixed by mechanical adaptors 2 and protective fittings.

The unit is supported by a metal plate 3 fixed to the heatsink.

The plate is sealed on all sides.

Once the support has been cut out, the drive kit is fixed to the base of the floorstanding or wall-mounted enclosure by means of this plate. The power terminals 5 are protected (IP 20).

■ Drive kit for power ratings ≥ 5.5 kW 6

The Altivar 31 drive components (heatsink, power and control subassemblies) are fixed by mechanical adaptors 2 and protective fittings.

The metal support plate 3 for the components is fitted with brackets 8 for mounting in a floor-standing or wall-mounted enclosure.

The plate is sealed on all sides 4.

Two fans are fitted behind the plate under the heatsink.

Additional fixing holes 7 are provided for component mounting (GV2 circuit-breaker, Vario switch disconnector, additional plate, etc.).

Drive kits are supplied with:

- A drilling and cutting template to assist with installation
- A user's manual with installation instructions and safety precautions.

Options and accessories

The following options and accessories can be used with the Altivar 31 drive kit:

- Braking resistors
- Line chokes

Various dialogue and communication options 9, 10, 11, 12 can be used with the drive, see pages 7 and 8.

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Dialogue options

- The Altivar 31 drive communicates with the following options:
- Remote terminal
- PowerSuite software workshop
- Ethernet/Modbus bridge
- Communication gateways

The communication function provides access to the drive's configuration, adjustment, control and signalling functions.

Remote terminal

The Altivar 31 can be connected to a remote terminal.

The remote terminal can be mounted on the door of an enclosure with IP 65 protection on the front panel.

The terminal provides access to the same functions as the display and integral keys on the drive (see page 45).

It can be used:

- to control, adjust and configure the drive remotely
- for visible remote signalling
- to save and download configurations (4 configuration files can be saved)

Description

- 1 Display
- □ Four 7-segment displays visible at 5 m
- Displays numeric values and codes
- □ The display flashes when a value is stored.
- □ The display flashes to indicate a fault on the drive.
- 2 Use of keys:
- □ Navigation arrows and ENT, ESC for settings and configurations
- □ FWD/REV key: reverses the direction of rotation of the motor
- RUN key: motor run command
- □ STOP/RESET key: motor stop command or drive fault reset



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Communication options



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PowerSuite software workshop

- PowerSuite advanced dialogue solutions offer the following advantages:
- Display messages in plain text and multiple languages
- Prepare work in design office without connecting the Altivar to the PC
- Save configurations and settings to floppy disk or hard disk and download them to the drive
- Print out settings
- Read and import Altivar 28 files into the Altivar 31.

See pages 28 and 29.

Ethernet/Modbus bridge

The Altivar 31 can be connected to an Ethernet network via an Ethernet/Modbus bridge.

Ethernet communication is primarily intended for the following applications:

- Coordination between PLCs
- Local or centralised supervision
- Communication with production management software
- Communication with remote I/O
- Communication with industrial control products

See pages 26 and 27.

Communication gateways

The Altivar 31 can connect to other communication buses by means of the following gateways:

- Fipio/Modbus,
- DeviceNet/Modbus
- Profibus DP/Modbus

See pages 26 and 27.

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Environment					
Conformity to standard	ds		Altivar 31 drives have been developed to conform to the strictest international		
			standards and the recommendations relating to electrical industrial control devices		
			(IEC, EN), in particular:		
FMC in	amunity		 IEC/EN 61000-4-2 level 3 		
			■ IEC/EN 61000-4-3 level 3		
			■ IEC/EN 61000-4-4 level 4		
			■ IEC/EN 61800-3, environments 1 and 2		
EMC co	onducted and radiated emissions for drives				
	All		IEC/EN 61800-3, environments: 2 (industrial supply) and 1 (public supply)		
			restricted distribution		
	ATV 31H018M2H015M2, ATV 31C018M2 CU15M2		EN 55011 class A group 1, EN 61800-3 category C2 With additional EMC filter:		
	ATV 31H037N4HU40N4,		■ EN 55022 class B group 1, EN 61800-3 category C1		
	ATV 31C037N4CU40N4				
	ATV 31HU22M2, ATV 31CU22M2, ATV 31HU55N4 HD15N4		EN 55011 class A group 2, EN 61800-3 category C3 With additional EMC filter (1):		
			 EN 55022 class A group 1, EN 61800-3 category C2 		
			EN 55022 class B group 1, EN 61800-3 category C1		
	ATV 31H018M3XHD15M3X,		With additional EMC filter (1):		
	ATV 3110/330X1D1330X		 EN 55022 class B group 1, EN 61800-3 category C1 		
C€ marking			The drives bear C€ marking in accordance with the European low voltage (73/23/EEC		
			and 93/68/EEC) and EMC (89/336/EEC) directives		
Product certification			UL, CSA, NOM 117 and C-Tick		
Degree of protection	ATV 31H000M2, ATV 31H000N4, ATV 31H000M3X. ATV 31H000S6X		IP 31 and IP 41 on upper part and IP 21 on connection terminals IP 20 without cover plate on upper part of cover		
	ATV 31C000M2, ATV 31C000N4		■ IP 55		
Degree of pollution			2		
Climatic treatment			TC		
Vibration resistance	Drive without r rail option		Conforming to IEC/EN 60068-2-6: 1.5 mm peak to peak from 3 to 13 Hz, 1 gn from 13 to 150 Hz		
Shock resistance			15 gn for 11 ms conforming to IEC/EN 60068-2-27		
Relative humidity		%	595 without condensation or dripping water, conforming to IEC 60068-2-3		
Ambient temperature	Storage	°C	- 25+ 70		
around the unit	Operation				
	ATV 31Heee	°C	- 10+ 50 without derating, with protective cover on top of the drive		
			- 10+ 60 with derating, without protective cover on top of the drive (see derating curves, page 36)		
	ATV 31C•••,	°C	- 10+ 40 without derating		
	ATV 31K				
Maximum operating al	titude	m	1000 without derating (above this, derate the current by 1% per additional 100 m)		
Operating position Maximum permanent an	ale in relation to the normal vertical		10° 10°		
mounting position					
Drive character	istics				
Output frequency rang	e	Hz	0500		
Switching frequency		kHz	216 adjustable during operation		
Speed range			150		
Transient overtorque			170-200% of nominal motor torque (typical value)		
Braking torque	Without braking resistor		Value of nominal motor forque (typical value) according to ratings:		
	Without blaking resistor		30% for > ATV 31●U15●●		
			50% for ≤ ATV 31eU15ee		
			150% for ≤ ATV 31€018M2		
Maximum transient cu	rrent		150% of the nominal drive current for 60 seconds (typical value)		
Voltage/frequency ratio	0		Sensorless flux vector control with PWM (pulse width modulation) type motor control		
			signal.		
			Possible options: specific ratios for pumps and fans, energy saving or constant torque		
			U/f for special motors.		
Frequency loop gain			Factory-set with the speed loop stability and gain		
			with fast cycles.		
Slip compensation			Automatic whatever the load. Can be suppressed or adjusted.		
· · ·		(1) See t	able on name 23 to check authorised cable lengths		

(1) See ta	able on	page 23	3 to check	authorised	cable	lenaths
1.	,		page -			00.010	

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Electrical characteri	stics		
Power supply	Voltage	V	200 - 15% to 240 + 10% single phase for ATV 31
	Voltage		200 - 15% to 240 + 10% 3-phase for ATV 31●●●N48 380 - 15% to 500 + 10% 3-phase for ATV 31●●●N49 555 - 15% to 500 + 10% 3-phase for ATV 31●●●N49
			525 - 15% to 600 + 10% 3-phase for ATV 31000056X
	Frequency	Hz	50 - 5% to 60 + 5%
Prospective short-circuit	For drives		
current ICC	ATV 31000M2	۸	< 1000 (ICC at connection point) for single phase power supply
		A A	< 5000 (ICC at connection point) for 3 phase power supply
	ATV 310037N4040M3X, ATV 310037N4040N4, ATV 31H075S6XHU40S6X	A	
	ATV 31HU55M3XHD15M3X, ATV 31HU55N4HD15N4, ATV 31KU55N4KD15N4, ATV 31KU55S6XHD15S6X	A	\leq 22000 (ICC at connection point) for 3-phase power supply
Output voltage			Maximum 3-phase voltage equal to line supply voltage.
Maximum connection capacity	For drives		
and tightening torque of the power supply terminals, motor,	ATV 31H018M2H075M2, ATV 31H018M3XHU15M3X		2.5 mm² (AWG 14) 0.8 Nm
braking module and DC bus	ATV 31HU11M2HU22M2, ATV 31HU22M3XHU40M3X, ATV 31H037N4HU40N4, ATV 31H075S6XHU40S6X		5 mm² (AWG 10) 1.2 Nm
	ATV 31HU55M3X, HU75M3X, ATV 31HU55N4, HU75N4, ATV 31HU55S6X, HU75S6X		16 mm² (AWG 6) 2.2 Nm
	ATV 31HD11M3X, HD15M3X, ATV 31HD11N4, HD15N4, ATV 31HD11S6X, HD15S6X		25 mm² (AWG 3) 4 Nm
Electrical isolation			Electrical isolation between power and control (inputs, outputs, power supplies)
Internal supplies available			 Short-circuit and overload protection: One +10 V (0/+ 8%) supply for the reference potentiometer (2.2 to 10 kΩ), maximum current 10 mA One + 24 V supply (min. 19 V, max. 30 V) for logic inputs, maximum current 100 mA
			 a Al1: analog voltage inputs Al1, Al2, Al3. Al1: analog voltage input 0 to +10V, impedance 30 kΩ (maximum safe voltage 30 V) Al2: analog bipolar voltage input ±10 V, impedance 30 kΩ (maximum safe voltage 30 V) Al3: analog current input X-Y mA by programming X and Y from 0 to 20 mA, with impedance 250 Ω AlP: potentiometer reference for ATV31●●A only Max. sampling time: 8 ms 10-bit resolution Precision ± 4.3% Linearity ± 0.2% of maximum value Use: 100 m maximum with shielded cable 25 m maximum with unshielded cable
Analog output configurable for voltage, current and logic output			 1 analog output configurable for voltage, current. AOC: analog current output 0 to 20 mA, maximum load impedance 800 Ω AOV: analog voltage output 0 to +10V, minimum load impedance 470 Ω 8-bit resolution Precision ± 1% Linearity ± 0.2% Only analog output AOC is configurable as a logic output. AOC: operation as logic output 24 V 20 mA max. Max. sampling time: 8 ms
Configurable relay outputs	R1A, R1B, R1C		1 relay logic output, one "N/C" contact and one "N/O" contact with common point. Minimum switching capacity: 10 mA for \pm 5 V. Maximum switching capacity: • on resistive load (cos $\varphi = 1$ and L/R = 0 ms): 5 A for \sim 250 V or \pm 30 V • on inductive load (cos $\varphi = 0.4$ and L/R = 7 ms): 2 A for \sim 250 V or \pm 30 V Max. sampling time: 8 ms Switching: 100,000 operations
	R2A, R2B		1 relay logic output, one "N/C" contact, contact open on fault. Minimum switching capacity: 10 mA for \pm 5 V. Maximum switching capacity: • on resistive load (cos φ = 1 and L/R = 0 ms): 5 A for \sim 250 V or \pm 30 V • on inductive load (cos φ = 0.4 and L/R = 7 ms): 2 A for \sim 250 V or \pm 30 V Max. sampling time: 8 ms Switching: 100,000 operations

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Electrical characte	eristics (continued)		
Logic inputs LI			6 programmable logic inputs Impedance 3.5 k Ω + 24 V internal or 24 V external power supply (min. 19 V, max. 30 V) Max. current: 100 mA Max. sampling time: 4 ms Multiple assignment makes it possible to configure several functions on one input (example: L11 assigned to forward and preset speed 2, L13 assigned to reverse and preset speed 3)
	Positive logic		State 0 if < 5 V or logic input not wired, state 1 if > 11 V
	Negative logic		State 0 if > 19 V or logic input not wired, state 1 if < 13 V
	CLI position		Connection to PLC output (see diagram page 36)
Maximum I/O connection c	apacity and tightening torque		2.5 mm² (AWG 14) 0.6 Nm
Acceleration and deceleration ramps			 Ramp profiles: Inear, can be adjusted separately from 0.1 to 999.9 s S, U or customised Automatic adaptation of deceleration ramp time if braking capacities exceeded, possible inhibition of this adaptation (use of braking resistor).
Braking to a standstill			by a signal on a programmable logic input by a signal on a programmable logic input automatically as soon as the estimated output frequency drops to < 0.5 Hz, period adjustable from 0 to 30 s or continuous, current adjustable from 0 to 1.2 In
Main protection and safety	features of the drive		 Thermal protection against overheating Protection against short-circuits between motor phases Protection against input phase breaks Protection against overcurrent between output phases and earth Line supply undervoltage and overvoltage safety circuits Line supply phase loss safety function, for 3-phase supply
Motor protection (see page 48)			Thermal protection integrated in the drive by continuous calculation of the I ² t
Dielectric strength	Between earth and power terminals		2040 V for ATV 310000 and M3X, 2410 V for ATV 310000N4, 2550 V for ATV 31000086X
	Between control and power terminals		~ 2880 V for ATV 31000 2 and M3X, ~ 3400 V for ATV 31000 N4, ~ 3600 V for ATV 31000 S
Insulation resistance to ea	rth		> 500 M Ω (electrical isolation) == 500 V for 1 minute
Signalling			Display coded by four 7-segment display units displaying the CANopen bus status (RUN and ERR).
Frequency resolution	Display units	Hz	0.1
Time constant for reference	Analog Inputs	HZ	0.1 to 100 Hz (calculate (high speed – low speed) /1024)
	change	1115	5 Modhus and CANopen are integrated into the drive and available via an R I45
Communication			connector
	Modbus		 RS 485 multidrop serial link Modbus in RTU mode Services supported: decimal function codes 03, 06, 16, 23 and 43 Broadcasting Number of addresses: drive address can be configured via the integrated terminal from 1 to 247 Maximum number of Altivar 31 drives connected: 31 (two 470 Ω master pulldown resistors) Transmission speed: 4800, 9600 or 19200 bps Used for connecting: the remote terminal (option) the PowerSuite software workshop a PLC a microprocessor card a PC
	CANopen		 To connect the ATV31 drive on the CANopen bus, use the VW3 CANTAP2 adapter. Services supported: Implicit exchange of Process Data Object 2 PDOs depending on DSP 402 velocity mode 2 configurable PDOs (data and transmission type) PDOs can be exchanged between slaves. Explicit exchange of Service Data Object 1 receive SDO and 1 transmit SDO Boot-up messages, emergency messages, node guarding and producer and consumer heartbeat, sync and NMT Number of addresses: drive address can be configured via the integrated terminal from 1 to 127 Maximum number of Altivar 31 drives connected: 127 Transmission speed: 10, 20, 50, 125, 250, 500 kbps or 1 Mbps

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Characteristics, special uses

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1 Self-cooled motor: continuous useful torque (1)

2 Force-cooled motor: continuous useful torque

3 Transient overtorque 1.7 to 2 Tn

4 Torque in overspeed at constant power (2)



Torque characteristics (typical curves)

The curves below define the available continuous torque and transient overtorque for both force-cooled and self-cooled motors. The only difference is in the ability of the motor to provide a high continuous torque at less than half the nominal speed

Special uses

Use with a motor with a different rating to that of the drive

The device can supply any motor which has a power rating lower than that for which it is designed.

For motor ratings slightly higher than that of the drive, check that the current taken does not exceed the continuous output current of the drive.

Test on a low power motor or without a motor

In a testing or maintenance environment the drive can be checked without having to switch to a motor with the same rating as the drive (particularly useful in the case of high power drives). This use requires deactivation of motor phase loss detection.

Connecting motors in parallel

The rating of the drive must be greater than or equal to the sum of the currents of the motors to be connected to the drive.

In this case, external thermal protection must be provided for each motor using probes or LR2 thermal bimetal overload relays designed for a 1.2 In motor. If the number of motors in parallel is greater than or equal to 3, it is advisable to install a 3-phase choke between the drive and the motors.

Switching the motor at the drive output

The drive can be switched when locked or unlocked. If the drive is switched on-thefly (drive unlocked), the motor is controlled and accelerates until it reaches the reference speed smoothly following the acceleration ramp.

This use requires configuration of automatic catching a spinning load ("catch on the fly") and activation of the function which manages the presence of a downstream contactor.

Example: breaking of downstream contactor



t1: deceleration without ramp (freewheel)

t2: acceleration with ramp

Typical applications: breaking safety circuit at drive outputs, "bypass" function, switching of motors connected in parallel.

(1) For power ratings ≤ 250 W, motor derating is less important (20% instead of 50% at very low frequencies).

(2) The nominal frequency of the motor and the maximum output frequency can be adjusted between 40 and 500 Hz.

Note: Check the mechanical overspeed characteristics of the selected motor with the manufacturer.

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