Variable speed drives

Altivar 78

Catalogue
May

06

a brand of Schneider Electric

Telemecanique

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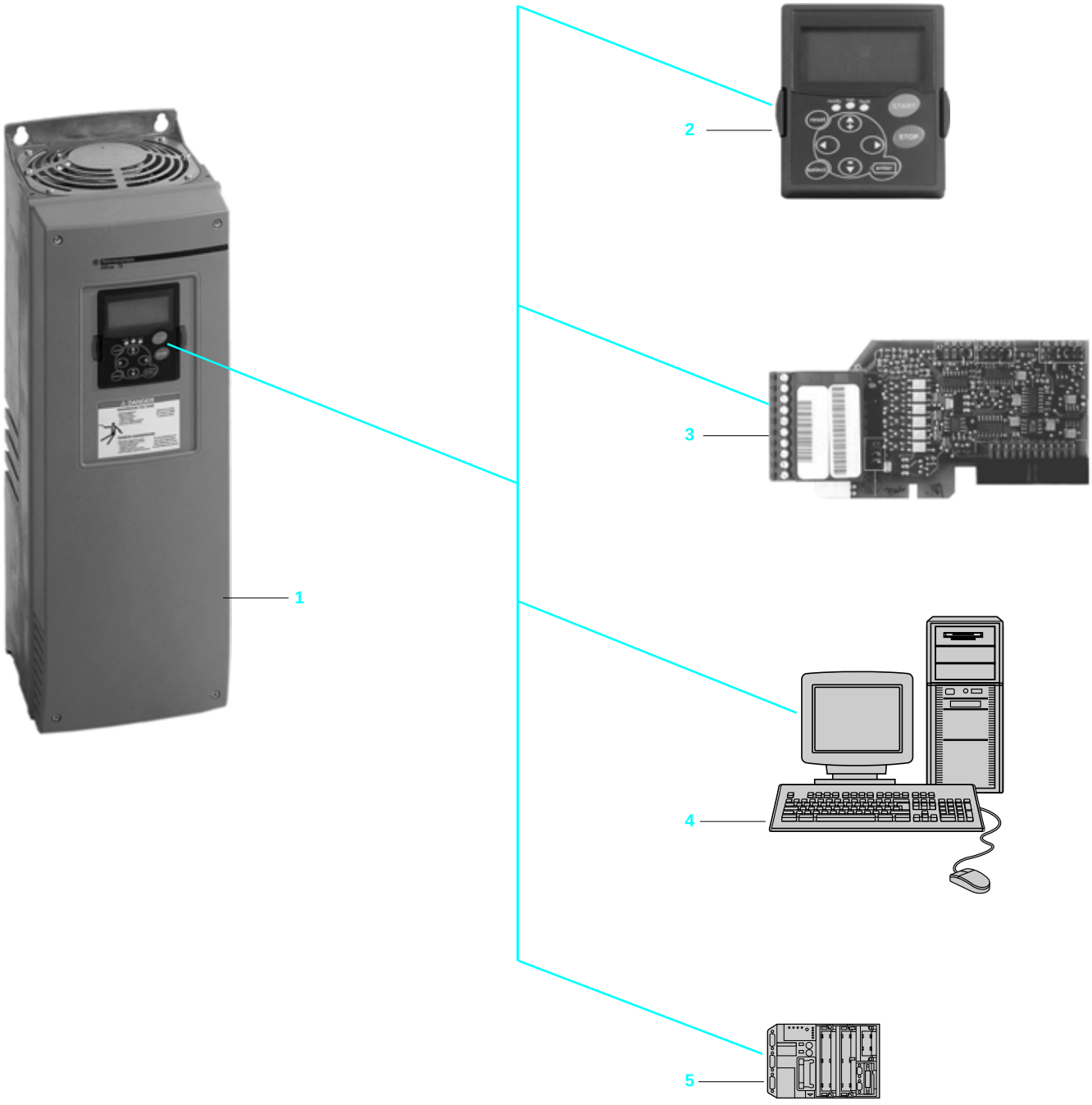

Variable speed drives for asynchronous motors
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Applications
A compact and robust variable speed drive for all types of 3-phase asynchronous motors, the Altivar 78 incorporates the latest technological developments and its innovative functions meet the requirements of the most common applications, notably:
- ventilation
- air conditioning
- pumping
- conveying
- grinding
- handling and lifting

The Altivar 78 1 has several application-specific preset configurations with a few basic parameters, which can be modified using the programming terminal 2 to create additional functions.

The Altivar 78 range of variable speed drives extends across a range of motor power ratings from 2.2 to 1300 KW *(2 to 1350 HP)* for high-torque applications and from 3 to 1500 KW *(3 to 1500 HP)* for standard-torque applications with a single voltage range from 525 to 690 V.

Despite its high performance, it is easy to adjust. Motor nameplate data entry and autotuning make it possible to obtain high torque together with remarkable drive quality, even at very low rotation speeds (< 0.5 Hz).
The Flux Vector Control function in closed loop mode is designed for applications which require exceptional speed precision even at very low speed, and full torque at zero speed.

Functions
The main functions are:
- Integrated PID regulator (flow rate, pressure, speed correction)
- 9 possible preset speeds
- Jog operation
- Brake release sequences for translational movement and hoisting
- User-definable analog and logic inputs
- +/- speed
- Skip frequencies
- Local/remote control function
- Logic functions
- Start-up and speed control via Flux Vector Control
- Fan and pump control function
- Motor and variable speed drive protection
- Automatic catching of spinning load with speed detection (catch on the fly)
- High overtorque on start-up
- Separate 24 V⎓ supply is possible for control circuit
- Integrated line choke for protection against supply overvoltage and reduction of harmonic distortion

Programming terminal
The Altivar 78 comes with a programming terminal 2 which:
- Controls the variable speed drive in local mode
- Configures the various parameters
- Provides a remote display and indication of the variable speed drive status
- Copies and backs up the parameters

Options
Available options, depending on the rating:
- Additional I/O card 3, 11 I/O cards available (see page 24)
- PC-based setup software 4 (see page 24)
- Various dialogue and communication options 5 (Modbus, Profibus DP, LONWORKS, CANopen slave, N2, DeviceNet communication cards) (see page 25)
- Braking units (see page 18)
- Braking resistors (see page 19)
- dv/dt filters when motor cables are longer than 30 metres (see page 16)
- Remote mounting kit for the programming terminal which allows the terminal to be installed on the door of an enclosure or on an operator panel (see page 12)
- IP 54 kit for increasing the degree of protection of the variable speed drive (see page 13)

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Dialogue

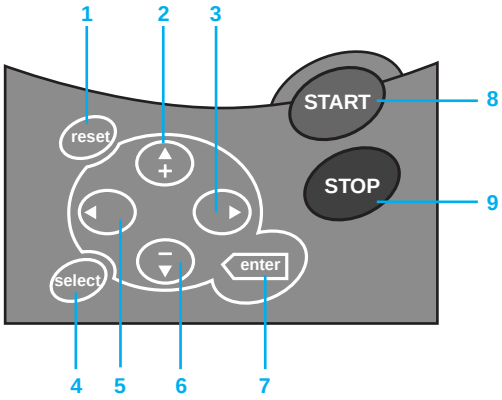
Presentation of the programming terminal

The Altivar 78 variable speed drive has a remote programming terminal on the front panel which allows:

- Local control of the variable speed drive
- Configuration of the various parameters
- Remote display and signalling of the variable speed drive status, in conjunction with a remote mounting kit (see page 12).

The programming terminal features an alphanumeric display with:

- Six variable speed drive status indicators (RUN, , STOP, READY, ALARM, FAULT)
- Three control indicators (I/O terminals, keypad, bus/comm) and three LED status indicators (ready, run, fault).



Presentation of the control keypad

The alphanumeric control keypad features 9 pushbuttons that are used to control the variable speed drive (and motor), set parameters and monitor values.

1 RESET:
To switch between the two most recent displays. This feature is a useful way of checking how a new value influences another value.

2 Edit values

3 "Right" button for menu selection:
- Move forward in menu
- Move cursor right (in Parameters menu)
- Switch to Edit mode

4 SELECT:
To reset active faults

5 "Left" button for menu selection:
- Move backward in menu
- Move cursor left (in Parameters menu)
- Exit Edit mode
- Hold down the button for 2 to 3 seconds to return to the main menu

6 Edit values

7 ENTER:
To confirm selections and to reset the fault history (2 to 3 seconds)

8 START:
To start the motor if the keypad is in active control mode

9 STOP:
To stop the motor (unless disabled by parameter R3.4/R3.6)

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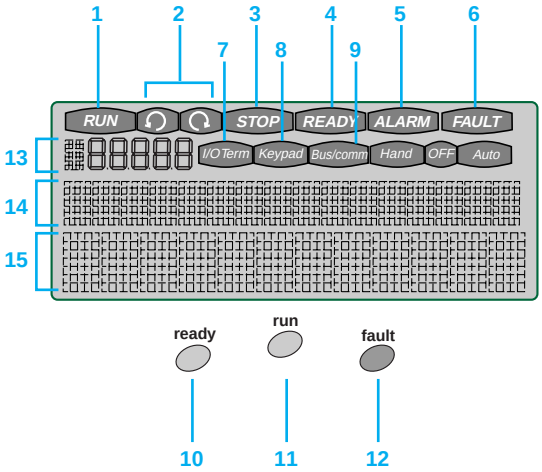
Dialogue



Operator interface

1	**RUN**	The motor is running. Blinks when the stop command has been given but the frequency is still ramping down.
2	↺ ↻	Indicates the direction of motor rotation.
3	**STOP**	Indicates that the drive is not running.
4	**READY**	Indicates that the drive is switched on. If a fault occurs on the drive, the symbol does not light up.
5	**ALARM**	Indicates that the variable speed drive is running outside a certain limit.
6	**FAULT**	Indicates that the drive has been stopped due to unsafe operating conditions.
7	**I/O Term**	Indicates that start/stop commands, reference values, etc., are given by the I/O.
8	**Keypad**	Indicates that the motor can be started or stopped or its reference values altered from the keypad.
9	**Bus/comm**	Indicates that the drive can be controlled via a fieldbus.
10	**ready**	Indicates that the drive is switched on. The READY status indicator lights up at the same time.
11	**run**	Indicates that the variable speed drive is running. Blinks when the STOP button has been pressed and the drive is still ramping down.
12	**fault**	Indicates that the variable speed drive has been stopped due to unsafe operating conditions. The FAULT status indicator blinks at the same time and a description of the fault is displayed.
13		Location indication: displays the symbol and number of the menu, parameter, etc. Example: M2 = Menu 2 (Parameters) ; P2.1.3 = Acceleration time.
14		Description line: displays the description of the menu, value or fault.
15		Value line: displays the numerical and text values of references, parameters, etc., and the number of submenus available in each menu.

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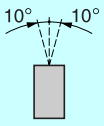
Environmental characteristics

Conformity to standards			Altivar 78 drives have been developed to conform to the strictest national and international standards and to the recommendations relating to electrical industrial control devices (IEC, EN, NFC, VDE), in particular: - Low voltage: EN 50178 - Electrical isolation: conforming to EN 50178, PELV - EMC immunity: conforming to IEC 61800-E, EN 50082-1, -2 - EMC emissions: conforming to IEC 61800-3
CE marking			Altivar 78 variable speed drives carry CE marking in accordance with the following European directives: - Low Voltage Directive EC 73/23 - EMC Directive 89/336 for industrial environments
Product certification			UL, c-UL
Degree of protection			
	ATV 78●U22Y…C16Y		IP 21/NEMA Type 1 or IP 54/NEMA Type 12
	ATV 78●U22Y…D22Y		IP 54/NEMA Type 12 kit for IP 21/NEMA Type 1 drives: installable on site
	ATV 780C20Y…M13Y		IP 00/open type
Vibration resistance		**Hz**	5 to 200 conforming to IEC/EN 50178/60068-2-6 and 60068-2-6 (60068-2-34, -35, -36) 3 mm peak to peak from 5 to 10.7 Hz 0.7 gn from 10.7 to 200 Hz
Shock resistance			Max. 15 gn for 11 ms conforming to EN 50178/EN 60068-2-27
Maximum ambient pollution			Level 2 conforming to IEC 60664-1 and EN 50178
Maximum relative humidity and **Environmental class**			95 % without condensation or dripping water, conforming to IEC 60068-2-3 3C2, conforming to IEC 60721-3-3
Ambient temperature around the device	Storage	**°C**	- 40…+ 70
	Operation (with a switching frequency of 1.5 kHz; for a higher frequency see below)	**°C**	High torque applications: - **ATV 78●U22Y** to **ATV 78●C16Y**: - 10 (no frost) to + 50 - **ATV 780C20Y** to **ATV 780M13Y** or **ATV 780FC20Y** to **ATV 780FM13Y**: - 10 (no frost) to +40 Standard torque applications: - 10 (no frost) to +40
Programmable switching frequency	Inv = max. nominal current of variable speed drive		To operate at a switching frequency from 1.5 to 6 kHz, select the drive rating according to the derating current value given in the table below:

ATV 78●/ ATV 78●F	**Ambient temperature**	**Switching frequency** (kHz)							
		1.5	**2**	**2.5**	**3**	**3.5**	**4**	**5**	**6**
U22Y to **D90Y**	40 °C	Inv	Inv	Inv	Inv	Inv	0.93 Inv	0.85 Inv	0.75 Inv
C11Y to **M13Y**	40 °C	Inv	0.90 Inv	0.82 Inv	0.74 Inv	0.67 Inv	0.62 Inv	0.53 Inv	0.47 Inv

Maximum operating altitude		**m**	1000 without derating 1000 to 3000 with current derating of 1% per additional 100 m
Operating position Maximum permanent angle in relation to the normal vertical mounting position			

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Drive characteristics

Output frequency range		**Hz**	0…320 Frequency stability: ± 0.01% at 50 Hz Resolution: 0.01 Hz
Switching frequency		**kHz**	1.5 to 6, factory setting 1.5
Speed range			1 to 100 in high torque configuration 1 to 1000 in FVC closed loop control mode
Speed accuracy			Without encoder feedback card: - 30% of nominal slip, speed > 10% of nominal motor speed - 50% of nominal slip, speed < 5% of nominal motor speed
			With encoder feedback in control mode: ± 0.01% of nominal speed
Transient overtorque on start-up			200% of nominal motor torque (typical value ± 10%) in high torque configuration, 150% in standard torque
Braking torque			Up to 30% of nominal motor torque without braking unit (typical value) Up to 100% with external braking resistor
Maximum transient current			525 to 690 V: 150% of nominal current in high torque operation for 60 s, then 100% in continuous operation 110% of nominal current in standard torque operation for 60 s, then 100% in continuous operation
Voltage/frequency ratio	ATV 78●●●●Y		Flux Vector Control without sensor; constant torque or variable torque
	ATV 78●F●●●Y		Flux Vector Control with sensor for more accurate speed and torque control

Electrical characteristics

Power supply	Voltage	**V**	525 to 690 V, ± 10% three-phase
	Frequency	**Hz**	45…66
Signalling			Via 3 LEDs on the programming terminal: - green: power on - green: running - red: fault
Output voltage			Maximum voltage equal to line supply voltage
Efficiency			97.5% (including line choke losses) at 50/60Hz at nominal load
Internal supplies available			1 +10 V output, 0 to +3%, max. 10 mA, with short-circuit protection 1 +24 V output, ± 15%, max. 150 mA, with short-circuit protection
External +24 V power supply			Used to supply the control circuit and option cards if the main power supply is cut +24 V power supply, ± 15%, min. 300 mA Separated from the internal power supply by a diode
Analog inputs	AI1		1 voltage analog input 0 to 10 V Impedance 200 kΩ Accuracy ± 1% of full scale (10 V) Resolution: 10 bits
	AI2		1 differential current analog input: 0 to 20 mA or 4 to 20 mA Max. load impedance: 250 Ω Resolution: 10 bits
Analog output	AO		1 current analog output 0 to 20 mA or 4 to 20 mA, configurable Max. external load: < 500 Ω Resolution: 10 bits, accuracy ± 3%
Logic inputs	DI●		6 bipolar inputs: positive or negative logic, 18 to 30 V ⎓ , configurable Impedance > 5 kΩ State 1 above 18 V, state 0 below 10 V
Programmable relay output			1 programmable relay output Switching voltage: 24 V/6 A ⎓, 250 V/6 A∿, 125 V/0.4 A ⎓ Max. continuous current < 2 A RMS Minimum switching capacity 5 V/10 mA Electrical isolation between line supply and relay power supply

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Protection characteristics

Overcurrent			Trip limit 4.0 x I_H (nominal drive current)
Overvoltage on DC bus		**V**	⎓ 1200
Undervoltage on DC bus		**V**	⎓ 461
Earth fault			If an earth fault occurs on the motor or motor cable, only the drive is protected
Phase loss	Input		Trips if a phase is missing
	Output		Trips if a phase is missing
Thermal protection against overheating		**°C**	Alarm at 85 Trips at 95
Motor protection			Yes, calculation of $I^2 t$
Motor stall			Yes
Motor underload			Yes
Short-circuit protection for +24 V and +10 V reference voltage			Yes

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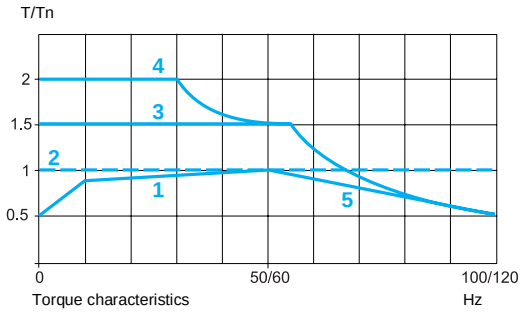

Torque characteristics

Torque characteristics (typical curves)

The curve opposite defines 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.

1 Self-cooled motor: continuous useful torque
2 Force-cooled motor: continuous useful torque *(1)*
3 Transient overtorque *(1)*
4 Possible overtorque at low speed *(1)*
5 Torque in overspeed at constant power *(2)*

(1) Torque available at zero speed with encoder feedback card.
*(2) **Caution**: Check the mechanical overspeed characteristics of the selected motor with the manufacturer.*

Special uses

Motor power rating different from that of variable speed drive

The variable speed drive can supply any motor which has a power rating between 20% and 120% of that for which it is designed. Ensure that the current drawn does not exceed the continuous output current of the drive.

Connecting motors in parallel

The variable speed drive rating must be greater than the sum of the motor currents to be connected to the variable speed drive. In this case, external thermal protection must be provided for each motor using probes (up to 6 motors) or thermal overload relays.
If the total length of the cables is greater than 30 m, the fitting of a line choke between the variable speed drive and the motor is recommended (dv/dt filter is recommended for supply voltages of 525, 660 and 690 V).
Autotuning is necessary for applications requiring a high start-up torque (conveyors, lifting). In this case the motors must be mechanically coupled, have the same power rating and the same cable length.
Autotuning is not necessary for applications which do not require a high start-up torque (pumps, fans). In this case the motor power ratings and the cable lengths may be different.
Each motor can be isolated by a contactor during operation. However, the motor should be reconnected to the variable speed drive in accordance with the precautions described below in "Coupling a contactor downstream of the variable speed drive."
The nominal current set for the variable speed drive must be equal to the sum of the motor currents.

Coupling a motor downstream of the variable speed drive

Connecting on the fly is possible if the current peak of the motor to be connected is less than the current supported by the variable speed drive at the time of coupling. In all cases it is preferable to lock the variable speed drive before closing the contactor and to unlock it after closing the power poles of the contactors.

Connection to an IT network

This type of connection is possible provided that no radio interference filters are installed. In addition, if the stray capacitance (or the filter capacitors) between the network and earth are excessive, there is a risk of premature wear on the variable speed drive in the event of a prolonged earth fault.

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109552-20-M

ATV 782D11Y

109560-34-M

ATV 782C16Y

High torque applications (150% Tn)

Motor				Altivar 78					
Power rating on motor plate				Input/output current *(1)*		Transient output current *(4)*	Power dissipated at nominal load	Reference *(5) (6) (7)*	Weight *(8)*
525 V	575 V	660 V	690 V	Nominal drive current *(2)*	150% of nominal current *(3)*				
kW	*HP*	kW	kW	A	A	A	W		kg
3-phase supply voltage 525 V to 690 V 50/60 Hz									
1.7	*2*	2.1	2.2	3.2	4.8	6.4	97	**ATV 78●U22Y**	18.500
2.3	*3*	2.9	3	4.5	6.8	9	111	**ATV 78●U30Y**	18.500
3	–	3.8	4	5.5	8.3	11	126	**ATV 78●U40Y**	18.500
4.2	*5*	5.3	5.5	7.5	11.3	15	170	**ATV 78●U55Y**	18.500
5.7	*7.5*	7.2	7.5	10	15	20	193	**ATV 78●U75Y**	18.500
8	*10*	11	11	13.5	20.3	27	295	**ATV 78●D11Y**	18.500
11	*15*	14	15	18	27	36	414	**ATV 78●D15Y**	18.500
14	*20*	18	18.5	22	33	44	450	**ATV 78●D18Y**	18.500
17	*25*	21	22	27	41	54	520	**ATV 78●D22Y**	18.500
23	*30*	29	30	34	51	68	630	**ATV 78●D30Y**	35.000
29	*40*	36	37	41	62	82	791	**ATV 78●D37Y**	35.000
34	*50*	43	45	52	78	104	1039	**ATV 78●D45Y**	58.000
42	*60*	53	55	62	93	124	1396	**ATV 78●D55Y**	58.000
57	*75*	72	75	80	120	160	2144	**ATV 78●D75Y**	58.000
68	*100*	86	90	100	150	200	2015	**ATV 78●D90Y**	146.000
84	*125*	105	110	125	188	213	2687	**ATV 78●C11Y**	146.000
100	*150*	126	132	144	216	245	3123	**ATV 78●C13Y**	146.000
122	–	153	160	170	255	289	3707	**ATV 78●C16Y**	146.000
152	*200*	191	200	208	312	375	3971	**ATV 780C20Y**	176,000
190	*250*	239	250	261	392	470	5157	**ATV 780C25Y**	207.000
240	*300*	301	315	325	488	585	6016	**ATV 780C31Y**	207.000
270	*400*	340	355	385	578	693	6410	**ATV 780C35Y**	335.000
342	*450*	430	450	460	690	828	7401	**ATV 780C45Y**	335.000
380	*500*	478	500	502	753	904	8058	**ATV 780C50Y**	378.000
426	*600*	536	560	590	885	1062	8400	**ATV 780C56Y**	414.000
479	*650*	603	630	650	975	1170	9450	**ATV 780C63Y**	414.000
540	*800*	679	710	650	975	1170	10 650	**ATV 780C71Y**	414.000
608	*800*	765	800	820	1280	1410	11 880	**ATV 780C80Y**	756.000
684	*900*	860	900	930	1380	1755	13 370	**ATV 780C90Y**	756.000
760	*1000*	956	1000	1030	1463	1755	15 080	**ATV 780M10Y**	786.000
989	*1350*	1243	1300	1300	1950	2340	19 070	**ATV 780M13Y** *(9)*	1512.000

High torque applications with integrated encoder feedback card

In the above references, replace **ATV 78●** with **ATV 78●F** or **ATV 780** with **ATV 780F**.
Example: **ATV 78●U22Y** becomes **ATV 78●FU22Y, ATV 780C71Y** becomes **ATV 780FC71Y.**

(1) The input and output current values are about the same at nominal speed and nominal load.
(2) Typical values for a 4-pole class B motor.
(3) 150% of the nominal current for 1 minute every 10 minutes.
(4) Transient output current for 2 seconds every 20 seconds.
(5) In the reference, replace the ● with 2 for an IP 21 (NEMA Type 1) drive or with 5 for an IP 54 (NEMA Type 12) drive.
*Example: **ATV 782U22Y** for IP 21 or **ATV 785U22Y** for IP 54.*
*For **ATV 780C20Y** to **ATV 780M13Y** drives, the product is only available in IP 00 (open type).*
*(6) To order a reinforced version of a drive for specific environmental conditions, add **S337** to the end of the reference for **ATV 785U22Y** to **ATV 785C16Y** drives and **ATV 780C20Y** to **ATV 780M13Y** drives.*
*Example: **ATV 785D75Y** becomes **ATV 785D75YS337**.*
(7) Drives are supplied as standard with a line choke, which on ATV 78●U22Y to ATV 78●C16Y drives is built in. On ATV 780C20Y to ATV 780M13Y drives it is supplied but not installed.
(8) The weight includes the drive and the line choke.
(9) Drive supplied as standard with a dv/dt filter.

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109652-20-M

ATV 782D11Y

109560-34-M

ATV 782C16Y

Standard torque applications (110% Tn)

Motor				Altivar 78					
Power rating on motor plate				Input/output current *(1)*		Transient output current *(4)*	Power dissipated at nominal load	Reference *(5) (6) (7)*	Weight *(8)*
525 V	575 V	660 V	690 V	Nominal drive current *(2)*	110% of nominal current *(3)*				
kW	*HP*	kW	kW	A	A	A	W		kg
3-phase supply voltage 525 V to 690 V 50/60 Hz									
2.3	*3*	2.9	3	4.5	5	6,4	104	**ATV 78●U22Y**	18.500
3	–	3.8	4	5.5	6.1	9	118	**ATV 78●U30Y**	18.500
4.2	*5*	5.3	5.5	7.5	8.3	11	141	**ATV 78●U40Y**	18.500
5.7	*7.5*	7.2	7.5	10	11	15	190	**ATV 78●U55Y**	18.500
8	*10*	11	11	13	14.9	20	227	**ATV 78●U75Y**	18.500
11	*15*	14	15	18	19.8	27	342	**ATV 78●D11Y**	18.500
14	*20*	18	18.5	22	24.2	36	455	**ATV 78●D15Y**	18.500
17	*25*	21	22	27	29.7	44	483	**ATV 78●D18Y**	18.500
23	*30*	29	30	34	37.4	54	614	**ATV 78●D22Y**	18.500
29	*40*	36	37	41	45.1	68	712	**ATV 78●D30Y**	35.000
34	*50*	43	45	52	57.2	82	901	**ATV 78●D37Y**	35.000
42	*60*	53	55	62	68.2	104	1160	**ATV 78●D45Y**	58.000
57	*75*	72	75	80	88	124	1670	**ATV 78●D55Y**	58.000
68	*100*	86	90	100	110	160	2345	**ATV 78●D75Y**	58.000
84	*125*	105	110	125	138	200	2286	**ATV 78●D90Y**	146.000
100	*150*	126	132	144	158	213	2998	**ATV 78●C11Y**	146.000
122	–	153	160	170	187	245	3639	**ATV 78●C13Y**	146.000
152	*200*	191	200	208	229	289	4263	**ATV 78●C16Y**	146.000
190	*250*	239	250	261	287	375	4803	**ATV 780C20Y**	176.000
240	*300*	301	315	325	358	470	5660	**ATV 780C25Y**	207.000
270	*400*	340	355	385	424	585	7089	**ATV 780C31Y**	207.000
342	*450*	430	450	460	506	693	7377	**ATV 780C35Y**	335.000
380	*500*	478	500	502	552	828	8635	**ATV 780C45Y**	335.000
426	*600*	536	560	590	649	904	9201	**ATV 780C50Y**	378.000
479	*650*	603	630	650	715	1062	9450	**ATV 780C56Y**	414.000
540	*800*	679	710	750	825	1170	10 650	**ATV 780C63Y**	414.000
609	*800*	765	800	820	902	1170	12 000	**ATV 780C71Y**	414.000
684	*800*	860	900	920	1012	1410	13 370	**ATV 780C80Y**	756.000
760	*900*	956	1000	1030	1130	1755	15 080	**ATV 780C90Y**	756.000
875	*1100*	1100	1150	1180	1298	1755	17 580	**ATV 780M10Y**	786.000
1141	*1500*	1434	1500	1500	1650	2340	21 780	**ATV 780M13Y** *(9)*	1512.000

(1) The input and output current values are about the same at nominal speed and nominal load.
(2) Typical values for a 4-pole class B motor.
(3) 110% of the nominal current for 1 minute every 10 minutes.
(4) Transient output current for 2 seconds every 20 seconds.
(5) In the reference, replace the ● with 2 for an IP 21 (NEMA Type 1) drive or with 5 for an IP 54 (NEMA Type 12) drive.
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*(6) To order a reinforced version of a drive for specific environmental conditions, add **S337** to the end of the reference for **ATV 785U22Y** to **ATV 785C16Y** drives and **ATV 780C20Y** to **ATV 780M13Y** drives.*
*Example: **ATV 785D75Y** becomes **ATV 785D75YS337**.*
(7) Drives are supplied as standard with a line choke, which on ATV 78●U22Y to ATV 78●C16Y drives is built in. On ATV 780C20Y to ATV 780M13Y drives it is supplied but not installed.
(8) The weight includes the drive and the line choke.
(9) Drive supplied as standard with a dv/dt filter.

Variable speed drives for asynchronous motors
Altivar 78
Accessories

DF-56507-6

VW3 A7810●

Remote mounting kit for programming terminal

The Altivar 78 is supplied with a remote programming terminal (see page 4).

A terminal support option allows remote mounting of the programming terminal at a distance of between 2 and 15 metres. It is particularly suitable for mounting on an enclosure door.

The mounting kit comprises:
- Terminal support
- Connection cable (length 2 or 15 m)
- Screws and washers

Description	Cable length m	For drives	Reference	Weight kg
Terminal support	2	ATV 78 all ratings	**VW3 A78102**	1.000
	15	ATV 78 all ratings	**VW3 A78103**	1.000

PC-based setup software ATV 78 Soft

ATV 78 Soft is provided on a CD-ROM shipped with the product.

The PC connection kit allows connection to a PC operating in a Microsoft Windows® environment.

Minimum PC configuration: Pentium 3 processor with 128 MB of RAM.
Operating system: Windows® 95, 98, NT, 2000 or XP.

Main functions:
- Drive configuration
- Configuration backup
- Printout of complete parameter list
- Comparison of parameters
- Configuration transfer from one drive to another
- Oscilloscope mode for maintenance
- Control and monitoring

Description	Cable length m	For drives	Reference	Weight kg
PC cable	1.5	ATV 78 all ratings	**VW3 A78332**	0.300

IP 54 kit (NEMA type 12)

The IP 54 kit increases the protection class of the variable speed drive enclosure from IP 21 to IP 54. The kit offers protection against dust and water spray. It does not protect the drive against powerful water jets or immersion, however.

The IP 54 kit comprises:
- IP 54 enclosure
- IP 54 cover with fan
- Cable gland with rubber grommets
- Rubber seals
- Screws, cable anchors, fasteners, warning sticker

Description	For drives	Reference	Weight kg
IP 54 kit	ATV 782U22Y...2D22Y ATV 782FU22Y...2FD22Y	**VW3 A78801**	1.500

Dimensions:
page 32

Variable speed drives for asynchronous motors
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Accessories

Kit for flush-mounting in a dust and damp proof enclosure

This kit allows the power section of the drive to be mounted outside the enclosure, reducing the power dissipated inside the enclosure. It is available for drives **ATV 782U227** to **ATV 782C16Y**.
This type of mounting requires a cutout in the enclosure.

The heatsink and fan mounted outside the enclosure have IP 54/NEMA type 12 degree of protection.

The mounting kit comprises:
- Seals
- Cable glands
- Fan
- Sealing tape
- Cable tie, screws
- Instructions and cutout dimensions

For drives	Reference	Weight kg
ATV 782U22Y...2D22Y ATV 782FU22Y...2FD22Y	**VW3 A78806**	0.370
ATV 782D30Y, 2D37Y ATV 782FD30Y, 2FD37Y	**VW3 A78807**	2.000
ATV 782D45Y...2D75Y ATV 782FD45Y...2FD75Y	**VW3 A78808**	3.000
ATV 782D90Y...2C16Y ATV 782FD90Y...2FC16Y	**VW3 A78809**	8.500

DF564077

VW3 A78DEMO

Demonstration case

The Altivar 78 demonstration case comprises:
- 115/230 V ∿ dual voltage input power supply
- ABS case
- Altivar 78 variable speed drive with programming terminal
- Power cord and PC connection cable
- PC software
- Switches, LEDs and analog counter

Description	Reference	Weight kg
Altivar 78 demonstration case	**VW3 A78DEMO**	12.700

Variable speed drives for asynchronous motors

Altivar 78

Reduction of current harmonics

The main solutions for reducing current harmonics are as follows:
- Line chokes (supplied with the Altivar 78)
- Passive filters
- Active compensators, also called Accusine active filters, marketed under the Merlin Gerin brand
- Hybrid filters

All four solutions can be used on the same installation. It is always easier and less expensive to handle harmonics at an installation level as a whole rather than at the level of each individual unit, particularly when using passive filters and active compensators.

Line chokes

Presentation

The Altivar 78 comes with line chokes to help reduce the current harmonic distortion generated by the variable speed drive and to help improve protection against overvoltages on the line supply. The integrated line chokes on the Altivar 78 are also used to minimize the line current.

The use of line chokes is recommended in particular under the following circumstances:
- Close connection of several drives in parallel
- Line supply with significant disturbance from other equipment (interference, overvoltages, switching capacitors)
- Line supply with voltage imbalance between phases above 1.8% of the nominal voltage
- Line supply with a very low impedance; e.g. the transformer power rating is 10 times greater than the drive rating
- Installation of a large number of variable speed drives on the same line
- If the installation includes a power factor correction unit, the line choke reduces the overload on the cos φ correction capacitors and limits the voltage spikes caused by capacitor switching.

Example of current harmonic levels for a 690 V/50 Hz line supply

Variable speed drives	H1		H5		H7		H11		H13	
	at 150% Tn	at 110% Tn	at 150% Tn	at 110% Tn	at 150% Tn	at 110% Tn	at 150% Tn	at 110% Tn	at 150% Tn	at 110% Tn
	A	A	%	%	%	%	%	%	%	%
ATV 78●U22Y, ●FU22Y	1.84	2.51	72.46	69.11	51.65	45.19	14.86	9.13	6.42	5.96
ATV 78●U30Y, ●FU30Y	2.51	3.35	69.11	69.10	45.19	45.45	9.13	10.29	5.96	6.53
ATV 78●U40Y, ●FU40Y	3.35	4.60	69.10	65.82	45.45	39.84	10.29	5.94	6.53	5.21
ATV 78●U55Y, ●FU55Y	4.60	6.28	65.82	63.58	39.84	36.49	5.94	5.89	5.21	5.80
ATV 78●U75Y, ●FU75Y	6.28	9.20	63.58	57.32	36.49	30.32	5.89	7.21	5.80	7.07
ATV 78●D11Y, ●FD11Y	9.20	12.55	57.32	45.73	30.32	22.68	7.21	6.20	7.07	4.96
ATV 78●D15Y, ●FD15Y	12.55	15.48	45.73	43.45	22.68	21.53	6.20	6.09	4.96	5.68
ATV 78●D18Y, ●FD18Y	15.48	18.41	43.45	41.32	21.53	17.83	6.09	6.15	5.68	5.17
ATV 78●D22Y, ●FD22Y	18.41	25.10	41.32	34.43	17.83	11.99	6.15	5.13	5.17	4.50
ATV 78●D30Y, ●FD30Y	25.10	31.38	45.91	40.78	21.76	17.02	6.61	5.93	5.75	4.64
ATV 78●D37Y, ●FD37Y	31.38	37.65	40.78	37.82	17.02	15.20	5.93	5.75	4.64	4.97
ATV 78●D45Y, ●FD45Y	37.65	46.02	43.42	38.00	19.82	16.32	6.49	5.51	4.92	4.67
ATV 78●D55Y, ●FD55Y	46.02	62.76	38.00	35.30	16.32	13.58	5.51	5.85	4.67	4.46
ATV 78●D75Y, ●FD75Y	62.76	75.31	35.30	32.22	13.58	10.63	5.85	5.64	4.46	4.08
ATV 78●D90Y, ●FD90Y	75.31	92.04	32.22	32.09	10.63	9.29	5.64	5.92	4.08	3.39
ATV 78●C11Y, ●FC11Y	92.04	110.45	38.32	36.03	15.87	13.19	5.81	6.03	5.05	4.29
ATV 78●C13Y, ●FC13Y	110.45	133.88	36.03	33.39	13.19	10.30	6.03	5.63	4.29	3.92
ATV 78●C16Y, ●FC16Y	133.88	167.35	33.39	31.74	10.30	9.65	5.63	5.72	3.92	3.53
ATV 780C20Y, 0FC20Y	167.35	209.18	37.69	35.58	16.62	10.90	6.29	5.97	3.94	3.56
ATV 780C25Y, 0FC25Y	209.18	263.57	40.05	34.87	15.27	11.65	5.95	5.33	4.19	3.94
ATV 780C31Y, 0FC31Y	263.57	297.04	34.87	33.90	11.65	11.28	5.33	5.00	3.94	3.98
ATV 780C35Y, 0FC35Y	297.04	376.53	43.10	39.70	18.10	14.70	7.20	7.00	3.90	3.30
ATV 780C45Y, 0FC45Y	376.53	418.37	39.70	38.40	14.70	13.40	7.00	6.90	3.30	3.20
ATV 780C50Y, 0FC50Y	418.37	468.57	46.70	44.90	21.10	19.20	6.90	6.80	4.10	3.70
ATV 780C56Y, 0FC56Y	468.57	527.15	43.00	41.30	17.60	15.90	7.00	6.90	3.70	3.40
ATV 780C63Y, 0FC63Y	527.15	594.09	41.30	39.80	15.90	14.30	6.90	6.90	3.40	3.20
ATV 780C71Y, 0FC71Y	527.15	669.39	41.30	38.10	15.90	12.90	6.90	6.80	3.40	3.20
ATV 780C80Y, 0FC80Y	677.9	761.6	40.30	38.56	15.06	13.25	7.20	7.08	3.41	3.18
ATV 780C90Y, 0FC90Y	761.6	845	40.98	36.93	13.25	11.87	7.08	6.96	3.18	3.12
ATV 780M10Y, 0FM10Y	847.8	973.7	41.61	39.74	15.90	13.90	7.10	6.98	3.46	3.12
ATV 780M13Y, 0FM13Y	1100.26	1267.84	39.05	36.99	14.90	13.09	7.47	7.22	3.64	3.46

Dimensions:
pages 28 to 32

Variable speed drives for asynchronous motors
Altivar 78
Reduction of current harmonics

Line chokes (continued)

Characteristics

Variable speed drives			Line choke								
	Nominal current (In) (1)		Inductance value	Impedance value for In at 150% Tn (high torque application)				Impedance value for In at 110% Tn (standard torque application)			
	at 150% Tn	at 110% Tn		525 V 60 Hz	575 V 60 Hz	660 V 50 Hz	690 V 50 Hz	525 V 60 Hz	575 V 60 Hz	660 V 50 Hz	690 V 50 Hz
	A	A	µH	%	%	%	%	%	%	%	%
ATV 78●U22Y, ●FU22Y	3	4	1500	0.44	0.40	0.29	0.28	0.60	0.55	0.40	0.38
ATV 78●U30Y, ●FU30Y	4	5	1500	0.60	0.55	0.40	0.38	0.80	0.73	0.53	0.51
ATV 78●U40Y, ●FU40Y	5	7	1500	0.80	0.73	0.53	0.51	1.10	1.01	0.73	0.70
ATV 78●U55Y, ●FU55Y	7	10	1500	1.10	1.01	0.73	0.70	1.50	1.37	1.00	0.95
ATV 78●U75Y, ●FU75Y	10	13	1500	1.50	1.37	1.00	0.95	2.20	2.01	1.46	1.40
ATV 78●D11Y, ●FD11Y	13	18	1500	2.20	2.01	1.46	1.40	3.00	2.74	1.99	1.90
ATV 78●D15Y, ●FD15Y	18	22	1500	3.00	2.74	1.99	1.90	3.71	3.38	2.46	2.35
ATV 78●D18Y, ●FD18Y	22	27	1500	3.71	3.38	2.46	2.35	4.41	4.02	2.92	2.79
ATV 78●D22Y, ●FD22Y	27	34	1500	4.41	4.02	2.92	2.79	6.01	5.49	3.98	3.81
ATV 78●D30Y, ●FD30Y	34	41	880	3.52	3.22	2.34	2.24	4.41	4.02	2.92	2.79
ATV 78●D37Y, ●FD37Y	41	52	880	4.41	4.02	2.92	2.79	5.29	4.83	3.50	3.35
ATV 78●D45Y, ●FD45Y	52	62	880	5.29	4.83	3.50	3.35	6.46	5.90	4.28	4.10
ATV 78●D55Y, ●FD55Y	62	80	575	4.22	3.86	2.80	2.68	5.76	5.26	3.82	3.65
ATV 78●D75Y, ●FD75Y	80	100	575	5.76	5.26	3.82	3.65	6.91	6.31	4.58	4.38
ATV 78●D90Y, ●FD90Y	100	125	300	3.61	3.29	2.39	2.29	4.41	4.02	2.92	2.79
ATV 78●C11Y, ●FC11Y	125	144	300	4.41	4.02	2.92	2.79	5.29	4.83	3.50	3.35
ATV 78●C13Y, ●FC13Y	144	170	300	5.29	4.83	3.50	3.35	6.41	5.85	4.25	4.06
ATV 78●C16Y, ●FC16Y	170	208	300	6.41	5.85	4.25	4.06	8.01	7.31	5.31	5.08
ATV 780C20Y, 0FC20Y	208	261	187	4.99	4.56	3.31	3.17	6.24	5.70	4.14	3.96
ATV 780C25Y, 0FC25Y	261	325	120	4.21	3.84	2.79	2.67	5.30	4.84	3.51	3.36
ATV 780C31Y, 0FC31Y	325	385	120	5.30	4.84	3.51	3.36	5.97	5.45	3.96	3.79
ATV 780C35Y, 0FC35Y	416	460	95	4.50	4.11	2.98	2.86	5.71	5.21	3.78	3.62
ATV 780C45Y, 0FC45Y	460	502	95	5.71	5.21	3.78	3.62	6.34	5.79	4.20	4.02
ATV 780C50Y, 0FC50Y	502	590	60	4.21	3.84	2.79	2.67	4.71	4.30	3.12	2.99
ATV 780C56Y, 0FC56Y	590	650	60	4.71	4.30	3.12	2.99	5.30	4.84	3.51	3.36
ATV 780C63Y, 0FC63Y	650	750	60	5.30	4.84	3.51	3.36	5.97	5.45	3.96	3.79
ATV 780C71Y, 0FC71Y	750	820	60	5.97	5.45	3.96	3.79	6.73	6.14	4.46	4.27
ATV 780C80Y, 0FC80Y	820	920	47.5	4.04	4.42	3.21	3.07	4.53	4.96	3.60	3.45
ATV 780C90Y, 0FC90Y	920	1030	47.5	4.53	0.58	3.60	3.45	5.07	4.96	4.03	3.86
ATV 780M10Y, 0FM10Y	1030	1180	37.5	4	0.59	3.18	3.05	4.59	4.96	3.65	3.49
ATV 780M13Y, 0FM13Y	1300	1500	31.67	4.27	0.8	3.39	3.25	4.92	4.96	3.92	3.75

(1) In is the nominal output current rating of the variable speed drive in standard torque applications (110% Tn) or in high torque applications (150% Tn).

Passive filters

Presentation

Passive filters can be used to reduce the current harmonics according to the harmonic orders to be filtered (H1 to H13). They thus consist of "steps", each step corresponding to a harmonic order. Orders 5 and 7 are those most commonly filtered.
The filter can be installed for a load or for a group of loads. Its design requires a detailed analysis of the supply and a research project. Its size depends on the harmonic range of the load and on the impedance of the source.
This type of filtering depends entirely on the source and the loads.

Note: *This type of filter can also be used to eliminate harmonic distortion which already exists on the line supply. Please consult your Regional Sales Office.*

Active compensators

Presentation

Compensators, connected in parallel on the load and on the line supply, measure current harmonics emitted by the equipment and automatically generate inverse current harmonics.
Their advantages are as follows:
- Independence in relation to the load and to the supply impedance
- Adaptive tuning

Note: *Please consult your Regional Sales Office.*

Hybrid filters

Presentation

Hybrid filters consist of a passive filter and an active compensator and represent an excellent compromise for handling harmonics.

Note: *Please consult your Regional Sales Office.*

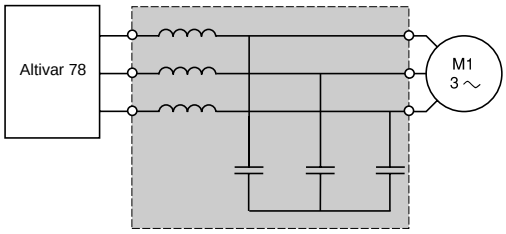
Dimensions:
pages 28 to 32

Variable speed drives for asynchronous motors

Altivar 78

Option: dv/dt filters

Presentation



dv/dt filter

dv/dt are the steep-front voltage pulses that travel along the leads in the circuit to the motor and are then returned in a "reflected wave".

If the leads are long enough, 30 metres or more, the reflection time corresponds to the transmission time, resulting in a high harmonic factor on the circuit. Overvoltages of up to 2100 V are commonly observed in 525/660/690 V ~ line supplies.
To avoid equipment failure, the use of a dv/dt filter is essential.

Installed between the variable speed drive and the motor, the dv/dt filter protects the motor by slowing the rate of voltage increase and minimizing the overvoltage that occurs at the motor terminals.

References

For variable speed drives	Max. cable length		dv/dt for 525/660/690 V ~		Reference	Weight
	Shielded	Unshielded	Nominal current	Max. loss		
	m	m	A	W		kg
ATV 78●U22Y…●D15Y **ATV 78●FU22Y…●FD15Y**	100	140	25	90	**VW3 A78601C**	7
ATV 78●D18Y…●D31Y **ATV 78●FD18Y…●FD31Y**	100	210	55	120	**VW3 A78602C**	12
ATV 78●D45Y…●D55Y **ATV 78●FD45Y…●FD55Y**	150	210	80	140	**VW3 A78603C**	15
ATV 78●D75Y…●D90Y **ATV 78●FD75Y…●FD90Y**	150	280	130	190	**VW3 A78604C**	23
ATV 78●C11Y…●C16Y **ATV 78●FC11Y…●FC16Y**	200	280	210	210	**VW3 A78605C**	35
ATV 780C20Y **ATV 780FC20Y**	200	350	280	350	**VW3 A78606C**	60
ATV 780C25Y **ATV 780FC25Y**	250	350	350	480	**VW3 A78607C**	70
ATV 780C31Y **ATV 780FC31Y**	250	350	420	650	**VW3 A78608C**	85
ATV 780C35Y…0C50Y **ATV 780FC35Y…0FC50Y**	250	420	600	850	**VW3 A78609C**	120
ATV 780C56Y…0C71Y **ATV 780FC56Y…0FC71Y**	300	420	820	1050	**VW3 A78610C**	140
ATV 780C80Y…0M10Y **ATV 780FC80Y…0FM10Y**	300	420	1200	1200	**VW3 A78611C**	160
ATV 780M13Y **ATV 780FM13Y**	300	420	1500	1400	**VW3 A78612C**	210

Dimensions:
page 33

Variable speed drives for asynchronous motors

Altivar 78

Option: Motor chokes

Presentation

The use of a motor choke between the drive and the motor is recommended for motor leads longer than 10 metres.

This makes it possible to:

- Limit dv/dt
- Limit overvoltage at the motor terminals
- Limit "reflected wave" from the motor back to the variable speed drive
- Filter interference caused by opening a contactor placed between the choke and the motor
- Reduce the motor earth leakage current.

Note: *Please consult your Regional Sales Office.*

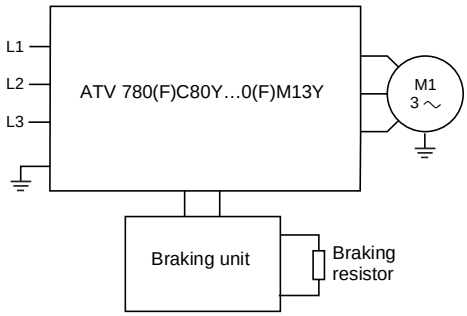
Variable speed drives for asynchronous motors

Altivar 78

Options: Braking units and resistors

Braking units

Presentation



Resistance braking enables the Altivar 78 drive to operate while braking to a standstill or during "generator" operation, by dissipating the energy in the braking resistor.

Drives ATV 780(F)C80Y to ATV 780(F)M13Y can be fitted with a braking unit. Please consult your Regional Sales Office.

Braking resistors

Presentation

The dynamic braking transistor and braking resistor allow the Altivar 78 drive to operate in quadrants 2 and 4 of the four-quadrant speed/torque curve.
In these quadrants of operation, the motor is essentially a generator through which energy is transferred from the motor load to the variable speed drive. This results in a rise in DC bus voltage to the variable speed drive, which may cause it to shut down to protect itself.

Braking resistors are generally used to dissipate the excess energy generated by the motor operating in this mode. The flow of current to the braking resistor is controlled by the dynamic braking transistor.

For drives ATV 780(F)C80Y to ATV 780(F)M13Y, the resistor required must be determined in accordance with the recommendations on pages 20 and 21.
You should also consult your Regional Sales Office.

The dynamic braking transistor is integrated in the drive from ATV 78●(F)U22Y to ATV 780(F)C71Y.

Characteristics

Type of braking resistor			**VW3 A78701L …A78703L**	**VW3 A78704L and A78705L**	**VW3 A78706L and A78707L**	**VW3 A78701H …A78703H**	**VW3 A78704H …A78707H**
Ambient air temperature around the device	Storage	**°C**	- 40…+ 70				
	Operation	**°C**	-40…+40 without derating. Up to 80 °C with current derating of 2.5% per °C above 40 °C				
Degree of protection of enclosure	Vertical mounting		IP 50	IP 21	IP 20	IP 21	IP 20
	In other cases		IP 50	IP 20	IP 20	IP 20	IP 20
Thermal protection			–		By temperature controlled switch		
Temperature-controlled switch	Activation temperature	**°C**	220				

Selection: pages 20 to 23
Dimensions: pages 34 to 37

Variable speed drives for asynchronous motors

Altivar 78

Option: Braking resistors

Braking resistors (continued)

For variable speed drives	Braking resistors				
	Minimum ohmic resistance at 20 °C *(1)*	Continuous power	Number of resistors required per drive	Reference	Weight
	Ω	kW			kg
Braking time: 5 s *(2)*					
ATV 78●U22Y…●U75Y ATV 78●FU22Y…●FU75Y	100	0.3	1	**VW3 A78701L**	1.700
ATV 78●D11Y…●D22Y ATV 78●FD11Y…●FD22Y	30	1.0	1	**VW3 A78702L**	4.000
ATV 78●D30Y…●D37Y ATV 78●FD30Y…●FD37Y	18	1.7	1	**VW3 A78703L**	7.000
ATV 78●D45Y…●D75Y *(3)* ATV 78●FD45Y…●FD75Y *(3)*	9	3.2	1	**VW3 A78704L**	16.000
ATV 78●D90Y…●C16Y *(3)* ATV 78●FD90Y…●FC16Y *(3)*	7	4	1	**VW3 A78705L**	28.000
ATV 780C20Y…0C31Y and ATV 780FC20Y…0FC31Y	2.5	11	1	**VW3 A78706L**	57.000
ATV 780C35Y…0C50Y and ATV 780FC35Y…0FC50Y	1.7	17	1	**VW3 A78707L**	86.000
ATV 780C56Y…0C71Y and ATV 780FC56Y…0FC71Y	2.5	11	2	**VW3 A78706L**	114.000
Braking time: 10 s *(2)*					
ATV 78●U22Y…●U75Y ATV 78●FU22Y…●FU75Y	100	0.79	1	**VW3 A78701H**	7.000
ATV 78●D11Y…●D22Y ATV 78●FD11Y…●FD22Y	30	2.8	1	**VW3 A78702H**	14.000
ATV 78●D30Y…●D37Y ATV 78●FD30Y…●FD37Y	18	5.5	1	**VW3 A78703H**	33.000
ATV 78●D45Y…●D75Y *(3)* ATV 78●FD45Y…●FD75Y *(3)*	9	9.4	1	**VW3 A78704H**	46.000
ATV 78●D90Y…●C16Y *(3)* ATV 78●FD90Y…●FC16Y *(3)*	7	12	1	**VW3 A78705H**	55.000
ATV 780C20Y…0C31Y and ATV 780FC20Y…0FC31Y	2.5	34	1	**VW3 A78706H**	160.000
ATV 780C35Y…0C50Y and ATV 780FC35Y…0FC50Y	1.7	50	1	**VW3 A78707H**	230.000
ATV 780C56Y…0C71Y and ATV 780FC56Y…0FC71Y	2.5	34	2	**VW3 A78706H**	320.000

Braking resistor connection kit

For variable speed drives	Reference	Weight kg
ATV 78●D45Y…●C16Y ATV 78●FD45Y…●FC16Y	**VW3 A78810**	1.250

(1) Do not use a resistor with a value less than the minimum value given in the table.
(2) For special applications such as hoisting, please refer to the curves on pages 22 and 23.
*(3) Braking resistor connection kit **VW3 A78810** must be used.*

Selection: pages 20 to 23
Dimensions: pages 34 to 37

Variable speed drives for asynchronous motors

Altivar 78

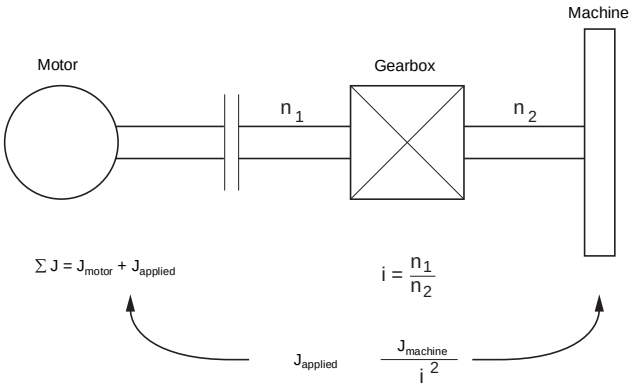
Option: Braking resistors

Determining the braking power

Calculating the braking time from the inertia

$$t_b = \frac{J \cdot \omega}{T_b + T_r} \qquad \omega = \frac{2\pi \cdot n}{60} \qquad T_b = \frac{\Sigma J \cdot (n_1 - n_2)}{9{,}55 \cdot t_b} \qquad \hat{P}_b = \frac{T_b \cdot n_1}{9{,}55} \qquad \overline{P}_b = \frac{\hat{P}_b}{2}$$

T_b	Motor braking torque	[Nm]
ΣJ	Total inertia applied to the motor	[kgm²]
n_1	Motor speed ahead of gearbox	[rpm]
n_2	Motor speed after gearbox	[rpm]
t_b	Braking time	[s]
$\hat{P}_b$	Maximum braking power	[W]
$\overline{P}_b$	Average braking power during t_b	[W]
T_r	Braking torque	[mN]



Braking power of an applied load moving horizontally with constant deceleration (e.g.: carriage)

$$W = \frac{w \cdot v^2}{2} \qquad \overline{P}_b = \frac{W}{t_b} \qquad \hat{P}_b = \overline{P}_b \cdot 2$$

W	Kinetic energy	[Joule]
w	Weight	[kg]
v	Speed	[m/s]
t_b	Braking time	[s]
$\hat{P}_b$	Maximum braking power	[W]
$\overline{P}_b$	Average braking power during t_b	[W]
T_b	Braking torque	[Nm]
n	Motor speed	[rpm]

Braking power for an active load (e.g.: test bench)

$$\overline{P}_b = \frac{T_b \cdot n}{9{,}55}$$

g	Acceleration	9.81 m/s²
a	Deceleration	[m/s²]
v	Linear downward speed	[m/s]
J	Moment of inertia	[kgms²]
ω	Angular speed	[rad/s]
t_b	Downward stopping time	[s]

Braking power for a downward vertical movement

$$\overline{P}_b = w \cdot g \cdot v \qquad \hat{P}_b = w \cdot (g + a) \cdot v + \frac{J \cdot \omega^2}{t_b} \qquad \omega = \frac{2\pi \cdot n}{60}$$

The braking power calculations are only valid if it is assumed that there are no losses ($\eta = 1$) and there is no resistive torque.
An accurate analysis must be made:

- Losses in the system:
  The losses generated in the motor (operating as a generator, quadrants II and IV) are of some help during the braking phase. Without exception, efficiency must be calculated to the braking power squared
- Resistive torque:
  There may sometimes be resistive torque related to mechanical friction, air and opposing quadratic torque of the fans.
  These phenomena, which are rarely taken into consideration, reduce the braking power.
  The power or resistive torque should be derived from the calculated braking power
- Motor torque

Additional phenomena, such as the wind, can cause an increase in the braking power. These phenomena must also be taken into consideration.

The required braking power is calculated as follows:

$$\hat{P}_{bR} = (\hat{P}_b - P_{load}) \times \eta total \qquad \overline{P}_{bR} = (\overline{P_b} - P_{load}) \times \eta total$$

$$\eta_{total} = \eta_{mec} \times \eta_{mot} \times 0{,}98$$

$\hat{P}_{bR}$	Maximum actual braking power	[W]
$\overline{P}_{bR}$	Continuous actual braking power	[W]
η_{total}	Total efficiency	
P_{load}	Braking power connected with the resistive or driving torque (not taken into account in the calculation). P_{load} can be positive or negative.	[W]
η_{drive}	Drive efficiency = 0.98	
η_{mec}	Mechanical efficiency	
η_{mot}	Motor efficiency	

Presentation: page 18 | Characteristics page 18 | References: page 19 | Dimensions: pages 34 to 37

Variable speed drives for asynchronous motors

Altivar 78

Option: Braking resistors

To select the braking power ($\hat{P}_b$, $\overline{P}_b$), it is also necessary to consider the following points:
- Type of installation and protection of the braking resistors
- Wiring conditions
- Problems with heat dissipation (air conditioning)
- Cost and possibility of depreciation of the installation due to the reduced costs of electrical energy

For braking, the braking resistor is selected to match the required power and the braking cycle.

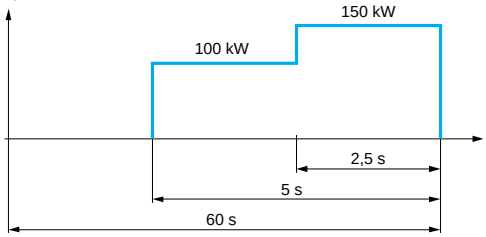
In general:

$$\hat{P}_{max} = \frac{U^2_d}{R}$$

$\hat{P}_{max}$	Maximum braking power available with the braking unit	[W]
P_{contin}	Continuous thermal braking power	[W]
U_d	Braking unit control level	[V]
I	Braking resistor thermal current (see the TH setting)	[A]
P_{cycle}	See the braking cycle diagram	

⚠ The drive has a protection device inside the braking resistor. See the set-up parameters E3.06, E3.07 and E3.08.
The programming guide includes a protection curve and other advice.
If this protection curve is suitable for your braking resistors, then the internal protection can be used. Otherwise, external protection must be provided by a thermal overload relay.

Cycle



Example of selection of a braking resistor for a hosting application

Thermal overload relay
P = nominal braking resistor power
R = resistance value

$P = R\,I^2 \rightarrow I = \sqrt{\frac{P}{R}}$ = nominal value of thermal overload relay
In the formula, we have: $\hat{P}_{max} = \frac{U^2 d}{R}$

$\hat{P}_{max}$ = braking unit power + R
$P_{continuous} = I^2R$ (resistor P)

Customer data: Raising/lowering cycle = **1 minute**
Td/Tn = **1.38**
Raising with nominal load at steady state: **106 kW**
ηtotal = **0.85**

Calculations: 106 kW leads to selection of a 120 kW motor
120 kW x 0.85 = 102 kW ➜ 100 kW braking at steady state
102 kW X 1.38 = 140 kW ➜ selection of a max. braking power of 150 kW
The variable speed drive used is a 132 kW **ATV 782C13Y** (min. braking resistance = 9 Ω)

The minimum resistance to be used is calculated according to the variable speed drive used, with the aid of braking resistor cycle curves.
Braking cycle: 60 s = 150 kW max. for 2.5 s and 100 kW for 5 s.
Braking resistor **VW3 A78705H** can be used since it accepts 100 kW for more than 5 s and 150 kW for 2.5 s.

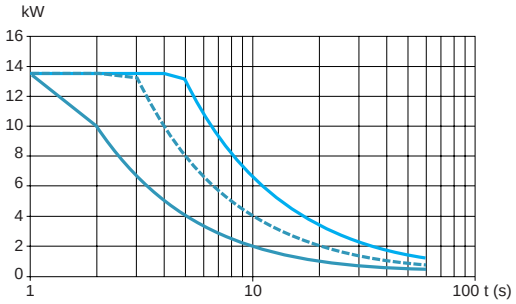
Variable speed drives for asynchronous motors

Altivar 78

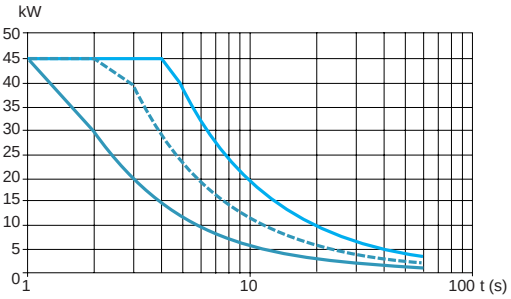
Characteristic curves for braking resistors

Braking resistors

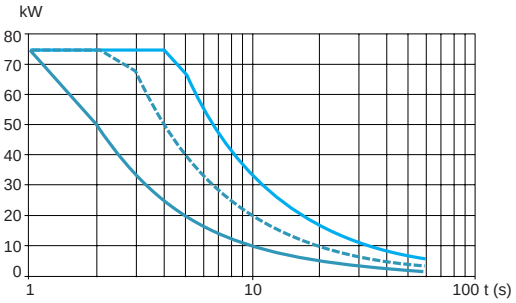
VW3 A78701L (P continuous = 0.3 kW)



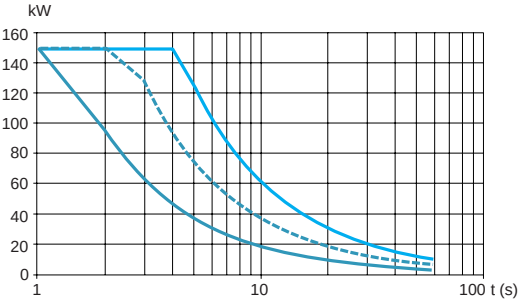
VW3 A78702L (P continuous = 1.0 kW)



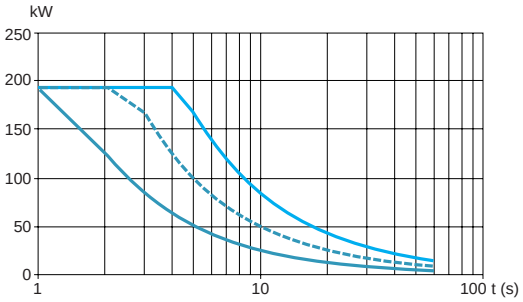
VW3 A78703L (P continuous = 1.7 kW)



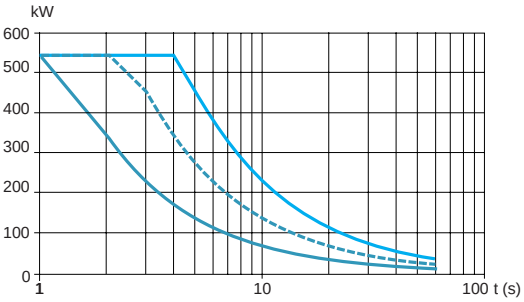
VW3 A78704L (P continuous = 3.2 kW)



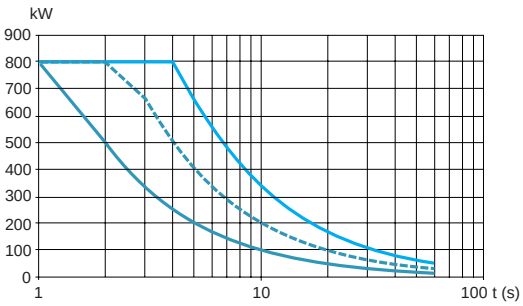
VW3 A78705L (P continuous = 4.0 kW)



VW3 A78706L (P continuous = 11 kW)



VW3 A78707L (P continuous = 17 kW)



P max (60 s cycle)
P max (120 s cycle)
P max (200 s cycle)

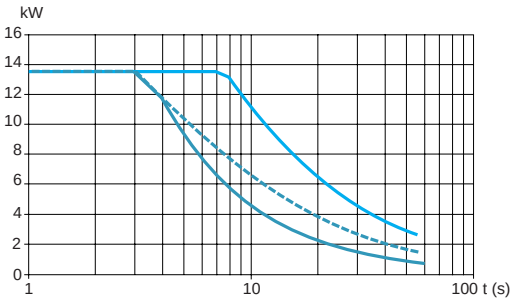
Variable speed drives for asynchronous motors

Altivar 78

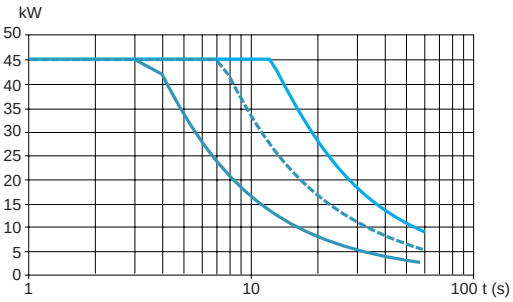
Characteristic curves for braking resistors

Braking resistors (continued)

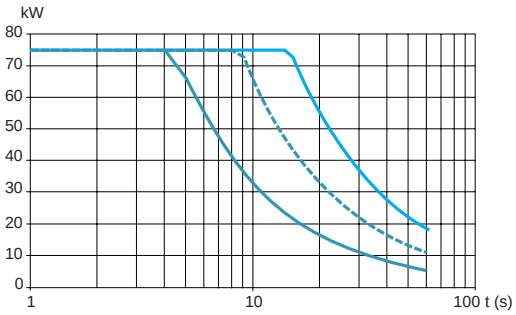
VW3 A78701H (P continuous = 0.79 kW)



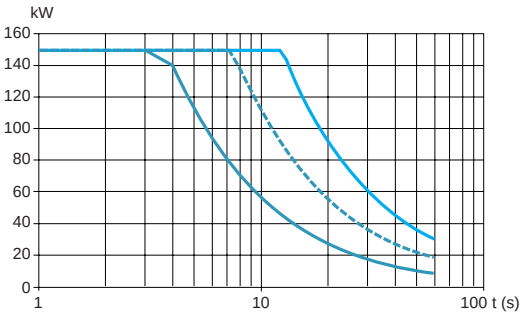
VW3 A78702H (P continuous = 2.8 kW)



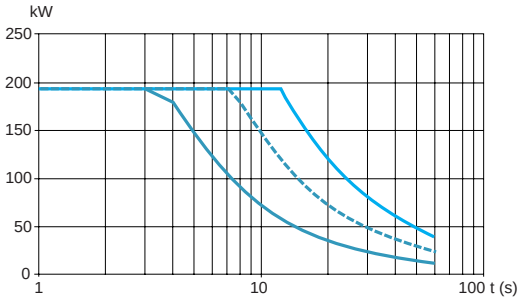
VW3 A78703H (P continuous = 5.5 kW)



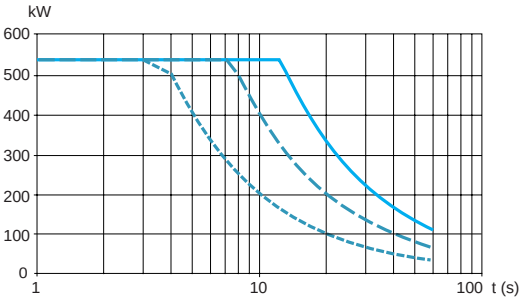
VW3 A78704H (P continuous = 9.4 kW)



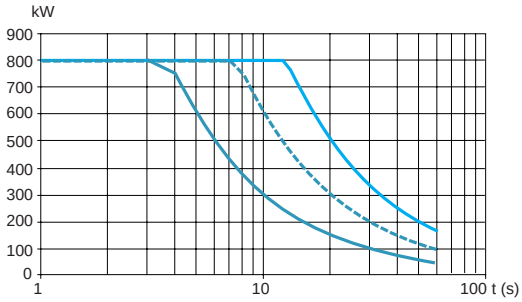
VW3 A78705H (P continuous = 12 kW)



VW3 A78706H (P continuous = 34 kW)



VW3 A78707H (P continuous = 50 kW)



P max (60 s cycle)
P max (120 s cycle)
P max (200 s cycle)

Variable speed drives for asynchronous motors

Altivar 78

Option: I/O extension cards

Presentation

The Altivar 78 variable speed drive is designed to take a total of 5 option cards, including fieldbus cards, in 5 slots labelled A to E on the control panel.

Environment

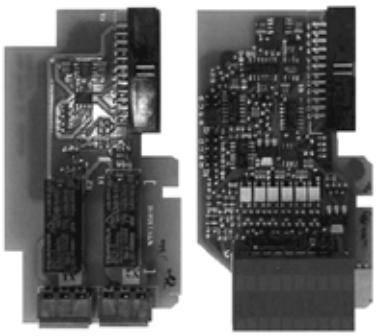
Ambient air temperature around the device	Operation	**°C**	- 10…+ 55
	Storage	**°C**	- 40…+ 60
Maximum relative humidity		**%**	< 95, without condensation
Maximum operating altitude		**m**	1000
Vibration resistance			0.5 gn at 9 to 200 Hz

Electrical characteristics

Analog inputs AI	AIV		0 to ± 10 V, R_i ≥ 200 kΩ, single-ended Resolution 10 bits/0.1%, accuracy ± 1% of the full scale (-10 to +10 V joystick control)
	AIC		0 (4) to 20 mA, R_i = 250 Ω, differential Resolution 10 bits/0.1%, accuracy ± 1% of the full scale
Analog outputs AO	AOV		0 (2) to 10 V, R_L ≥ 1kΩ, resolution 10 bits, accuracy ≤ ± 2%
	AOC		0 (4) to 20 mA, R_L< 500 Ω, resolution 10 bits/0.1%, accuracy ≤ ± 2%
Digital inputs DI	DC		Control voltage 24 V ⎓ state 0 if < 5 V, state 1 if > 11 V
	AC		Control voltage 42 to 240 V ∿ state 0 if < 33 V, state 1 if > 35 V
Auxiliary voltage	Output		24 V ⎓ (± 15%), max. 250 mA (total load from 24 V ⎓ external outputs, 150 mA max. from one card)
	Input		24 V ⎓ (± 10%, max. ripple voltage 100 mV RMS), max. 1 A In special applications where PLC-type functions are included in the control unit, the input can be used as an external auxiliary power supply for control cards, I/O extension cards and communication cards.
Output voltage			10 V 0 to +2%, max. 10 mA
Open collector output DO			10 mA, 48 V ⎓ maximum
Relay outputs RO			Switching capacity 24 V ⎓ / 8 A 1250 V ∿ / 8 A 125 V ⎓ / 0.4 A Max. direct current 2 A RMS Min. switched current 5 V/10 mA
Thermistor input TI			R_{trip} = 4.7 kΩ (PTC type)
Encoder control voltage			+ 5 V/+ 12 V/+ 15 V/+ 24 V (see schemes on page 40)
Encoder connections			Inputs, outputs (see schemes on page 40)

References

DF565074



VW3 A7820●

Description	Slot no.	Reference	Weight kg
6 DI, 1 DO, 2 AI, 1 AO, + 10, 24 V/EXT + 24 V	A	**VW3 A78201** *(1)*	0.200
2 RO (NO/NC)	B	**VW3 A78202** *(1)*	0.200
1 RO (NO/NC), 1 RO (NO), 1 thermistor input	B	**VW3 A78203** *(3)*	0.200
3 DI (RS 422 encoder), + 5 V + 15 V output	C	**VW3 A78204** *(2)* *(3)*	0.200
3 DI (10 to 24 V encoder), + 15 V + 24 V output	C	**VW3 A78205** *(2)* *(3)*	0.200
6 DI, 1 DO, 2 AI, 1 AO, + 10, 24 V/EXT + 24 V, all I/O are electrically isolated	A	**VW3 A78206** *(3)*	0.200
Redundant encoder card with two encoder inputs (used as master/slave), + 15 V or + 24 V range	C	**VW3 A78207** *(2)* *(3)*	0.200
1 + 24 V/Ext + 24 V, 3 100 channels	B, C, D, E	**VW3 A78208** *(3)*	0.200
1 RO (NO), 5 digital inputs 42 to 240 V ∿	B, C, D, E	**VW3 A78209** *(3)*	0.200
2 isolated AO, 1 AI	B, C, D, E	**VW3 A78210**	0.200
3 RO (NO)	B, C, D	**VW3 A78211**	0.200

*(1) Cards **VW3 A78201** and **A78202** are integrated in the Altivar 78 variable speed drive.*
*(2) For Flux Vector Control applications in closed loop mode, use cards **VW3 A78204**, **A78205** and **A78207** with an ATV 78●F●●●● variable speed drive (see page 10).*
*(3) To order a reinforced version for specific environmental conditions, add **S337** to the reference. Example: **VW3 A78201** becomes **VW3 A78201S337**.*

Schemes:
pages 40 and 41

Variable speed drives for asynchronous motors

Altivar 78

Option: Communication cards

Presentation

The Altivar 78 variable speed drive can be connected to various communication networks (Modbus, DeviceNet, Profibus DP, LonWorks and CANopen) using a communication card or communication module.

Functions common to all communication cards:

- Control (accessible in read/write mode): start/stop, speed reference, fault reset, etc.
- Monitoring (accessible in read-only mode): drive status register, motor speed, motor current, logic I/O status register, fault register, etc.
- Authorization of local control (via terminals)
- Configuration (accessible in read/write mode): all variable speed drive parameter registers
- Adjustment (accessible in read/write mode): ramp time, thermal protection, speed range, current limit, etc.

Characteristics

Protocol	Modbus	DeviceNet	Profibus DP	LonWorks	N2	CANopen
Number of devices on network	31	64	127	64	32	127
Transmission speed	0.3 - 38.4 kbps	125 - 500 kbps	0.96 - 12 Mbps	87 kBaud	9.6 kbps	0.01 - 1 Mbps
Physical interface	RS 485 half-duplex	RS 485 CANopen	RS 485 half-duplex	Twisted pair	Twisted pair	CANopen (ISO 11898)

References

533828

VW3 A78307

Description	Slot number	Reference *(1)*	Weight kg
Modbus: connected to fieldbus via a 5-pin connector (N2 possible)	D, E	**VW3 A78306**	0.300
Profibus DP: connected to fieldbus via a 5-pin connector	D, E	**VW3 A78307**	0.300
CANopen slave: connected to fieldbus via a 5-pin connector	D, E	**VW3 A78308**	0.300
DeviceNet: connected to fieldbus via a 5-pin connector	D, E	**VW3 A78309**	0.300
LonWorks: connected to fieldbus via a 3-pin connector	D, E	**VW3 A78312**	0.300

*(1) To order a reinforced version for specific environmental conditions, add **S337** to the reference.*
*Example: **VW3 A78306** becomes **VW3 A78306S337***

Variable speed drives for asynchronous motors
Altivar 78

Table showing possible combinations for Altivar 78 variable speed drives

Motor	Altivar 78 variable speed drive for high torque or standard torque applications	Options *(1)*			
		dv/dt filter	Braking resistor - cycle times: 60/120/200 s *(2)*		Braking resistor connection kit
			Braking time 5 s	Braking time 10 s	
3-phase power supply: 525 to 690 V 50/60 Hz	**ATV 78●U22Y, ●FU22Y**	VW3 A78601C	VW3 A78701L	VW3 A78701H	–
	ATV 78●U30Y, ●FU30Y	VW3 A78601C	VW3 A78701L	VW3 A78701H	–
	ATV 78●U40Y, ●FU40Y	VW3 A78601C	VW3 A78701L	VW3 A78701H	–
	ATV 78●U55Y, ●FU55Y	VW3 A78601C	VW3 A78701L	VW3 A78701H	–
	ATV 78●U75Y, ●FU75Y	VW3 A78601C	VW3 A78701L	VW3 A78701H	–
	ATV 78●D11Y, ●FD11Y	VW3 A78601C	VW3 A78702L	VW3 A78702H	–
	ATV 78●D15Y, ●FD15Y	VW3 A78601C	VW3 A78702L	VW3 A78702H	–
	ATV 78●D18Y, ●FD18Y	VW3 A78602C	VW3 A78702L	VW3 A78702H	–
	ATV 78●D22Y, ●FD22Y	VW3 A78602C	VW3 A78702L	VW3 A78702H	–
	ATV 78●D30Y, ●FD30Y	VW3 A78602C	VW3 A78703L	VW3 A78703H	–
	ATV 78●D37Y, ●FD37Y	VW3 A78602C	VW3 A78703L	VW3 A78703H	–
	ATV 78●D45Y, ●FD45Y	VW3 A78603C	VW3 A78704L	VW3 A78704H	VW3 A78810
	ATV 78●D55Y, ●FD55Y	VW3 A78603C	VW3 A78704L	VW3 A78704H	VW3 A78810
	ATV 78●D75Y, ●FD75Y	VW3 A78604C	VW3 A78704L	VW3 A78704H	VW3 A78810
	ATV 78●D90Y, ●FD90Y	VW3 A78604C	VW3 A78705L	VW3 A78705H	VW3 A78810
	ATV 78●C11Y, ●FC11Y	VW3 A78605C	VW3 A78705L	VW3 A78705H	VW3 A78810
	ATV 78●C13Y, ●FC13Y	VW3 A78605C	VW3 A78705L	VW3 A78705H	VW3 A78810
	ATV 78●C16Y, ●FC16Y	VW3 A78605C	VW3 A78705L	VW3 A78705H	VW3 A78810
	ATV 780C20Y, 0FC20Y	VW3 A78606C	VW3 A78706L	VW3 A78706H	–
	ATV 780C25Y, 0FC25Y	VW3 A78607C	VW3 A78706L	VW3 A78706H	–
	ATV 780C31Y, 0FC31Y	VW3 A78608C	VW3 A78706L	VW3 A78706H	–
	ATV 780C35Y, 0FC35Y	VW3 A78609C	VW3 A78707L	VW3 A78707H	–
	ATV 780C45Y, 0FC45Y	VW3 A78609C	VW3 A78707L	VW3 A78707H	–
	ATV 780C50Y, 0FC50Y	VW3 A78609C	VW3 A78707L	VW3 A78707H	–
	ATV 780C56Y, 0FC56Y	VW3 A78610C	2 x VW3 A78706L	2 x VW3 A78706H	–
	ATV 780C63Y, 0FC63Y	VW3 A78610C	2 x VW3 A78706L	2 x VW3 A78706H	–
	ATV 780C71Y, 0FC71Y	VW3 A78610C	2 x VW3 A78706L	2 x VW3 A78706H	–
	ATV 780C80Y, 0FC80Y	VW3 A78611C	–	–	–
	ATV 780C90Y, 0FC90Y	VW3 A78611C	–	–	–
	ATV 780M10Y, 0FM10Y	VW3 A78611C	–	–	–
	ATV 780M13Y, 0FM13Y	VW3 A78612C	–	–	–
Pages	10 and 11	16	19		19

(1) Line chokes are supplied with Altivar 78 variable speed drives (see pages 14 and 15).
(2) For special applications such as hoisting, please refer to the curves on pages 20 and 21.

	I/O extension card	Communication card	Remote mounting kit for programming terminal	PC cable	IP 54 kit (NEMA type 12)	Kit for flush-mounting in a dust and damp proof enclosure
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	VW3 A78801	VW3 A78806
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	VW3 A78801	VW3 A78806
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	VW3 A78801	VW3 A78806
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	VW3 A78801	VW3 A78806
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	VW3 A78801	VW3 A78806
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	VW3 A78801	VW3 A78806
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	VW3 A78801	VW3 A78806
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	VW3 A78801	VW3 A78806
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	VW3 A78801	VW3 A78806
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	VW3 A78807
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	VW3 A78807
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	VW3 A78808
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	VW3 A78808
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	VW3 A78808
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	VW3 A78809
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	VW3 A78809
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	VW3 A78809
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	VW3 A78809
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	VW3 A782●●	VW3 A783●●	VW3 A7810●	VW3 A78332	–	–
	24	25	12	12	12	13

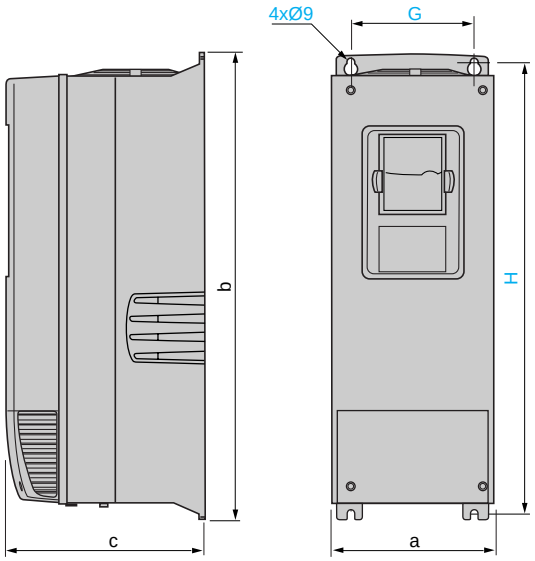
Variable speed drives for asynchronous motors

Altivar 78

Variable speed drives

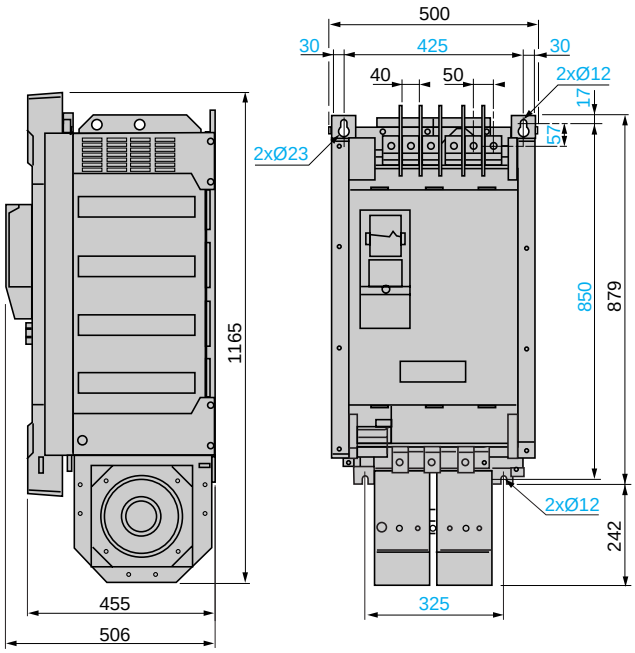
Variable speed drives

ATV 78●(F)U22Y to ATV 78●(F)C16Y (with integrated line choke)

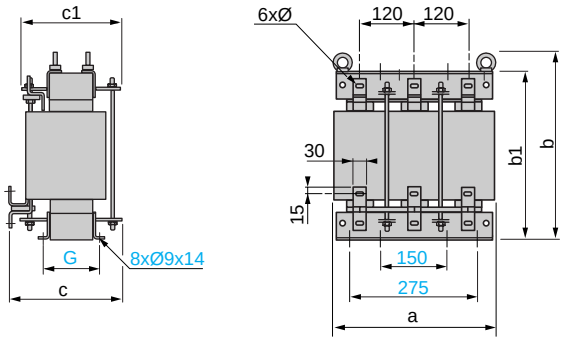


ATV 78●, ATV 78●F	a	b	c	G	H
U22Y…D22Y	195	558	237	148	541
D30Y, D37Y	237	630	257	190	614
D45Y…D75Y	289	755	344	255	732
D90Y…C16Y	480	1150	362	400	1120

ATV 780(F)C20Y to ATV 780(F)C31Y (line choke supplied with variable speed drive but not integrated)



Line choke



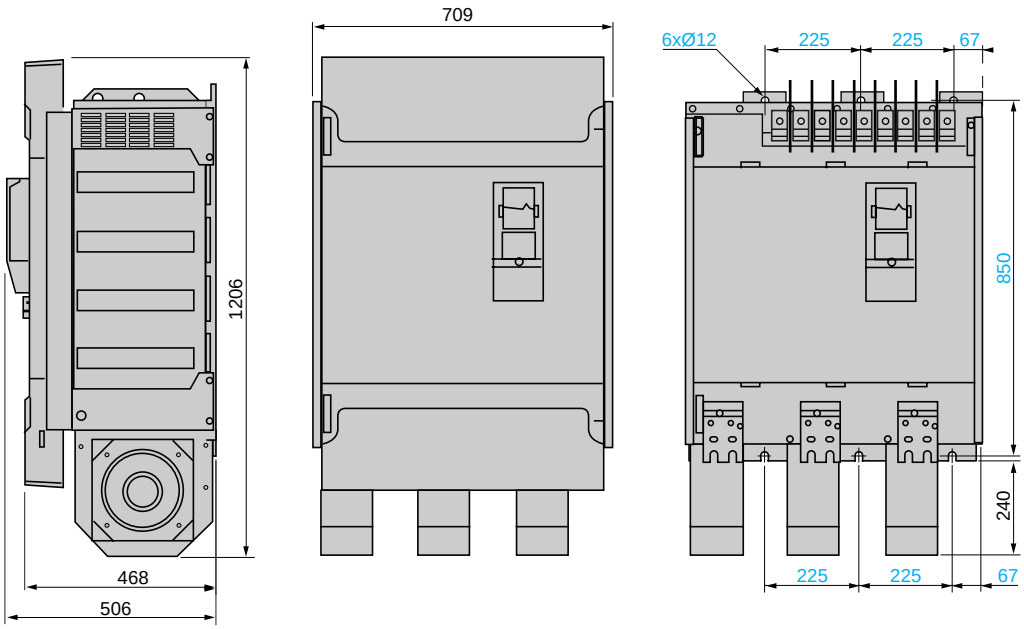
For ATV 78 drives	a	b	b1	c	c1	G	Ø
0C20Y 0FC20Y	354	357	319	230	206	108	9x14
0C25Y, 0C31Y 0FC25Y, 0FC31Y	350	421	383	262	238	140	11x15

Presentation: pages 2 and 3
Characteristics: pages 6 to 9
References: pages 10 and 11
Schemes: pages 40 and 41

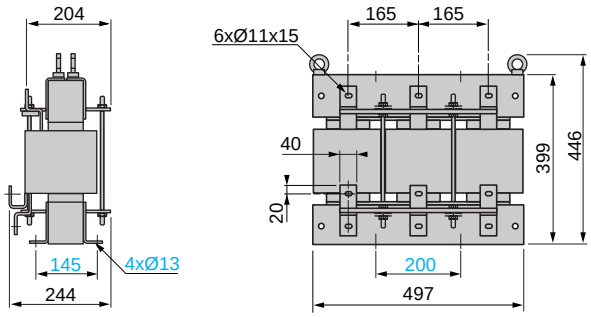
Variable speed drives (continued)

ATV 780(F)C35Y to ATV 780(F)C50Y (line choke supplied with variable speed drive but not integrated)

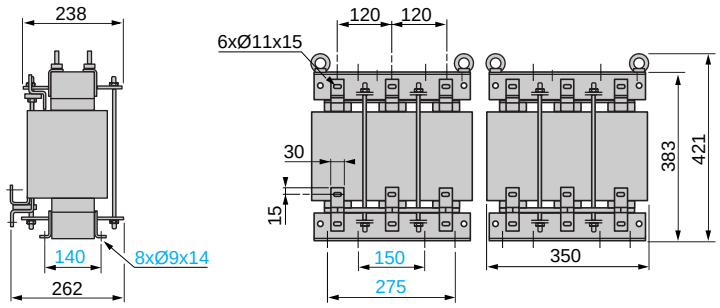
Without terminal cover



Line choke for ATV 780(F)C35Y and ATV 780(F)C45Y variable speed drives



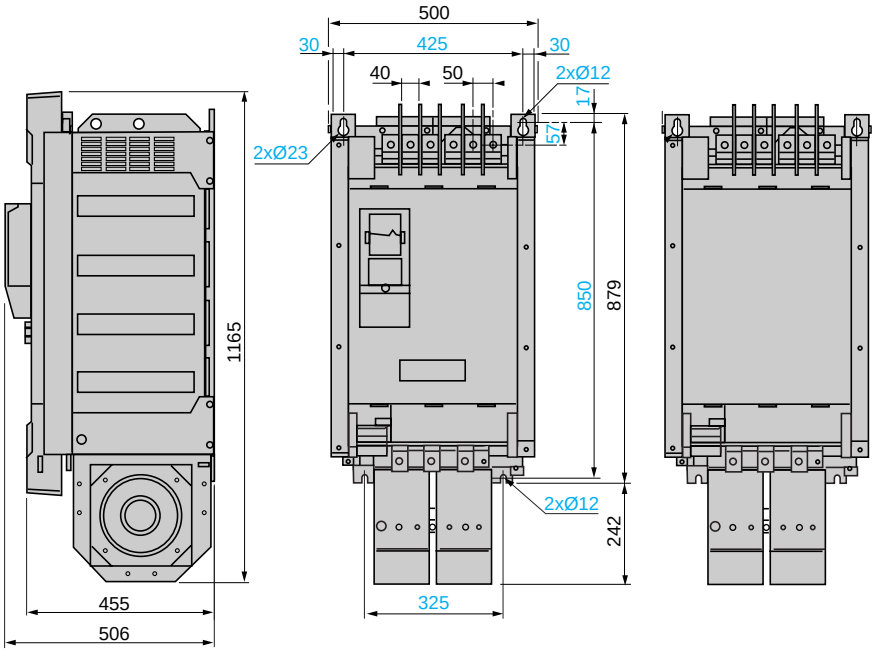
Line choke for ATV 780(F)C50Y variable speed drives *(1)*



(1) Two line chokes supplied with the drive.

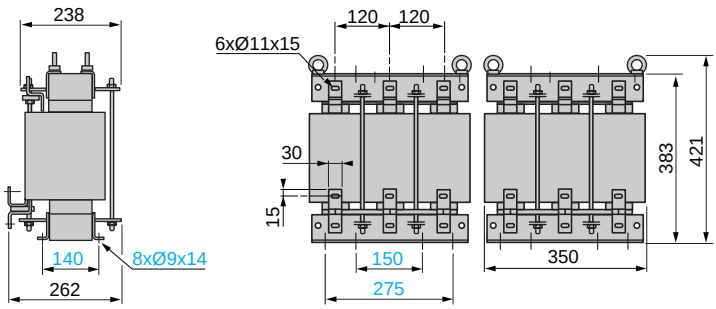
Variable speed drives (continued)

ATV 780(F)C56Y to ATV 780(F)C71Y *(1)* **(line choke supplied with variable speed drive but not integrated)**



(1) Two power supply units and one control unit supplied with the drive.

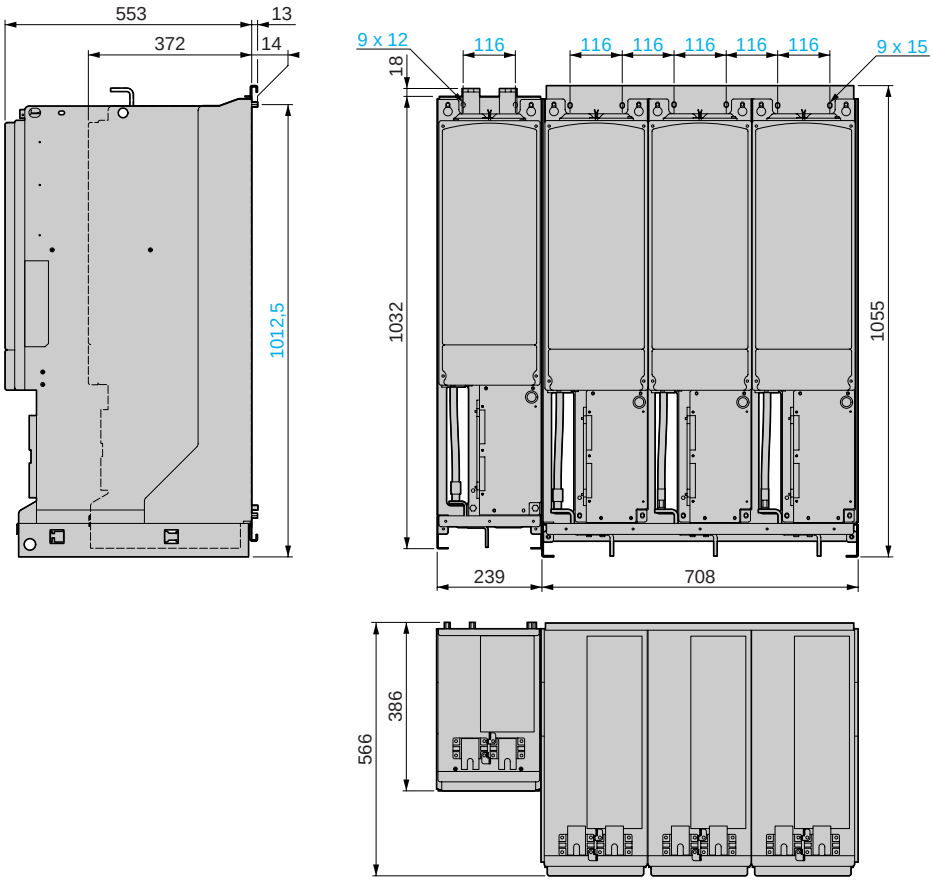
Line choke *(1)*



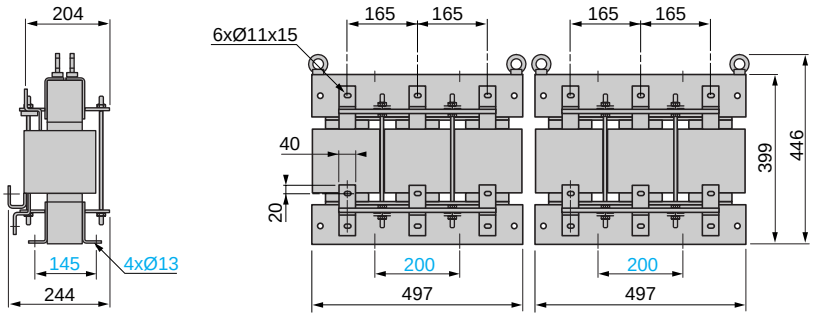
(1) Two line chokes supplied with the drive.

Variable speed drives (continued)

ATV 780(F)C80Y to ATV 780(F)M10Y (line choke supplied with variable speed drive but not integrated)

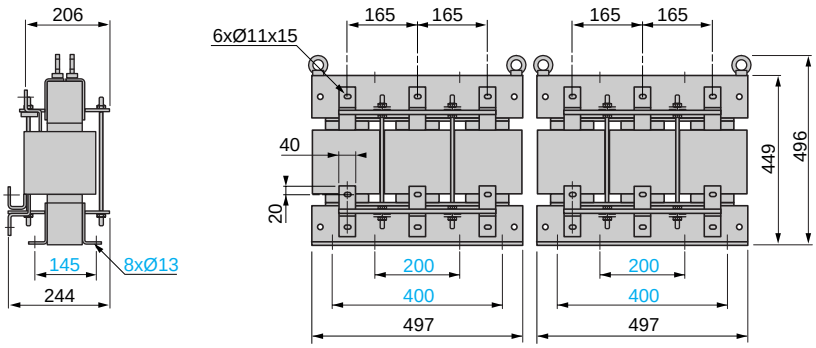


Line choke for ATV 780(F)C80Y and ATV 780(F)C90Y variable speed drives *(1)*



(1) Two line chokes supplied with the drive.

Line choke for ATV 780(F)M10Y variable speed drives



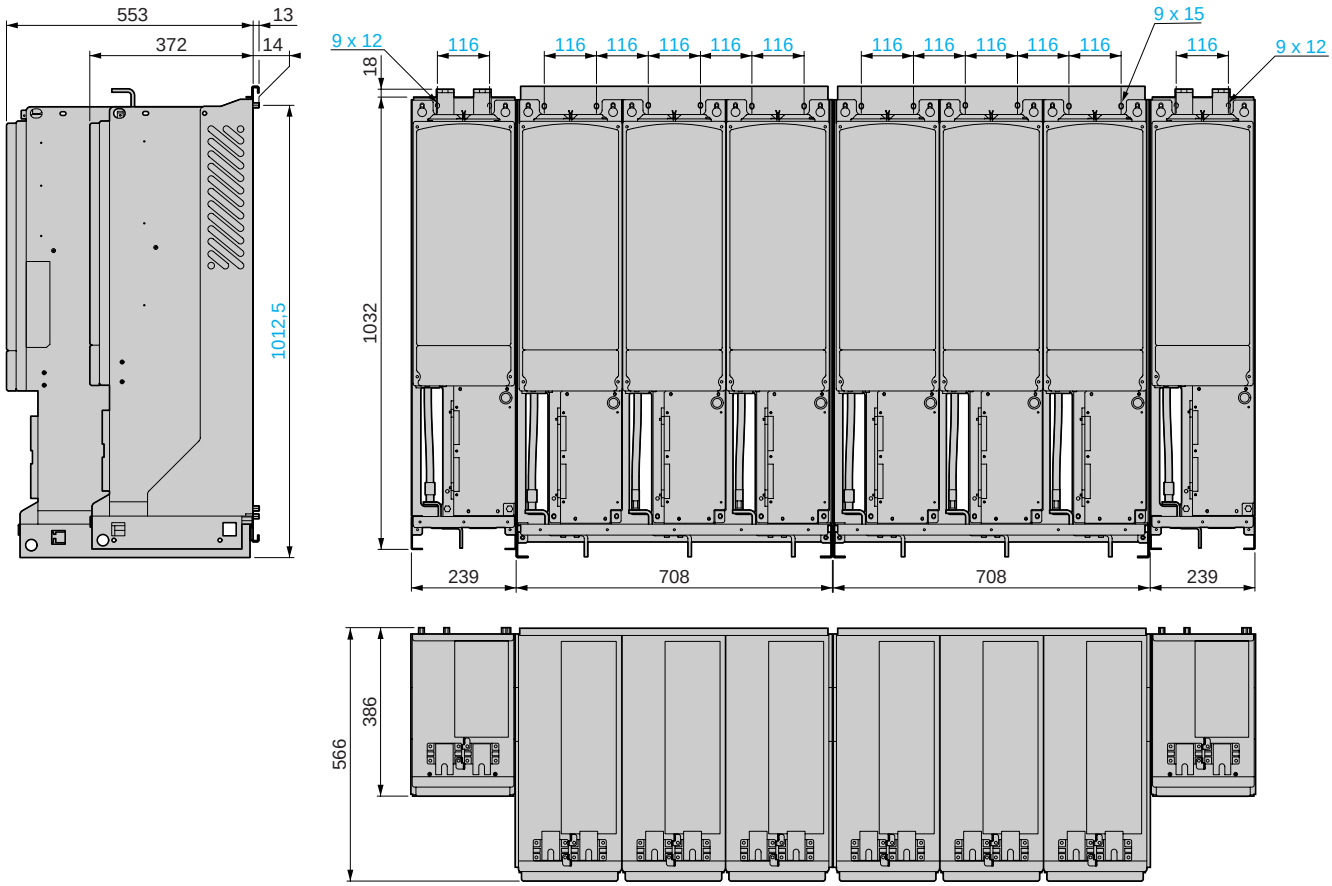
Variable speed drives for asynchronous motors

Altivar 78

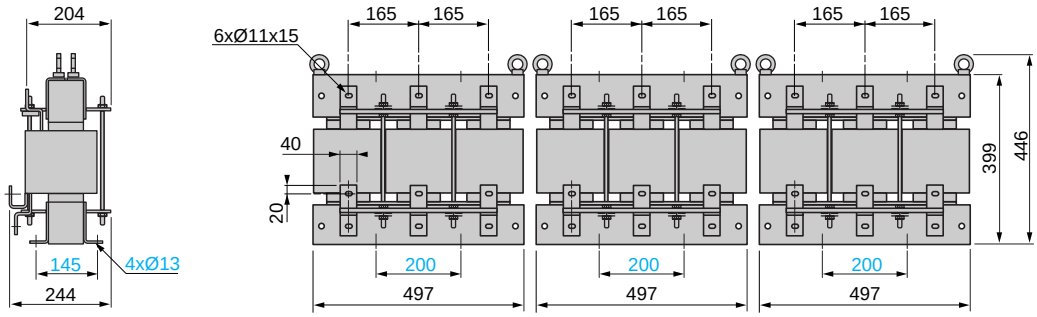
Variable speed drives, remote mounting kit for programming terminal

Variable speed drives (continued)

ATV 780(F)M13Y (line choke supplied with variable speed drive but not integrated)



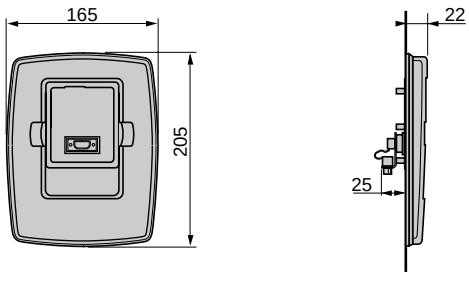
Line choke (1)



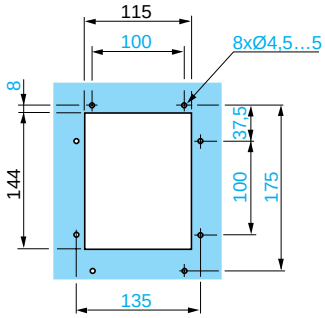
(1) Three line chokes supplied with the drive.

Remote mounting kit for programming terminal

VW3 A78102 and VW3 A78103



Cutouts and drill holes



Presentation: pages 2 and 3
Characteristics: pages 6 to 9
References: pages 10 and 11
Schemes: pages 40 and 41

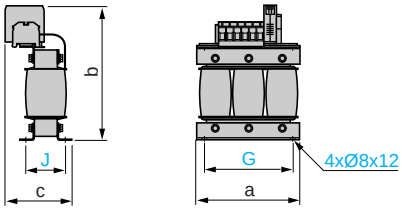
Variable speed drives for asynchronous motors

Altivar 78

dv/dt filters

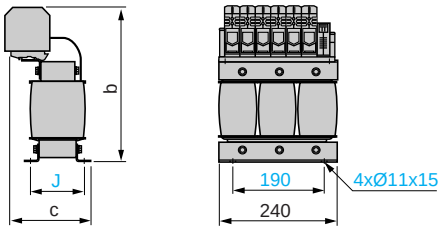
dv/dt filters

VW3 A78601C to VW3 A78603C



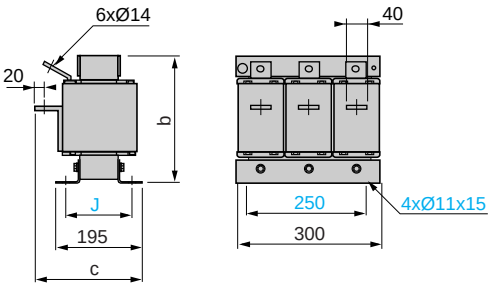
VW3	a	b	c	G	J
A78601C	155	220	130	130	72
A78602C	190	250	130	170	78
A78603C	210	280	135	180	81

VW3 A78604C and VW3 A78605C



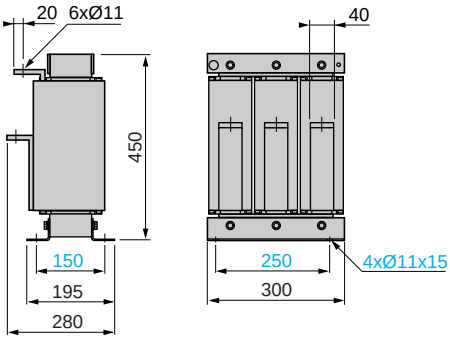
VW3	b	c	J
A78604C	300	160	105
A78605C	320	185	125

VW3 A78606C to VW3 A78608C

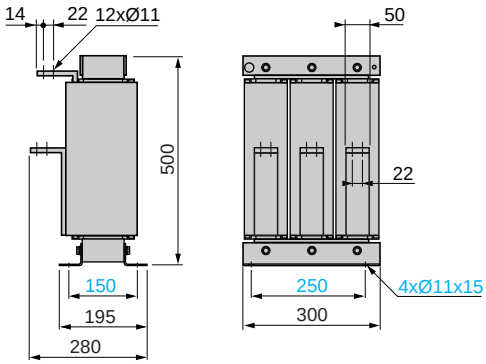


VW3	b	c	J
A78606C	270	235	125
A78607C	270	250	150
A78608C	330	250	150

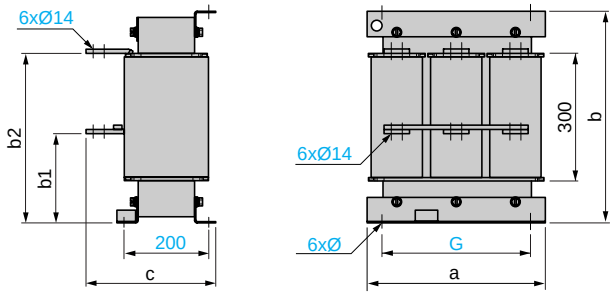
VW3 A78609C



VW3 A78610C



VW3 A78611C and VW3 A78612C



VW3	a	b	b1	b2	c	G	Ø
A78611C	420	500	210	400	310	350	11x15
A78612C	480	599	285	510	325	400	13x18

Presentation: page 16

References: page 16

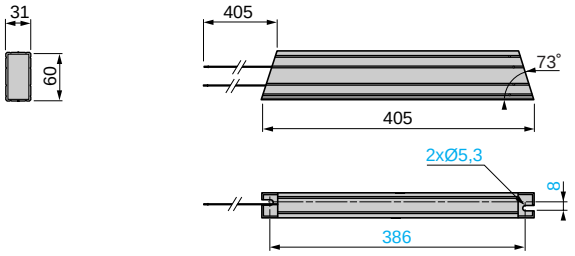
Variable speed drives for asynchronous motors

Altivar 78

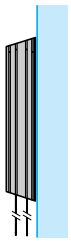
Braking resistors

Braking resistors: braking time 5 s

VW3 A78701L

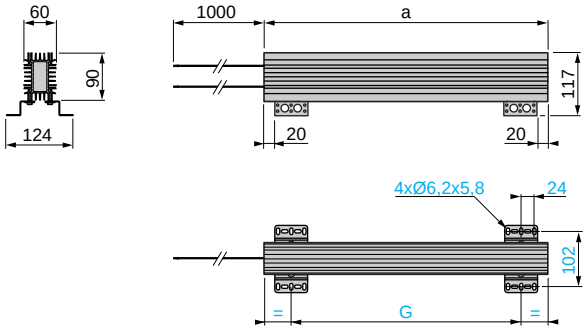


Mounting recommendations *(1)*

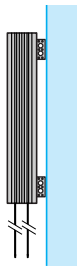


(1) For vertical mounting, the cables must be located at the bottom.

VW3 A78702L and VW3 A78703L



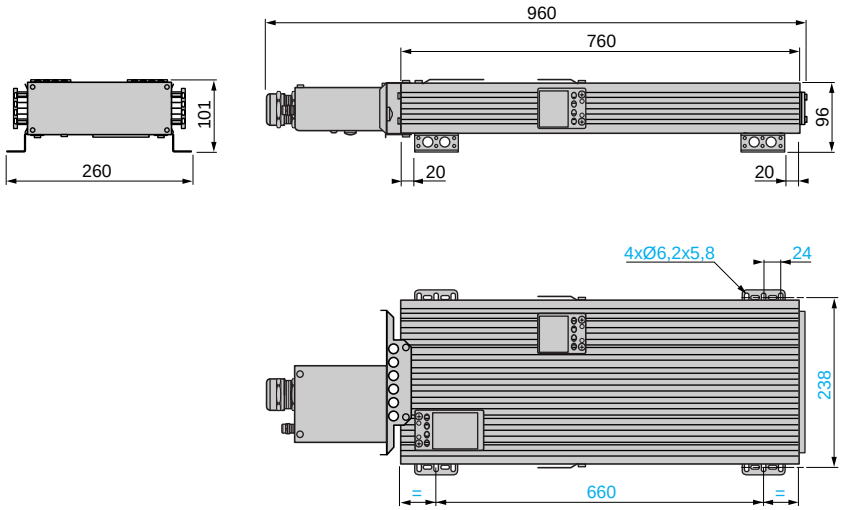
Mounting recommendations *(1)*



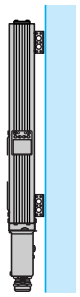
VW3	a	G
A78702L	426	326
A78703L	725	626

(1) For vertical mounting, the cables must be located at the bottom.

VW3 A78704L



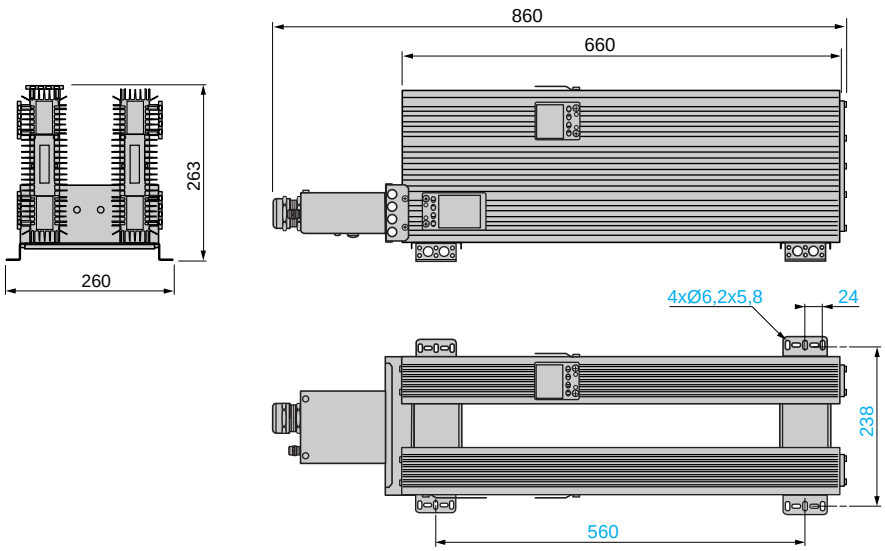
Mounting recommendations *(1)*



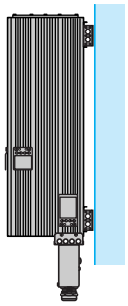
(1) For vertical mounting, the cables must be located at the bottom.

Braking resistors: braking time 5 s (continued)

VW3 A78705L

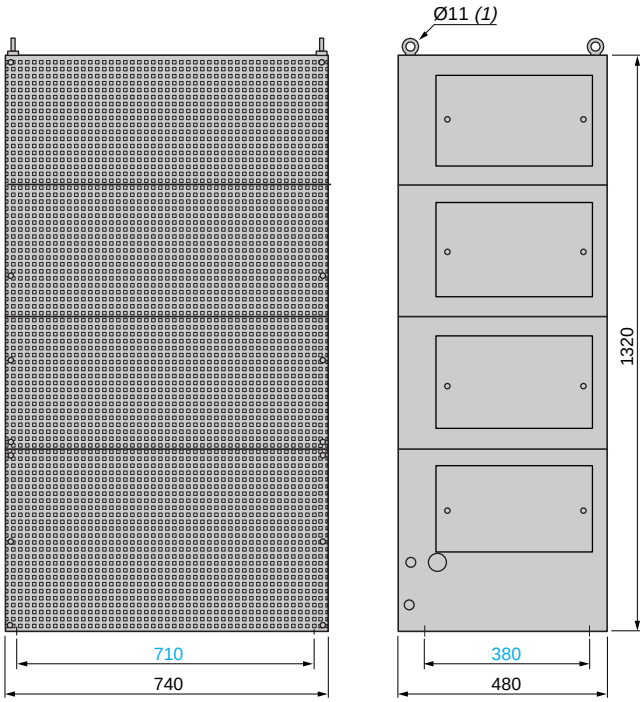


Mounting recommendations *(1)*



(1) For vertical mounting, the cables must be located at the bottom.

VW3 A78706L and VW3 A78707L



(1) Lifting eye bolt.

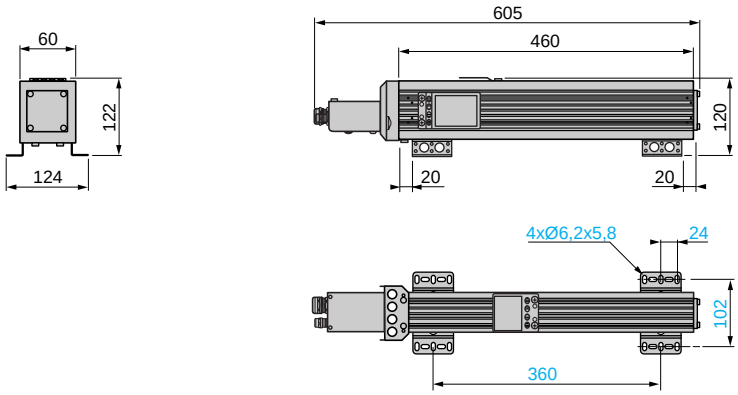
Variable speed drives for asynchronous motors

Altivar 78

Braking resistors

Braking resistors: braking time 10 s

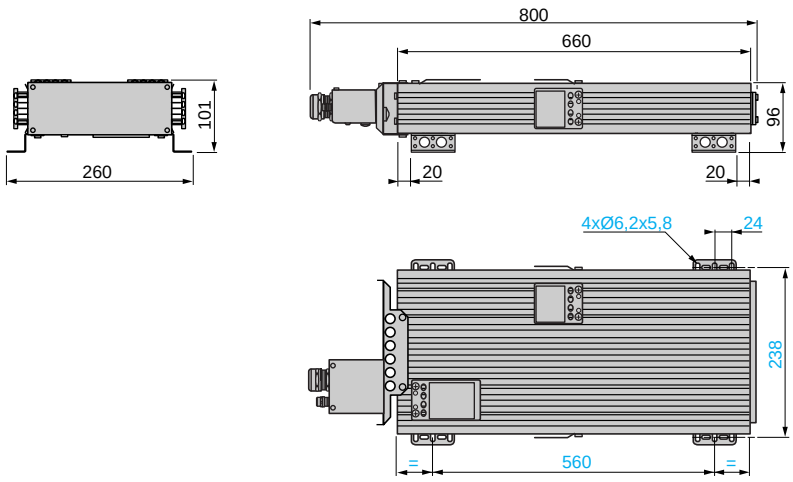
VW3 A78701H



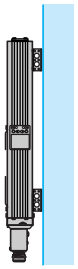
Mounting recommendations *(1)*

(1) For vertical mounting, the cables must be located at the bottom.

VW3 A78702H

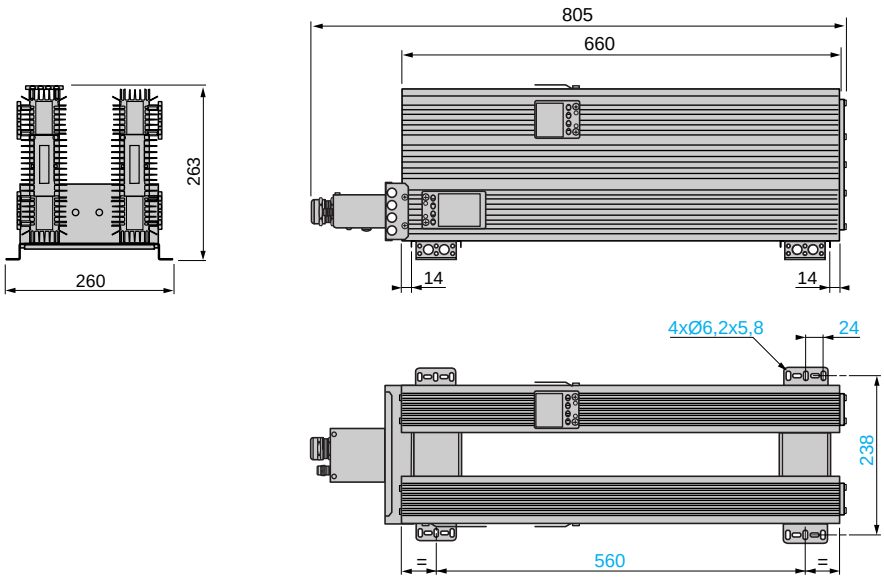


Mounting recommendations *(1)*

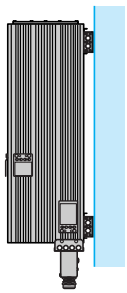


(1) For vertical mounting, the cables must be located at the bottom.

VW3 A78703H



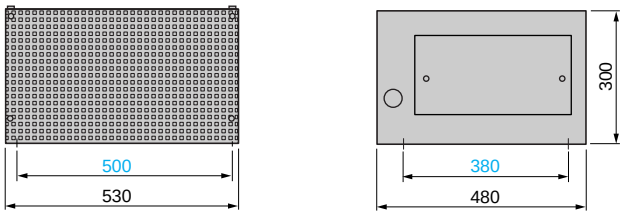
Mounting recommendations *(1)*



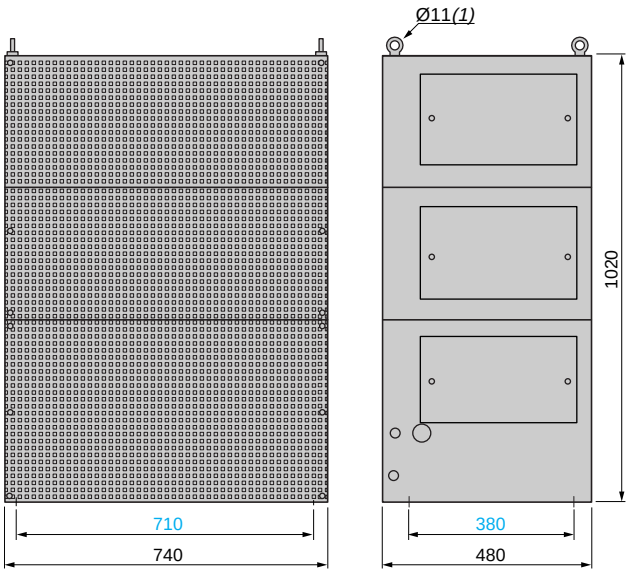
(1) For vertical mounting, the cables must be located at the bottom.

Braking resistors: braking time 10 s (continued)

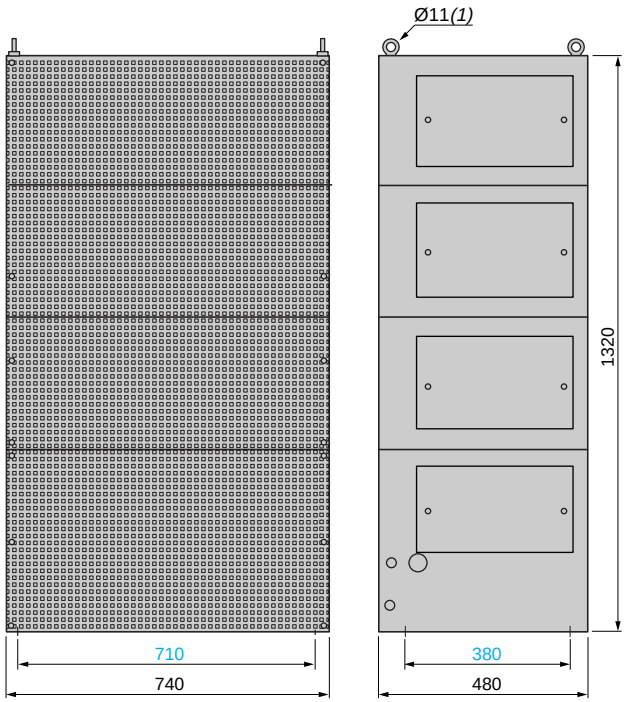
VW3 A78704H and VW3 A78705H



VW3 A78706H



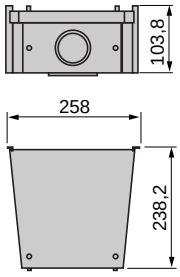
VW3 A78707H



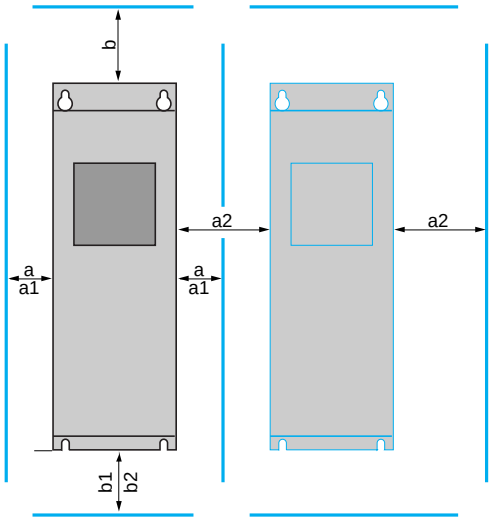
(1) Lifting eye bolt.

Braking resistor connection kit for ATV 78●(F)D45Y to ●(F)C16Y

VW3 A78810



Variable speed drives for asynchronous motors
Altivar 78



Mounting recommendations

Mounting recommendations for ATV 78●(F)U22Y to ●(F)C16Y variable speed drives

- Observe the minimum clearance space shown opposite when installing
- Install the Altivar 78 in a vertical position
- Make provision for evacuation of hot air to the outside of the enclosure
- Make provision for an air inlet on the enclosure door
- Pay attention to the ambient temperature (see characteristics on page 6)

Avoid harmful environments such as those with high temperatures or humidity levels and those containing dust, dirt or corrosive gases. The location must be well ventilated and away from direct sunlight.

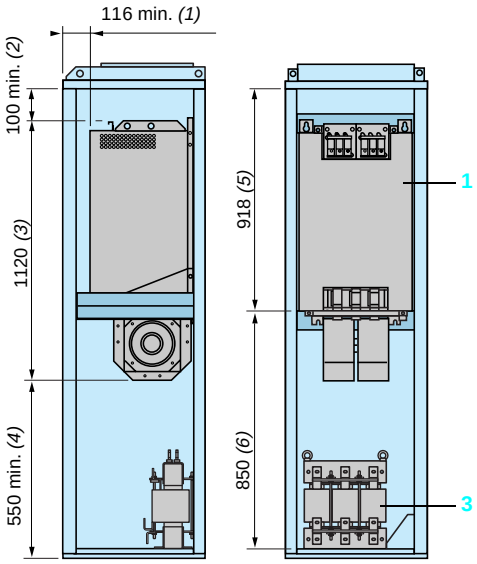
If several units are mounted one above the other, the minimum clearance required is equal to b + b1 (b + b2), see figure opposite.

For variable speed drives	a mm	a1 mm	a2 mm	b mm	b1 mm	b2 mm
ATV 78●U22Y…●D22Y ATV 78●FU22Y…●FD22Y	30	–	20	160	80	–
ATV 78●D30Y and ●D37Y ATV 78●FD30Y and ●FD37Y	80	–	80	300	100	–
ATV 78●D45Y…●D75Y ATV 78●FD45Y…●FD75Y	80	150	80	300	200	–
ATV 78●D90Y…●C16Y ATV 78●FD90Y…●FC16Y	50	–	80	400	250	350

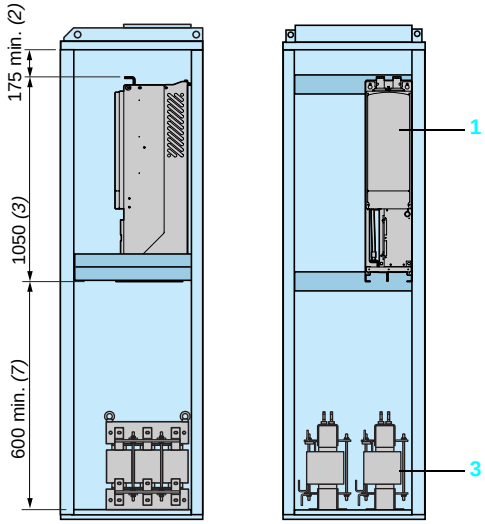
a: Clearance around the variable speed drive (see also a1 and a2)
a1: Clearance needed on either side of the variable speed drive for changing the fan(s) without disconnecting the motor cables
a2: Distance between variable speed drives or between drive and enclosure
b: Clearance above the variable speed drive
b1: Clearance below the variable speed drive
b2: Clearance needed below the variable speed drive for changing the fan(s)

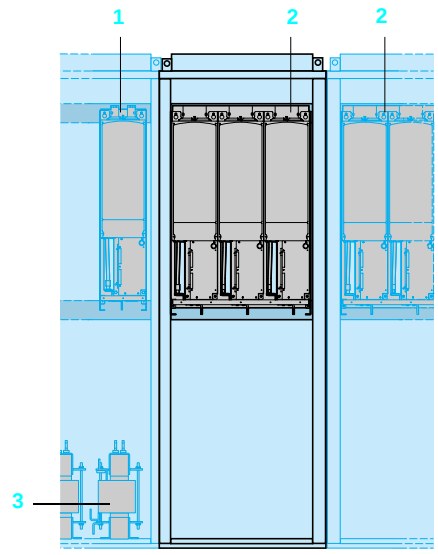
Air flow rate depending on the drive rating

For variable speed drives	Flow rate m^3/h
ATV 78●U22Y…●D22Y ATV 78●FU22Y…●FD22Y	425
ATV 78●D30Y and ●D37Y ATV 78●FD30Y and ●FD37Y	425
ATV 78●D45Y…●D75Y ATV 78●FD45Y…●FD75Y	650
ATV 78●D90Y…●C16Y ATV 78●FD90Y…●FC16Y	1300



ATV 780(F)C20Y to ATV 780(F)C71Y





ATV 780(F)C80Y to ATV 780(F)M13Y

Mounting recommendations for ATV 780(F)C20Y to ATV 780(F)M13Y variable speed drives

Drives ATV 780(F)C20Y to ATV 780(F)M13Y have IP 00 degree of protection (open type).

Installing the line choke

For ATV 780(F)C20Y to ATV 780(F)C71Y drives

The recommended location for the line choke is the bottom left of the enclosure, close to the rear panel.
Fasten the line choke to the mounting plate or use mounting rails.

For ATV 780(F)C80Y to ATV 780(F)M13Y drives

The recommended location for the line choke is the bottom of the control unit enclosure 1, close to the rear panel.
Pay particular attention to the mounting of the line chokes where a 600 mm enclosure is used in the case of ATV 780(F)C80Y to ATV 780(F)M10Y drives or an 800 mm enclosure in the case of ATV 780(F)M13Y drives.
Fasten the line choke to the mounting plate or use mounting rails.

Nota : *For ATV 780(F)C50Y to ATV 780(F)M10Y drives fitted with two line chokes in parallel or ATV 780(F)M13Y drives fitted with three line chokes in parallel, the chokes must be wired in the same way. If the chokes are wired differently, the variable speed drive may be damaged.*

Mounting the drive

ATV 780(F)C20Y to ATV 780(F)C71Y drives

The drives are supplied with a separate line choke 3, a control unit 1 and a mounting plate, together with connection cables.

We recommend mounting the Altivar 78 drives on rails to facilitate future servicing work.
- Fasten the mounting rails to the sides of the enclosure at a minimum distance of 910 mm from the top of the enclosure.
- Leave a minimum clearance of 50 mm between the rails and the side of the enclosure to allow the circulation of air for cooling.

ATV 780(F)C80Y to ATV 780(F)M13Y drives

The drives are supplied with a control unit 1, power supply unit 2 and line chokes 3 (not integrated).

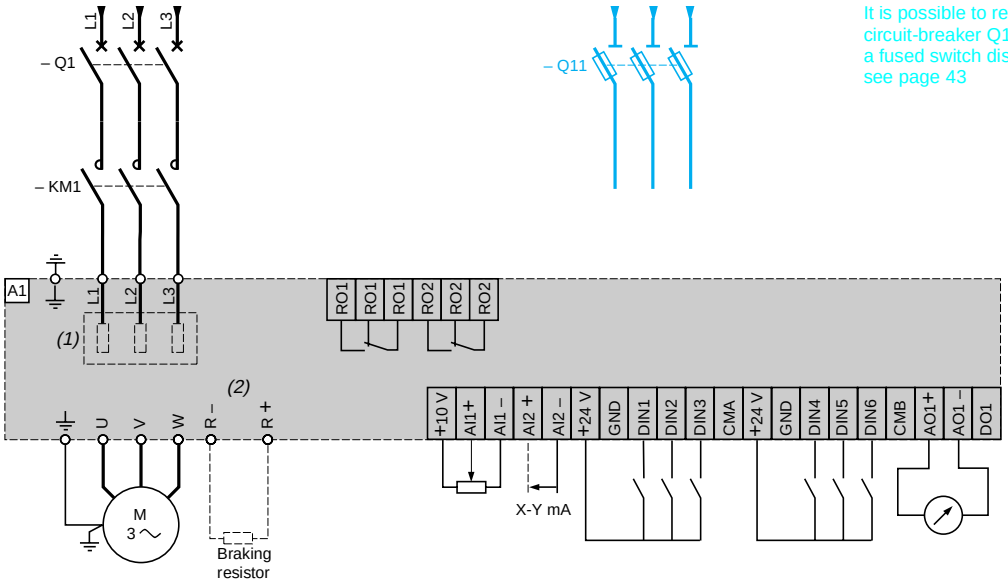
We recommend mounting the Altivar 78 drives on rails to facilitate future servicing work.

Note: *Drives ATV 780(F)C56Y to ATV 780(F)M13Y can be mounted side by side, with no clearance.*

(1) Minimum distance from the enclosure door, to allow the control unit to be installed in front of the power module
(2) Minimum distance from the top of the enclosure, to allow room for power cables and fuses
(3) Drive height
(4) Minimum distance from the bottom of the enclosure if the line choke is installed at the bottom of the enclosure. If the line choke is installed in another location, the distance must not be less than 290 mm. The clearance needed below the variable speed drive for changing the fan(s) must not be less than 70 mm
(5) Minimum distance between the mounting rails and the top of the enclosure
(6) Minimum distance between the mounting rails and the bottom of the enclosure. If the line choke is not installed in the bottom of the enclosure, the distance must not be less than 590 mm
(7) Minimum distance from the bottom of the enclosure if the line choke is installed at the bottom of the enclosure. If the line choke is installed in another location, the distance must not be less than 300 mm

Variable speed drives for asynchronous motors
Altivar 78

Wiring diagram for ATV 78●(F)U22Y to ATV 780(F)M13Y (3-phase supply voltage: 525 to 690 V)



It is possible to replace circuit-breaker Q1 with a fused switch disconnector Q11, see page 43

*(1) The line choke is integrated in drives **ATV 78●(F)U22Y** to **●(F)C16Y.** It is supplied with variable speed drives **ATV 780(F)C20Y** to **ATV 780(F)M13Y**, but is not mounted inside the product.*

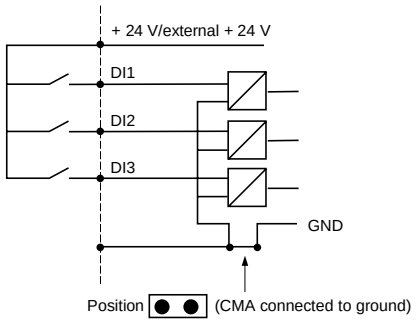
*(2) A dynamic braking resistor can be added to variable speed drives **ATV 78●(F)U22Y** to **●(F)C71Y**. If the braking resistor is fitted with a temperature-controlled switch, wire this switch to a logic input (e.g. DIN6) and assign this logic input to "External fault" (see the Programming Guide for more information).*

***Note:** To wire the I/O extension cards, **VW3 A78201** to **VW3 A78211**, please refer to the I/O option manual.*

Examples of recommended schemes

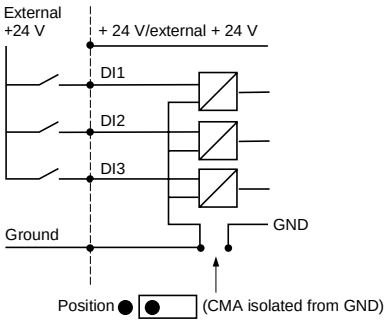
Connection of logic inputs

With internal + 24 V power supply

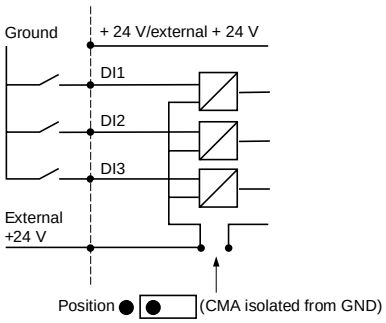


With external + 24 V power supply and CMA isolated from GND using the onboard jumper

Positive logic



Negative logic

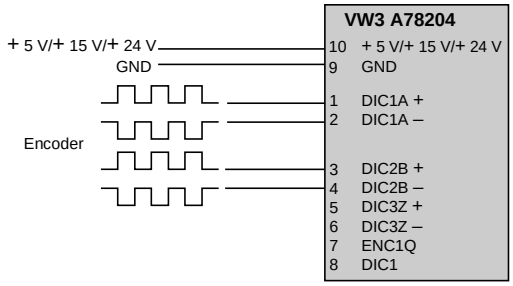


Examples of recommended schemes (continued)

Connection of encoders

Differential connection of TTL type encoder with internal or external + 5 V power supply

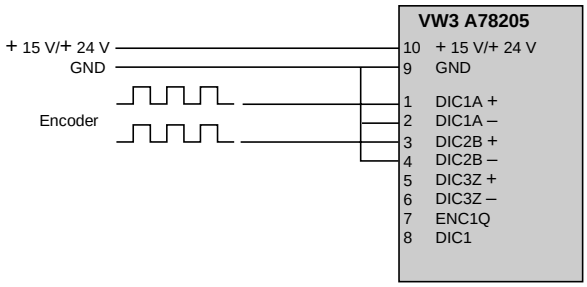
+ 5 V/+ 15 V/+ 24 V from the VW3 A78204 extension card or an external power supply *(1)*



(1) If an external power supply is used, connect the ground of the external supply to terminal 9 on the VW3 A78205 card and to the encoder ground.

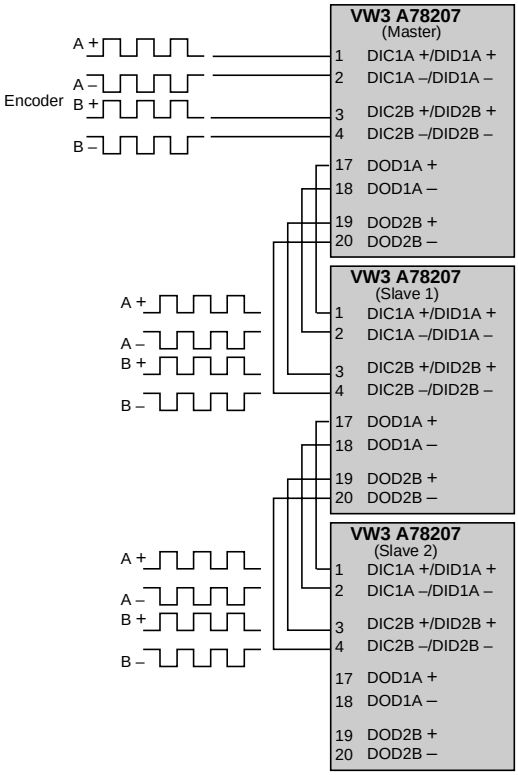
Single-ended connection of HTL type encoder (high-voltage transistor logic) (open source) with internal or external + 24 V power supply

+ 15 V/+ 24 V from the VW3 A78205 extension card or an external power supply *(1)*



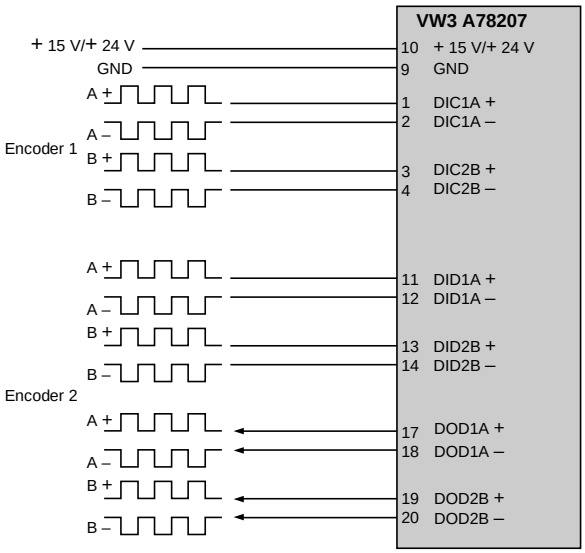
(1) If an external power supply is used, connect the ground of the external supply to terminal 9 on the VW3 A78205 card and to the encoder ground.

Connection of one encoder to three VW3 A78207 option cards



Connection of two encoders to one VW3 A78207 option card

+ 15 V/+ 24 V from the VW3 A78207 extension card



Variable speed drives for asynchronous motors

Altivar 78
Motor starters

Protection by circuit breaker

3-phase supply voltage: 525 to 690 V 50/60 Hz *(for 2.2 to 1300 kW or 2 to 1350 HP motors).*

Input current for applications		Circuit breaker	Contactor	Variable speed drive
High torque (150% Tn)	**Standard torque (110% Tn)**	**Reference** *(1)*	**Reference** *(2) (3)*	**Reference** *(4)*
A	**A**			
3	4.5	**GV2 P10**	**LC1 D09●●**	**ATV 78●U22Y, ●FU22Y**
4	5.5	**GV2 P10**	**LC1 D09●●**	**ATV 78●U30Y, ●FU30Y**
5	7.5	**GV2 P14**	**LC1 D09●●**	**ATV 78●U40Y, ●FU40Y**
7	10	**GV2 P14**	**LC1 D09●●**	**ATV 78●U55Y, ●FU55Y**
10	13	**GV2 P16**	**LC1 D09●●**	**ATV 78●U75Y, ●FU75Y**
13	18	**GV2 P21**	**LC1 D09●●**	**ATV 78●D11Y, ●FD11Y**
18	22	**GV2 P22**	**LC1 D09●●**	**ATV 78●D15Y, ●FD15Y**
22	27	**NS80HMA50**	**LC1 D18●●**	**ATV 78●D18Y, ●FD18Y**
27	34	**NS80HMA50**	**LC1 D25●●**	**ATV 78●D22Y, ●FD22Y**
34	41	**NS80HMA50**	**LC1 D32●●**	**ATV 78●D30Y, ●FD30Y**
41	52	**NS80HMA65**	**LC1 D40●●**	**ATV 78●D37Y, ●FD37Y**
52	62	**NS80HMA65**	**LC1 D65●●**	**ATV 78●D45Y, ●FD45Y**
62	80	**NS100●MA100**	**LC1 D80●●**	**ATV 78●D55Y, ●FD55Y**
80	100	**NS160●MA150**	**LC1 D80●●**	**ATV 78●D75Y, ●FD75Y**
100	125	**NS160●MA150**	**LC1 D80●●**	**ATV 78●D90Y, ●FD90Y**
125	144	**NS160●MA150**	**LC1 F115●●**	**ATV 78●C11Y, ●FC11Y**
144	170	**NS250●MA220**	**LC1 F115●●**	**ATV 78●C13Y, ●FC13Y**
170	208	**NS250●MA220**	**LC1 F185●●**	**ATV 78●C16Y, ●FC16Y**
208	261	**NS400●STR43ME**	**LC1 F265●●**	**ATV 780C20Y, 0FC20Y**
261	325	**NS400●STR43ME**	**LC1 F330●●**	**ATV 780C25Y, 0FC25Y**
325	385	**NS400●STR43ME**	**LC1 F400●●**	**ATV 780C31Y, 0FC31Y**
385	460	**NS630●STR43ME**	**LC1 F630●●**	**ATV 780C35Y, 0FC35Y**
460	502	**NS630●STR43ME**	**LC1 F630●●**	**ATV 780C45Y, 0FC45Y**
502	590	**NS630●STR43ME**	**LC1 F630●●**	**ATV 780C50Y, 0FC50Y**
590	650	**NS800 Micrologic 2.0**	**LC1 F800●●**	**ATV 780C56Y, 0FC56Y**
650	750	**NS800 Micrologic 2.0**	**LC1 F800●●**	**ATV 780C63Y, 0FC63Y**
650	820	**NS800 Micrologic 2.0**	**LC1 BM●●**	**ATV 780C71Y, 0FC71Y**
820	920	**NS1000 Micrologic 2.0**	**LC1 BM●●**	**ATV 780C80Y, 0FC80Y**
920	1030	**NS1250 Micrologic 2.0**	**LC1 BM●●**	**ATV 780C90Y, 0FC90Y**
1030	1180	**NS1250 Micrologic 2.0**	**LC1 BM●●**	**ATV 780M10Y, 0FM10Y**
1300	1500	**NS1600 Micrologic 2.0**	**LC1 BP●●**	**ATV 780M13Y, 0FM13Y**

(1) NS●●●: Product sold under the Merlin Gerin brand. Please consult your Regional Sales Office.
(2) The contact reference requires the addition of the code corresponding to the coil voltage. Please consult your Regional Sales Office.
(3) Composition of contactors:
LC1 D09 to LC1 D80: 3 or 4 poles + 1 "N/O" auxiliary contact + 1 "N/C" auxiliary contact
LC1 F115 to LC1 F800: 2 to 4 poles
LC1 B●: 1 to 4 poles
(4) In the reference, replace the ● with 2 for an IP 21 (NEMA type 1) drive or with 5 for an IP 54 (NEMA type 12) drive.

Variable speed drives for asynchronous motors
Altivar 78
Motor starters

Fuse protection

3-phase supply voltage: 525 to 690 V 50/60 Hz *(for 2.2 to 1300 kW or 2 to 1350 HP motors)*

Input current for applications		Fuse				Contactor	Variable speed drive
High torque	Standard torque	North America (600 V)		Europe (690 V)		Reference *(1) (2)*	Reference *(3)*
(150% Tn)	(110% Tn)	Fast-acting	Fuse class	Fast-acting	Fuse class		
A	A	A		A			
3	4.5	10	J	10	gG/gL	**LC1 D09●●**	**ATV 78●U22Y, ●FU22Y**
4	5.5	10	J	10	gG/gL	**LC1 D09●●**	**ATV 78●U30Y**, ●FU30Y
5	7.5	10	J	10	gG/gL	**LC1 D09●●**	**ATV 78●U40Y, ●FU40Y**
7	10	15	J	16	gG/gL	**LC1 D09●●**	**ATV 78●U55Y, ●FU55Y**
10	13	15	J	16	gG/gL	**LC1 D09●●**	**ATV 78●U75Y, ●FU75Y**
13	18	20	J	20	gG/gL	**LC1 D09●●**	**ATV 78●D11Y, ●FD11Y**
18	22	25	J	25	gG/gL	**LC1 D09●●**	**ATV 78●D15Y, ●FD15Y**
22	27	35	J	35	gG/gL	**LC1 D18●●**	**ATV 78●D18Y, ●FD18Y**
27	34	40	J	35	gG/gL	**LC1 D25●●**	**ATV 78●D22Y, ●FD22Y**
34	41	50	J	50	gG/gL	**LC1 D32●●**	**ATV 78●D30Y, ●FD30Y**
41	52	60	J	63	gG/gL	**LC1 D40●●**	**ATV 78●D37Y, ●FD37Y**
52	62	80	J	80	gG/gL	**LC1 D65●●**	**ATV 78●D45Y, ●FD45Y**
62	80	100	J	80	gG/gL	**LC1 D80●●**	**ATV 78●D55Y, ●FD55Y**
80	100	125	J	100	gG/gL	**LC1 D80●●**	**ATV 78●D75Y, ●FD75Y**
100	125	150	J	160	gG/gL	**LC1 D80●●**	**ATV 78●D90Y, ●FD90Y**
125	144	175	J	160	gG/gL	**LC1 F115●●**	**ATV 78●C11Y**, ●FC11Y
144	170	200	J	170	gG/gL	**LC1 F115●●**	**ATV 78●C13Y, ●FC13Y**
170	208	250	J	250	gG/gL	**LC1 F185●●**	**ATV 78●C16Y, ●FC16Y**
208	261	400	J	700	aR	**LC1 F265●●**	**ATV 780C20Y, 0FC20Y**
261	325	500	J	700	aR	**LC1 F330●●**	**ATV 780C25Y, 0FC25Y**
325	385	600	J	700	aR	**LC1 F400●●**	**ATV 780C31Y, 0FC31Y**
385	460	700	J	1100	aR	**LC1 F630●●**	**ATV 780C35Y, 0FC35Y**
460	502	800	L	1250	aR	**LC1 F630●●**	**ATV 780C45Y, 0FC45Y**
502	590	900	L	700	aR	**LC1 F630●●**	**ATV 780C50Y, 0FC50Y**
590	650	1000	L	700	aR	**LC1 F800●●**	**ATV 780C56Y, 0FC56Y**
650	750	1200	L	700	aR	**LC1 F800●●**	**ATV 780C63Y, 0FC63Y**
650	820	1200	L	700	aR	**LC1 BM●●**	**ATV 780C71Y, 0FC71Y**
820	920	1400	L/– *(4)*	1250/1000 *(5)*	aR	**LC1 BM●●**	**ATV 780C80Y, 0FC80Y**
920	1030	1600	L/– *(4)*	1250/1000 *(5)*	aR	**LC1 BM●●**	**ATV 780C90Y, 0FC90Y**
1030	1180	1800	L/– *(4)*	1250/1000 *(5)*	aR	**LC1 BM●●**	**ATV 780M10Y, 0FM10Y**
1300	1500	2500	L/– *(4)*	1250/1000 *(5)*	aR	**LC1 BP●●**	**ATV 780M13Y, 0FM13Y**

(1) The contact reference requires the addition of the code corresponding to the coil voltage. Please consult your Regional Sales Office.
(2) Composition of contactors:
LC1 D09 to LC1 D80: 3 poles + 1 "N/O" auxiliary contact + 1 "N/C" auxiliary contact
LC1 F115 to LC1 F800: 3 to 4 poles
LC1 B●: 1 to 4 poles
(3) In the reference, replace the ● with 2 for an IP 21 (NEMA type 1) drive or with 5 for an IP 54 (NEMA type 12) drive.
(4) Please consult your Regional Sales Office.
(5) The first class corresponds to fuses for ∿ current, the second to fuses for ⎓ current.

Product reference index

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DIA2ED2050501EN

ART. 807180

05 / 2006 - V2.0