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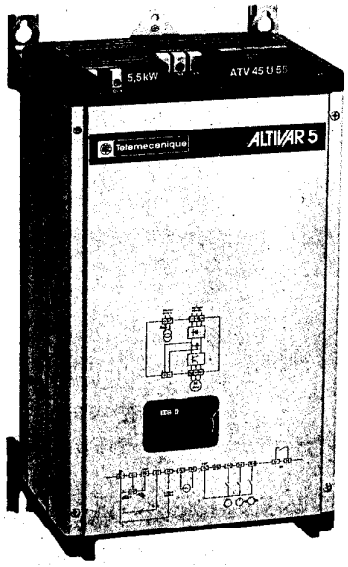
Find the *Schneider Electric / Telemecanique ATV45075N* at our website: *Click HERE*

Telemecanique

ALTIVAR® 5 series 45

variable speed controllers for asynchronous motors

user's manual



from 0,75 to 22 kW

three phase supply

- 220/240V → ATV-45•••M
- 380/415V → ATV-45•••
- 440/500V → ATV-45•••N

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WARNING

When the speed controller power supply is switched on, the power units, as well as a certain number of control components are connected to the mains supply ; contact with these parts is extremely dangerous.

After disconnecting the ALTIVAR from the mains voltage, wait 5 minutes before carrying out any operation inside the controller. This period corresponds to the time constant for the discharge of the capacitors. The + and – terminals are also connected to the potential of the capacitors.

During operation, the motor can be stopped by cancelling the run command or the speed reference set-point, while the speed controller remains energized. If untimely restarting needs to be prevented for personnel safety reasons, this electronic interlock is inadequate. Provision must be made for the disconnection of the power circuit.

NOTE

The speed controller includes safety devices which, in the event of a fault, can trigger the stopping of the controller, and hence the motor. The motor itself can also be subject to stoppage by mechanical jamming. Finally, voltage fluctuations and power supply failures in particular, can also cause the motor to stop.

The disappearance of the fault causing the stoppage can initiate a restart involving a hazard for certain types of machines or installations, especially those which must conform to specific safety regulations.

It is important that in such cases the user should take appropriate steps to prevent such restarting possibilities. For example, by the use of an underspeed detector, causing the disconnection of the speed controller power supply in the event of a non-programmed motor stoppage.

As a general rule, the speed controller power supply must always be switched off before carrying out any operation on either the electrical or the mechanical parts of the installation or the machine.

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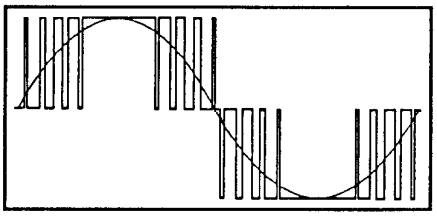
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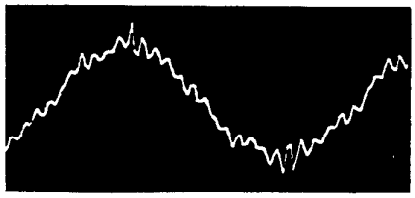
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The ALTIVAR ATV 45 is a frequency inverter operating on the principle of synthesizing a sine wave by pulse width modulation (PWM).



The resulting waveform of the current is very close to a sine wave.



When associated with a standard three phase asynchronous squirrel cage motor, the ALTIVAR ATV 45 provides a simple and reliable motor/speed controller combination.

In order to obtain the best possible results from the ALTIVAR ATV 45, read this guide carefully and apply all the relevant information and recommendations given.

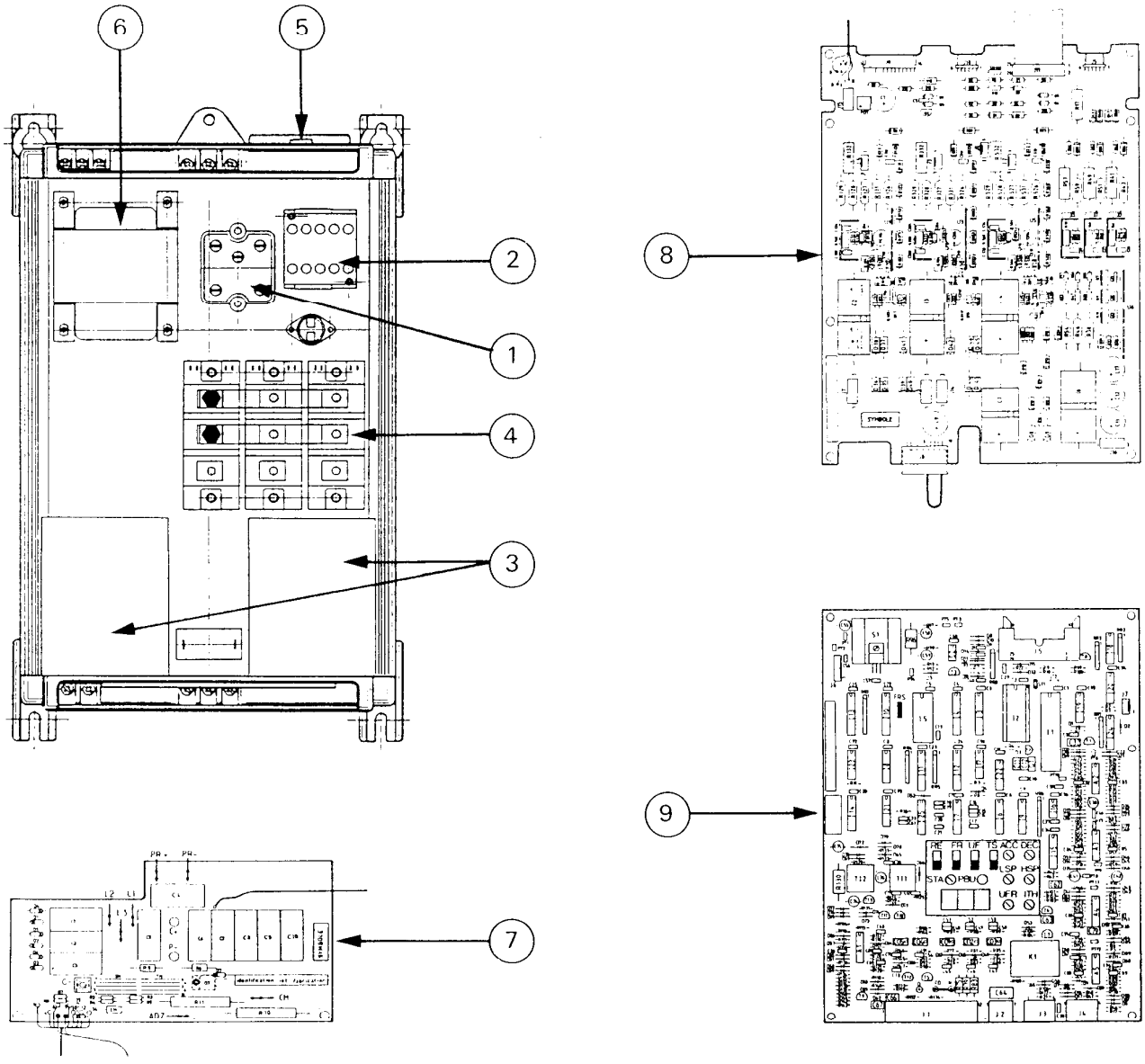
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Remove the ALTIVAR ATV 45 from its packing, and check that it shows no signs of having been damaged during transport.

Make sure that the speed controller label conforms to the delivery note corresponding to the purchase order.

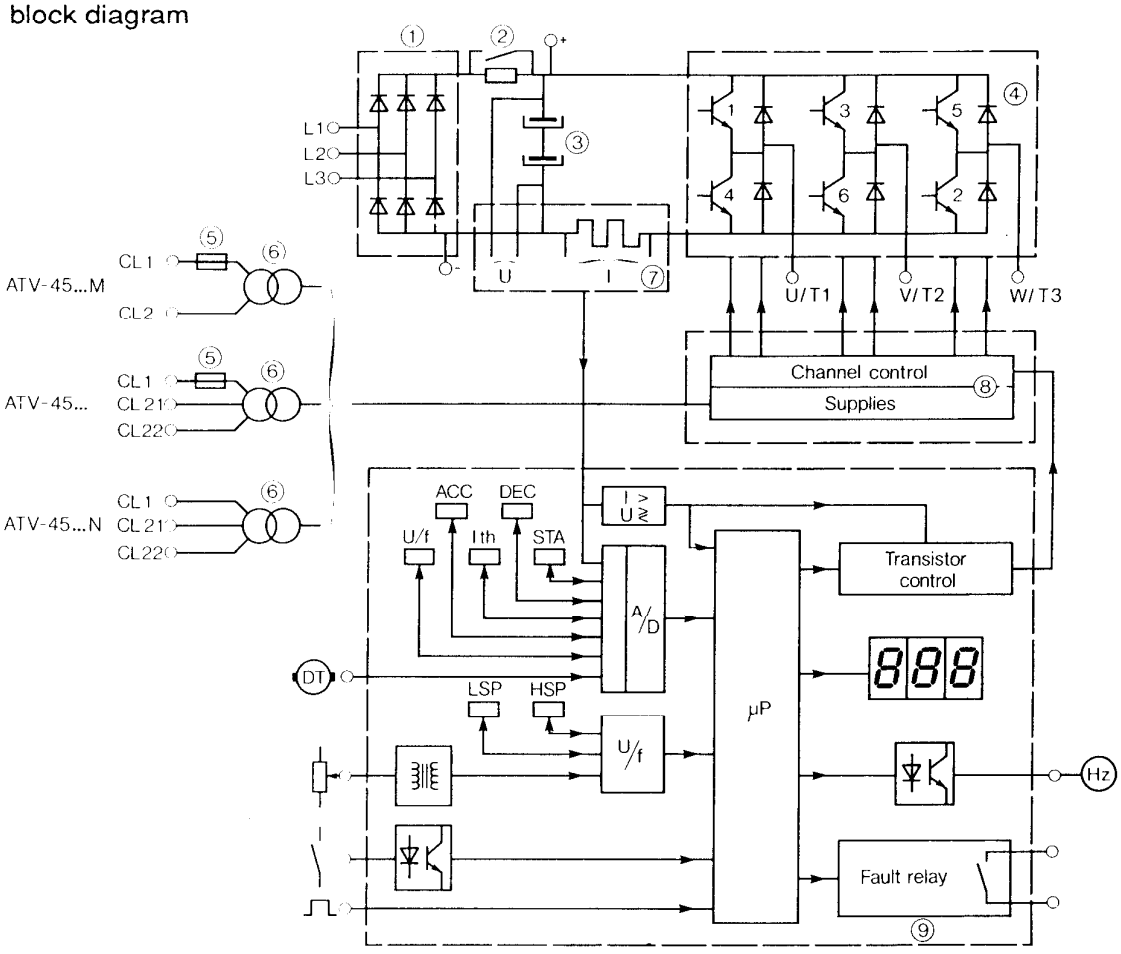
Design and operation

Technology



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Functional block diagram



Description of functions

① Rectifier

② Charge current limiting device

③ Filter capacitors

④ Transistorised inverter bridge

⑤ Control circuit fuse

⑥ Control circuit transformer

⑦ Measuring board

⑧ Transistors control power board

⑨ Microprocessor control board

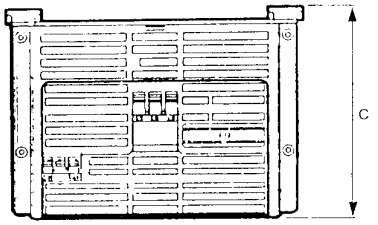
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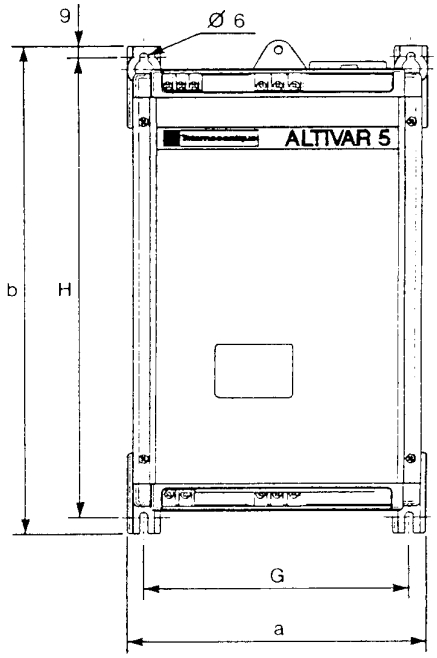
Reference **ATV-45...M**	220/240V	075M	-	U22M	-	U40M	U55M	U75M	D11M	D15M	-	-
Reference **ATV-45...**	380/415V	075	U15	U22	U30	U40	U55	U75	D11	D15	-	D22
Reference **ATV-45...N**	440/500V	075N	U15N	U22N	-	U40N	U55N	U75N	D11N	D15N	D18N	D22N
Motor power (kW)		0,75	1,5	2,2	3	4	5,5	7,5	11	15	18,5	22
Motor power (HP)		1	2	3	4	5,5	7,5	10	15	20	25	30
Supply voltage		ATV-45...M 220/240V, ATV-45... 380/415V, ATV-45...N 440/500V, +10 % -15 %										
Mains frequency		50/60 Hz										
Line current (A)	ATV-45...M	5	-	14	-	27	33	42	63	80	-	-
Line current (A)	ATV-45...	3,3	6	9	12	16	20	26	36	48	-	72
Line current (A)	ATV-45...N	2,7	5	7	-	11	16	21	31	40	51	60
Output voltage		maximum value equal to mains voltage										
Frequency range		1 to 67/80 Hz , 1 to 110/132 Hz, 1 to 87/104/120 Hz (see p. 23)										
Rated current (A)	ATV-45...M	3,6	-	9,6	-	18	22	28	42	54	-	-
Transitory current (A)	ATV-45...M	5,4	-	13,5	-	24,5	30	41,2	57	76	-	-
Rated current (A)	ATV-45...	2,2	4	6	8	10,5	13	17,5	24	32	-	48
Transitory current (A)	ATV-45...	3,2	5,5	8,5	11	14	17,5	24	32	44	-	65
Rated current (A)	ATV-45...N	1,8	3,4	4,8	-	7,6	11	14	21	27	34	40
Transitory current (A)	ATV-45...N	3	5,5	7,5	-	11,5	16,5	21	31	40	51	60
Total dissipated power at rated load (W)		75	95	115	135	165	195	270	360	480	590	700
Torque / overtorque		(see p. 18)										
Speed set-point inputs		0-10V, 0-20 mA, 4-20 mA (see p. 16)										
Low speed / high speed limits		adjustable (see p. 25)										
Acceleration / deceleration ramps		0,2 - 60 seconds (see p. 24)										
Speed regulation		with tachogenerator (see p. 33/44)										
Reversing		control inputs (see p. 14/15)										
Braking to standstill		by d.c. injection { automatic during 0,5 s if the frequency becomes < 1 Hz manual by external signal (see p. 14/15)										
Slow-down braking		by optional resistance (see p. 36)										
Speed controller protections		against short-circuits { between output phases between output phases and earth against mains supply under / over voltage against excessive overheating (vigitherm)										
Motor protection		incorporated electronic thermal protection (see p. 14/25)										
Control system communication		optional serial link (see p. 46)										
Operating temperature		0°C to + 40°C										
Storage temperature		- 25°C to + 70°C										
Humidity		*90 % maximum without condensation or dripping water (see recommendations on p. 13)*										
Altitude		≤ 1000 m (above this, derating by 3 % for each additional 1000 m)										
Degree of protection		IP20										

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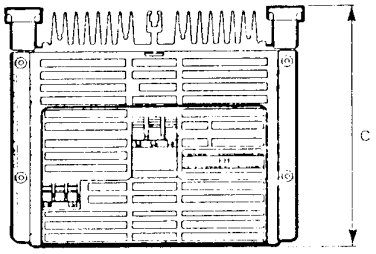
Dimensions and weights

ATV-45075 (M) (N)
ATV-45U15 (N)

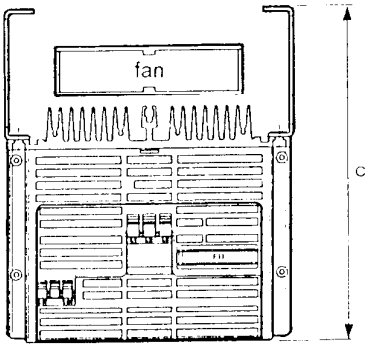




ATV-45U22 (M) (N)
ATV-45U30
ATV-45U40 (M) (N)
ATV-45U55 (N)



ATV-45U55M
ATV-45U75 (M) (N)
ATV-45D11 (M) (N)
ATV-45D15 (M) (N)
ATV-45D18N
ATV-45D22 (N)



Reference	a mm	b mm	c mm	G mm	H mm	Weight kg
ATV-45075 (M) (N) ATV-45U15 (N)	239	382	170	212	360	8 8,5
ATV-45U22 (M) (N) ATV-45U30 ATV-45U40 (M) (N)	239	402	192	212	380	11 11,5 11,5
ATV-45U55 (N)	239	442	192	212	420	12,5
ATV-45U55M ATV-45U75 (M) (N)	234	405	268	208	360	15 15
ATV-45D11 (M) (N)	234	555	268	208	510	21
ATV-45D15 (M) (N) ATV-45D18N ATV-45D22 (N)	234	595	268	208	550	23,5 25 25

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Climatic environment

Temperature
Humidity
Altitude
Degree of protection

} see technical characteristics (p. 6)

Pollution : protect the speed controller against
- dust,
- corrosive gases,
- splashing liquid.

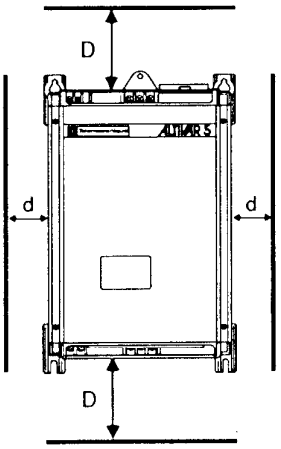
Mounting precautions

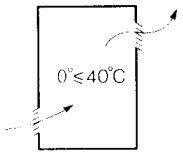
- Mount the controller vertically.
- Do not locate near heat radiating elements.

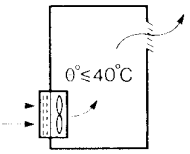
Mounting in general purpose enclosure

Degree of protection IP23.

In order to ensure adequate air flow inside the product :
- leave sufficient space around the speed controller :
  - d ≥ 50 mm,
  - D ≥ 100 mm,
- provide ventilation louvres,
- verify that the ventilation is sufficient ; if not, fit a cooling fan with filter.







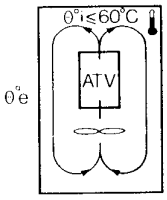
Mounting in dust and damp protecting enclosure

Degree of protection IP54.

Provide a ventilating fan to circulate the air inside the enclosure and prevent hot spots in the speed controller :

- flow : 100 dm³/s, fan mounted beneath the speed controller at a distance ≤ 50 mm.

This arrangement enables utilisation of the speed controller in an enclosure with a maximum internal temperature of 60°C.



Calculation of the enclosure size

Maximum thermal resistance Rth (°C/W) :

$$Rth = \frac{60 - \theta°e}{P}$$

θ°e = maximum external temperature in °C,
P = total power dissipated in the enclosure in W.

For the power dissipated by the controllers at rated load : see characteristics, page 6.

Useful heat exchange surface area of the enclosure S (m²) :
(sides + top + front for a wall mounted enclosure)

$$S = \frac{K}{Rth}$$

K = thermal resistance of the enclosure per m²
(K = 0,12 for a metal enclosure type DE1-HB).

Insulated enclosures should not be used, due to their poor thermal conduction.

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Calculation example

ATV-45U40 (4 KW) mounted in a dust and damp protecting enclosure with internal cooling fan.
Maximum external temperature : 30 °C.

- Power dissipated inside the enclosure : 165 W.
- Maximum thermal resistance :

$$Rth = \frac{60 - 30}{165} = 0{,}18°C/W$$

Minimum useful heat exchange surface area :

$$S = \frac{0{,}12}{0{,}18} = 0{,}67\ m^2$$

Useful heat exchange surface area of a DE1-HB543 wall mounted enclosure :

- height : 600 mm,
- width : 500 mm,
- depth : 250 mm.

$S = (0{,}6 \times 0{,}5) + (0{,}25 \times 0{,}5) + 2\ (0{,}6 \times 0{,}25) = 0{,}725\ m^2$

Based on the initial hypotheses, the enclosure is suitable.

Recess mounting

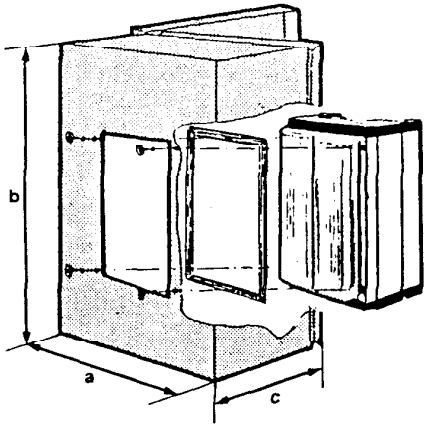
In order to reduce power dissipated in the enclosure, the speed controller can be recess mounted in the back of the enclosure, with the radiator on the outside.

As before, in order to obtain a temperature which does not exceed 60°C, the air inside the enclosure *must be kept cool* by the addition of a cooling fan, which can have a lower flow : 44 dm^3/s.

This arrangement necessitates a cut out and a mounting kit as defined in the section on mounting in dust and damp protecting enclosure (see p. 34).

The minimum metal enclosure dimensions enabling the mounting of one speed controller only, with an internal fan, in an external ambient air temperature < 30°C, are given in the table below :

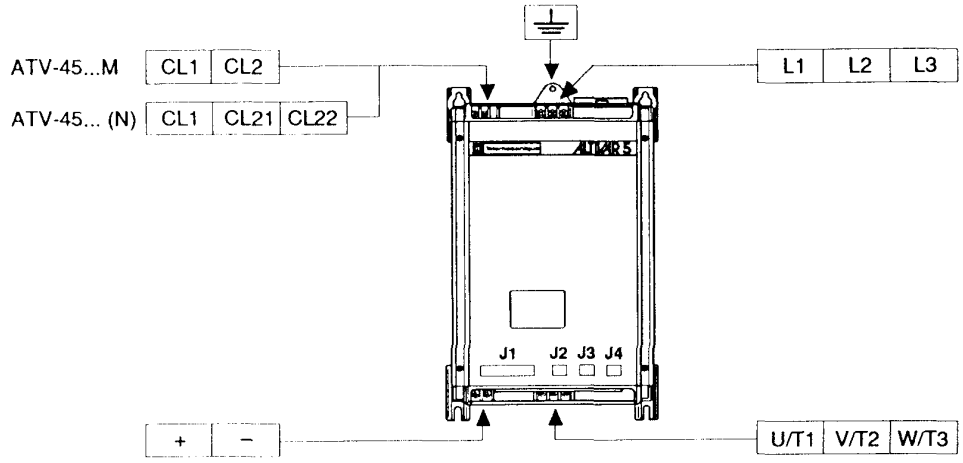
Mounting kit *reference*	ALTIVAR *reference*	a *mm*	b *mm*	c *mm*	Pi * W
VY1-A451U1501	ATV-45075 (M) (N) ATV-45U15 (N)	300 300	500 500	200 200	70 85
VY1-A451U4001	ATV-45U22 (M) (N) ATV-45U30 ATV-45U40 (M) (N)	400 400 400	500 500 500	250 250 250	85 90 105
VY1-A451U7501	ATV-45U55 (M) (N) ATV-45U75 (M) (N)	400 400	600 600	250 250	120 80
VY1-A451D1101	ATV-45D11 (M) (N)	500	700	250	95
VY1-A451D1501	ATV-45D15 (M) (N) ATV-45D18N ATV-45D22 (N)	500 500 500	700 700 700	250 250 250	110 130 130



* Pi – power dissipated in the enclosure by a recess mounted speed controller.

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Terminal strips

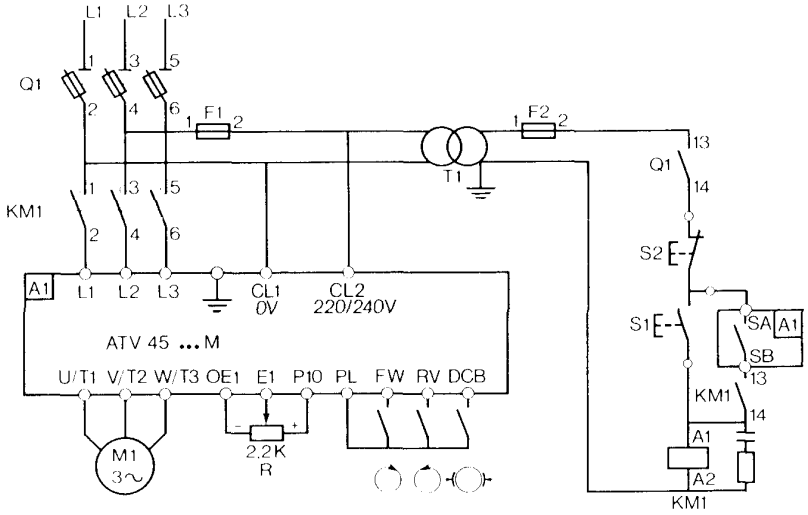


	Item	Function		Characteristics		
				ATV-45...M	ATV-45...	ATV-45...N
	L1	Power supply - three phase		220/240V + 10 % – 15 % 50/60 Hz	380/415V + 10 % – 15 % 50/60 Hz	440/500V + 10 % – 15 % 50/60 Hz
	L2					
	L3					
	CL1	Control supply - single phase		0V	0V	0V
	CL2			220/240V		
	CL21				*380V (mains ≤ 400V)*	*440V (mains ≤ 480V)*
	CL22 *				415V (mains > 400V)	500V (mains > 480V)
	U/T1	Output connections to the motor		220/240V at 50/60 Hz	380/415V at 50/60 Hz	440/500V at 50/60 Hz
	V/T2					
	W/T3					
	+	Filtered intermediary continuous voltage		290 to 435V	500 to 750V	550 to 800V
	–					
J1	OE1	Speed set-point input common		0V		
	E1	Input 1 - Speed set-point voltage		0-10V, Ze = 28 kΩ		
	P10	Output voltage		10V, Is = 10 mA		
	E2	Input 2 - Speed set-point voltage		0-10V, Ze = 28 kΩ		
	EC	Input 3 - Speed set-point current		0-20 mA, 4-20 mA, Ze = 100 Ω		
	FA	Frequency output signal		*2,5V to 50 Hz, Is = 1 mA*		
	FB					
	PL	Control inputs supply		24V, Is = 60 mA		
	OE2 (NL)	Control inputs common		0V (do not connect to OE1, see page 15)		
	FW	Forward control input		24V (minimum 19V, maximum 30V)		
	RV	Reverse control input		Ze = 1,5 kΩ		
	DCB	Standstill braking control input				
J2	SA	Fault relay output	- closes when supply is switched on	Voltage free contact 220/240V - 50/60 Hz - 2A		
	SB		- opens on fault			
J3	SN+	Speed signal	Speed regulation option (see p. 44)	0-5V, Ze = 10 kΩ		
	OVN	Common				
	SGN	Speed sign				
	PN	Option present				
J4	RX	Reception	Serial link option (see p. 46)			
	TX	Transmission				
	PX	Option present				
	OX	Common				

* If necessary : remove the terminal cover.

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Recommended circuit diagram **ATV-45...M**



Equipment required

This list is valid for both possible versions of the circuit diagram.

M1	Motor (kW / HP)	0,75 / 1	2,2 / 3	4 / 5,5	5,5 / 7,5	7,5 / 10	11 / 15	15 / 20
A1	ALTIVAR **ATV-45**	**075M**	***U22M***	***U40M***	***U55M***	***U75M***	***D11M***	***D15M***
Q1	Isolator	LS1-D2531A65		GK1-EK			DK1-GB	
	+ 3 fuses type g1	DF2-CN06	DF2-CN16	DF2-EN32	DF2-EN40	DF2-EN50	DF2-FN80	DF2-FN100
KM1	Contactor LC1-D	093•A65	123•A65	253•A65	323•A65	403•	633•	803•
	Suppressor	LA9-D09980						
F1 **F2**	Fuse type aM * Fuse type g1 * (if control 220V) *Fuse carriers*	DF2-CA02 DF2-CN02 DF6-AB10						
T1	Transformer	63 VA			100 VA	160 VA		
R	Potentiometer	SZ1-RV1202						
S1-S2	Push-buttons	XB2-B•••						

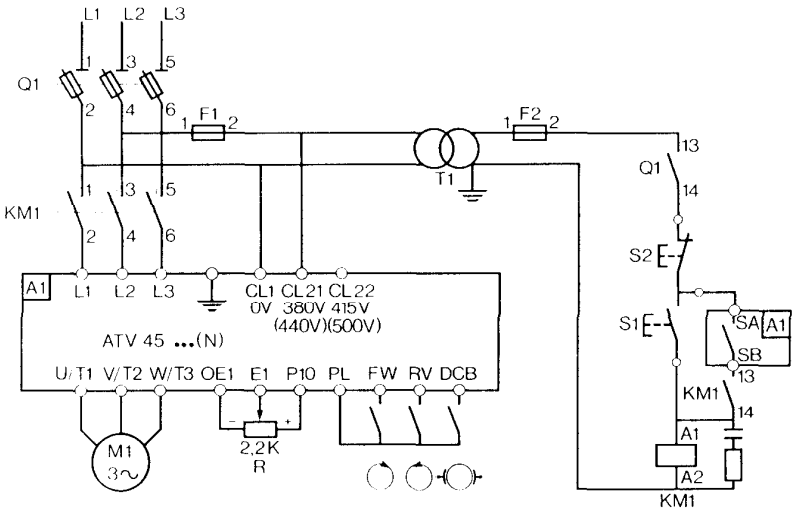
* Or circuit breaker type GB2-C•••

Cabling

Terminals	For ALTIVAR	Recommended section	
		mm²	AWG
CL1-CL2-PL-FW-RV-DCB-SA-SB	All ratings	1	18
OE1-E1-P10-E2-EC	All ratings	1 (twisted cable)	18
L1-L2-L3-U/T1-V/T2-W/T3	ATV-45075M	1,5	16
	ATV-45U22M	2,5	14
	ATV-45U40M, U55M	4	12
	ATV-45U75M	6	10
	ATV-45D11M	10	8
	ATV-45D15M	16	6

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Recommended circuit diagram **ATV-45... (N)**



Equipment required

This list is valid for both possible versions of the circuit diagram.

M1	Motor (kW / HP)	0,75 / 1	1,5 / 2	2,2 / 3	3 / 4	4 / 5,5	5,5 / 7,5	7,5 / 10	11 / 15	15 / 20	18,5 / 25	22 / 30
A1	ALTIVAR **ATV-45**	**075 (N)**	**U15 (N)**	**U22 (N)**	**U30**	**U40 (N)**	**U55 (N)**	**U75 (N)**	**D11 (N)**	**D15 (N)**	**D18N**	**D22 (N)**
Q1	Isolator	LS1-D2531A65							GK1-EK	DK1-FB		DK1-GB
	+ 3 gl fuses DF2-	CN04	CN06	CN10	CN12	CN16	CN20	CN25	EN40	FN50	FN63	FN80
KM1	Contactor LC1-D	093•A65	093•A65	093•A65	093•A65	123•A65	173•A65	253•A65	323•A65	403•	503•	633•
	Suppressor	LA9-D09980										
F1 **F2**	Fuse type aM Fuse type g1 * (if control 220V) *Fuse carriers*	DF2-CA02 DF2-CN02 DF6-AB10										
T1	Transformer	63 VA						100 VA		160 VA		
R	Potentiometer	SZ1-RV1202										
S1-S2	Push-buttons	XB2-B•••										

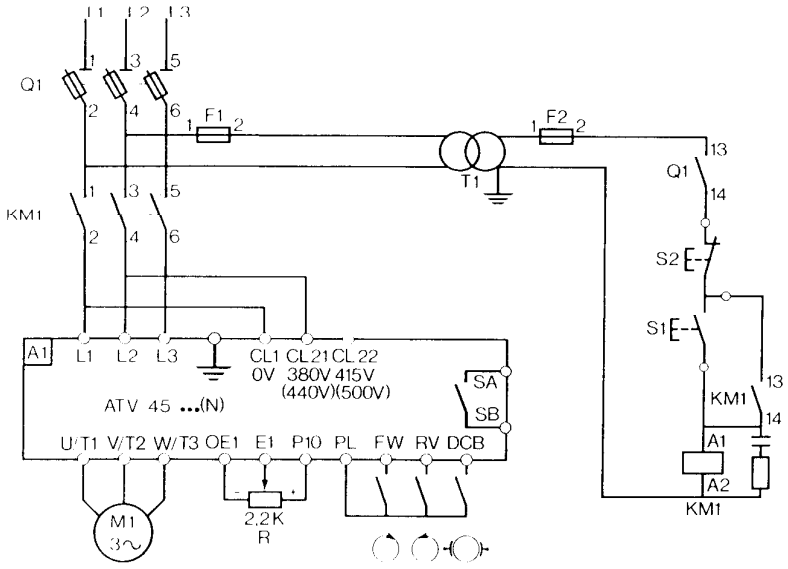
* Or circuit breaker type GB2-C•••

Cabling

Terminals	For ALTIVAR	Recommended section	
		mm²	AWG
CL1-CL2•-PL-FW-RV-DCB-SA-SB	All ratings	1	18
OE1-E1-P10-E2-EC	All ratings	1 (twisted cable)	18
L1-L2-L3-U/T1-V/T2-W/T3	ATV-45075 (N), U15 (N)	1,5	16
	ATV-45U22 (N), U30	2,5	14
	ATV-45U40 (N), U55 (N)	2,5	14
	ATV-45U75 (N)	4	12
	ATV-45D11 (N), D15 (N)	6	10
	ATV-45D18N, D22 (N)	10	8

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Alternative circuit diagram



The power and the control circuits are fed simultaneously.

It is advisable to use the fault relay for signalling, should the speed controller lock (terminals SA-SB).

Drawback of this solution :

- no fault signal memory in the event of line contactor drop out.

This solution is inadvisable if the line contactor is frequently operated.

Other alternative

Replacing the isolator-fuses-contactor with :

- either a circuit breaker,
  or a contactor breaker type integral 32/63.

Recommendations

WARNING : - Check the power connections before switching on.
If, owing to a wiring error, mains voltage is applied to output terminals U/T1, V/T2, and W/T3, the speed controller will be damaged.
- Do not connect terminals OE1 and OE2(NL) (see p. 15).
- Avoid on-load switching between the speed controller output and the motor.
- If utilisation requirements necessitate the mounting of a contactor between the speed controller and the motor, provide a special sequence (see p. 20).

INTERMITTENT DUTY

In order to avoid frequent operation of the line contactor through the use of push-buttons S1-S2, use the control inputs (terminals FW-RV) instead.

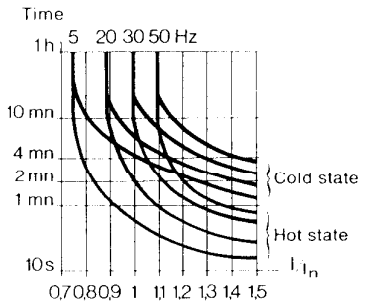
HUMIDITY

If there is danger of condensation, it is advisable to maintain the control supply of the speed controller switched on during periods when the machine is switched off; alternatively fit a heating system.

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Thermal protection of the motor

Indirect thermal protection of the motor is incorporated in the speed controller.



This device takes into account :
- the current absorbed by the motor,
- the motor speed (ventilation),
- an ambient temperature of 40°C.

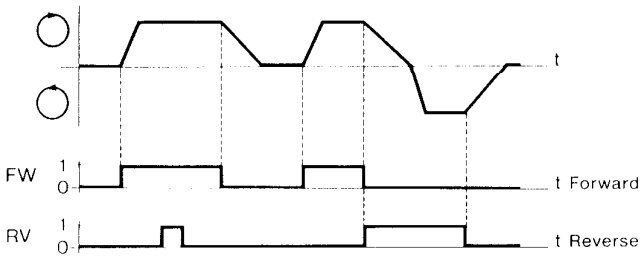
See tripping curves on the left.

For adjustment and monitoring of the thermal state of the motor, see p. 25.

Direct thermal protection, using PTC thermistor probes embedded in the motor windings, associated with an LT2-S protection relay, must be provided for operation in severe ambient conditions :
- high ambient temperature ($\theta \geq 40°C$),
- possibility of cooling fins clogging,
- insufficient ventilation.

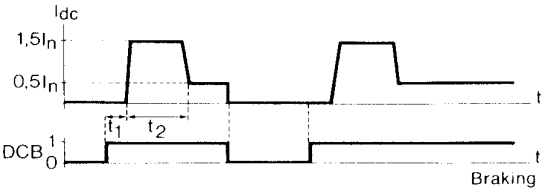
Function of the control inputs

Direction of rotation



- the direction control selected first takes priority over the other,
- ramp deceleration,
- braking to standstill by automatic d.c. injection during 0,5 s if the frequency becomes < 1 Hz,
- to stop on "free wheel", switch off the speed controller power supply.

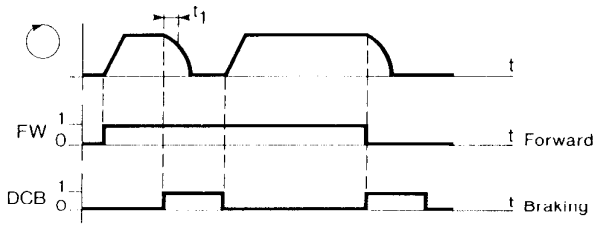
Braking to standstill by d.c. injection



- t_1 dead time - waiting for the motor to demagnetise,
  t_1 depends on motor speed and power (between 0 and 1,5 seconds).

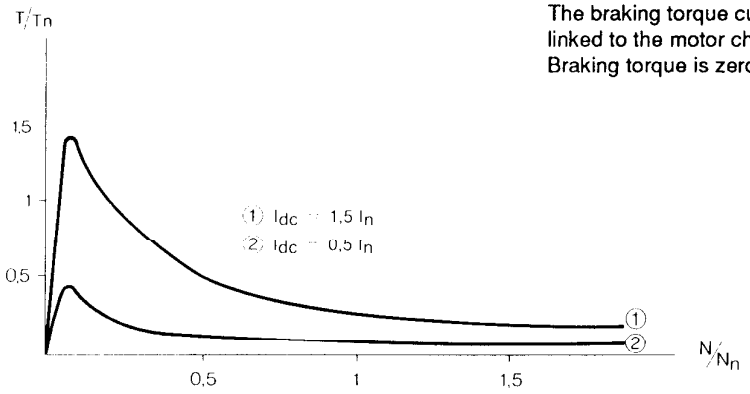
- t_2 = 3 seconds.

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The braking control takes priority over the directional control.

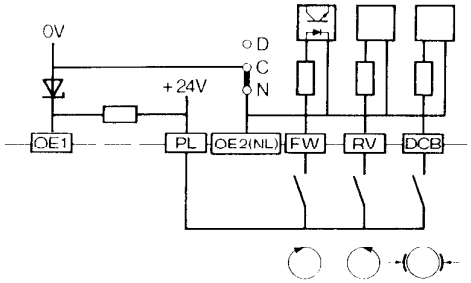
Typical braking curves



The braking torque curves are linked to the motor characteristics. Braking torque is zero at standstill.

Utilisation of the control inputs

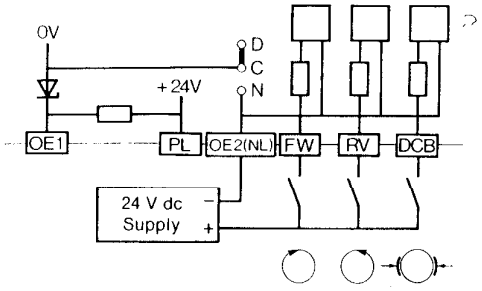
Operating on internal supply



The control inputs :
- are isolated from the mains,
- have a common point with the set-point inputs.

Terminals OE1 and OE2 are at different potentials.
Do not connect together.

Operating on external supply



The control inputs :
- are isolated from the mains
- are isolated from the set-point inputs.

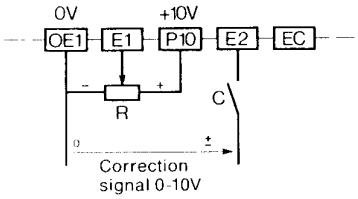
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Function of the speed set-point inputs

- The set-point fixes the speed of the rotating field in the motor.
  The real speed remains dependent on the acceleration and deceleration ramps as well as on the torque capabilities of the motor/speed controller combination.
- The resulting set-point value is the algebraic sum of the different set-points applied simultaneously, within the limits of the frequency range selected.
- The speed range is linked to the low and high speed threshold settings, see p. 25.
- The speed set-point inputs are isolated from the mains.
- The 10V internal supply (terminals OE1-P10) is protected against short-circuits.

Utilisation of the speed set-point inputs

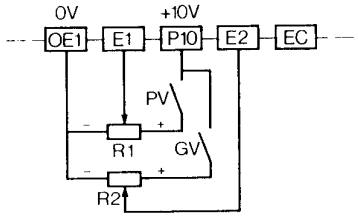
Example 1 : manual set-point with correction signal



1 kΩ ≤ R ≤ 10 kΩ

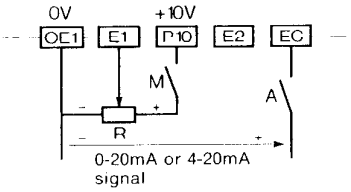
C : correction while operating

Example 2 : selection of two manual set-points



PV : low speed
GV : high speed

Example 3 : automatic set-point, from 0-20 mA or 4-20 mA sensor



A : automatic
M : manual

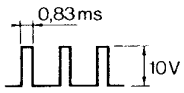
For selection of 0-20 mA/4-20 mA see settings p. 22.

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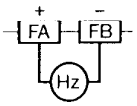
Stator frequency display

Function : remote display of speed. The speed indication is only approximate ; it does not take motor slip into account.

Signal :



Connection : - moving scale magneto-electric voltmeter.
mean voltage : U = 6,6V for 132 Hz,
U = 2,5V for 50 Hz.



- digital frequency meter :

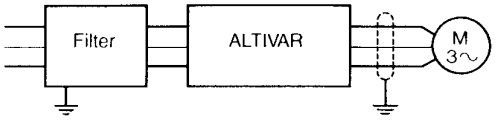
fs = f/6 fs : stator frequency
f : signal frequency

Wiring precautions

Power

The frequency inverter emits high frequency electromagnetic waves of low intensity. These cause interference signals, which may affect the operation of audio-frequency equipment.

This interference can be reduced by screening the motor cables, using a good earth connection, and by installing suppression filters on the supply side of the controller, see page 47.

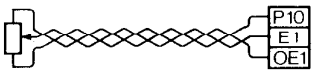


Control circuits

Although the control circuits are protected and filtered, it is recommended to reduce interference to a minimum by separating control circuits from power circuits.

Speed set-point inputs

These circuits must be protected against interference signals.
The use of twisted cable is recommended, with a pitch of 25 to 50 mm.



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Available torque

Continuous duty : motor derating is linked to two causes.

- Although the current waveform is very close to a sine wave, motor heating is slightly greater than that obtained by direct supply from the mains. The resulting reduction in torque is of the order of 5%. This is lower than manufacturing tolerance limits.

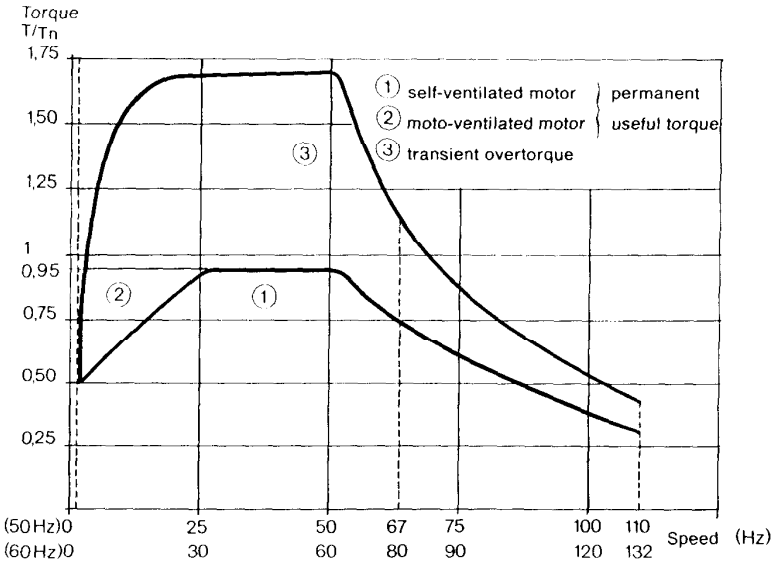
- For self-ventilating motors, the ventilation needed for the cooling of the motor is linked to the motor speed.
  This results in derating, which occurs at approximately half of the rated speed.

Transient operation periods

Overtorque possibilities are linked to the maximum peak current which the controller can provide, and the extent to which these overloads are repeated.

Overspeed operation (f ≥ 50/60 Hz)

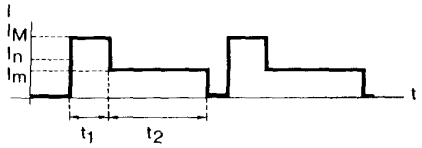
As the voltage can no longer change with frequency, this results in a decrease of the induction in the motor, which causes a loss in torque. The manufacturer will advise whether the motor is capable of operating in overspeed conditions.



Intermittent duty

The starting and braking rate is limited by the value of the overloads, their duration, as well as the load during normal running and the motor cooling possibilities.

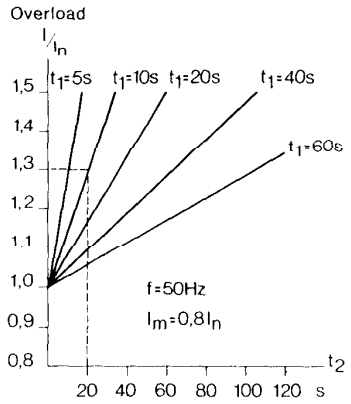
On intermittent duty, the current which causes the motor and speed controller to overheat appears as follows :



IM : overload current
In : rated current
Im : *normal running current*

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The following curves can be used to determine the ratio between the overload duration and the operating time at 0,8 of the rated current at rated speed.



EXAMPLE : following an overload of 1,3 In for 10 seconds, it would require 20 seconds at 0,8 In to return to the previous thermal state.

If the normal running speed is lower than the rated speed, time t2 will be longer.

Association with different motors

ALTIVAR speed controllers are designed to drive motors with a corresponding power rating. They can, however, be used with motors having different power ratings providing that certain precautions are observed.

Depending on the motor characteristics, and the performance necessary for the application, the use of a special software is recommended (see p. 45).

Motor power ≤ rated power of the controller

This combination is possible.

As compensation is not at the optimum level, this can lead to a reduction in continuous torque at low speed. Adjust the U/f ratio if necessary (see p. 25).

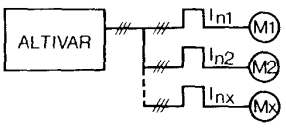
If motor power is < 0,5 controller rated power, correct adjustment of motor thermal protection is impossible (see p. 25).
Cancel the internal protection and use standard external protection (overload relay or thermistors).

Motor power > rated power of the controller

Magnetising current peaks limit this combination to the motor power immediately above the controller rating.

Again, compensation is not at the optimum level, and the U/f ratio should be adjusted if necessary (see p. 25). The motor current must remain lower than, or equal to the speed controller's rated current.

Motors in parallel



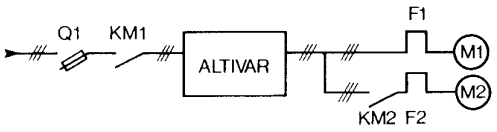
Speed controller selection :
controller In ≥ In1 + In2 + ... Inx.

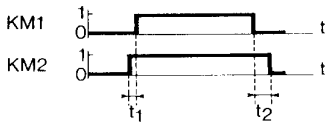
Each motor should be protected by a thermal overload relay.

Compensation is not at the optimum level. Adjust the U/f ratio if necessary (see p. 25).
If the motors have different power ratings, the ratio adjustment can only be a compromise. If the load is to be shared between the motors, override the slip compensation (see p. 33).

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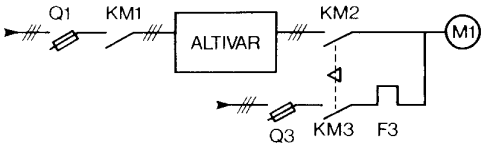
Additional motor connected downstream of the speed controller

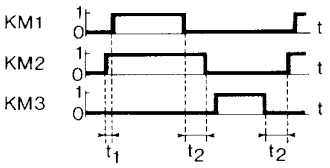




- Comply with the sequence shown : t_1 = 20 ms,
  t_2 = 1,5 s (demagnetisation of the motor).
- If the power of the motor to be connected is low in comparison with the rating of the speed controller, and it produces an acceptable overload (maximum current ≤ controller transient current), connection on the run is possible.

Direct coupling of the motor to the mains : "BY-PASS"





- Comply with the sequence shown : t_1 = 20 ms,
  t_2 = 1,5 s (demagnetisation of the motor).

Use of a brake motor

- Electric brake

Make sure that the brake winding is brought out to terminals, without a common point with the stator. The brake should be supplied separately at its rated voltage and switched on simultaneously with the motor.

- Tapered rotor motor

The brake is released by the magnetic field of the motor.
Experience shows that this kind of motor can be used with a frequency inverter.
The brake is released at a frequency ≥ 5 Hz.

Use of a synchronised asynchronous motor

Operating is possible provided the slip compensation has been overridden (see page 33) :

Operation at constant torque in overspeed

Operating is possible with motors supplied in the following way :

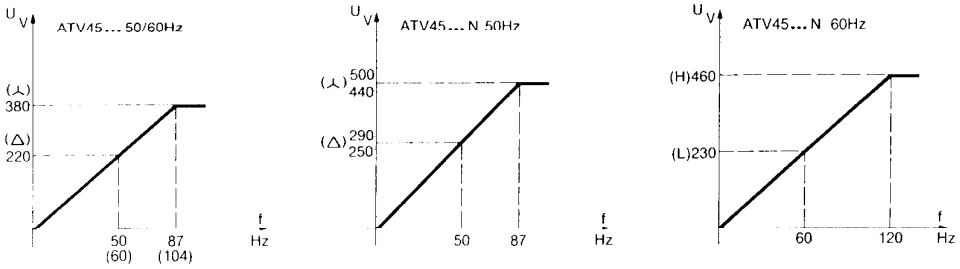
127V (Δ) / 220V (人)	250V (Δ) / 440V (人)
220V (Δ) / 380V (人)	290V (Δ) / 500V (人)
240V (Δ) / 415V (人)	230V (L) / 460V (H)

Ensure that the motor is suitable for overspeed operation.
Use the low voltage connection (Δ or L).
The rated current to be used for speed controller selection is that taken by the motor when connected at low voltage.

Set the frequency range and voltage/frequency ratio selector switches (see p. 23).

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of the motor/speed controller combination



EXAMPLE : operation of a given 4 kW 1500 rpm motor at 87 Hz ; the power at 2610 rpm is 7 kW (rated current absorbed at 220 V : 16,5A). Speed controller selected : ATV-45U75 (7,5 kW - 17,5A).

Motor installation

Mount and couple the motor carefully, so as to eliminate any possible problems with vibrations and resonance.

Adaptation to the driven machine

The motor/speed controller combination must be adequately rated to :

- overcome the load torque of the driven machine over the whole speed range used,
- supply the transient overtorque needed for the required accelerations, see curves p.18.

If braking is required for rapid deceleration, refer to the following possibilities :

- d.c. injection braking (see p. 14/15),
- slow-down braking (see p. 36).

Precautions to be taken according to the type of machine load :

- constant torque load (conveyors) :
  ensure that the starting torque is compatible with the available overtorque,

- quadratic torque load (fans and centrifugal pumps) :
  adjust the U/f ratio and override the slip compensation (see p. 33) ;
  the torque increases rapidly with the speed, and it may be necessary to limit the maximum speed so that the motor / speed controller combination's capabilities are not exceeded,

- constant power load (winders) :
  check the speed range ;
  the torque is highest at low speed, check the torque capability at the lowest speed, provide forced ventilation if necessary,

- driving load / high inertia :
  examine the braking possibilities (see p. 36), and the use of special software (see p. 45),

- machines with fast cycles :
  use the special software (see p. 45).

Adaptation to the mains supply

If a suitable mains supply is not available, the controller can be supplied via a three phase transformer or autotransformer rated as follows :

ATV-45075 (M) (N)	2,2 kVA	ATV-45U55 (M) (N)	12,5 kVA
ATV-45U15 (N)	4 kVA	ATV-45U75 (M) (N)	16 kVA
ATV-45U22 (M) (N)	5,5 kVA	ATV-45D11 (M) (N)	22 kVA
ATV-45U30	7,5 kVA	ATV-45D15 (M) (N)	28 kVA
ATV-45U40 (M) (N)	10 kVA	ATV-45D18N, D22 (N)	45 kVA

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The ALTIVAR ATV 45 is factory preset to meet the most common utilisation requirements.
The preset values are marked below with an asterisk *.
The specific ATV-45•••N values are marked with two asterisks **.
Check that they are compatible with your requirements.

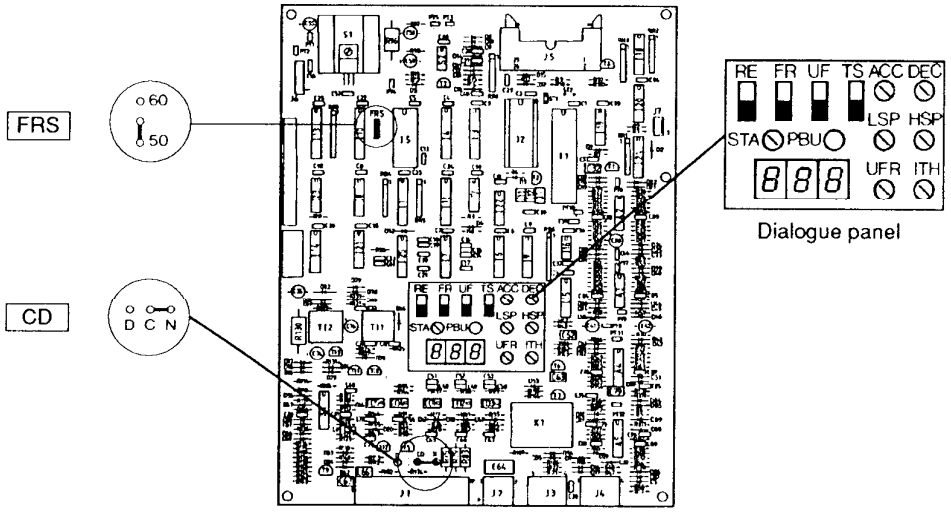
If so, after checking the connections (see circuit diagrams pages 11 to 13), the speed controller can be switched on.

If not, readjust the settings.

The setting controls are grouped on the front of the control board, and are accessible after removing the front cover, which is fixed by four quarter turn fasteners. Switch off the speed controller before removing the cover.

CAUTION : do not touch the components.

Layout of the setting controls



Modification of the settings

Links : select with power and control circuits switched off

CD - selection of the control inputs supply (see p. 15)

* D C N selection of internal supply

D C N selection of 24V DC external supply

FRS - selection of the output frequency at rated voltage

* 60 / 50 rated output frequency 50 Hz

** 60 / 50 rated output frequency 60 Hz

Selector switches : the data selected is only registered at control circuit switch on. The selector switches are inoperative when the controller is switched on, except for RE, which remains functional.

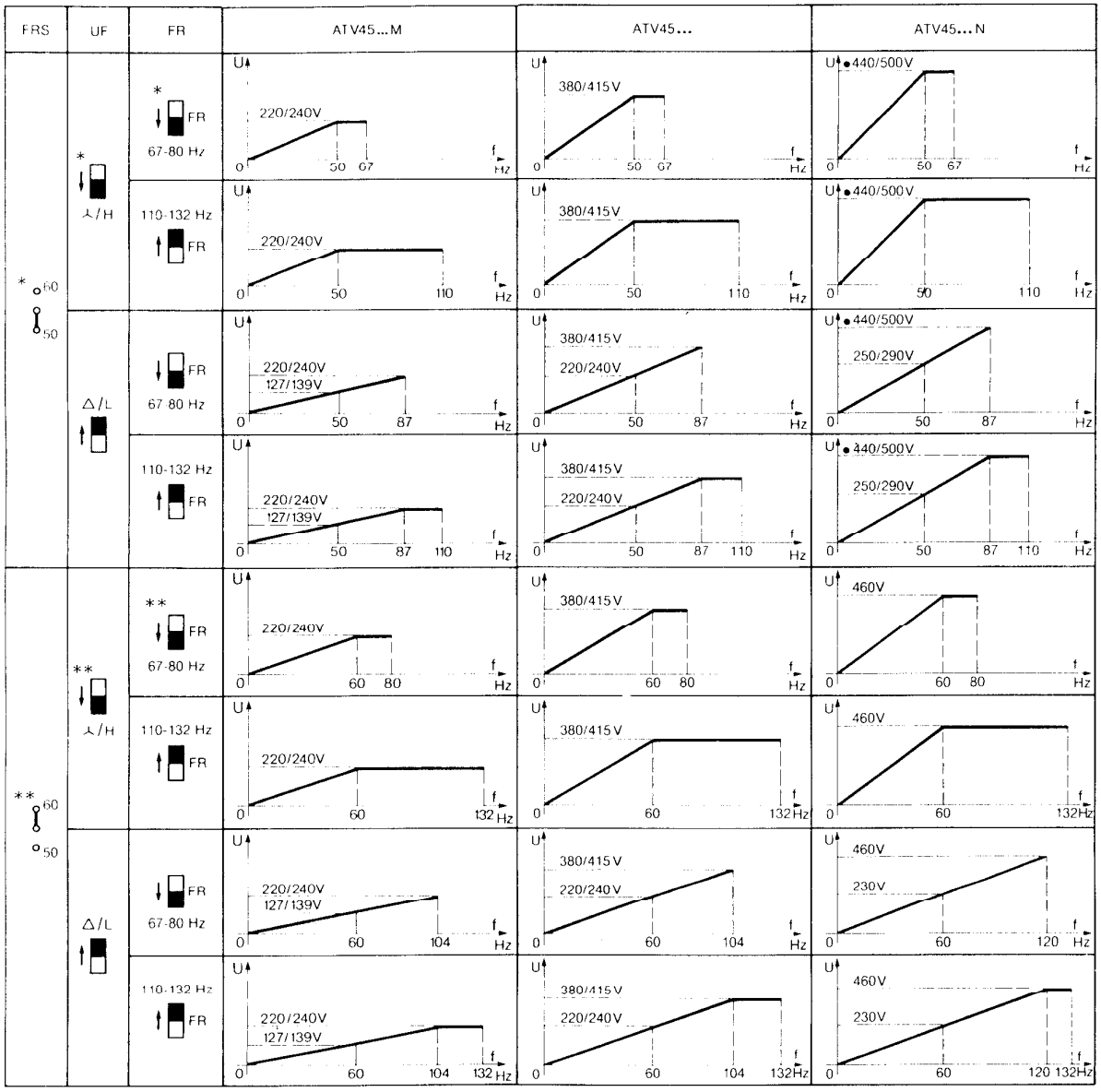
RE - selection of the speed set-point input on terminal EC (see p. 16)

* 4 - 20mA reference 0-20 mA
RE
0 - 20mA

4 - 20mA reference 4-20 mA
RE
0 - 20mA

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UF FR - selection of frequency range and voltage/frequency ratio



U = output voltage • 440V or 500V according to mains voltage at 50 Hz.
For mains voltage < 480 V U = 440V. For mains voltage > 480 V U = 500V. (Characteristics p.6)

TS - selection of the test sequence (see p. 30)

* ON TS OFF normal operation

ON TS OFF self-diagnostic

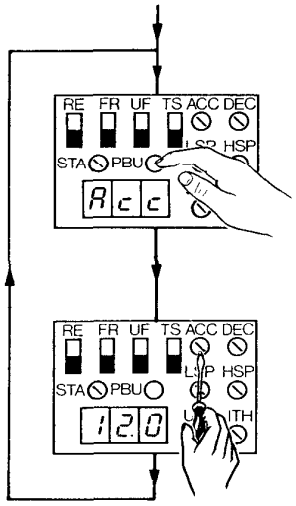
CAUTION : do not switch TS to ON position while the controller is operating (see p. 28).

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Potentiometers

The potentiometers are permanently operative, the set values are displayed on the dialogue panel.

Use of the dialogue panel



Look for the code corresponding to the parameter to be set (PBU push-button).

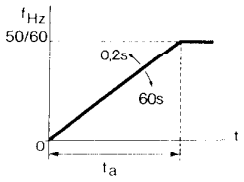
Set to the required value, which is shown on the display.

The sequence and signification of the codes are given on page 27.

FUNCTION OF THE POTENTIOMETERS

Acceleration

ACC +

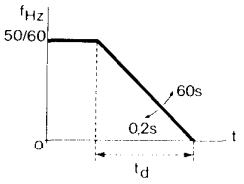


The acceleration ramp adapts itself automatically according to the overtorque capacity.

* preset value 2 s

Deceleration

DEC +



* preset value 5 s

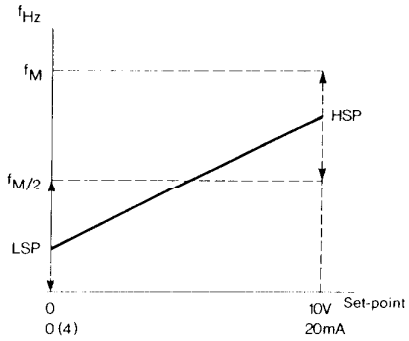
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Low speed - High speed

LSP ○+ HSP ○+

f_M = maximum selected frequency

When the low speed is at minimum, the controller remains locked for set-point values lower than 1 Hz.



preset values LSP * at minimum
HSP * 50 Hz
** 60 Hz

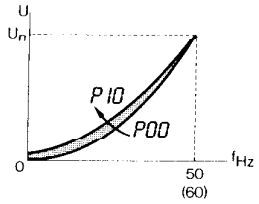
Voltage/frequency ratio

UFR P00 N00 P10 N10

* n00 : factory setting corresponding to most applications.

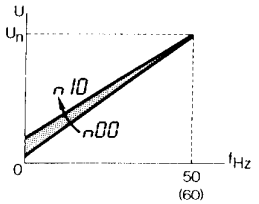
- Operation with quadratic torque loads : fans and centrifugal pumps.

In order to improve motor efficiency, set the potentiometer between P00 and P10 so as to obtain correct and silent operation with minimum current.



- Applications needing high torque at low speed.

If the torque is inadequate, increase progressively from n00 to n10 until the correct operation is obtained.



Thermal motor protection

ITH ○+

Setting the thermal motor protection (see p. 14).
Setting range : 0,45 to 1,05 of the speed controller's rated current.
* preset to 0,9 of the speed controller's rated current (see p. 6).
Set to the rated motor current.
When the potentiometer is at maximum, against the stop in the clockwise direction, the protection is cancelled. Corresponding code : nEH.
With force-ventilated motors, or if the motor power is too low, cancel the internal protection and use standard external protection (overload relay or thermistors).

Stability

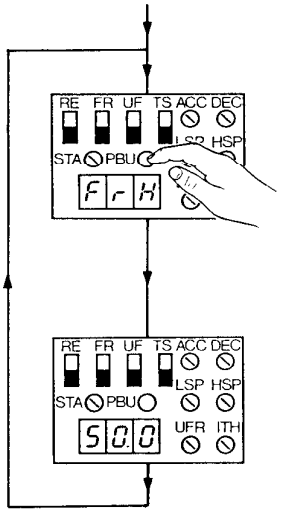
STA ○+

Stability setting.
* initial position : against the stop in the anti-clockwise direction.
In the event of instability, turn clockwise until correct operation is obtained.

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Using the dialogue panel

The setting and operating parameters can be displayed on the dialogue panel.



Look for the code corresponding to the parameter to be displayed (PBU push-button).

Read the value of the parameter selected.

The sequence and signification of the codes are given on page 27.

Note :

- If the control remains switched on, each time the device starts up the display will go back to the selected parameter.

- Once the frequency reference has been selected, a flashing display indicates overload. The speed reference is no longer followed.
  If this data appears in transitional mode, increase the corresponding ramp time.

- Other messages may appear during operation.

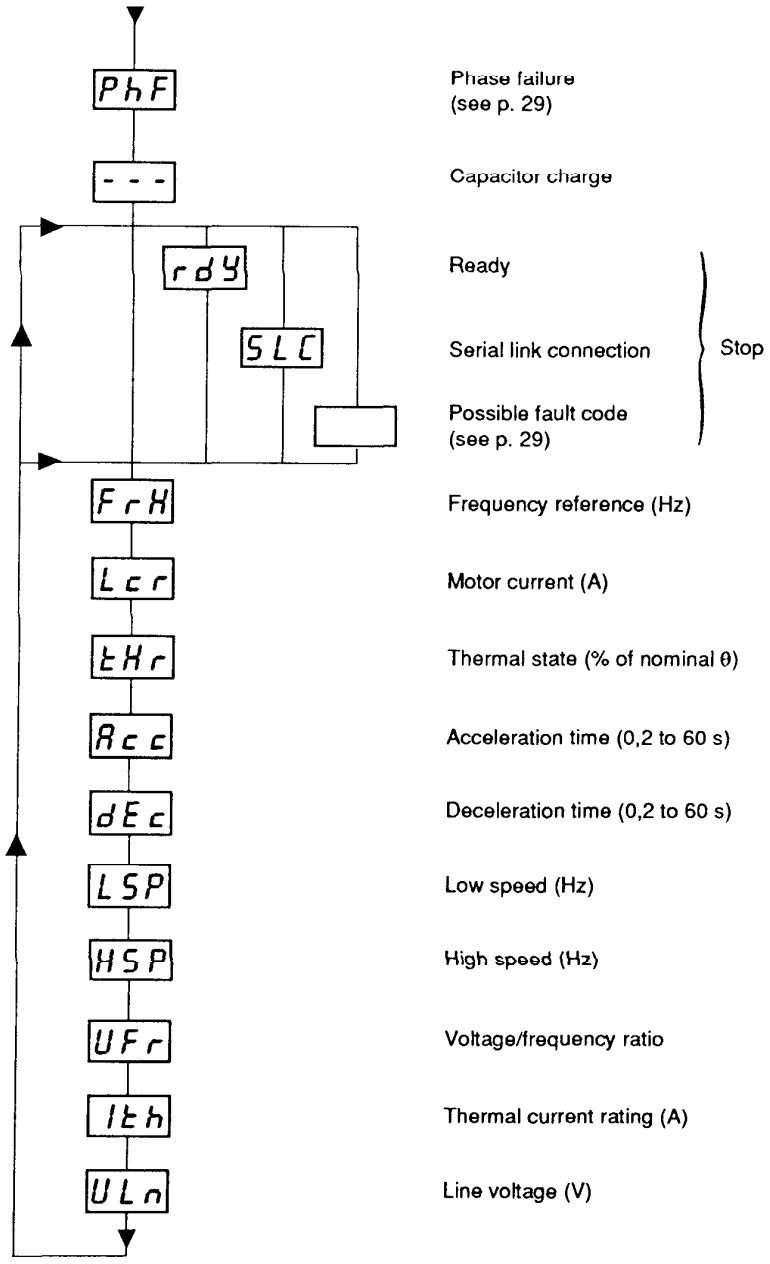
  `Obr` Over braking.
  Capacitors overvoltage caused by excessive braking.
  Increase the deceleration time.

  `dcb` D.C. injection braking.
  This code indicates acceptance of the brake signal.

- The supply voltage value `ULn` can only be used when the speed controller is locked.

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Operational and setting parameter codes



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Maintenance



Before carrying out any operation inside the controller, switch off the supply circuits and make sure that the capacitors are fully discharged (about 5 minutes after switch off).

CAUTION : the d.c. voltage across the + and – terminals can reach 800V when charged.

- The ALTIVAR ATV 45 does not require preventive maintenance, nevertheless the following operations are recommended at regular intervals :

  • check the condition and tightness of the connections,
  • make sure that the ventilation is effective and that the temperature around the controller remains at an acceptable level,
  • remove the dust from the controller, if necessary.

- Should anything unusual occur when putting the controller into service, or during operation, make sure that all the recommendations relating to the environment and to mounting and connecting the controller have been complied with.

Maintenance assistance facilities

The ALTIVAR is able to detect a certain number of faults and display them in the form of codes.

Fault codes : see table page 29.

Fault storage

The first fault detected is displayed and stored if the control circuit voltage stays on. The fault relay drops out.
Use of the circuit diagrams shown on pages 11 and 12 is recommended.

Fault storage erasure

The fault code may be steady or flashing.
In either case, switch off the power supply to the controller.

If the fault code is steady, switch the power supply back on ; this has the effect of erasing the fault storage and resetting the controller.

If the fault code is flashing, this indicates that the fault is still present. Find the cause and wait for the code to be steady before switching the power supply back on to reset the controller.

Special case : code [OCF]

With this type of fault, it is essential to switch off the power and control supplies of the controller and check the connecting cables and the motor insulation. Carry out the self-diagnostic programme before resetting (see p. 30).

Special code [InF]

This code may appear when the controller is switched on. If so, switch off the supply circuits and wait for the capacitors to discharge. Remove the protective cover and check the control board's J5 connector, as well as the power board's J6 connector.

This code may also appear if the selector switch TS is moved to the ON position, while the speed controller is operating. Should this be the case, switch off the controller, return the selector switch TS to the OFF position, and switch the control supply back on to reset the controller.

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Fault codes

Codes	Signification	Probable cause	Trouble-shooting procedure
[ ]	No display or partial display	- no control supply	→ check : the control voltage the supply fuses the internal fuse the connectors (see p. 32)
		- control voltage too low	
PhF	Phase failure	- no supply to controller L1-L2-L3	→ check : the power supply the supply fuses
		- power fuses blown	→ check the rectifier (see p. 31)
		- short power cut (t ≥ 200 ms)	→ reset
		- internal connections	→ check the connectors (see p. 32)
USF	Under voltage	- supply too low U ≤ 185V (M), 320V or 380V (N)	→ check the power voltage
		- temporary voltage drop (t ≥ 200 ms)	→ reset
		- internal connections	→ check the connectors (see p. 32)
OSF	Over voltage	- supply too high U ≥ 265V (M), 460V or 550V (N)	→ check the power voltage
		- capacitors overvoltage following excessive braking	→ reset if [ULn] ≤ 265V (M), 460V or 550V (N)
		- ATV-45•••N on supply 500V - 50Hz	→ check the FRS link position
OhF	Over temperature	- radiator temperature too high ≥ 75°C	→ check the motor load, the fan and the climatic environment around the controller ; wait for it to cool down before resetting
		- power board's J8 connector disconnected	→ check the connector (see p. 32)
		- overheating of the braking resistance (if braking option fitted)	→ check the braking conditions and change the resistance if necessary
OLF	Motor overload	- thermal trip owing to prolonged overload or loss of phase V or W if [tHr] ≥ 118 %	→ check the [ItH] setting and compare with motor In - check the load and compare with the operating speed - check the motor connections - wait for approximately 7 mn before resetting
		- phase U failure if [tHr] < 118 %	→ check the motor connections
		- motor power too low	→ cancel the internal protection
ObF	Excessive braking	- capacitors overvoltage owing to excessive braking or a driving load (even with braking option)	→ increase the deceleration time - add the braking option if necessary - reset if [ULn] ≤ 265V (M), 460V or 550V (N)
OcF	Over current	- short-circuit or earthing on the controller output	→ switch off power and control - check the connecting cables and motor insulation, with the controller disconnected
		- internal controller fault	→ use the self-diagnostic
		- excessive transient operation	→ reset

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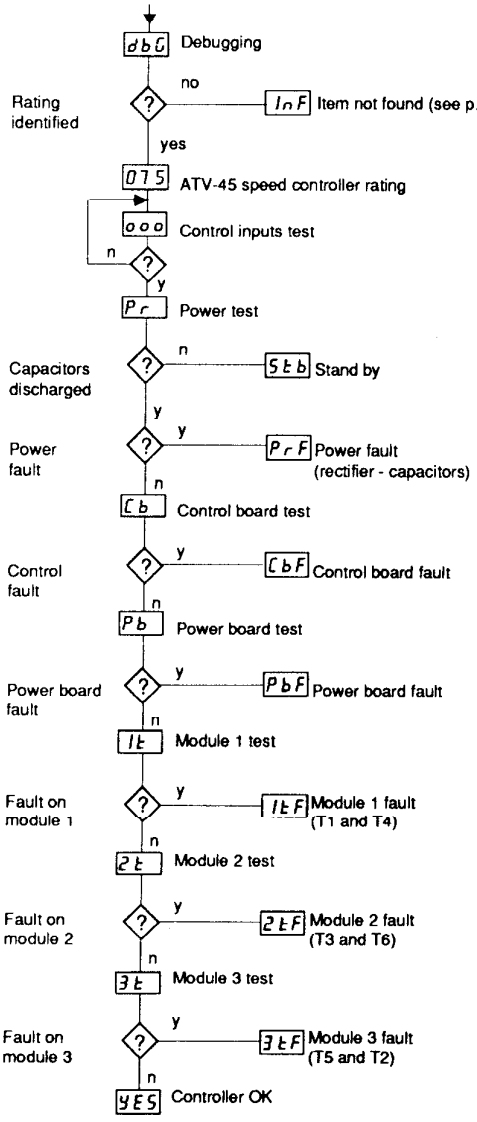
Self-diagnostic

The speed controller has a self-diagnostic system incorporated. It enables the main functions to be checked.

Procedure

- Switch off power and control circuits.
- Wait about 5 minutes for the capacitors to discharge.
- Disconnect the motor.
- Select the test sequence : selector switch TS to ON (see p. 23).
- Switch the controller back on.

Codes



	FW	RV	DCB	Validate the inputs
0V	0	0	0	to test them
24V	1	1	1	(time available = 6s)

CAUTION :

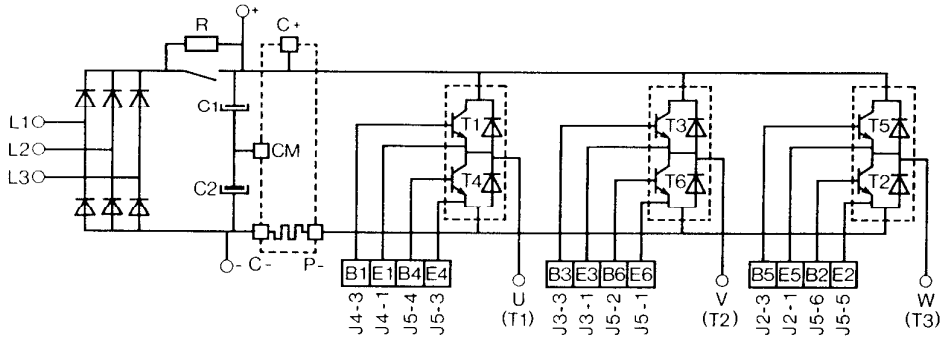
Do not switch the power supply back on during the test sequence.

- Switch off the control to reset the test sequence to zero.
- After rectifying the fault, run a second test to check the controller condition.
- It is essential to put TS back to the OFF position before switching the power supply back on.

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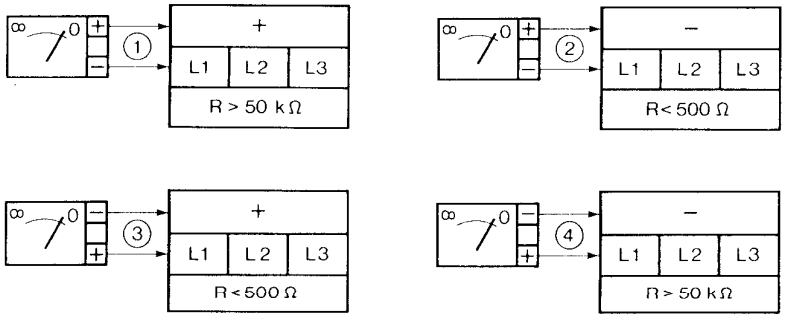
Checking the power components

Circuit diagram



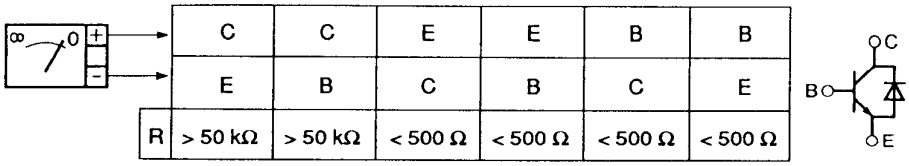
Checking the rectifier

Test instrument : digital or moving scale ohmmeter.
Under no circumstances must a magneto type ohmmeter (megger) be used.



If the results are abnormal, disconnect the rectifier and test directly on the terminals.
Tests ① and ③ are carried out using the load resistor.
If R ≥ 500 Ω in test ③, check the state of this resistance.

Example of a power transistor check



	C	C	E	E	B	B
	E	B	C	B	C	E
R	> 50 kΩ	> 50 kΩ	< 500 Ω	< 500 Ω	< 500 Ω	< 500 Ω

These tests enable a fault to be detected, but cannot give the assurance that the component is correct.

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Connectors

Control board

Connector	Conductors		Function	Interconnection
	number	colour		
J1	12	-	user terminals (see p. 10)	control sequence
J2	2	-		
J3	4	-		speed regulation option
J4	4	-		serial link option
J5	26	blue	control signals	power board
J6	4	red black green blue	control board supply	

Power board

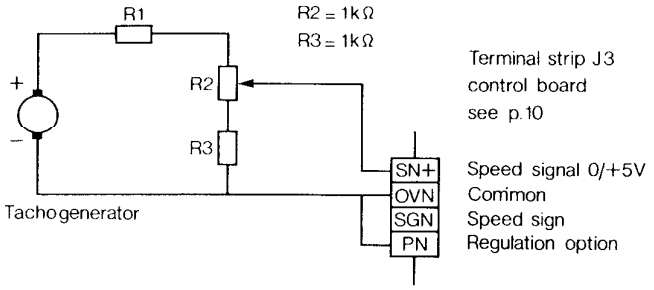
J1	1	red	common C +	measuring board
J2	2	red black	E5 B5 } transistor control T5	transistors modules
J3	2	red white	E3 B3 } transistor control T3	
J4	2	red blue	E1 B1 } transistor control T1	
J5	6	red yellow red purple red green	E6 B6 } transistor control T6 E4 B4 } transistor control T4 E2 B2 } transistor control T2	
J6	8	red	control signals	measuring board
J7	2	blue	upper channel supply T1	transformer
J13	2	red	upper channel supply T3	
J14	2	yellow	upper channel supply T5	
J15	2	grey	input circuit supply	
J16	3	green black green	lower channels and control supply	
J8	10	-	control signals	braking option
J10	4	black black red red	} heating } monitoring } end of charge } control	vigitherm charge relay

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Unidirectional speed regulation

Measuring the real motor speed with a tachogenerator allows the speed to be regulated. This being the case, automatic slip compensation depending on load incorporated in the ALTIVAR ATV 45 is cancelled and replaced by the speed regulation loop.

When the motor is used in one direction only, the tachogenerator can be connected to the speed controller via a simple adaptation circuit.



Utilisation safety measures

- Comply with the polarities shown for the tachogenerator connections.
- The SN+ terminal voltage must be < + 5V.
- Link PN to 0VN.
- Use the controller in the forward direction only (terminal FW).
- Connect the tachogenerator using twisted cables.

CAUTION : neither this adaptation circuit, nor that of the tachogenerator are isolated from the supply.

Accuracy : ± 0,1 % of the maximum speed for : - a torque variation from 0,2 Tn to Tn,
- a speed range from 1 to 50.

Calculation of R1 : calculate the maximum voltage provided by the tachogenerator.

EXAMPLE : motor 1500 rpm at 50 Hz
tachogenerator 0,06 V/rpm
frequency range 67 Hz
} $U = 0{,}06 \times 1500 \times \frac{67}{50} = 120{,}6$ V

R2 slide in median position : $R1 = 1{,}5 \times \frac{120{,}6}{5} - 2 = 34\ k\Omega$. Use 33 kΩ.

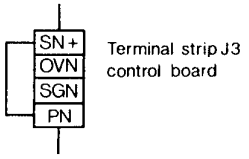
Adjustments

Connect a voltmeter to the tachogenerator terminals.
Adjust the R2 potentiometer to its minimum setting, in fully anti-clockwise position.
Start the motor and set maximum speed, using the reference potentiometer.
Turn R2 clockwise until the corresponding voltage is obtained.

Slip compensation override

Where the speed regulation facilities are not used, a link connecting terminals SN+ and PN will effectively override the automatic slip compensation built into the ALTIVAR ATV45. This arrangement may be required for certain applications :

- supplying synchronised asynchronous motors,
- ventilators, centrifugal pumps, ...



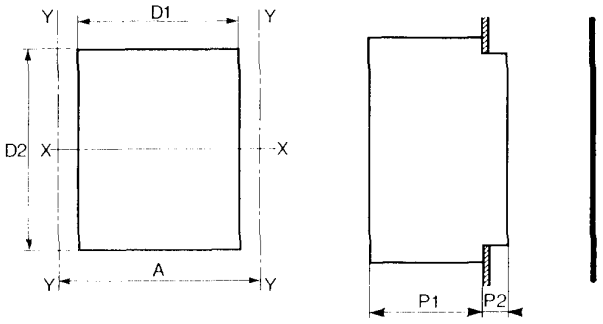
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Mounting in dust and damp protecting enclosure

In order to reduce power dissipated in the enclosure, the speed controller can be recess mounted in the back of the enclosure, with the radiator on the outside.

Follow carefully the mounting instructions given on pages 8 and 9.

Diagram of cut out to be made in enclosure



Provide a free space at the back of the enclosure sufficiently large for ventilation.

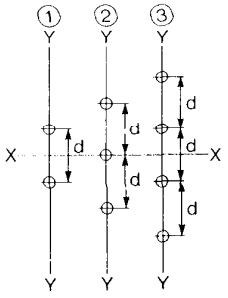
ALTIVAR reference	D1 mm	D2 mm	A mm	P1 mm	P2 mm	Drawing	Drillings d mm	Drillings Ø mm	Reference of mounting kit
ATV-45075 (M) (N) ATV-45U15 (N)	194	278	212	160	0	①	160	7	VY1-A451U1501
ATV-45U22 (M) (N) ATV-45U30 ATV-45U40 (M) (N)	172	342	212	165	25	②	150	7	VY1-A451U4001
ATV-45U55 (N)	172	382	212	165	25	②	150	7	VY1-A451U7501
ATV-45U55M ATV-45U75 (M) (N)	172	382	212	165	104	②	150	7	
ATV-45D11 (M) (N)	172	532	212	165	104	③	150	7	VY1-A451D1101
ATV-45D15 (M) (N) ATV-45D18N ATV-45D22 (N)	172	572	212	165	104	③	150	7	VY1-A451D1501

Assemble the kit according to drawings :

① - Flat self-adhesive gasket

② and ③ - Flat self-adhesive gaskets
- Dust and damp protective plates
- Screws and accessories

Each kit is delivered with mounting instructions.



WARNING : for the ATV-45U55M, U75 (M) (N), D11 (M) (N), D15 (M) (N), D18N, D22 (N), the fan situated on the outside of the enclosure retains IP20 degree of protection.

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Enclosed speed controllers

The speed controllers ALTIVAR ATV-45... (**for 380/415V range only**) are available in dust and damp protecting metal enclosures.

The reference for the enclosed unit is that of the speed controller followed by Q5.
Every enclosure contains an ALTIVAR and a fan to cool the air on the interior.

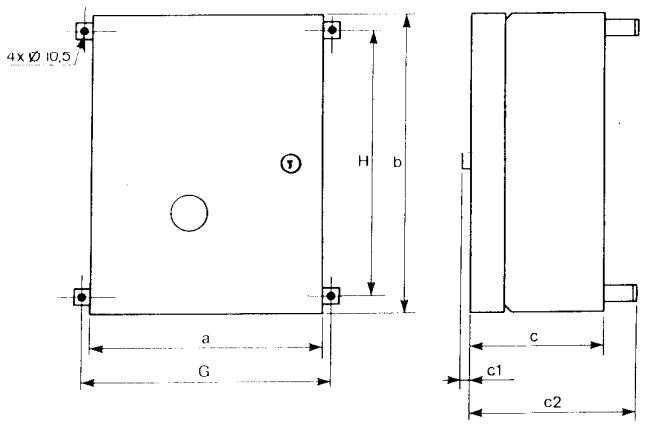
Characteristics : - degree of protection IP54,
- RAL 7032 grey paint,
- inspection window in door for displaying codes,
- locks with RONIS n°455 key.

Connections

The upper and lower sides of the enclosure contain holes with plugs for fitting cables, allowing cable glands (which are not supplied) to be fitted.

Cable glands required
- ATV-45075Q5 to U40Q5 : 7 x PE13
- ATV-45U55Q5 and U75Q5 : 4 x PE13 + 3 x PE16
- ATV-45D11Q5 to D22Q5 : 4 x PE13 + 3 x PE21

Dimensions



Enclosed unit reference	Sizes (mm) a	b	c	c1	c2	Fixing (mm) H	G	Weight (kg)
ATV-450/5Q5 ATV-45U15Q5	300	500	200	6,3	230	462	324	16
ATV-45U22Q5 ATV-45U30Q5 ATV-45U40Q5	400	500	250	6,3	280	462	424	21,5
ATV-45U55Q5	400	600	250	6,3	280	562	424	25,2
ATV-45U75Q5*	400	600	250	6,3	357	562	424	27,7
ATV-45D11Q5* ATV-45D15Q5* ATV-45D22Q5*	600	800	300	6,3	407	762	624	44,2 46,7 48,2

* The external radiator fan retains IP20 degree of protection.

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Slow-down braking Speed regulation

These two options are combined in the same module, common to the ATV-45075 (M) (N) to D22 (N) range of ALTIVAR.

This module can be clipped on to the left side of the speed controller.

Reference : VW3-A45101.

Supplied with the module are :

- two multi-core cables with connectors for connection to the speed controller :
  - slow-down braking option : the power board's J8 connector,
  - speed regulation option : the control board's J3 connector,
- instructions for mounting and connecting.

Two of the module's pre-wired conductors enable connection to the + and – terminals of the speed controller.

The braking resistance must be installed separately (see p. 42).

Environment

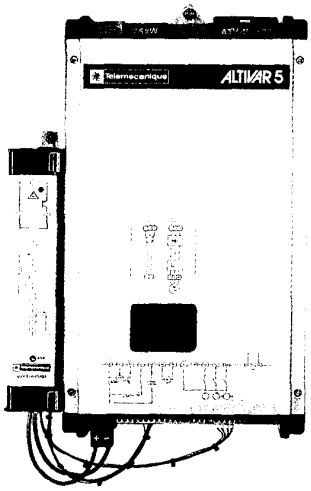
Environmental conditions are identical to those of the ALTIVAR (see p. 6).

Degree of protection of the module : IP20.

Dimensions

Hight = 255 mm.
Width = 55 mm.

Weight = 1,2 kg.



Slow-down braking

When the frequency produced by the controller decreases rapidly, the motor behaves like an asynchronous generator and produces a braking torque. The motor feeds energy back to the controller. Braking power depends on the rate of deceleration, the inertia of the moving mass and the resistive torque.

As the controller cannot feed the energy back into the supply, this causes an increase in the voltage of the filter capacitors, which limits the braking effect, potentially causing the controller to lock into overvoltage (code [0 b F]).

Part of the braking energy is dissipated as losses in the motor, the corresponding braking torque varying from 10 to 35% of the rated motor torque.

The slow-down braking option allows a higher braking torque to be obtained, and ensures that part of the braking energy is dissipated in an external resistance.

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Composition

The slow-down braking option comprises :

- a module including :

  • a power transistor, which ensures the switching of the braking resistance across the filter capacitors terminals,
  • the control electronics,
  • a low speed relay, which will control a brake, if necessary :
    - pick up at f > 5 Hz and I motor ≥ 0,7 rated speed controller current,
    - drop out at f ≤ 5 Hz,
  • a pilot light, indicating capacitors charge,

- a separate braking resistance, to be supplied if necessary.

Characteristics

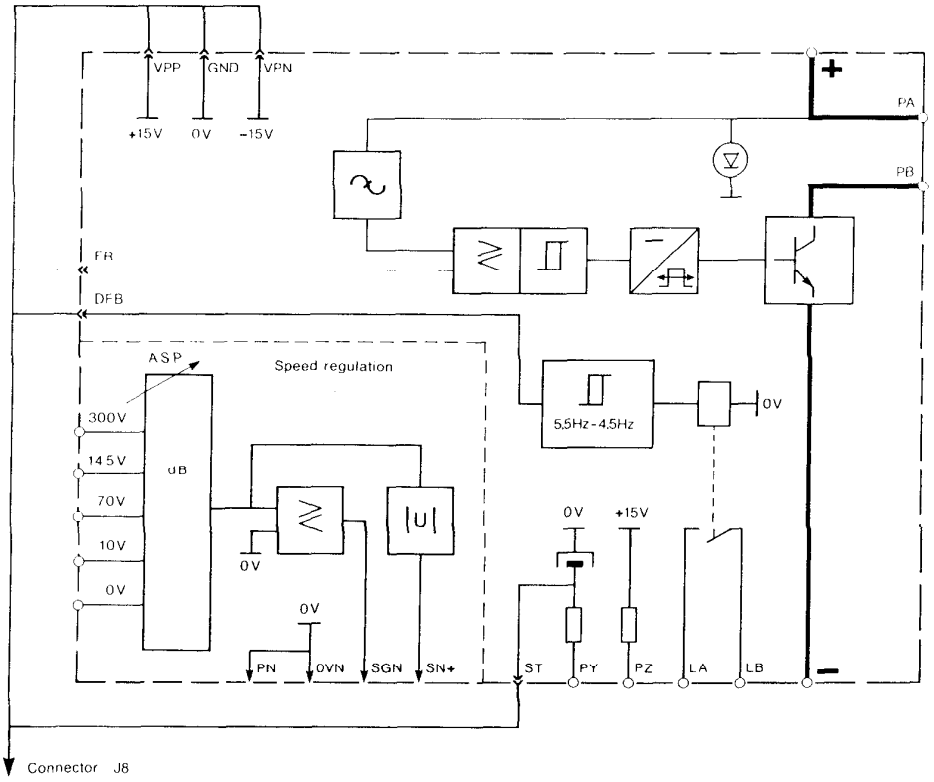
The module is rated for continuous supply of a braking power of 6 kW.

In practice, the maximum transmissible current is linked to :

- the ohmic value of the braking resistance,
- the current limitation of the associated controller.

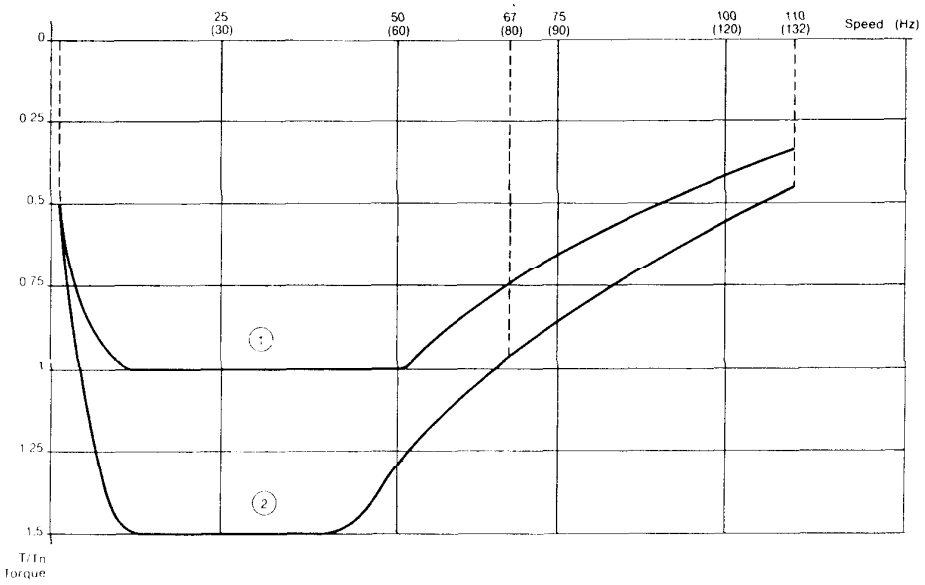
The module is protected against short-circuits at the braking resistance terminals.

Functional block diagram



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Available braking torque



① Continuous braking torque (driving load)
② Maximum transitory braking torque

When frequency is < 10 Hz, braking torque decreases rapidly.

Slip compensation does not exist with hypersynchronous braking.

Braking power calculation

- High inertia machine, non driving load

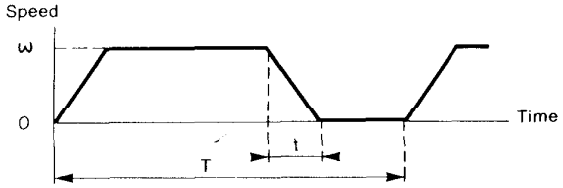
Braking torque on deceleration : $Tf = J \frac{\Delta\omega}{\Delta t}$ in N.m,

J : total moment of inertia referred to the motor shaft in kg.m^2,
$\Delta\omega$: speed difference in rad/s,
Δt : deceleration time in seconds.

Instantaneous braking power : $Pf = Tf\ \omega$ in W.
Average braking power during deceleration : $Pfd = 0{,}5\ Tf\ \Delta\omega$ in W.

Average braking power during one cycle : $Pfm = Pfd \frac{t}{T}$ in W.

t : braking time in seconds,
T : time of one cycle in seconds.



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- Driving load, continuous operation of unspecified duration

Braking is treated as continuous braking : Pf = Pfm = Tf ω in W,

Tf : braking torque in N.m,
ω : speed in rad/s.

CAUTION : whatever the application, the instantaneous braking power necessary must be ≤ 1,5 the rated torque of the speed controller.

Braking resistance selection

The braking resistance is defined by its ohmic value and power dissipation capacity.

Ohmic value of resistance

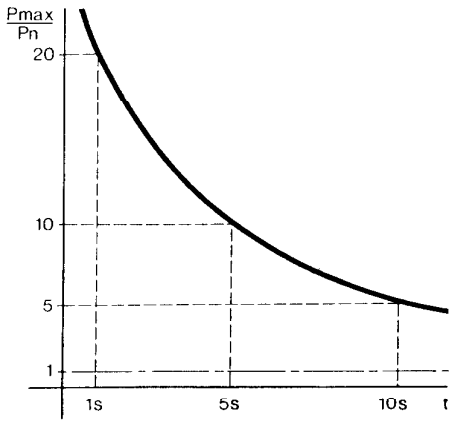
Reference **ATV-45...M**	220/240V	075M	-	U22M	-	U40M	U55M	U75M	D11M	D15M	-	-
Minimum value of braking resistance (Ω)		47			-	22	10			8	-	-
Reference **ATV-45...**	380/415V	075	U15	U22	U30	U40	U55	U75	D11	D15	-	D22
Reference **ATV-45...N**	440/500V	075N	U15N	U22N	-	U40N	U55N	U75N	D11N	D15N	D18N	D22N
Minimum value of resistance (Ω)		100					27			22	15	
Cabling : recommended section (mm^2)		2,5					4					

Power of the resistance :

- rated Pn : power that can be dissipated continuously ; it must be greater than the average braking power Pfm,

- maximum Pmax : power that can be dissipated over a short period on intermittent duty ; it must be greater than braking power Pf.

Possibilities of resistance overload following braking time t



For a resistance of rated power Pn, a maximum Pmax power, equal to twenty times Pn would be acceptable if the braking lasts 1 second, or five times Pn if the braking lasts 10 seconds.

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Standard resistances (for the most common operating conditions)

Reference **ATV-45...M**	220/240V	075M	-	U22M	-	U40M	U55M	U75M	D11M	D15M	-	-
Reference **ATV-45...**	380/415V	075	U15	U22	U30	U40	U55	U75	D11	D15	-	D22
Reference **ATV-45...N**	440/500V	075N	U15N	U22N	-	U40N	U55N	U75N	D11N	D15N	D18N	D22N
Standard resistance (Ω)		100					27				27	
Rated power (W)		72					280				700	
Dimensions (mm) H x W x D *		153 x 20 x 60					306 x 30 x 80				450 x 55 x 105	
Reference	VY1-AD	R100W072					R027W280				R027W700	

* Dimensions of resistance with thermocontact and fixing brackets.

Resistance calculation example

A motor with the following characteristics : - power : 0,75 kW,
- rated speed : 1450 rpm,
- moment of inertia : 0,002 kg.m²,

drives a machine with : - inertia 10 times that of the motor,
- resistive torque one tenth of the rated motor torque.

The requirement is to stop in 1 second from rated speed at a rate of 10 cycles per minute.

Rated angular speed : $\omega n = \frac{2\pi N}{60} = \frac{2\pi\ 1450}{60} = 152$ rad/s

Rated motor torque : $Tn = \frac{Pn}{\omega n} = \frac{750}{152} = 4,9$ N.m

Resistive torque : $Tr = \frac{4,9}{10} = 0,49$ N.m

Total inertia : $J = 0,002 + 10 \times 0,002 = 0,022$ kg.m²

Braking torque : $T = J \frac{\Delta\omega}{\Delta t} = 0,022 \times \frac{152}{1} = 3,34$ N.m

Motor braking torque : $Tf = T - Tr = 3,34 - 0,49 = 2,85$ N.m

Instantaneous braking power : $Pf = Tf\ \omega = 2,85 \times 152 = 433$ W

Average braking power during deceleration : $Pfd = 0,5\ Tf\ \Delta\omega = 0,5 \times 2,85 \times 152 = 216$ W

Cycle time : $T = \frac{60}{10} = 6$ s

Average braking power during one cycle : $Pfm = Pfd \frac{t}{T} = 216 \times \frac{1}{6} = 36$ W

Standard resistance VY1-AD R100W072 :

- rated power : Pn = 72 W, thus > Pfm,
- maximum power possible for 1 second (see curve on page 39) : Pmax = 20 x 72 = 1440 W, thus > Pf.

} the resistance is suitable.

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Further resistance calculation example

A motor with the following characteristics : - power : 4 kW,
- rated speed : 1450 rpm,
- moment of inertia : 0,0135 kg.m²,

drives a machine with : - inertia twenty times that of the motor,
- resistive torque one tenth of the rated motor torque.

The requirement is to stop in 5 seconds from rated speed at a rate of 2 cycles per minute.

Rated angular speed : $\omega n = \frac{2\pi N}{60} = \frac{2\pi\ 1450}{60} = 152$ rad/s

Rated motor torque : $Tn = \frac{Pn}{\omega n} = \frac{4000}{152} = 26,3$ N.m

Resistive torque : $Tr = \frac{26,3}{10} = 2,63$ N.m

Total inertia : $J = 0,0135 + 20 \times 0,0135 = 0,2835$ kg.m²

Braking torque : $T = J \frac{\Delta\omega}{\Delta t} = 0,2835 \times \frac{152}{5} = 8,62$ N.m

Motor braking : $Tf = T - Tr = 8,62 - 2,63 = 6$ N.m

Instantaneous braking power : $Pf = Tf\ \omega = 6 \times 152 = 912$ W

Average braking power during deceleration : $Pfd = 0,5\ Tf\ \Delta\omega = 0,5 \times 6 \times 152 = 456$ W

Cycle time : $T = \frac{60}{2} = 30$ s

Average braking power during one cycle : $Pfm = Pfd \frac{t}{T} = 456 \times \frac{5}{30} = 76$ W

Standard resistance VY1-ADR100W072 is not suitable :

- rated power : Pn = 72 W. thus < Pfm.
- maximum power possible for 5 seconds (see curve on page 39) :
  Pmax = 10 x 72 = 720 W, thus < Pf.

Select a resistance with the same value (100Ω) and greater power value in order to be able to dissipate the required braking power.

WARNING



The precise resistance calculation, as shown in the previous examples, is **imperative** for severe duty applications, requiring high braking power : hoisting (vertical movement), high inertia machines, driving loads, ...

If the required braking torque is high, choose a resistance with an ohmic value equal or marginally higher than the minimum value shown in the table on page 39.

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Installation of the resistance

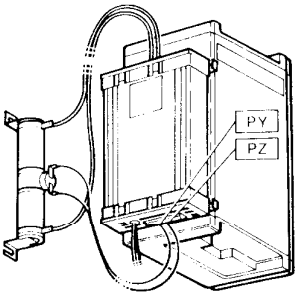
Supplied with the standard resistance are : - a thermocontact and two clamping collars,
- two fixing brackets,
- mounting and connecting instructions.

When installing, make sure that there is a free space of 50 mm minimum around the resistance to ensure evacuation of the heat dissipated.



In order to avoid all accidental contact with the braking resistance (maximum d.c. voltage of 800V between terminals, and a heightened temperature, capable of reaching 350°C when operating), the installation of a protective cover is recommended. Provide openings for circulation of the air required for evacuating dissipated calories.

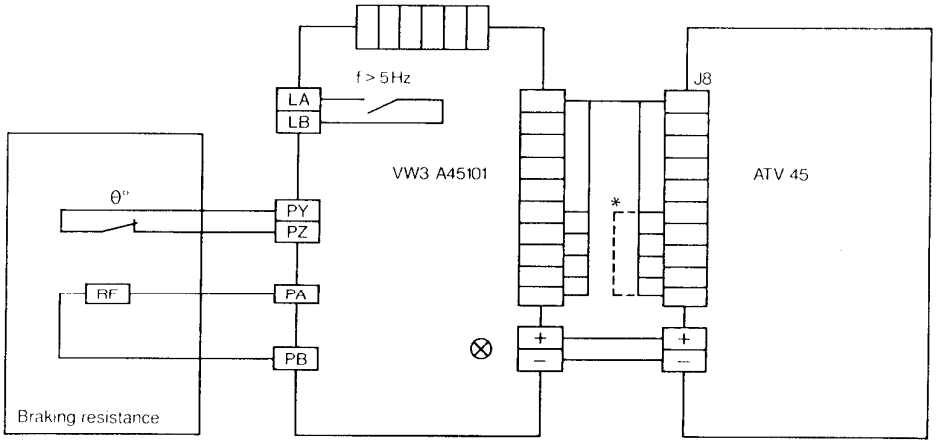
Installation and connection of the optional module

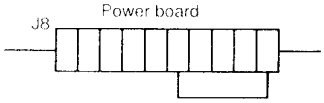


Follow the procedure described in the instructions delivered with the module.

Safety precautions to take when wiring the resistance :

- as the d.c.voltage at the resistance terminals can reach 750 to 800V at the start of braking, use conductors with a high insulation class (1000V),
- ensure that the thermocontact is connected to the terminals PY-PZ of the braking module ; if this is not done, the data "contact open" will cause the controller to lock when switched on. displaying the code [0hF] .





* If the braking option is not to be used, the connector delivered with the speed controller must be plugged into J8, in order to cancel the temperature control of the braking resistance.

If the speed regulation option is not to be used, do not connect the wire between the module and the control board's J3 connector.

If the motor is fitted with a brake whose windings are accessible via terminals, connect the contact of the low speed relay available at terminals LA-LB into the control sequence.
Characteristics : 220/240V - 50/60Hz - 2A.

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Initial setting up

The initial setting up of the braking option needs no adjusting.

After checking the connections, and perhaps adjusting the speed controller settings, the ALTIVAR can be switched on.

Should there be any doubt as to the braking power, proceed in the following manner :

- preset a deceleration ramp time longer than the required braking time,
- start the motor and carry out successive braking operations, gradually reducing the ramp time until the final adjustment is reached, making sure that the braking cycles are identical to those for actual use.

If the resistance heats up to an abnormal level, the thermocontact should open and the controller will lock, displaying the code [0hF].

If this occurs, check the braking conditions, and change the resistance if necessary for a resistance with the same ohmic value, and higher rated power.

Maintenance

Where there is excessive braking, the speed controller may display the following codes :

[0br]	Deceleration ramp not followed	Increase the deceleration time
[0bF]	Capacitors overvoltage owing to too severe braking or a driving load	

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Speed regulation

Measuring the real motor speed with a tachogenerator allows the speed to be regulated. This being the case, automatic slip compensation depending on load incorporated in the ALTIVAR ATV 45 is cancelled and replaced by the speed regulation loop.

The speed regulation option ensures the following functions :

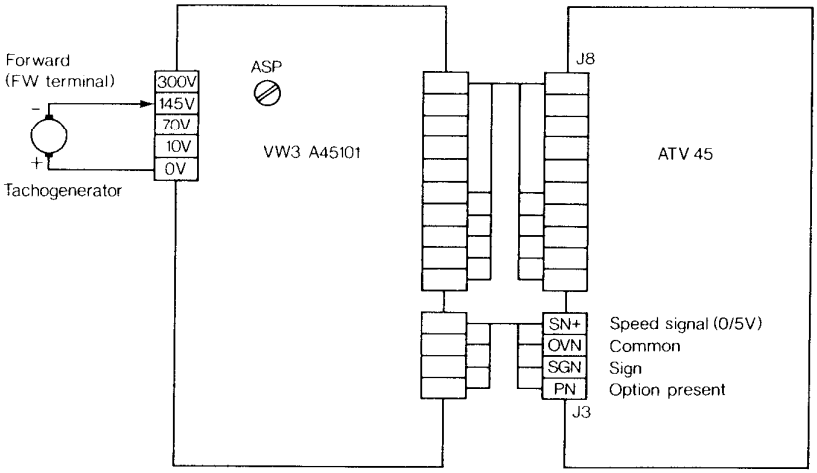
- adapting the voltage value provided by the tachogenerator,
- developing the absolute value and the sign of the voltage signal to ensure regulation in both directions.

CAUTION : neither this adaptation circuit, nor that of the tachogenerator are isolated from the supply.

Accuracy : ± 0,1 % of the maximum speed for : - a torque variation from 0,2 Tn to Tn,
- a speed range from 1 to 50.

Connections

Use the cable supplied with the option to connect the module to the control board's J3 connector.



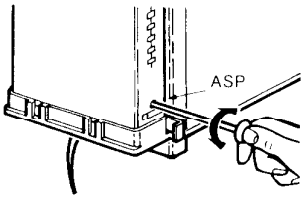
Connecting the tachogenerator :

- calculate the maximum voltage provided by the tachogenerator :

EXAMPLE : motor 1500 rpm at 50 Hz
tachogenerator 0,06 V/rpm
frequency range 67 Hz
$U = 0,06 \times 1500 \times \frac{67}{50} = 120,6\ V$

- using a twisted cable, connect the tachogenerator to the module terminals, with values immediately above the value calculated : 0V-145V in the example below.

Adjustments



Connect a voltmeter to the tachogenerator terminals.
Turn the ASP potentiometer to the fully anti-clockwise position.
Start the motor and set maximum speed using the reference potentiometer.
Turn ASP clockwise until the corresponding voltage is obtained.

If the setting remains inoperative, reverse the tachogenerator connections.

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Special software

Using special software with the ALTIVAR ATV 45 instead of the standard controller's memory allows the following applications to be resolved :

- control of special motors :
  - with conical rotor,
  - with pole changing (Dalhander),
  - with two or more windings,
  - synchronised asynchronous,
  - with high torque (for handling applications),
- combination of motor and speed controller with widely different power ratings, or a number of motors in parallel controlled by a single speed controller,
- hoisting (vertical movements), in conjunction with the VW3-A45101 braking option,
- machines with fast cycles,
- machines with positioning on stopping,
- machines with very high inertia (normally requiring the use of the braking option).

Reference and structure

The special software option, reference VW3-A45102 : ATV-45... (N), or VW3-A45202 : ATV-45...M, comprises :

- tweezers to extract the standard controller's memory,
- a special memory, mounted on a rigid support,
- a special user's manual.

Characteristics

The use of the special software modifies a certain number of settings and the sequence of the codes on the dialogue panel, particularly :

- the UFR potentiometer's setting zones (voltage/frequency ratio) :
  - zone F00 to F10 : identical to the zone n00 to n10 of the standard speed controller,
  - zone L00 to L10 : - improved torque performance in transitional phases by faster change of motor torque,
    - reduced automatic adaptation of the U/f ratio according to the load,
    - compared with the setting zone n00 to n10 of the standard speed controller, the adjustment range is multiplied by five,
- the STA potentiometer, with a different function, enables the gain of the frequency loop to be modified. The set value in % can be displayed on the dialogue panel. The operator can therefore adjust the controller's response time.

If the ALTIVAR is fitted with the braking option, the setting of LSP potentiometer automatically adjusts the detection threshold of the low speed relay integrated into the module (brake control in hoisting applications).

Other special characteristics :

- in the zone F00 to F10 : automatic d.c. injection braking during 0,5 s when the stator frequency becomes < 1Hz,
- delay when stop (breaking circuit to terminal FW or RV), or reversing is signalled :
  - 20 ms typical,
  - 40 ms maximum,
- delay during changes of speed set-point : between 0 and 43 ms,
- safety feature with hoisting applications (vertical movements) if the ALTIVAR ATV 45 is fitted with the VW3-A45101 option and the motor fitted with a tachogenerator : the controller locks and the code SPF is displayed if the difference between the speed reference at ramp output and the speed feedback signal is > 10Hz.

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Serial communication

The exchange of data between an ALTIVAR ATV 45 and an automation control system (programmable controller, computer) is carried out by a single asynchronous serial link.

The speed controller can be controlled either by the serial link in LINE mode, or by the control and speed set-point inputs in LOCAL mode.

In LINE operating mode, certain adjustments are modifiable :

- speed limits LSP and HSP : from 0 to the maximum value of the selected range,
- ramp times ACC and DEC : from 0,2 to 997 seconds.

Two kinds of link are feasible :

- point to point by interposing an isolating interface module,
- multidrop, via a serial communication coupler.

Isolating interface

The isolating interface unit reference VW3-A45104 enables an ALTIVAR ATV 45 to be linked to a TSX 47/67/87 range PC fitted with a TSX SCM coupler. It is delivered with a connecting cable for the speed controller and a special manual.

The link is in a 0-20 mA current loop (half duplex).The exchanges are made in ASCII at 9600 bauds, with a special question/answer type protocol.

Serial communication coupler

Equipped with a microprocessor, the multidrop communication coupler authorises more sophisticated transmissions and ensures the control of various protocols (UNI-TELWAY, MODBUS...) with the most current standards :

- RS 232 C,
- 20 mA current loop (serial or parallel),
- RS 485.

Its usage enables a TSX 47/67/87 range PC fitted with a UNI-TELWAY version TSX SCM coupler to be connected to one or more speed controllers by a single link (in that case, one coupler should be provided for each ALTIVAR). It ensures the galvanic isolation of the link with regard to the associated controller.

Presentation : metal case ; size (in mm) : H 192, W 47, D 158 (fixing H 170/180).
Reference : VW3-A45103FM for 110-127/220-240 V, 50/60 Hz supply,
VW3-A45103BD for 24 V d.c. supply.

The coupler is delivered with a connecting cable for the speed controller and a special manual.
On the front are fitted :
- 3 signal displays : normal operation, addressing fault, link fault,
- 12 selector switches depending on protocol, standard of transmission, data format, and transfer speed (300 to 19200 bauds).

Transmissible data (point to point or multidrop link) :

- operating mode (reading or writing) : LOCAL, LINE,
- commands (reading or writing) : start, frequency reference (signal and value), braking, LSP and HSP speed limits, ACC and DEC ramp times,
- signalling (reading only) : supply voltage, motor current, thermal state, frequency, state register, fault register, operating mode register,
- configuration (reading of the potentiometers) : adjustment of the thermal protection, ramp times, voltage/frequency ratio, stability potentiometer.

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Attenuating input filters
(220/240V or 380/415V supply)

The input filters are intended to limit development of interference in the mains supply which can be created by the ALTIVAR and which can affect receivers (radio, television, interphone, ...).

Characteristics

These filters enable the speed controllers to conform to international standards (CISPR 14, VDE 0875-1/11-84), as far as radio-electrical interference in conduction mode is concerned.

The application range is limited to devices whose maximum current is less than 25A.
This limits use to the following controllers : ATV-45U55M (220/240V) and ATV-45D11 (380/415V).

Installation, connections

Mount the filter near the controller, at a distance ≤ 15 cm.

Join the filter and speed controller earths and link them to the protective earth. The connections should be as short as possible (limited to the length of the filter cables) and of low impedance. A good quality earth is required.

To limit the radiation effect, twist the input and ouput pairs of filter cables, and use screened and twisted cables for all other connections with the speed controller (motor, reference, controls, ...), taking care that the screening is connected to the protective earth.

Notes

In order to limit radiation produced by the cables connecting the ALTIVAR to the motor, install the controller as near as possible to the motor.

Separate the power circuits from the control circuits.

If the supply to the control circuit of the controller (CL1-CL2•) is located upstream of the input filter, an additional filter must be fitted to this supply ; otherwise, link L1-CL1 and L2-CL2• terminals.

References, dimensions

ALTIVAR reference	Filter	Reference	Dimensions* mm	Weight kg
ATV-45075 (M) ATV-45U15	Input	VY1-A451U1502	150 x 125 x 65	1,5
ATV-45U22 (M) ATV-45U30 ATV-45U40 ATV-45U55	Input	VY1-A451U5502	250 x 150 x 65	2
ATV-45U40M ATV-45U55M ATV-45U75 ATV-45D11	Input	VY1-A451D1102	350 x 220 x 70	2,5
ATV-45... (M)	Control	VY1-A05102	48 x 48 x 30	0,1

* The dimensions are given as a guide, and are liable to change.

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	Description	For ALTIVAR	Reference
Boards	Control board	ATV-45075 (N) to D22 (N)	VX4-A451
		ATV-45075M to D15M	VX4-A452
	Measuring board	ATV-45075M, U15	VX4-A45102
		ATV-45U22 (N)	VX4-A45103
		ATV-45U30, U40N	VX4-A45104
		ATV-45U22M, U40	VX4-A45105
		ATV-45U55 (N)	VX4-A45106
		ATV-45U75 (N)	VX4-A45107
		ATV-45D11	VX4-A45108
		ATV-45D15	VX4-A45109
		ATV-45D22	VX4-A45110
		ATV-45075 (N)	VX4-A45111
		ATV-45D11N	VX4-A45112
		ATV-45D15N	VX4-A45113
		ATV-45D18N, D22N	VX4-A45114
		ATV-45U40M	VX4-A45115
		ATV-45U55M	VX4-A45116
		ATV-45U75M	VX4-A45117
		ATV-45D11M	VX4-A45118
		ATV-45D15M	VX4-A45119
	Power board	ATV-45075M, U22M	VX5-A451U22M
		ATV-45075, U15, U22, U30	VX5-A451U30
		ATV-45U40, U55, U75	VX5-A451U75
		ATV-45D11, D15	VX5-A451D15
		ATV-45U40M to D15M	VX5-A451D15M
		ATV-45D22	VX5-A451D22
		ATV-45075N, U15N, U22N, U40N	VX5-A451U40N
		ATV-45U55N, U75N	VX5-A451U75N
		ATV-45D11N, D15N, D18N	VX5-A451D15N
		ATV-45D22N	VX5-A451D22N
Rectifier	25A-1200V	ATV-45075 (M), U15, U22, U30	VZ3-DM6025M1201
	30A-1200V	ATV-45U22M, U40 (M), U55	VZ3-DM6030M1201
	60A-1200V	ATV-45U55M, U75 (M), D11, D15	VZ3-DM6060M1201
	100A-1200V	ATV-45D11M, D15M, D22	VZ3-DM6100M1201
	25A-1600V	ATV-45075N, U15N, U22N, U40N	VZ3-DM6025M1601
	30A-1600V	ATV-45U55N	VZ3-DM6030M1601
	60A-1600V	ATV-45U75N, D11N, D15N, D18N	VZ3-DM6060M1601
	100A-1600V	ATV-45D22N	VZ3-DM6100M1601
Modules with 2 transistors	50A-600V	ATV-45U22M, U40M	VZ3-BM2050M0601
	75A-600V	ATV-45U55M	VZ3-BM2075M0601
	100A-600V	ATV-45U75M	VZ3-BM2100M0601
	150A-600V	ATV-45D11M	VZ3-BM2150M0601
	200A-600V	ATV-45D15M	VZ3-BM2200M0601
	30A-1000V	ATV-45075 (M), U15, U22, U30	VZ3-BM2030M1001
	50A-1000V	ATV-45U40, U55, U75	VZ3-BM2050M1001
	75A-1000V	ATV-45D11	VZ3-BM2075M1001
	100A-1000V	ATV-45D15	VZ3-BM2100M1001
	150A-1000V	ATV-45D22	VZ3-BM2150M1001
	30A-1200V	ATV-45075N, U15N, U22N, U40N	VZ3-BM2030M1201
	50A-1200V	ATV-45U55N, U75N	VZ3-BM2050M1201
	75A-1200V	ATV-45D11N	VZ3-BM2075M1201
	100A-1200V	ATV-45D15N, D18N	VZ3-BM2100M1201
	150A-1200V	ATV-45D22N	VZ3-BM2150M1201
Control fuse	1A g1 (8,5 x 31,5)	ATV-45••• (M)	DF2-BN0100 *
Cooling fan	Flow 100 dm³/s	ATV-45U55M, U75 (M), D11 (M), D15 (M), D22	SZ1-XH07
	Flow 44 dm³/s	ATV-45U75N, D11N, D15N, D18N, D22N	SZ1-XH23

* Sold in lots of 10.

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