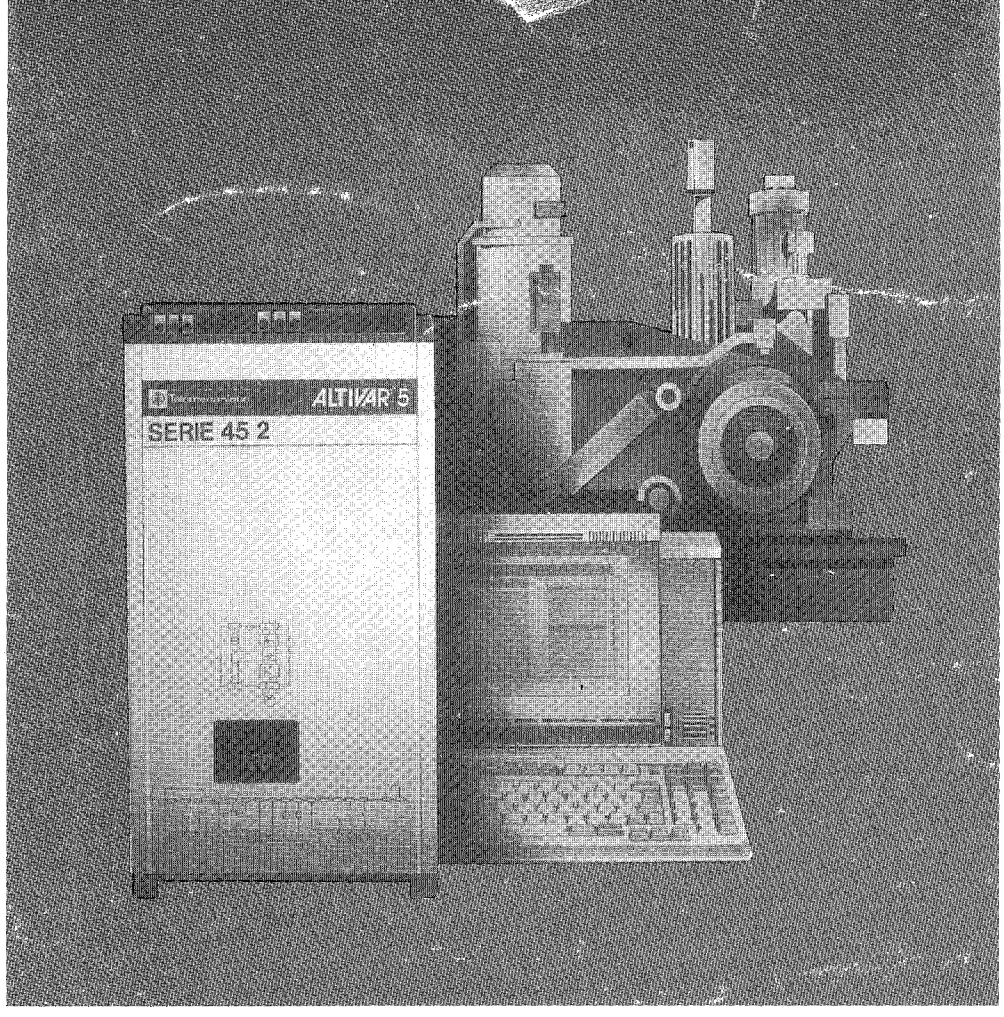


ALTIVAR® 5 series 45 2 variable speed controllers for asynchronous motors

user's manual

Telemecanique

GROUPE SCHNEIDER

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 contoller. This period corresponds to the time constant for the discharge of the capacitors. The + and – terminals (or PA-PB for the controllers from 37 to 90 kW) 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, while the speed controller remains energized. If 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 cause the tripping of the controller, and hence stop the motor. The motor itself can also be subject to stoppage by mechanical jamming,voltage fluctuations and power supply failures in particular.

The clearance 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. 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.

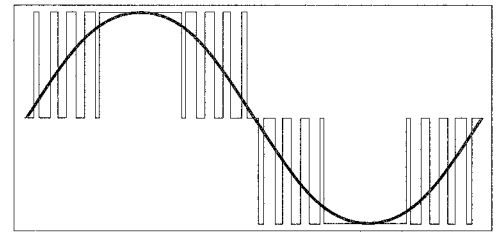
As a general rule, the speed controller power supply must always be switched off before carrying out any operation on either the electrical or the mechanical parts of the installation or the machine.

Contents

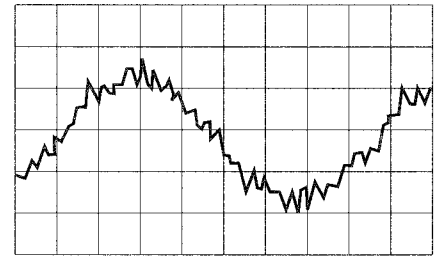
STANDARD APPLICATIONS

SPECIAL APPLICATIONS

The ALTIVAR ATV-45 2 is a frequency inverter operating on the principle of synthesizing a sine wave by pulse width modulation (PWM).



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

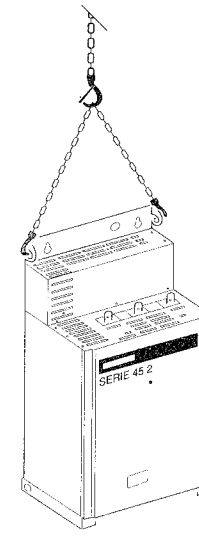


When associated with a standard three phase asynchronous squirrel cage motor, the ALTIVAR ATV-45 2 provides a simple and reliable motor/speed controller combination.

In order to obtain the best possible results from the ALTIVAR ATV-45 2, read this guide carefully and apply all the relevant information and recommendations given.

Remove the ALTIVAR ATV-45 2 from its packaging 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.



ALTIVAR 37 to 90 kW

The device can be handled :

- either using a hoist, attaching it to the two lifting rings to be found on the upper part,

- or in a horizontal position, with its back resting on a pallet.

The variable speed controller can be placed on the ground in an upright position.

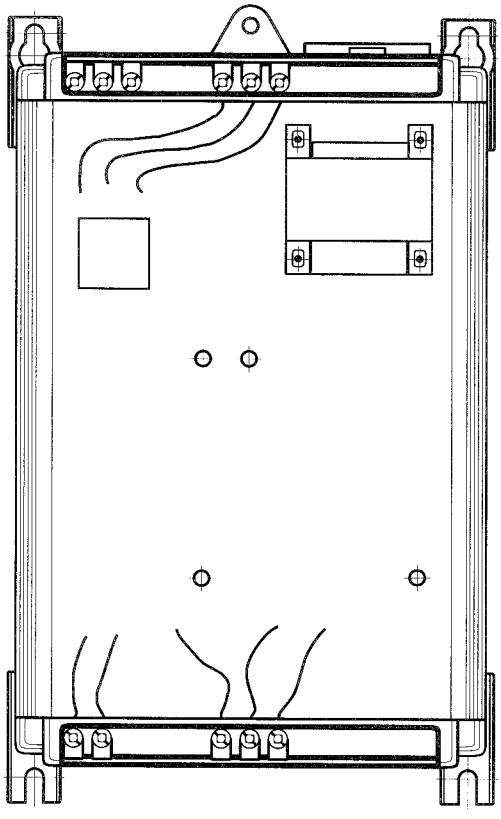
ALTIVAR 0,75 to 4 kW (except ATV-452U40M and U40S)

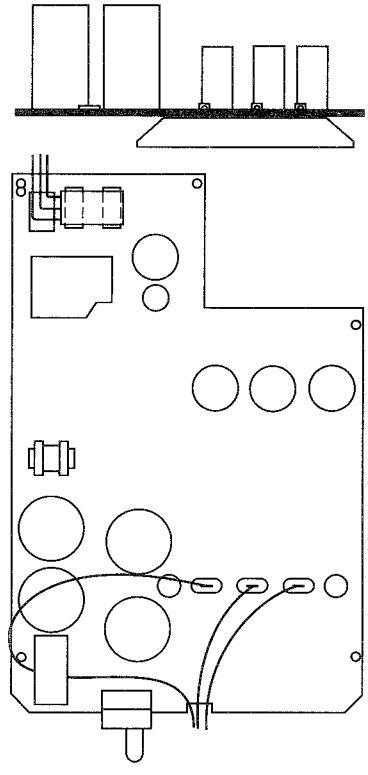
Technology

Variable speed controllers 0,75 and 2,2 kW at 220/240 V : **ATV-452075M and U22M**
0,75 to 4 kW at 380/415 V : **ATV-452075 to U40**
0,75 to 4 kW at 440/500 V : **ATV-452075N to U40N**

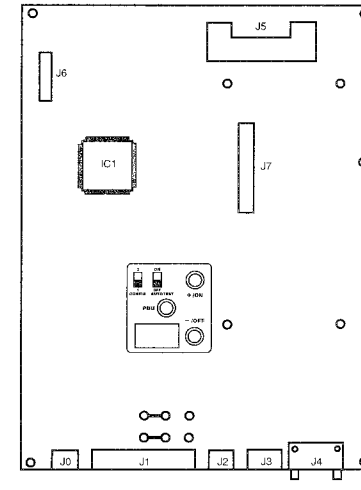
The measurement board components, the smoothing capacitors, the vigitherm and the 6 transistor module are all mounted on the power board.

The rectifier and the supply transformer are mounted separately.





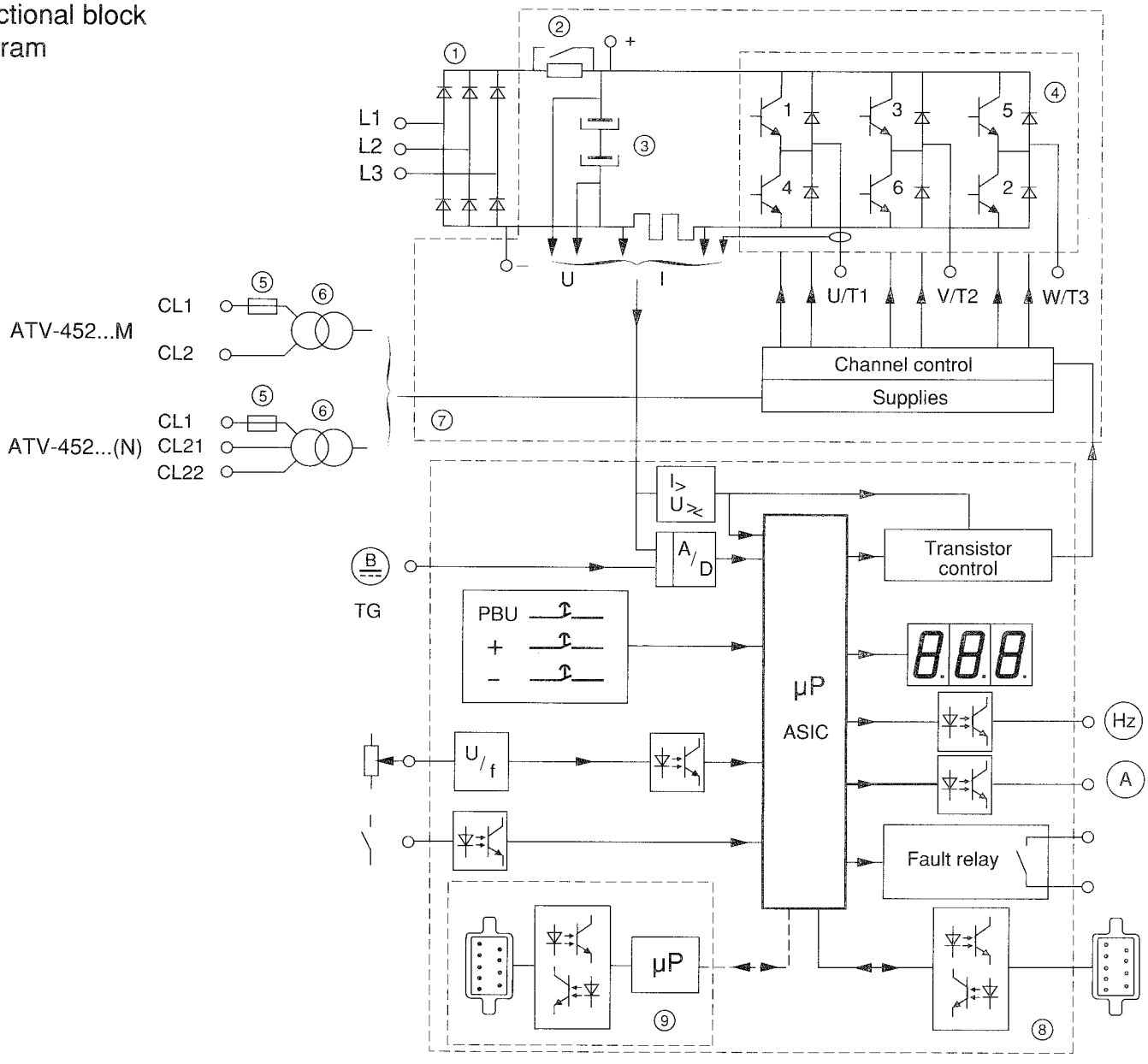
Power board



Control board

ALTIVAR 0,75 to 4 kW (except ATV-452U40M and U40S)

Functional block diagram



Description of the functions

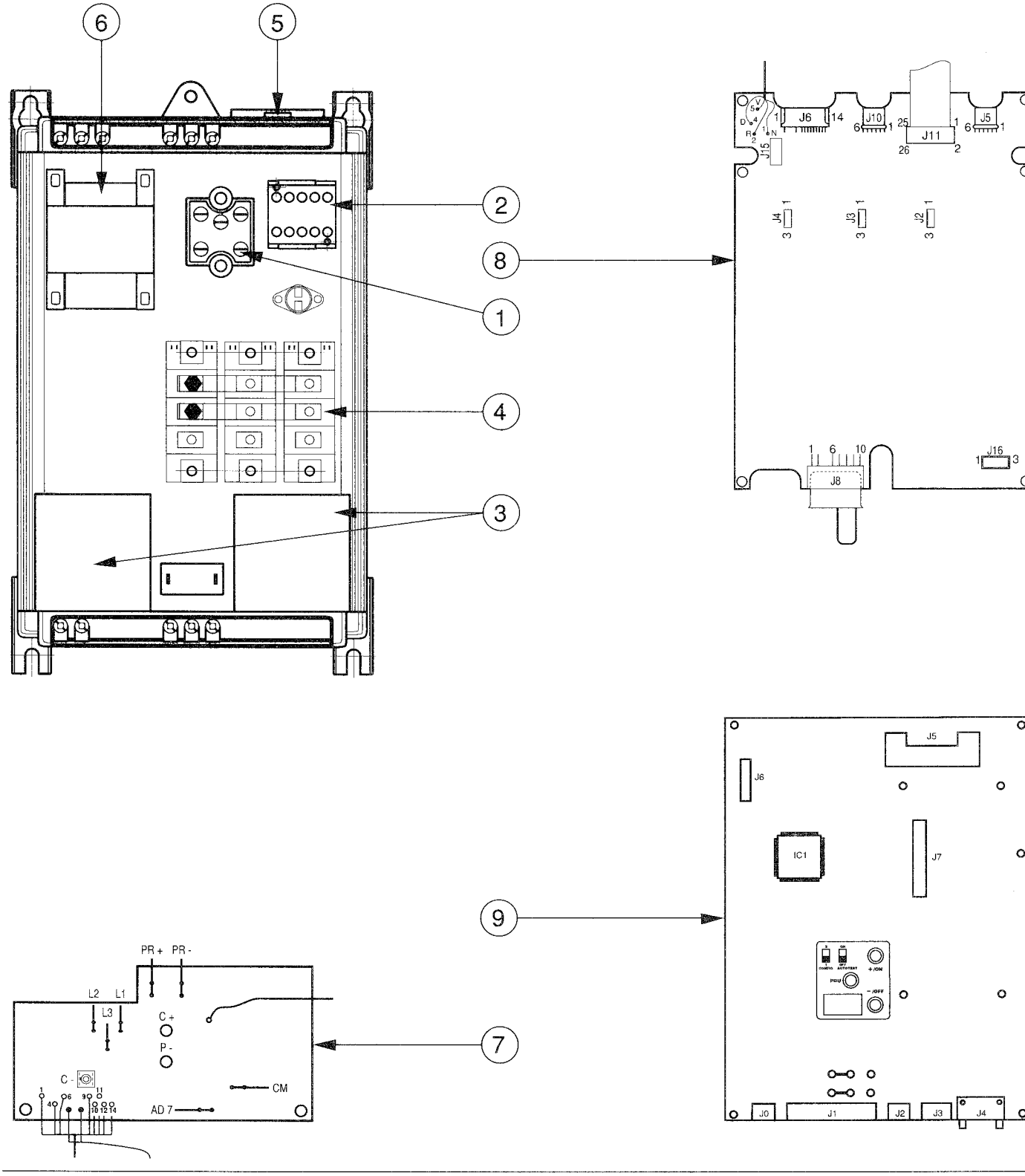
1. Rectifier
2. Charge current limiting device
3. Filter capacitors
4. Transistor inverter bridge
5. Plug-in fuse carrier with fuse (ATV-452...) or link (ATV-452...N)
6. Control transformer
7. Transistor power board
8. Microprocessor control board
9. Communication option board

ALTIVAR 4 to 30 kW (except ATV-452U40 and U40N)

Technology

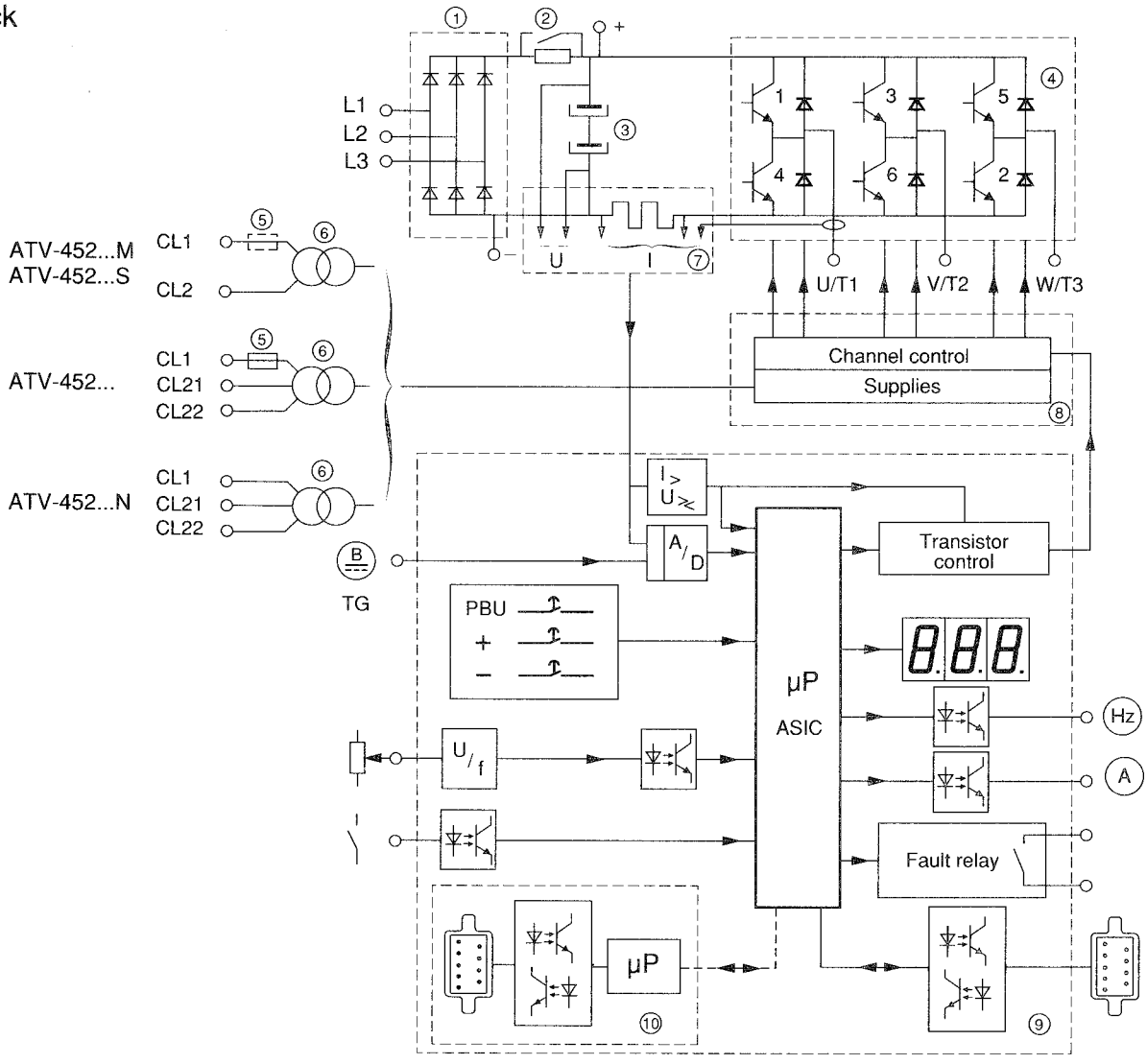
Variable speed controllers

ATV-452U40M to D15M
ATV-452U55 to D30
ATV-452U55N to D30N
ATV-452U40S to D30S



ALTIVAR 4 to 30 kW (except ATV-452U40 and U40N)

Functional block diagram



Description of the functions

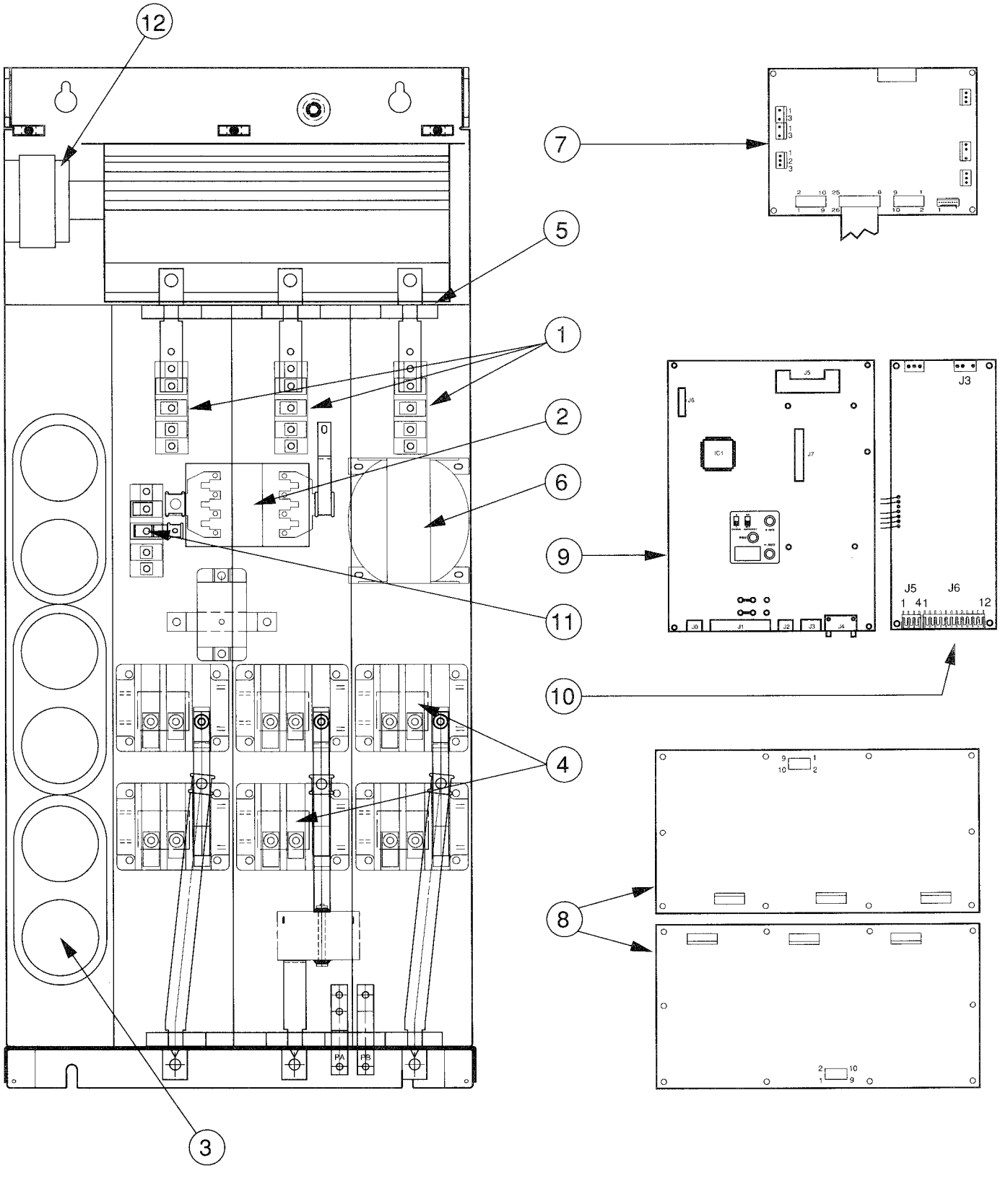
1. Rectifier
2. Charge current limiting device
3. Filter capacitors
4. Transistor inverter bridge
5. Plug-in fuse carrier : - with fuse for the ATV-452...M and ATV-452...
   - with link for the ATV-452...N and ATV-452...S
6. Control transformer
7. Measurement board
8. Transistor control board
9. Microprocessor control board
10. Communication option board

ALTIVAR 37 to 90 kW

Technology

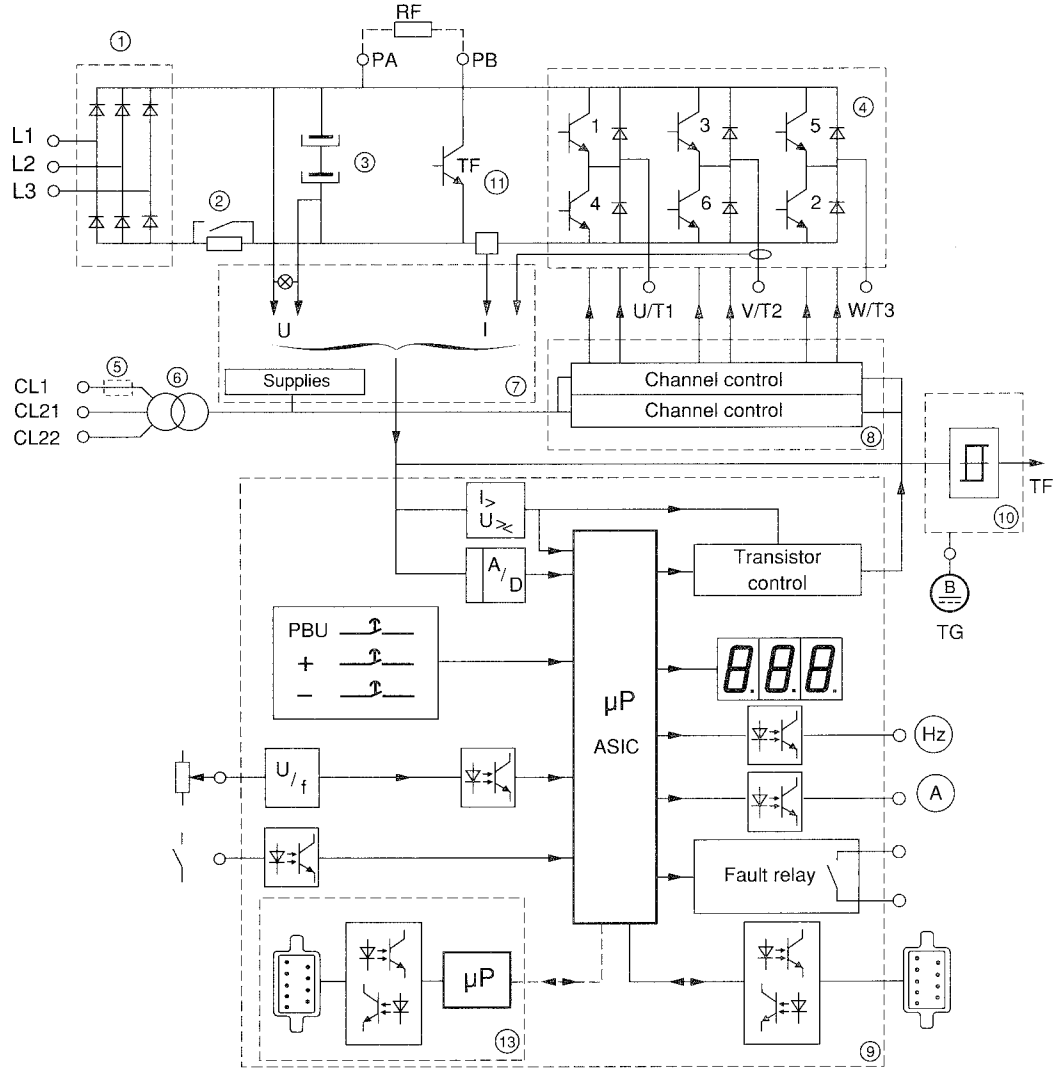
Variable speed controllers

ATV-452D37 to D90
ATV-452D37N to D90N
ATV-452D55S



ALTIVAR 37 to 90 kW

Functional block diagram



Description of the functions

1. Rectifiers
2. Charge current limiting device
3. Filter capacitors
4. Transistor inverter bridge
5. Plug-in fuse carrier : - with fuse for the ATV-452...
   - with link for the ATV-452...N and ATV-452...S
6. Control transformer
7. Measurement board
8. Transistor control boards
9. Microprocessor control board
10. Slow-down braking and speed regulation option board
11. Braking transistor
12. Fan
13. Communication option board

Supply voltage	Reference	Motor power kW	Motor power HP	Line * Current A	Rated Current A	Transient Current A	Total dissipated power at rated load (W)
220/240 V +10 % -15 % 50/60 Hz	**ATV-452075M**	0,75	1	5	3,6	5,4	75
	ATV-452U22M	2,2	3	14	9,6	13,5	115
	ATV-452U40M	4	5,5	27	18	24,5	165
	ATV-452U55M	5,5	7,5	33	22	30	195
	ATV-452U75M	7,5	10	42	28	41,2	270
	ATV-452D11M	11	15	63	42	57	360
	ATV-452D15M	15	20	80	54	76	480
380/415 V +10 % -15 % 50/60 Hz	**ATV-452075**	0,75	1	3,3	2,2	3,2	75
	ATV-452U15	1,5	2	6	4	5,5	95
	ATV-452U22	2,2	3	9	6	8,5	115
	ATV-452U30	3	4	12	8	11	135
	ATV-452U40	4	5,5	16	10,5	14	165
	ATV-452U55	5,5	7,5	20	13	17,5	195
	ATV-452U75	7,5	10	26	17,5	24	270
	ATV-452D11	11	15	36	24	32	360
	ATV-452D15	15	20	48	32	44	480
	ATV-452D22	22	30	72	48	65	650
	ATV-452D30	30	40	100	66	90	750
	ATV-452D37	37	50	118	79	108	850
	ATV-452D55	55	75	172	115	158	1250
	ATV-452D75	75	100	228	152	207	1700
	ATV-452D90	90	125	280	187	255	2000

*** Line current**

The values given correspond to the current taken by the speed controllers on a low impedance mains supply, with the rated load and speed conditions, for the associated motor.

These values can be reduced by adding line inductances (p. 36), or in the event of supply via a suitable transformer or auto-transformer (p. 35).

Supply voltage	Reference	Motor power kW	Motor power HP	Line * Current A	Rated Current A	Transient Current A	Total dissipated power at rated load (W)
440/500 V +10 % -15% 440/500 V 50 Hz 460 V 60 Hz	**ATV-452075N**	0,75	1	2,7	1,8	3	75
	ATV-452U15N	1,5	2	5	3,4	5,5	95
	ATV-452U22N	2,2	3	7	4,8	7,5	115
	ATV-452U40N	4	5,5	11	7,6	11,5	165
	ATV-452U55N	5,5	7,5	16	11	16,5	195
	ATV-452U75N	7,5	10	21	14	21	270
	ATV-452D11N	11	15	31	21	31	360
	ATV-452D15N	15	20	40	27	40	480
	ATV-452D18N	18,5	25	51	34	51	590
	ATV-452D22N	22	30	60	40	60	650
	ATV-452D30N	30	40	78	52	78	750
	ATV-452D37N	37	50	98	65	98	850
	ATV-452D55N	55	75	144	96	144	1250
	ATV-452D75N	75	100	186	124	186	1700
	ATV-452D90N	90	125	234	156	234	2000
525/575 V +10 % -15 % 525 V 50 Hz 575 V 60 Hz	**ATV-452U40S**	3,7	5	10	7	10	165
	ATV-452U75S	7,5	10	19	13	19	270
	ATV-452D15S	15	20	37	25	37	480
	ATV-452D30S	30	40	64	43	64	750
	ATV-452D55S	55	75	117	77	117	1250

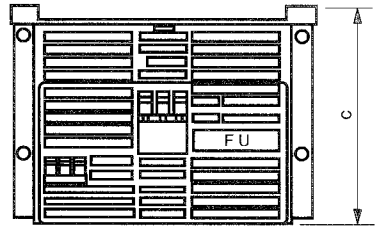
Output voltage	maximum voltage equal to mains voltage
Frequency range	1 to 67/80 Hz, 1 to 110/132 Hz, 1 to 87/104/120 Hz (p. 46) 1 to 200 Hz (option p. 78)
Torque / overtorque	see page 31
Speed reference	0-10 V, 0-20 mA, 4-20 mA (p. 28) other possibilities : see "Special Applications" p. 81
Frequency resolution	analogue reference : 0,015 Hz digital reference (by serial link) : 0,1 Hz
Reference response time	10 ms < t < 20 ms
Low speed / high speed limits	adjustable (p. 48)
Ramps acceleration	0,2 to 990 seconds (p. 47)
Ramps deceleration	0,2 to 990 seconds (p. 47)
Speed regulation	with optional tachogenerator (p. 72)
Reversing	control inputs (p. 25) optional : adaptation for ± 10 V control (p. 61)
Braking to standstill	by DC injection : automatic for 0,5 s if the frequency becomes < 1 Hz by DC injection : manual by external signal (p. 25)
Slow-down braking	by optional resistance (p. 62)
Speed controller protection	against short-circuits : between output phases (1) against short-circuits : between output phases and earth against mains supply under / overvoltage against overheating (vigitherm)
Motor protection	incorporated electronic thermal protection (p. 30)
Automated system dialogue	incorporated point to point serial link (p. 113) optional multidrop serial link (p. 78) complete programming by compatible micro-computer (p. 96) or by optional terminal (p. 100)
Temperature	operation : 0°C to + 40°C (+ 32°F to + 100°F) storage : - 25°C to + 70°C (- 15°F to + 160°F)
Humidity	93 % maximum without condensation or dripping water (see recommendations p. 24)
Altitude	≤ 1000 m (above this derate by 3 % for every 1000 m)
Degree of protection	open : IP20 (ALTIVAR 45 2 from 0,75 to 30 kW) IP10 (ALTIVAR 45 2 from 37 to 90 kW) optional : IP54 (p. 74)

(1) ATV-452D55S, D75N, D90N : protection assured if length of motor-speed controller cables ≥ 25 m, if not, fit inductances (p. 36).

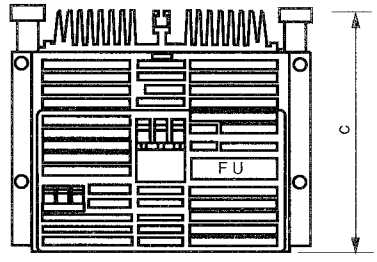
ALTIVAR 0,75 to 30 kW

Dimensions
Weights

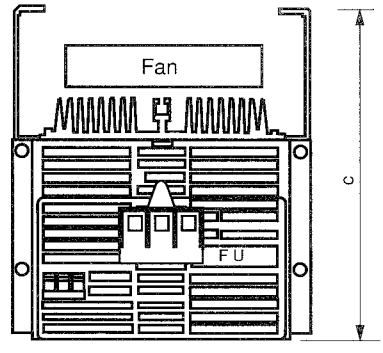
ATV-452075 (M) (N)
ATV-452U15 (N)

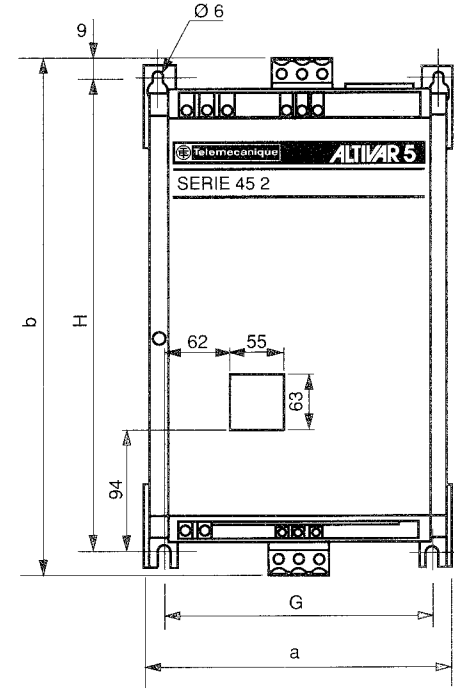


ATV-452U22 (M) (N)
ATV-452U30
ATV-452U40 (M) (N) (S)
ATV-452U55 (N)



ATV-452U55M
ATV-452U75 (M) (N) (S)
ATV-452D11 (M) (N)
ATV-452D15 (M) (N) (S)
ATV-452D18N
ATV-452D22 (N)
ATV-452D30 (N) (S)





Reference	a mm	b mm	c mm	G mm	H mm	Weight kg
ATV-452075 (M) (N) ATV-452U15 (N)	239	382	170	212	360	8 8,5
ATV-452U22 (M) (N) ATV-452U30 ATV-452U40 (M) (N) (S)	239	402	192	212	380	11 11,5 11,5
ATV-452U55 (N)	239	442	192	212	420	12,5
ATV-452U55M ATV-452U75 (M) (N)	234	405	268	208	360	15 15
ATV-452U75S ATV-452D11 (M) (N)	234	555	268	208	510	21 21
ATV-452D15 (M) (N) (S) ATV-452D18N ATV-452D22 (N)	234	595	268	208	550	23,5 25 25
ATV-452D30 (N) (S)	234	880	268	208	750	30

For dimensions in inches :
multiply by 0,03937.

For weight in pounds :
multiply by 2,2.

ALTIVAR 0,75 to 30 kW

Climatic environment

Temperature
Humidity
Altitude
Degree of protection

} see technical characteristics (p. 12)

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

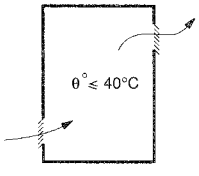
Mounting precautions

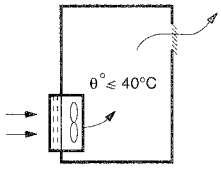
- Mount the speed controller vertically.
- Do not locate near heat radiating elements.

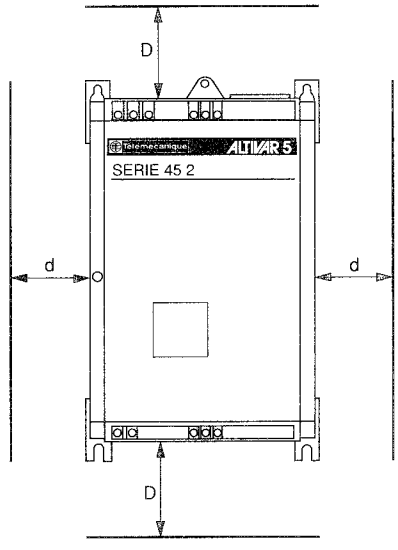
Mounting in general purpose metal enclosure

Degree of protection IP23.

In order to ensure adequate airflow inside the product :
- leave sufficient space around the controller :
  - d ≥ 50 mm (2"),
  - D ≥ 100 mm (4"),
- provide ventilation louvres,
- check that the ventilation is sufficient; if not, fit a cooling fan with filters.





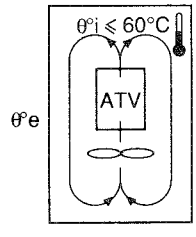


Mounting in a dust and damp proof metal enclosure

Degree of protection IP54.

Provide a ventilating fan to circulate air inside the enclosure and prevent hot spots in the speed controller :
- flow : 100 dm³/s (200 CFM), fan mounted beneath the speed controller at a maximum distance of 50 mm (2").

This arrangement enables operation of the speed contoller in an enclosure with a maximum internal temperature of 60°C (140°F).



Other possibility : use the optional ventilation kit (p. 75).

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 p. 10 and 11.

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 DE2-HB).

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

Calculation example

ATV-452U40 (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 heatsink on the outside. This arrangement necessitates a cut out and a mounting kit as defined in the section on mounting in dust and damp protecting enclosure (p.74). 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 rate (44 dm^3/s,100 CFM) or by using the ventilation kit (p. 75).

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 :

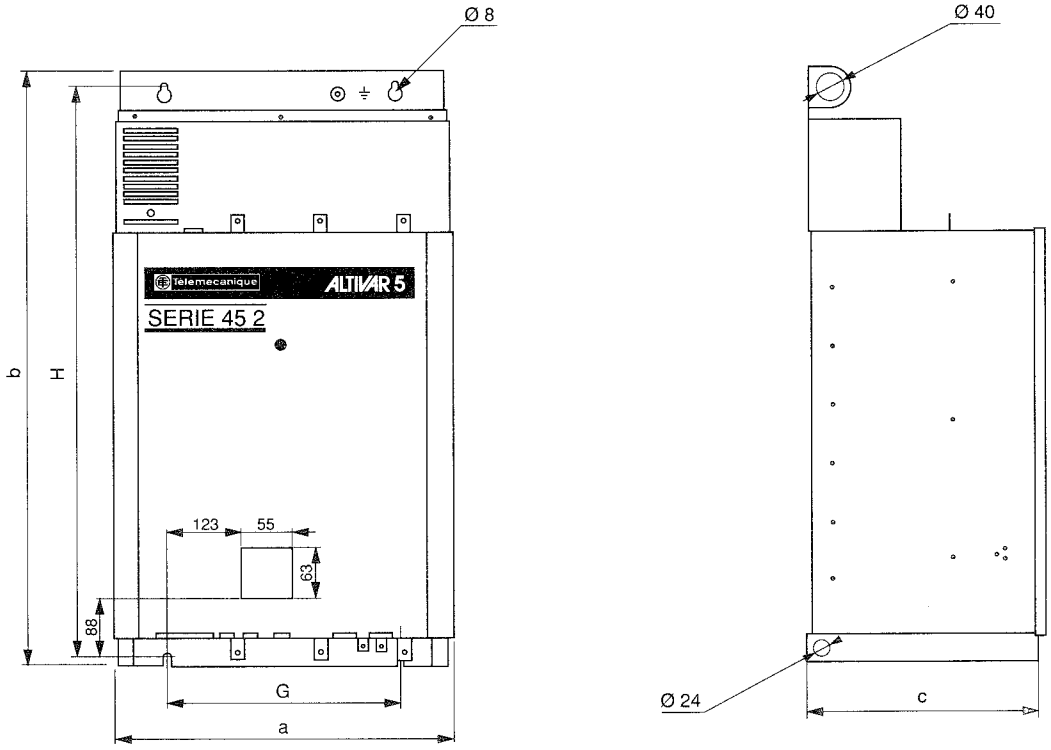
Mounting kit reference	Reference ALTIVAR	H mm	W mm	D mm	Pi * W
VY1-A451U1501	ATV-452075 (M) (N) ATV-452U15 (N)	500 500	300 300	200 200	70 85
VY1-A451U4001	ATV-452U22 (M) (N) ATV-452U30 ATV-452U40 (M) (N) (S)	500 500 500	400 400 400	250 250 250	85 90 105
VY1-A451U7501	ATV-452U55 (M) (N) ATV-452U75 (M) (N)	600 600	400 400	250 250	120 80
VY1-A451D1101	ATV-452U75S ATV-452D11 (M) (N)	700 700	500 500	250 250	95 95
VY1-A451D1501	ATV-452D15 (M) (N) (S) ATV-452D18N ATV-452D22 (N)	700 700 700	500 500 500	250 250 250	110 130 130
VY1-A451D3001	ATV-452D30 (N) (S)	900	700	300	150

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

For dimensions in inches : multiply by 0,03937.

ALTIVAR 37 to 90 kW

Dimensions Weights



Reference	a mm	b mm	c mm	G mm	H mm	Weight kg
ATV-452D37 (N)	484	860	365	335	820	86
ATV-452D55 (N) (S)	484	1040	365	335	1000	105
ATV-452D75 (N)	595	1188	365	445	1160	140
ATV-452D90 (N)	595	1188	365	445	1160	140

Dimensions in inches : multiply by 0,03937.
Weight in pounds : multiply by 2,2.

Climatic environment

Temperature
Humidity
Altitude
Degree of protection

} see technical characteristics (p.12)

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

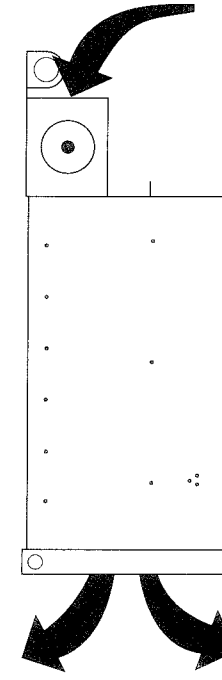
Mounting precautions

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

ALTIVAR 37 to 90 kW

Speed controller ventilation

The ALTIVAR ATV-45 2 speed controller is forced air cooled.



A fan is mounted on the upper part of the controller, and is protected by a perforated cover, draws in the ambient air, which flows from top to bottom, accross the heatsink cooling fins which carry the power components, and is expelled at the bottom. When mounting the controller, ensure that the air inlets and outlets are not obstructed.

Fan characteristics :

- flow rate : 210 dm^3/s (450 CFM),
- supply : from the control voltage,
- controlled by the thermocontact fixed onto the heatsink :
  - which closes when the temperature reaches 50°C,
  - which opens when the temperature falls to around 30°C.

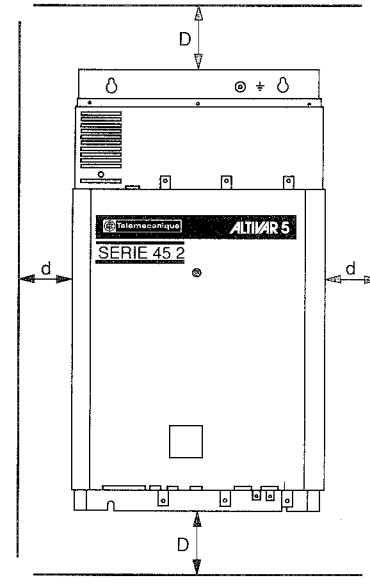
Thermal protection of the speed controller is ensured by another thermocontact fixed onto the heatsink, which opens when the temperature reaches about 75°C :

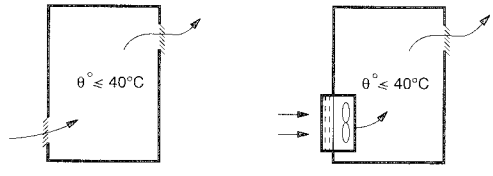
- the speed controller locks and the fault code [OHF] appears on the dialogue panel display,
- the ventilation continues operating if the control supply is maintained, enabling the controller to be rapidly cooled down.

Mounting in a general purpose metal enclosure

Degree of protection IP23.

In order to ensure adequate air flow inside the product :
- leave sufficient space around the controller :
  - d ≥ 50 mm (2"),
  - D ≥ 100 mm (4"),
- provide ventilation louvres,
- check that the ventilation is sufficient; if not, fit a cooling fan with filters.





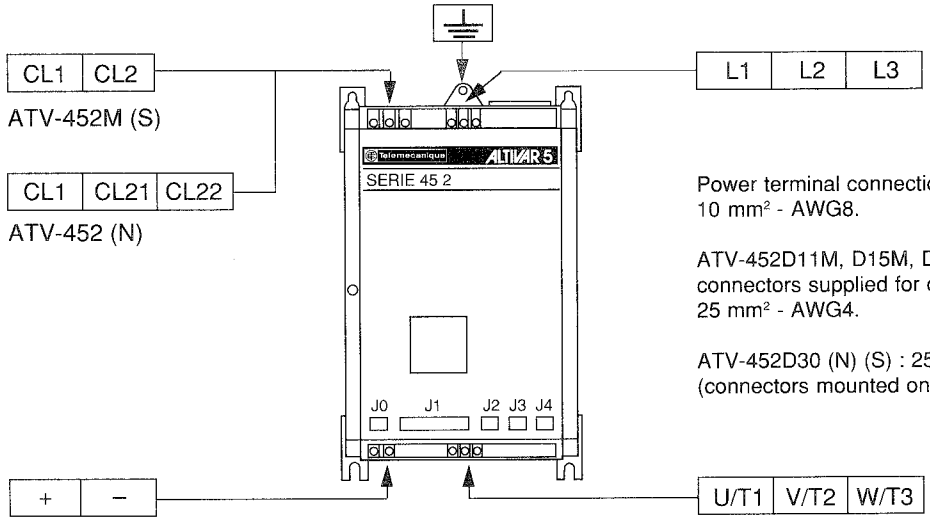
Mounting in a dust and damp proof metal enclosure

Degree of protection IP54.

Provide a ventilating fan to circulate the air inside the enclosure and prevent hot spots on the speed controller. See power dissipated by speed controllers (p. 10 and 11).

Terminal strips

ALTIVAR
0,75 to 30 kW

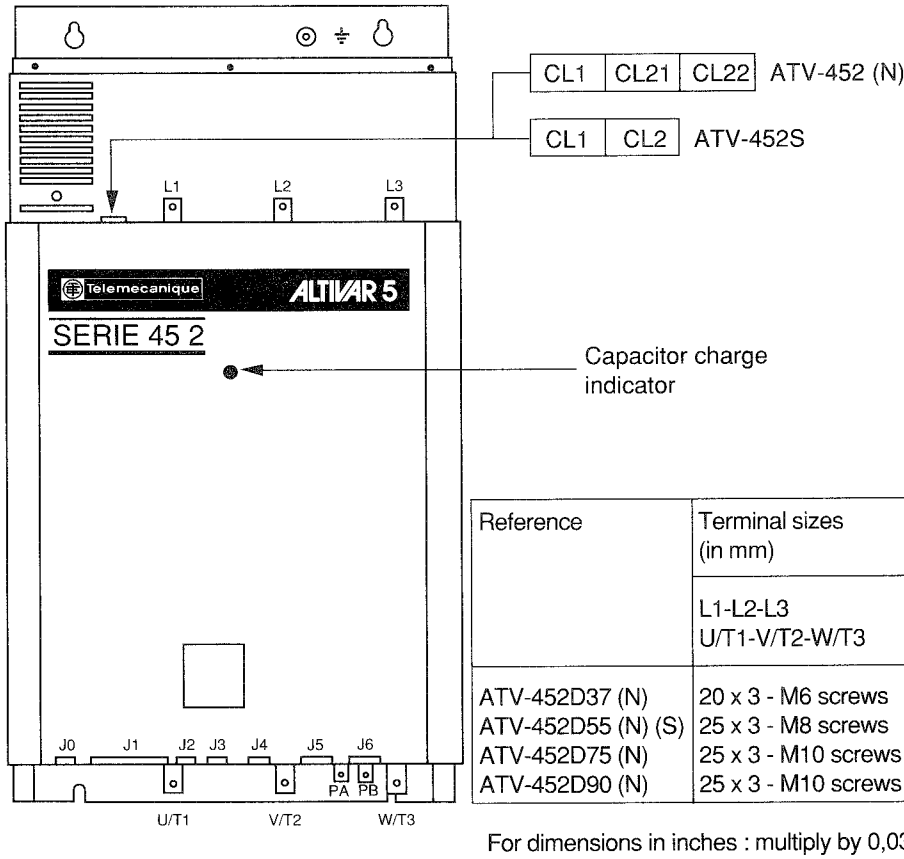


Power terminal connection size :
10 mm² - AWG8.

ATV-452D11M, D15M, D18N, D22 (N) : connectors supplied for connection up to 25 mm² - AWG4.

ATV-452D30 (N) (S) : 25 mm² - AWG4 (connectors mounted on the controller).

ALTIVAR
37 to 90 kW



Reference	Terminal sizes (in mm)	
	L1-L2-L3 U/T1-V/T2-W/T3	PA-PB
ATV-452D37 (N) ATV-452D55 (N) (S) ATV-452D75 (N) ATV-452D90 (N)	20 x 3 - M6 screws 25 x 3 - M8 screws 25 x 3 - M10 screws 25 x 3 - M10 screws	15 x 3 - M6 screws

For dimensions in inches : multiply by 0,03937.

Protection of the terminals against direct finger contact :

- the speed controller is delivered with insulating covers which must be fitted to the power terminals after wiring,
- the PA and PB terminals are covered with an insulating material. Should the slow-down braking option be used, remove the insulation so that the external resistance can be connected.

ALTIVAR 0,75 to 30 kW

Terminal strips

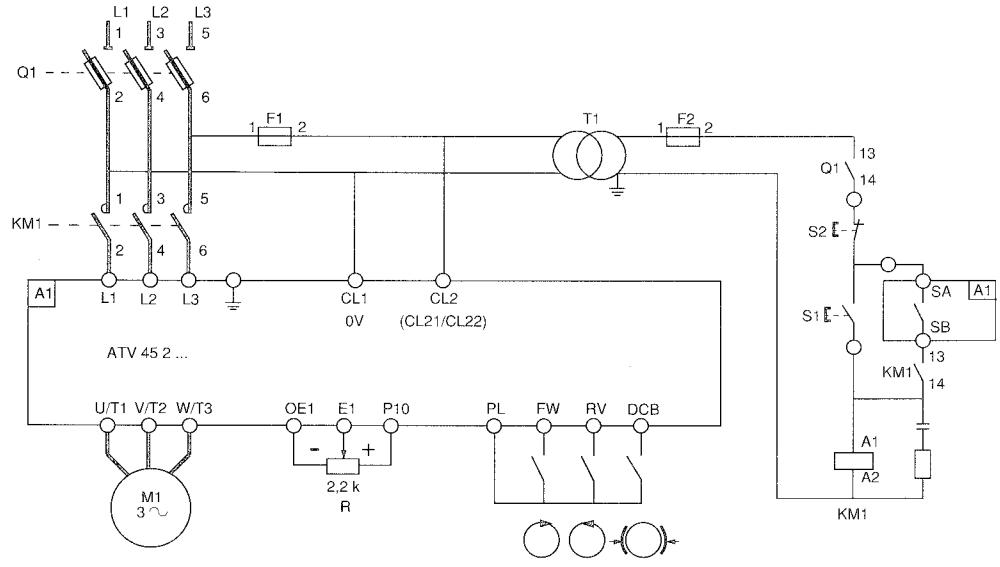
	Item	Function		Characteristics			
				ATV-452•••M	ATV-452•••	ATV-452•••N	ATV-452•••S
	L1 L2 L3	Power supply - three phase		220/240 V +10 % -15 % 50/60 Hz	380/415 V +10 % -15 % 50/60 Hz	440/500 V +10 % -15 % 50/60 Hz	525/575 V +10 % -15 % 50/60 Hz
	CL1 CL2 CL21 CL22	Control supply - single phase (if necessary remove the terminal cover)		0V 220/240 V	0V 380V (Un ≤ 400V) 415V (Un > 400V)	0V 440V (Un ≤ 480V) 500V (Un > 480V)	0V 525/575 V
	U/T1 V/T2 W/T3	Output connections to the motor		220/240 V at 50/60 Hz	380/415 V at 50/60 Hz	440/500 V at 50/60 Hz	525/575 V at 50/60 Hz
	+ –	Smoothed intermediary DC voltage		290 to 435 V	500 to 750 V	550 to 800 V	650 to 1000 V
J0	LI1 LI2 PL	Logic input 1 Logic input 2 Control input supply		24 V (minimum 19 V, maximum 30 V), Ze = 1,5 kΩ 24 V (minimum 19 V, maximum 30 V), Ze = 1,5 kΩ 24 V, Is = 40 mA maximum			
J1	OE1 E1 P10 E2 EC	Speed reference input common Input 1 - Speed reference voltage Output voltage Input 2 - Speed reference voltage Input 3 - Speed reference current		0V 0 - 10 V, Ze = 28 kΩ 10 V, Is = 10 mA 0 - 10 V, Ze = 28 kΩ 0 - 20 mA, 4 - 20 mA, Ze = 100 Ω			
	A01 A02	Analogue output 1 Analogue output 2		0 - 20 mA, 10 V maximum 0 - 20 mA, 10 V maximum			
	PL NL FW RV DCB	Control input supply Negative supply Forward control input Reverse control input DC injection braking control input		24 V, Is = 60 mA maximum –15 V, Is = –10 mA maximum 24 V 24 V 24 V	minimum 19 V, maximum 30 V, Ze = 1,5 kΩ		
J2	SA SB	Fault relay output		Closes when supply is switched on, opens on fault Voltage free contact (220/240 V, 50/60 Hz, 2 A maxi)			
J3	SN+ OVN SGN PN	Speed sign Common Speed signal Option present	Braking and speed regulation option (p. 62/72)	0 - 5 V, Ze = 10 kΩ Inputs not isolated from the mains ⚠			
J4	1 2 3 4 5 6 7 8 9	REC- (current loop receiver) RX (reception RS232C) TX (transmission RS232C) Reserved GND (common RS232C) and EMI- REC+ (current loop receiver, +15 V) Reserved Reserved EMI+ (current loop transmitter)		Communication with compatible microcomputer, programmable controller or terminal by serial link			

ALTIVAR 37 to 90 kW

Terminal strips

	Item	Function		Characteristics		
				ATV-452•••	ATV-452•••N	ATV-452•••S
	L1 L2 L3	Power supply - three phase		380/415 V +10 % -15 % 50/60 Hz	440/500 V +10 % -15 % 50/60 Hz	525/575 V +10 % -15 % 50/60 Hz
	CL1 CL2 CL21 CL22	Control supply - single phase (if necessary remove the terminal cover)		0V 380 V (Un ≤ 400 V) 415 V (Un > 400 V)	0V 440 V (Un ≤ 480 V) 500 V (Un > 480 V)	0V 525/575 V
	U/T1 V/T2 W/T3	Output connections to the motor		380/415 V at 50/60 Hz	440/500 V at 50/60 Hz	525/575 V at 50/60 Hz
	PA PB	Braking resistance		500 to 750 V	550 to 800 V	650 to 1000 V
J0	LI1 LI2 PL	Logic input 1 Logic input 2 Control input supply		24 V (minimum 19 V, maximum 30 V), Ze = 1,5 kΩ 24 V (minimum 19 V, maximum 30 V), Ze = 1,5 kΩ 24 V, Is = 40 mA maximum		
J1	OE1 E1 P10 E2 EC	Speed reference input common Input 1 - Speed reference voltage Output voltage Input 2 - Speed reference voltage Input 3 - Speed reference current		0V 0 - 10 V, Ze = 28 kΩ 10 V, Is = 10 mA 0 - 10 V, Ze = 28 kΩ 0 - 20 mA, 4 - 20 mA, Ze = 100 Ω		
	A01 A02	Analogue output 1 Analogue output 2		0 - 20 mA, 10 V maximum 0 - 20 mA, 10 V maximum		
	PL NL FW RV DCB	Control input supply Negative supply Forward control input Reverse control input DC injection braking control input		24 V, Is = 60 mA maximum –15 V, Is = –10 mA maximum 24 V 24 V 24 V	minimum 19 V, maximum 30 V, Ze = 1,5 kΩ	
J2	SA SB	Safety relay output		Closes when supply is switched on, opens on fault Voltage free contact (220/240 V, 50/60 Hz, 2 A maxi)		
J3	SN+ OVN SGN PN	Speed signal Common Speed sign Option present	Braking and speed regulation option (p. 62/72)	0 - 5 V, Ze = 10 kΩ Inputs not isolated from the mains ⚠		
J4	1 2 3 4 5 6 7 8 9	REC- (current loop receiver) RX (reception RS232C) TX (transmission RS232C) Reserved GND (common RS232C) and EMI- REC+ (current loop received, +15 V) Reserved Reserved EMI+ (current loop transmitter)		Communication with compatible microcomputer, programmable controller or terminal by serial link		
J5	SN+ SGN PN	Speed signal Speed sign Option present		Connect to J3 if using the speed regulation option (p. 72)		
J6	300 V 145 V 70 V 10 V 0V	Tachogenerator	Braking and speed regulation option (p. 62/72)	Ze = 530 kΩ Ze = 260 kΩ Ze = 140 kΩ Ze = 20 kΩ		
	PZ PY	Braking resistance thermocontact		Where necessary		
	LA LB	Mechanical brake control relay		Voltage free contact (220/240 V, 50/60 Hz, 2 A max)		

Recommended circuit diagram



Equipment required ATV-452075M to D15M (220/240 V)

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-452**	**075M**	**U22M**	**U40M**	**U55M**	**U75M**	**D11M**	**D15M**
Q1	Isolator	LS1-D2531A65		GK1-EK			DK1-GB	
	+ 3 fuses type gI	DF2-CN06	DF2-CN16	DF2-EN32	DF2-EN40	DF2-EN50	DF2-FN80	DF2-FN100
KM1	Contactor LC1-D	0910••	1210••	2510••	3210••	4011••	6511••	8011••
	Suppressor	LA4-DA2U						
F1 **F2**	Fuse type aM * Fuse type gI * (220V control) 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-452075M	1,5	16
	ATV-452U22M	2,5	14
	ATV-452U40M, U55M	4	12
	ATV-452U75M	6	10
	ATV-452D11M	10	8
	ATV-452D15M	16	6

Equipment required

ATV-452075 (N) to D30 (N) 380/415 V (N : 440/500 V)

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	30/40
A1	**ALTIVAR ATV-452**	**075(N)**	**U15(N)**	**U22(N)**	**U30**	**U40(N)**	**U55(N)**	**U75(N)**	**D11(N)**	**D15(N)**	**D18N**	**D22(N)**	**D30(N)**
Q1	Isolator	LS1-D2531A65							GK1-EK	DK1-FB		DK1-GB	
	+ 3 fuses type gI DF2-	CN04	CN06	CN10	CN12	CN16	CN20	CN25	EN40	FN50	FN63	FN80	FN100
KM1	Contactor LC1-D	0910••	0910••	0910••	0910••	1210••	1810••	2510••	3210••	4011••	5011••	6511••	8011••
	Suppressor	LA4-DA2U											
T1	Transformer	63 VA						100 VA		160 VA			

ATV-452D37 (N) to D90 (N) 380/415 V (N : 440/500 V)

M1	Motor (kW / HP)	37 / 50	55 / 75	75 / 100	90 / 125
A1	**ALTIVAR ATV-452**	**D37 (N)**	**D55 (N)**	**D75 (N)**	**D90 (N)**
Q1	Isolator	DK1-HC	DK1-HC	DK1-JC	DK1-JC
	+ 3 fuses type gI	DF2-GN1121	DF2-GN1161	DF2-HN1201	DF2-HN1251
KM1	Contactor + coil Suppressor	LC1-D8011•• LA4-DA2U	LC1-F115 LX1-FF••• LA9-F980	LC1-F150 LX1-FF••• LA9-F980	LC1-F185 LX1-FG••• LA9-F980
T1	Transformer	160 VA	250 VA	250 VA	400 VA

Equipment required, all ratings, all models

F1 **F2**	Fuse type aM Fuse type gI* Fuse carriers	DF2-CA02 DF2-CN02, DF2-CN04 for D55 (N), D75 (N) and D90 (N) (if 220 V control) DF6-AB10
R	Potentiometer	SZ1-RV1202
S1-S2	Push-buttons	XB2-B•••

* or GB2-C••• circuit breaker

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-452075 (N), U15 (N)	1,5	16
	ATV-452U22 (N), U30	2,5	14
	ATV-452U40 (N), U55 (N)	2,5	14
	ATV-452U75 (N)	4	12
	ATV-452D11 (N), D15 (N)	6	10
	ATV-452D18N, D22 (N)	10	8
	ATV-452D30 (N)	16	6
	ATV-452D37 (N)	25	4
	ATV-452D55 (N)	35	1
	ATV-452D75 (N)	50	00
	ATV-452D90 (N)	70	000
PA-PB	ATV-452D37 (N), D55 (N)	25	4
	ATV-452D75 (N), D90 (N)	2 x 25 in //	2 x 4

Equipment required

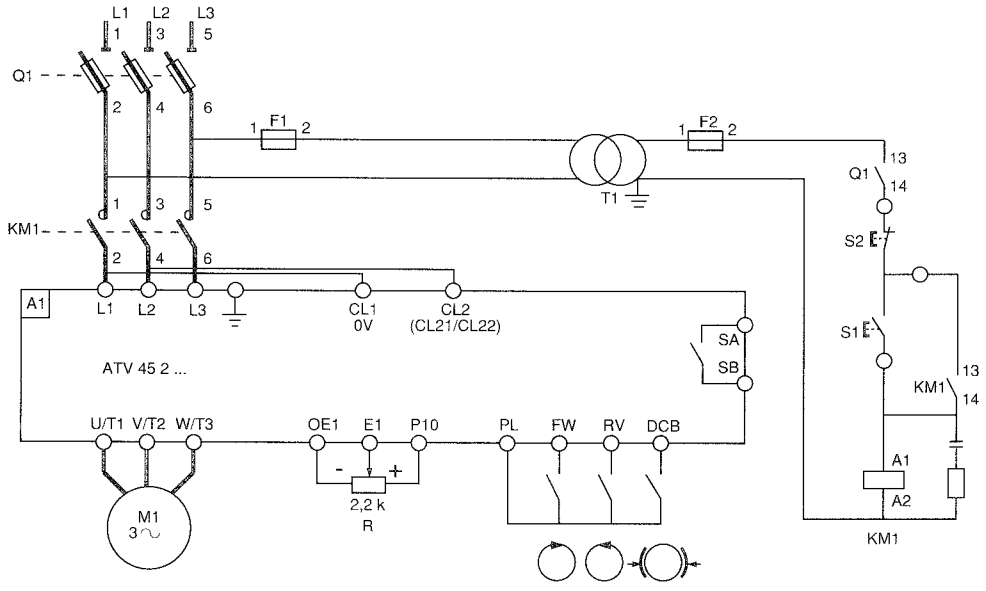
ATV-452U40S to D55S 525/575 V

M1	Motor (kW / HP)	3,7 / 5	7,5 / 10	15 / 20	30 / 40	55 / 75
A1	**ALTIVAR ATV-452**	**U40S**	**U75S**	**D15S**	**D30S**	**D55S**
Q1	Isolator	LS1-D2531A65	LS1D2531A65	GK1-EK	DK1-GB	DK1-HC
	+ 3 fuses type gl (A)	10	20	40	80	125
KM1	Contactor + coil Suppressor	LC1-D1210•• LA4-DA2U	LC1-D1810•• LA4-DA2U	LC1-D3210•• LA4-DA2U	LC1-D6311•• LA4-DA2U	LC1-F115 LX1-FF••• LA9-F980
F1 **F2**	Control type aM fuses (A) type gl	2 2	2 2	2 2	2 2	2 4
T1	Transformer	63 VA	63 VA	100 VA	160 VA	250 VA
R	Potentiometer	SZ1-RV1202				
S1-S2	Push-buttons	XB2-B•••				

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-452U40S	2,5	14
	ATV-452U75S	2,5	14
	ATV-452D15S	6	10
	ATV-452D30S	10	8
	ATV-452D55S	25	4
PA-PB	ATV-452D55S	25	4

Alternative circuit diagram



The power and the control circuits are supplied simultaneously.

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

Drawback of this solution :

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

Other possibilities

Replacement of the isolator-fuses-contactor with :

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

Recommendations

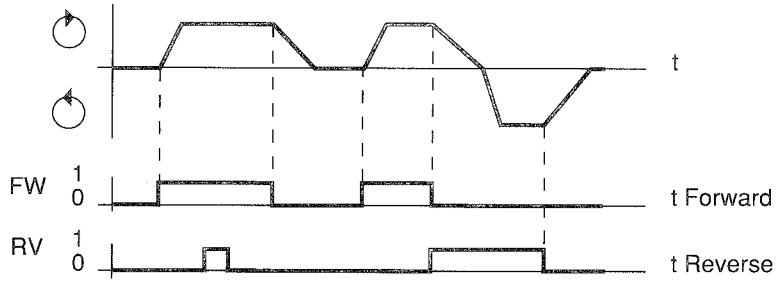
WARNING : - Check the power connections before switching on.
If, due to a wiring error, mains voltage is applied to output terminals U/T1, V/T2, W/T3, the speed controller will be damaged.
- Avoid on-load switching between the speed controller output and the motor.
- If a contactor is required for switching between the speed controller and the motor, it is necessary to use a special sequence (p. 33).

HUMIDITY

If there is a possibility of condensation, it is recommended to keep the control supply switched on, during periods when the motor is not running or alternatively fit anti-condensation heaters.

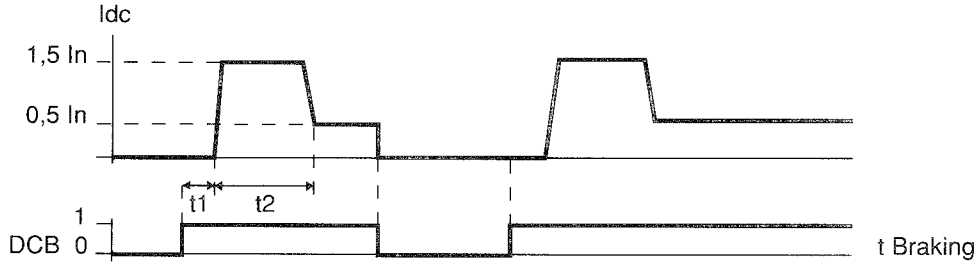
Function of the control inputs

Direction of rotation

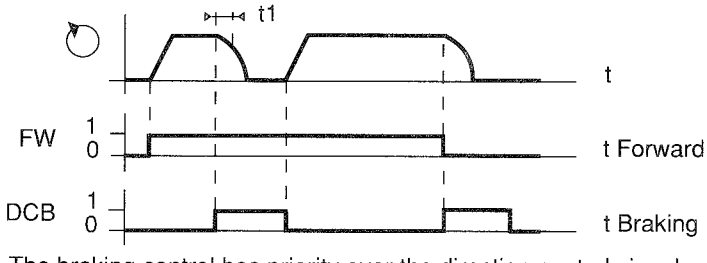


– the direction control input selected first takes priority over the other,
– deceleration ramp, and braking to standstill by automatic DC injection during 0,5 s when the frequency becomes < 1 Hz.

DC injection braking



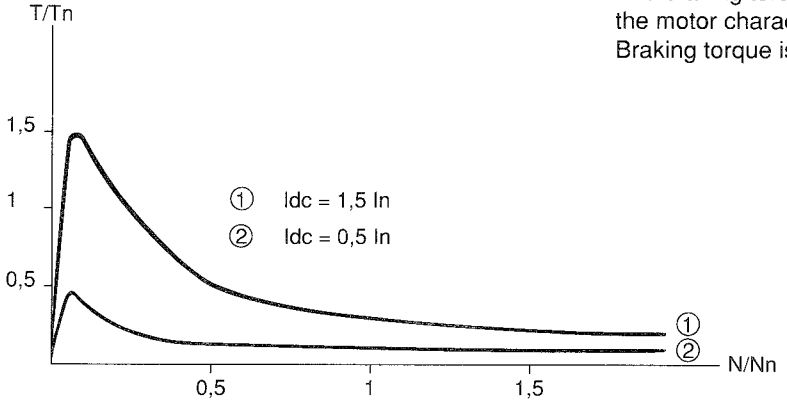
– t1 dead time - waiting for the motor to demagnetise,
t1 depends on the motor speed and power (between 0 and 4 seconds),
– t2 = 3 seconds.



The braking control has priority over the direction control signals.

Typical braking curves

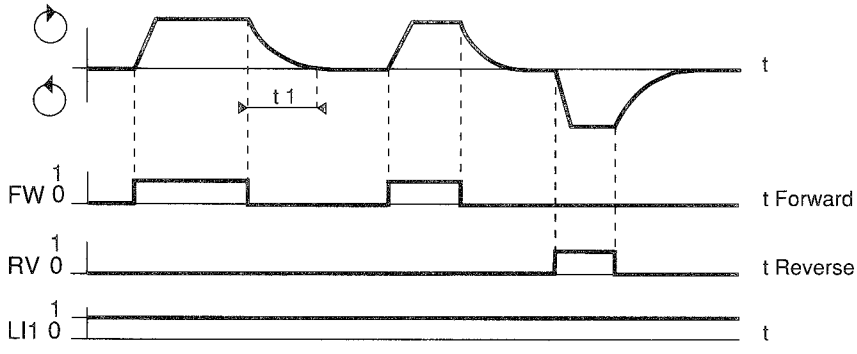
The braking torque curves are linked to the motor characteristics.
Braking torque is zero at standstill.



The DC current can be adjusted to a lower value.
Refer to the 2nd part of this document : "Special applications" (p. 81).

Functions of the control inputs

Freewheel stopping

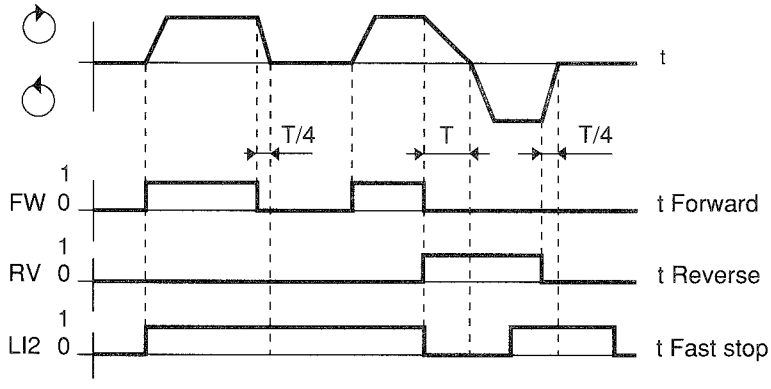


– Deceleration without ramp, speed controller locked.

t1 depends on motor speed, machine inertia and resistive torque.

⚠ Do not give the run command before the motor has completely stopped.

Fast stopping



The deceleration time is divided by 4 with a minimum of 0,2 s, depending on load conditions of the motor-speed controller combination.

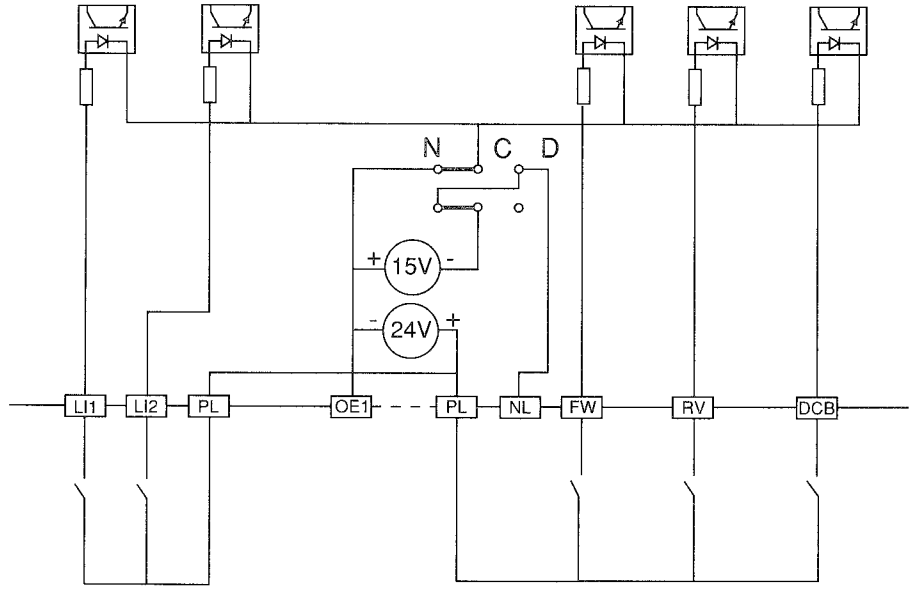
Input LI1 (freewheel stop) has priority over LI2 (fast stop).

Other functions

It is possible to assign the logic inputs to functions other than those described above.
Refer to the 2nd part of this document : "Special applications" (p. 81).

Utilization of the control inputs

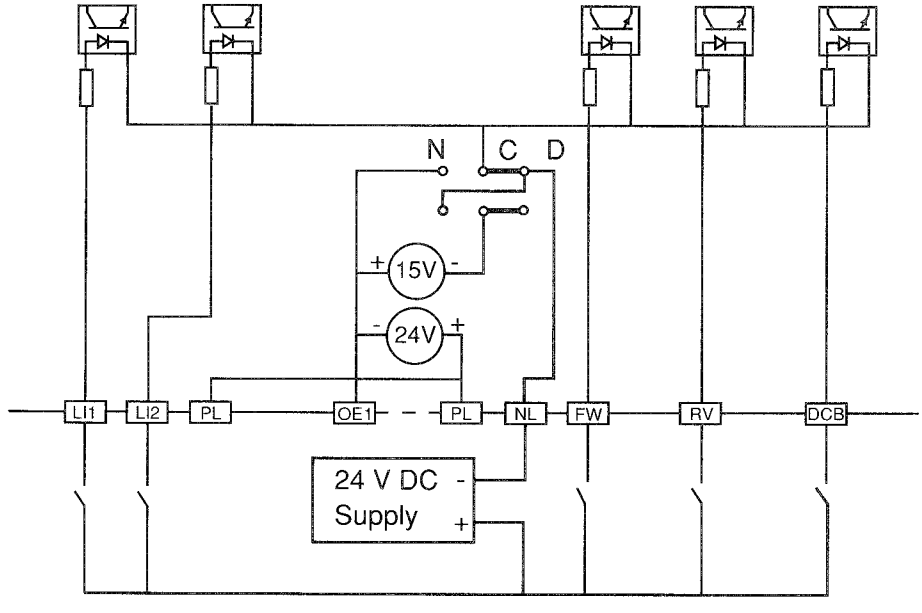
Operating from internal supply



The control inputs :

– are isolated from the mains,
– have a common point with the reference inputs.

Operating from external supply



The control inputs :

– are isolated from the mains,
– are isolated from the reference inputs.

WARNING

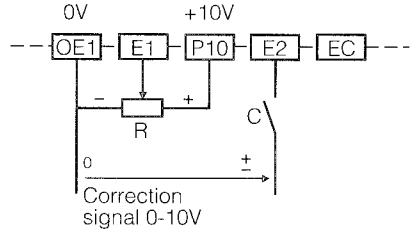
Set the two switches with power and control supplies switched off.
They must both be in the same position, to the right, or the left.

Function of the speed reference inputs

- The reference sets the speed of the rotating field in the motor.
  The actual speed remains dependent on the acceleration and deceleration ramps as well as on the torque capabilities of the motor / speed controller combination.
- The resulting reference value is the algebraic sum of the different speed references 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. 48.
- The speed reference inputs are isolated from the mains.
- The 10V internal supply (terminals OE1-P10) is protected against short-circuits.

Utilization of the speed reference inputs

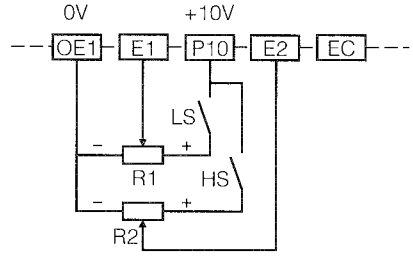
Example 1 : manual reference with correction signal



1 kΩ ≤ R ≤ 10 kΩ

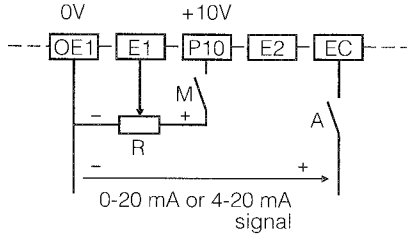
C : correction enabled

Example 2 : selection of two manual references



LS : low speed
HS : high speed

Example 3 : automatic reference 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. 45.

Other possibilities

Refer to the 2nd part of this document : "Special applications" (p. 81).

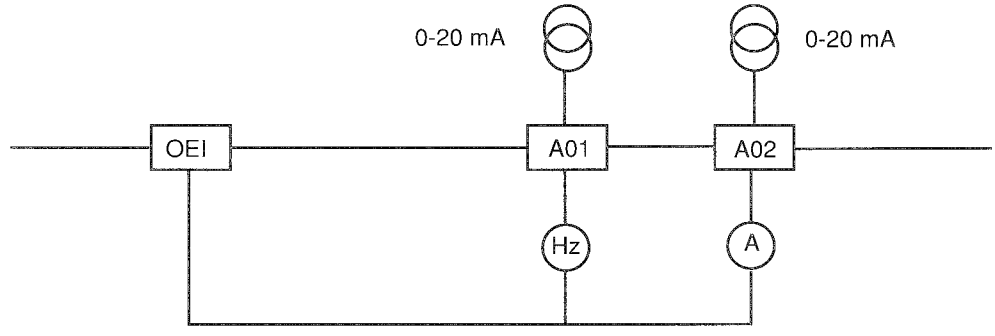
Analogue outputs

The variable speed controller has two 0-20 mA analogue outputs : A01 and A02.

The current supplied by these two outputs is proportional to :
- A01 : motor frequency,
- A02 : motor current.

Maximum output voltage : +10 V for a maximum impedance of 500 Ω.

Scale factor :
- A01 : 20 mA corresponds to high speed (see settings p. 48),
- A02 : 20 mA corresponds to 1,82 times the rated current of the speed controller (see characteristics p. 10 and 11).



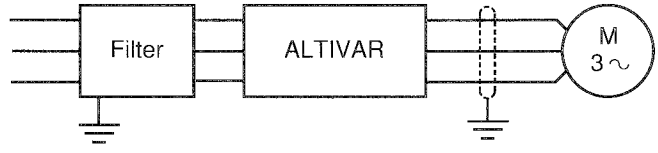
NOTE
The two analogue outputs can be modified to 4-20 mA and assigned to other variables.
Refer to the 2nd part of this document : "Special applications" (p. 81).

Wiring precautions

Power

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

This interface can be reduced by screening the motor cables, ensuring a good earth and by fitting suppressors on the incoming side of the controller (p. 77).

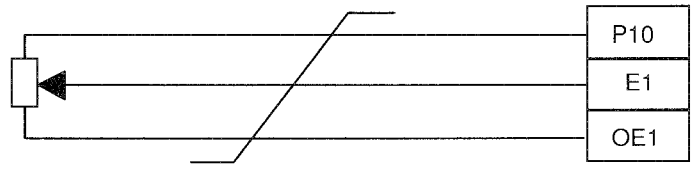


Control

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

Speed reference

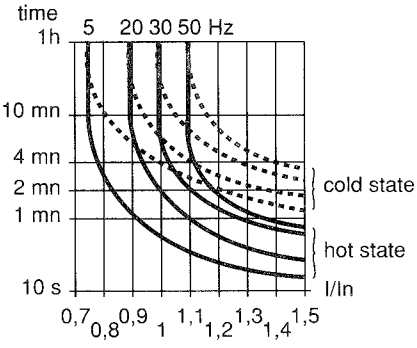
These circuits must be protected against interference signals.
The use of twisted cable is recommended, with a pitch of 25 to 50 mm.



of the motor/speed controller combination

Thermal protection of the motor

Indirect thermal protection of the motor is incorporated in the speed controller, taking into account.



- the current absorbed by the motor,
- the motor speed (ventilation),
- an ambient air temperature of 40°C.

See tripping curves on the left.

For adjustment and monitoring of the thermal state of the motor, see p. 49.

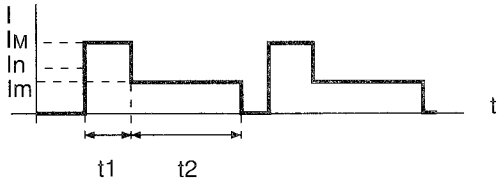
To provide direct thermal protection, use PTC thermistor probes embedded in the motor windings, associated with an LT2-S protection relay, for operation in severe ambient conditions :

- high ambient temperature ($\theta \geq 40°C$),
- risk of cooling fins clogging,
- insufficient ventilation.

Intermittent duty

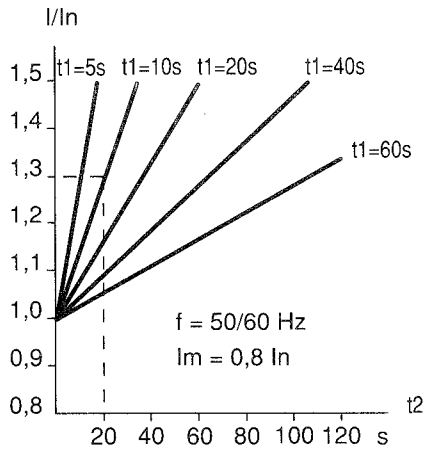
The amount of starting and braking is limited by the value of the overloads, their duration, as well as the load during normal running and the motor cooling possibilities.

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 runnning current

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.

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 in the order of 5 %. This is lower than manufacturing tolerance limits.

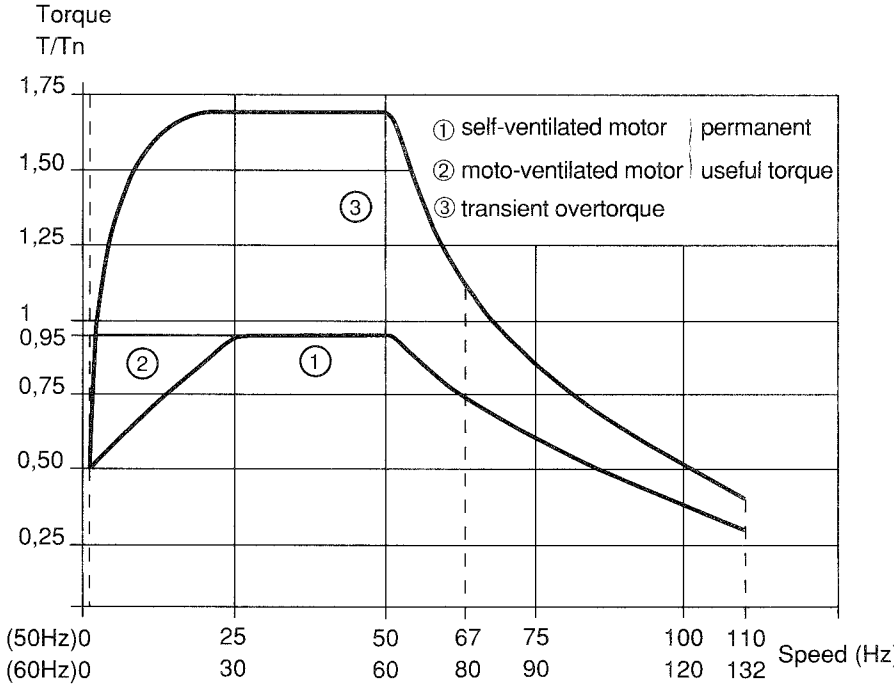
- For self-ventilating motors, the ventilation needed for the cooling of the motor is linked to the motor speed.
  This results in derating, which occurs at approximately half of the rated speed.

Transient operating 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.



Overtorque = 1,7 Tn : typical value at ± 10 %.

of the motor/speed controller combination

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 part 2 of this document, "Special Applications" (p. 81).

Motor power ≤ speed controller rated power

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 (p. 48).

If motor power is < 0,5 controller rated power, correct adjustment of motor thermal protection is impossible (p. 49).
Cancel the internal protection and use standard external protection (overload relay or thermistors).

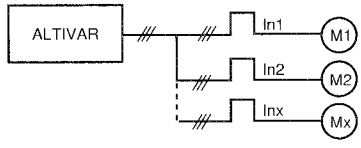
Motor power > rated power of the controller

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. 48). The motor current must remain lower than, or equal to the speed controller's rated current.

Fit a three phase inductance between the speed controller and the motor, if necessary (p. 36).

Motors in parallel



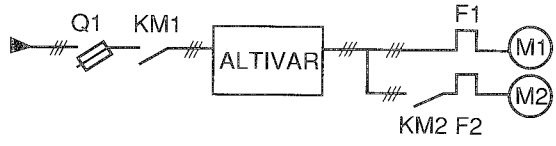
Speed controller selection :
Speed controller $In \geq In_1 + In_2 + ... Inx$.

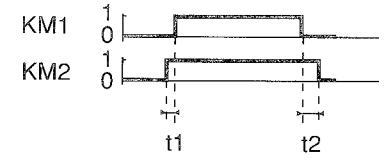
Each motor should be protected by a thermal overload relay.

Compensation is not at the optimum level. Adjust the U/f ratio if necessary (p. 48).
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 (p. 45).

If there are ≥ 3 motors, fitting a three phase inductance between the speed controller and the motor is recommended (p. 36).

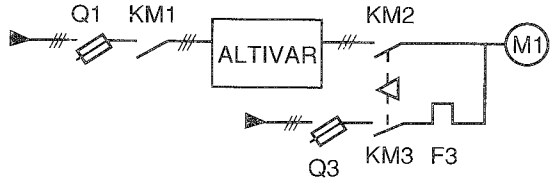
Additional motor connected downstream of the speed controller

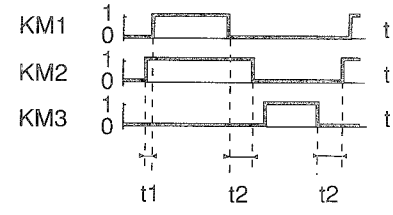




- Comply with the sequence shown : t1 = 20 ms,
  t2 = 1,5 s (demagnetisation of the motor).
- If the power of the motor to be connected is low in comparison with the rating of the speed controller, and it produces an acceptable overload (maximum current ≤ controller transient current), connection on the run is possible.

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





- Comply with the sequence shown : t1 = 20 ms,
  t2 = 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 to 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, but requires special adjustments. Refer to part 2 of this document "Special Applications" (p. 81).

Use of a synchronised asynchronous motor

Operation is possible provided the slip compensation has been overridden (p. 45).

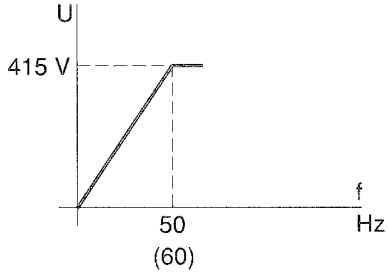
of the motor/speed controller combination

Operation at constant torque in overspeed

This type of operation is possible providing the motor winding torque is adjusted, and the voltage / frequency ratio adapted.
The various possibilities are specified below.

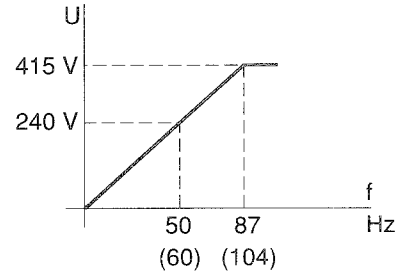
Example : ATV-452••• (380/415 V)
motor : 240 (Δ) / 415 V (⅄)

Motor connected in ⅄ (coupling 1)



Operation at constant torque
up to 50 (60) Hz

Motor connected at Δ (coupling 2)



Operation at constant torque
up to 87 (104) Hz

Ensure that the motor is suitable for overspeed operation.

In the event of operation with low voltage connection (connection 2), the rated current to be used for speed controller selection is that taken by the motor when connected in this configuration.

Example : operation of a 4 kW 1500 rpm 415 V 50 Hz motor at 87 Hz, the power at 2610 rpm is 7 kW.
Rated current at 240 V : 16,5 A.
Speed controller selected : ATV-452U75 (7,5 kW - 17,5 A).

Various types of motor to be used

		coupling 2 / coupling 1
ATV-452•••M	(220/240 V)	127 V (Δ) / 220 V (⅄) 139 V (Δ) / 240 V (⅄)
ATV-452•••	(380/415 V)	220 V (Δ) / 380 V (⅄) 240 V (Δ) / 415 V (⅄)
ATV-452•••N	(440/500 V)	250 V (Δ) / 440 V (⅄) 290 V (Δ) / 500 V (⅄) 230 V (L) / 460 V (H)
ATV-452•••S	(525/575 V)	300 V (Δ) / 525 V (⅄) 330 V (Δ) / 575 V (⅄)

Installation of the motor

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

of the motor/speed controller combination

Adaptation to the motor load

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

- overcome the load torque of the motor load over the whole speed range used,
- supply the transient overtorque needed for the required accelerations, see curves p. 31.

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

- DC injection braking (p. 25),
- slow-down braking (p. 62).

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 (p. 48) and override the slip compensation (p. 45);
  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;
  if 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 (p. 62), and use if needed particular adjustments (p. 81),

- machines with fast cycles :
  refer to part 2 of this document : "Special applications" (p. 81).

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-452075 (M) (N)	1,5 kVA	ATV-452D15 (M) (N) (S)	22 kVA
ATV-452U15 (N)	3 kVA	ATV-452D18N	28 kVA
ATV-452U22 (M) (N)	4 kVA	ATV-452D22 (N)	32 kVA
ATV-452U30	5,5 kVA	ATV-452D30 (N) (S)	45 kVA
ATV-452U40 (M) (N) (S)	7 kVA	ATV-452D37 (N)	52 kVA
ATV-452U55 (M) (N)	9 kVA	ATV-452D55 (N) (S)	75 kVA
ATV-452U75 (M) (N) (S)	12 kVA	ATV-452D75 (N)	100 kVA
ATV-452D11 (M) (N)	16 kVA	ATV-452D90 (N)	125 kVA

of the motor/speed controller combination

Line inductances

The use of line inductances is strongly recommended in the following circumstances :

- mains subject to interference from other loads (interference, overvoltage),
- speed controller supplied by a line with very low impedance (proximity of power transformers with more than 10 times the speed controller power), especially if the speed controller power is ≥ 55 kW,
- installation of a large number of frequency inverters on the same line.

The use of these inductances provides the following advantages :

- increased protection against input rectifier bridge overvoltages,
- reduction of the current absorbed by the speed controller at full load : the inductances recommended enable limitation of the line current to a value equal to that of the motor current,
- reduction of the load on the power factor correction capacitors, where fitted in the installation.

Inductances between the speed controller and the motor

The addition of inductances between the speed controller and the motor is recommended in the following circumstances :

- speed controller and motor connected by cables > 100 metres long,
- motor control in parallel, if the number is ≥ 3,
- motors with more than 6 poles, with a low power factor and stator inductance,
- motor with a higher power value than the speed controller power,
- ATV-452D55S, D75N, D90N : to ensure protection against short-circuits between output phases, if the speed controller-motor connection cables are < 25 metres long.

The use of these inductances enables reduction of :

- the values of the current peaks taken by the motor,
- earth leakage interference currents,
- radio interference created by the motor connection cables,
- vibrations and motor noise.

Recommended three phase inductances

The inductances recommended can be used on line and / or between the speed controller and the motor.

Characteristics		For speed controllers	Reference
5 mH	5 A	ATV-452075 (M) (N) ATV-452U15 (N) ATV-452U22 (N)	VZ1-L005UM50T
1,7 mH	15 A	ATV-452U22M ATV-452U30 ATV-452U40 (M) (N) (S) ATV-452U55 (N)	VZ1-L015UM17T
0,8 mH	30 A	ATV-452U55M ATV-452U75 (M) (N) (S) ATV-452D11 (N) ATV-452D15 (N) (S)	VZ1-L030U800T
0,6 mH	40 A	ATV-452D11M ATV-452D18N ATV-452D22N	VZ1-L040U600T
0,35 mH	70 A	ATV-452D15M ATV-452D22 ATV-452D30 (N) (S) ATV-452D37 (N)	VZ1-L070U350T
0,17 mH	150 A	ATV-452D55 (N) (S) ATV-452D75 (N)	VZ1-L150U170T
0,1 mH	250 A	ATV-452D90 (N)	VZ1-L250U100T

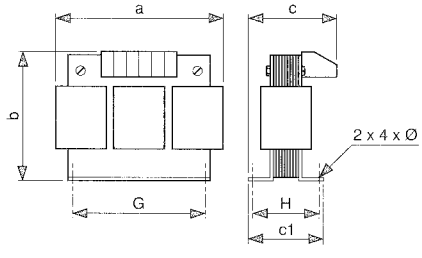
of the motor/speed controller combination

Electrical characteristics

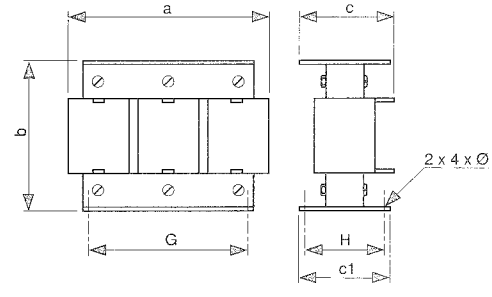
Reference	I A	L mH	Losses W	Screw terminal connections ⏚	 Inputs / Outputs
VZ1-L005UM50T	5	5	24	M10/10P	6 x M4/6
VZ1-L015UM17T	15	1,7	44	M10/10P	6 x M10/10
VZ1-L030U800T	30	0,8	58	M10/10P	6 x M16/12
VZ1-L040U600T	40	0,6	67	M10/10P	6 x M16/12
VZ1-L070U350T	70	0,35	80	M10/10P	6 x M35/16
				Bar terminations	
VZ1-L150U170T	150	0,17	160	M8 screws	6 x 20 x 5
VZ1-L250U100T	250	0,1	200	M8 screws	6 x 30 x 5

Dimensions - Weights

VZ1-L005UM50T to L070U350T



VZ1-L150U170T and L250U100T



Reference	a	b	c	c1	G	H	Ø	Weight (kg)
VZ1-L005UM50T	100	130	60	52	40/60	40	5	1,000
VZ1-L015UM17T	120	150	80	75	60/80,5	52	6	2,100
VZ1-L030U800T	150	180	120	100	75/106,5	76	7	4,100
VZ1-L040U600T	180	215	130	100	85/122	76	7	5,100
VZ1-L070U350T	180	215	150	130	85/122	97	7	8,000
VZ1-L150U170T	270	240	170	140	105/181	96	11,5	14,900
VZ1-L250U100T	270	240	220	160	105/181	125	11,5	24,300

Installation precautions

Install the inductances vertically (as shown on the diagrams above), leaving sufficient space to ensure the circulation of the air needed for cooling.

⚠ When operation is prolonged, the temperature of the metal parts can exceed 100°C.

The ALTIVAR ATV-45 2 is factory preset to meet the most common utilization requirements.
The preset values are marked below with an asterisk *.
The specific ATV-452•••N and S values are marked with 2 asterisks **.
Check that they are compatible with your requirements.

If so, after checking the connections (see recommended circuit diagram, page 21), 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 without removing the front cover, but simply by lifting the protective flap.

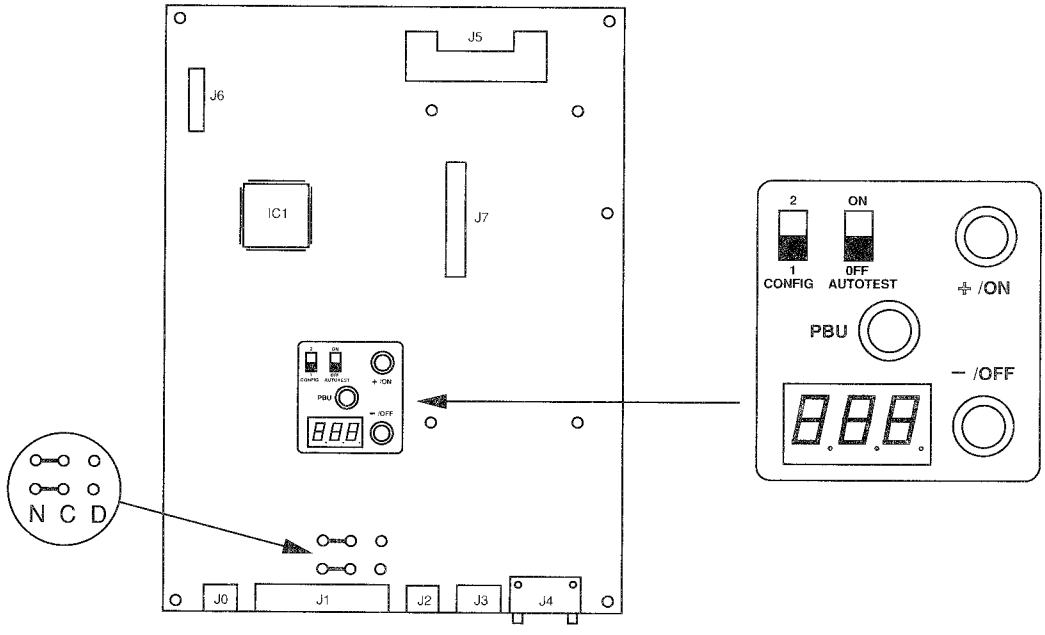
In order to modify the position of the C links, access to the control board must be obtained.

For ≤ 30 kW models : undo the quarter turn fasteners, and open the cover from the left to the right.

For ≥ 37 kW models : remove the cover, fixed by captive screws.

CAUTION : do not touch the components.

Layout of the setting controls



C links

Selection of the control inputs supply (p. 27).

Select with the power and control circuits switched off.

*  Selection of internal supply

 Selection of 24 V DC external supply

The 2 switches **must** be in the same position simultaneously, either to the left, or to the right.

Switches

* 

Enables access to configuration parameters (p. 45).

CONFIG

* 

Selection of the test sequence (p. 53).

AUTOTEST

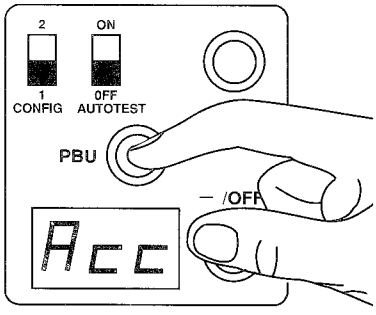
Push-buttons

PBU — Prolonged pressing of the PBU push-button causes the scrolling on the displays of the parameters to be displayed or adjusted (see scrolling order, p. 42 or 43).

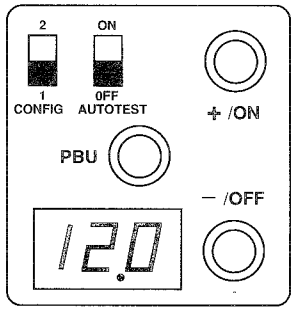
+ /ON — Pressing the + /ON push-button enables increasing of a parameter value, or validation of a function.

– /OFF — Pressing the – /OFF push-button enables decreasing of a parameter value, or disabling of a function.

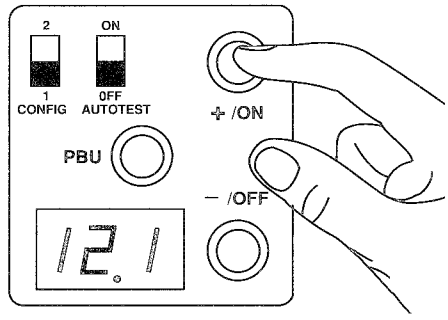
EXAMPLE



Call up parameter



Parameter value

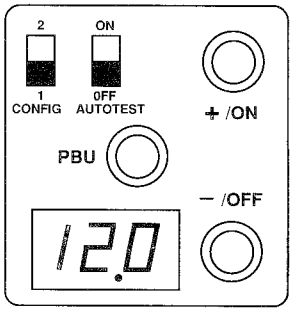


Adjustment of parameter

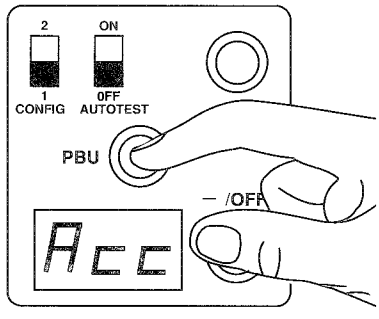
Simultaneous pressing of PBU and + /ON enables scrolling of the parameters in the reverse order from the one given on page 42 or 43.

When a parameter value is displayed, the nature of the parameter can be called up again by briefly pressing the PBU push-button.

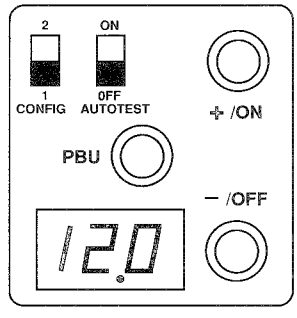
EXAMPLE



Parameter not known



Call up parameter



Parameter value

Display of settings and electrical values

With the CONFIG selector switch in position 1, and without a push-button being pressed, the various displays possible are as follows:

Speed controller on stop

rdY	Speed controller ready.
--F	Possible fault, see list and meanings, pages 51 and 52.
SLc	Speed controller ready with serial communication option board.

After switching on

FrH → 45.0 Value of the frequency reference, or another parameter selected during the previous operating period. For example :

LCr → 23.7 Motor current.

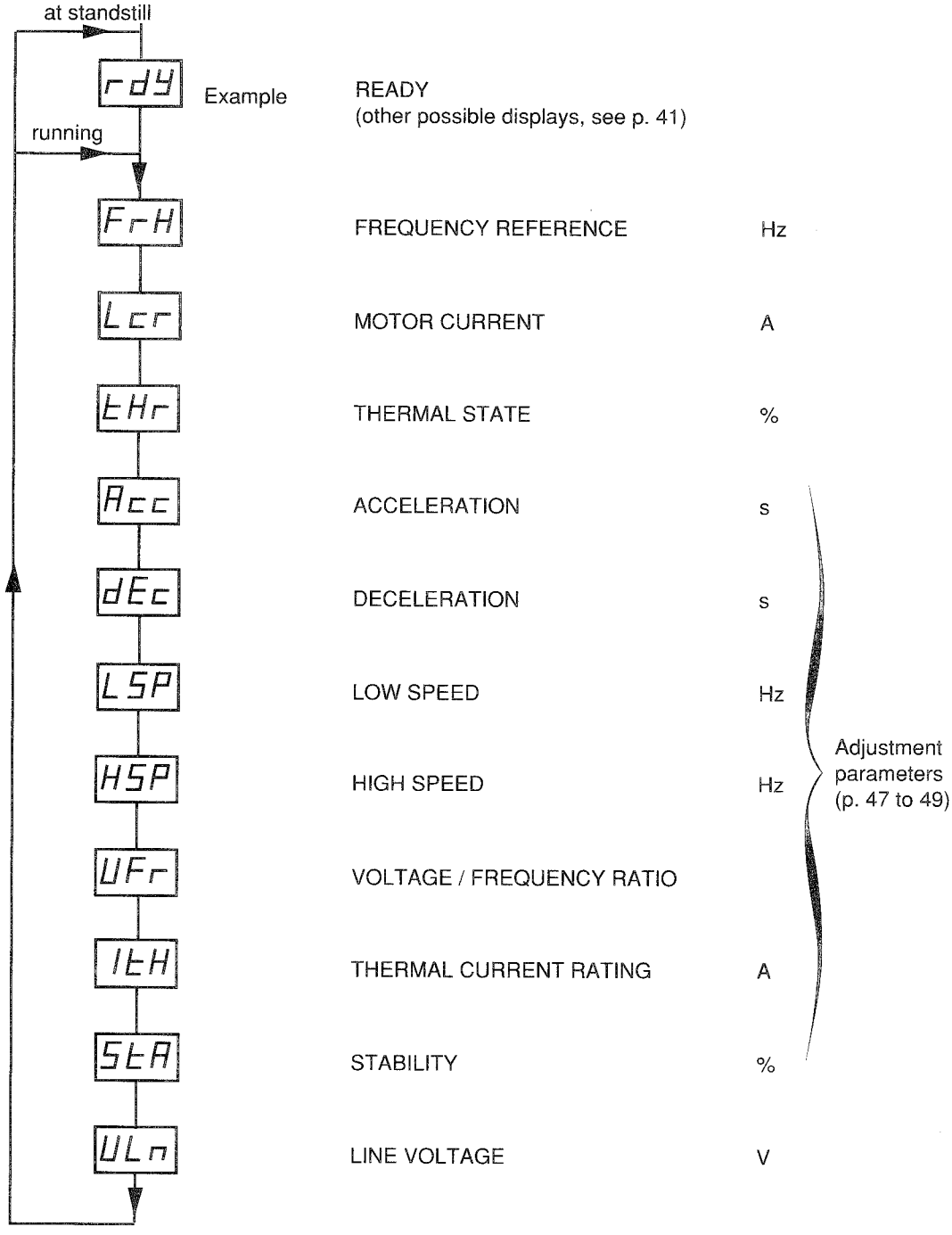
Other displays possible during operation

dcb	D.C. braking : braking by DC injection validated. This code shows that the braking command has been accepted.
Obr	Overbraking : excessive braking causes capacitor overvoltage. The deceleration time must be increased.

Simplified input

The CONFIG selector switch being in position 1, prolonged pressing of the PBU push-button enables display of the main operating parameters in the following order :

2
1
CONFIG

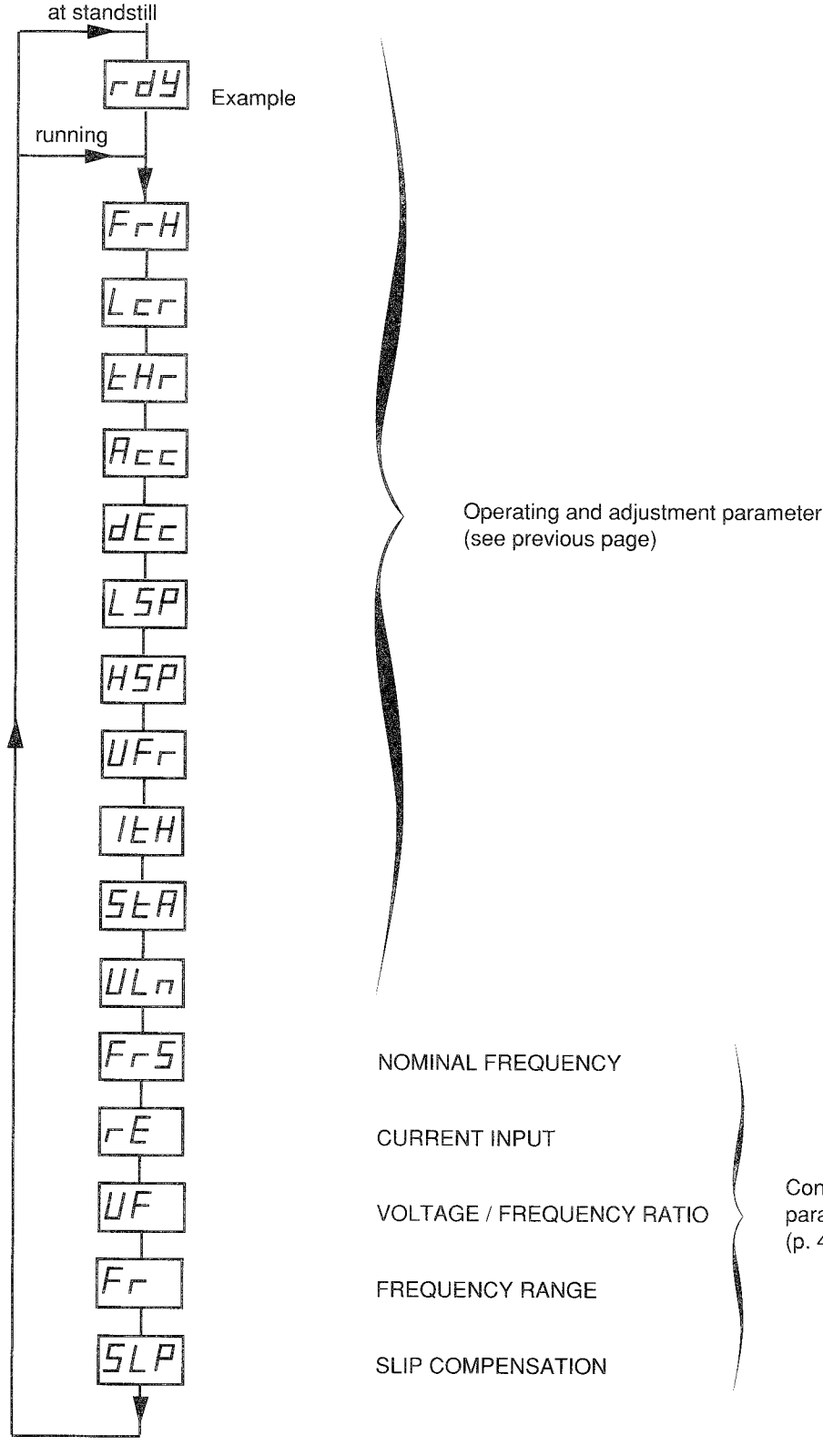


Note

The value of the mains voltage ULn cannot be used when the speed controller is locked. In addition, the value read can be incorrect if the mains voltage is subject to problems (distortion, interference).

Complete display

The speed controller's control circuit being switched on, turn the CONFIG selector switch to position 2. Prolonged pressing of the PBU push-button enables display of all the operating parameters in the following order :

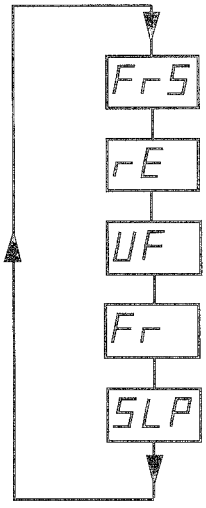


Readjustment of the settings

Configuration parameters

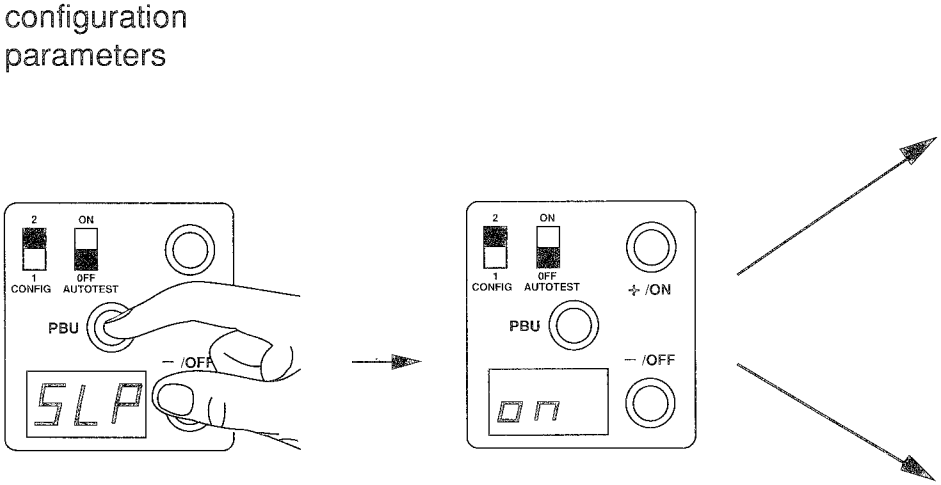
These parameters can be displayed at any time by putting the CONFIG selector switch in position 2.

These parameters can be modified provided that the CONFIG selector switch is in position 2 when the speed controller's control circuit is switched on.
The speed controller remains locked while the switch is in position 2.
Prolonged pressing of the PBU push-button enables display of single configuration parameters in the following order :



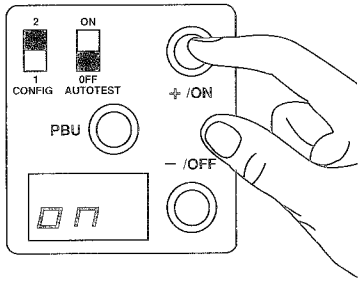
Modification of the configuration parameters

EXAMPLE

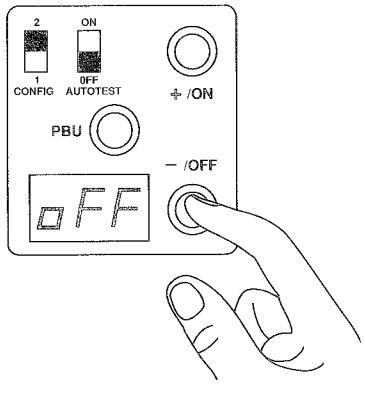


Call up parameter

Parameter value



Parameter adjustment



Modification of the configuration parameters

After changing the value of one of the parameters, turn the CONFIG switch to position 1 to revert to the list of parameters on page 42.
The value of the configuration parameters is STORED in a permanent memory (EEPROM).

In the event the value of one of the parameters being changed, the new value is recorded in the memory the moment the CONFIG switch is moved to position 1.
If the variable speed controller is switched off before the value has been recorded, the parameter remains unchanged.

List of the configuration parameters and the possible values

The preset values are marked with an asterisk *.
The specific ATV-452•••N (440/500 V) and ATV-452•••S (525/575 V) values are marked with 2 asterisks **.

FrS	50	*	Nominal motor frequency : 50 Hz
	60	**	Nominal motor frequency : 60 Hz
rE	0.20	*	Current reference : 0 - 20 mA
	4.20		Current reference : 4 - 20 mA
UF	I-H	*	Voltage / frequency with connection 1 / High
	2-L		Voltage / frequency with connection 2 / Low
Fr	67	* or 80.4 **	Maximum frequency
	or 87	or 104 or 110 or 120 or 132	
SLP	on	*	Slip compensation on
	oFF		Slip compensation off

It may be necessary to eliminate the slip compensation for certain applications :

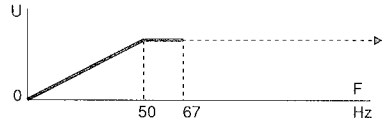
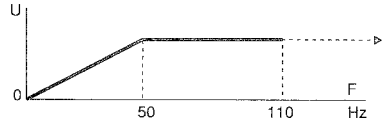
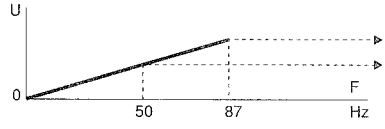
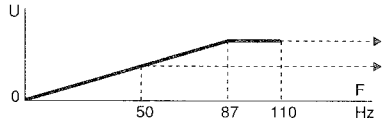
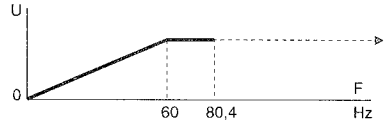
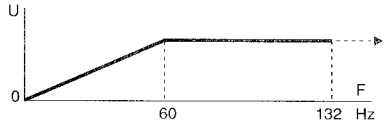
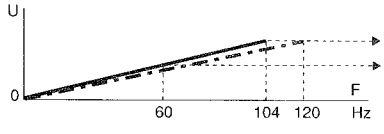
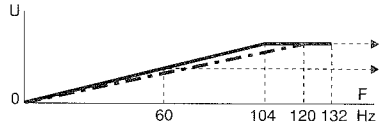
- supply of synchronised asynchronous motors,
- fans, centrifugal pumps, ...

NOTE

If the speed controller is fitted with the VW3-A45503 optional communication board (p. 78), the Adr parameter (address) appears after the parameters above.
Refer to the operator's manual supplied with the option.

Voltage / frequency

The various voltage / frequency possibilities depending on the parameters [FrS], [UF] and [Fr] are given in the table below.

[FrS]	[UF]	[Fr]	ATV	452•••M	452•••	452•••N	452•••S
50	I-H	67		220 / 240 V	380 / 415 V	440 / 500 V	525 V
		110		220 / 240 V	380 / 415 V	440 / 500 V	525 V
	2-L	87		220 / 240 V 127 / 139 V	380 / 415 V 220 / 240 V	440 / 500 V 250 / 290 V	525 V 300 V
		110		220 / 240 V 127 / 139 V	380 / 415 V 220 / 240 V	440 / 500 V 250 / 290 V	525 V 300 V
60	I-H	80,4		220 / 240 V	380 / 415 V	460 V	575 V
		132		220 / 240 V	380 / 415 V	460 V	575 V
	2-L	104 120		220/240V-104Hz 127/139V-60Hz	380/415V-104Hz 220/240V-60Hz	460V - 120Hz 230V - 60Hz	575V - 104Hz 330V - 60Hz
		132		220/240V 104 to 132Hz 127/139V-60Hz	380/415V 104 to 132Hz 220/240V-60Hz	460V 120 to 132Hz 230V-60Hz	575V 104 to 132Hz 330V-60Hz

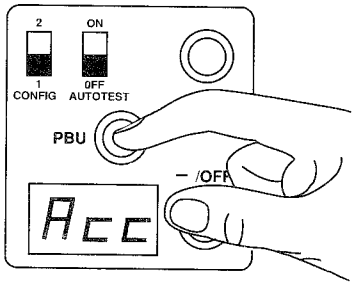
Readjustment of the settings

Adjustment parameters

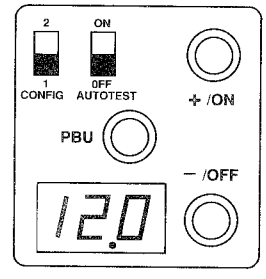
The adjustment parameters can be displayed and modified at any moment, whether the speed controller is running or not.

Modification of the setting parameters.

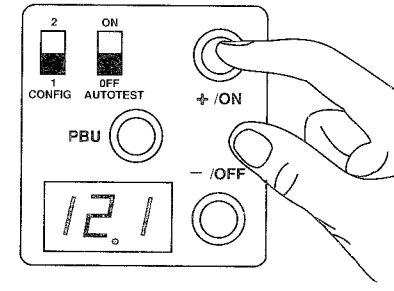
EXAMPLE



Call up parameter



Parameter value

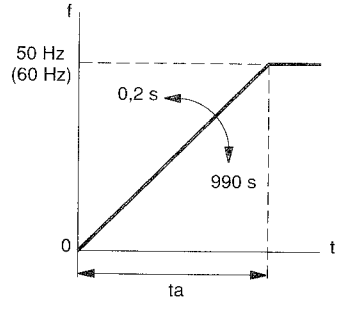


Parameter adjustment

The value of the parameters is stored in a permanent memory (EEPROM). In the event of a parameter value being changed, the new value is recorded in the memory, either the moment that another parameter is called up, or at the end of 10 seconds.
If neither of these conditions is fulfilled (the controller is switched off before 10 seconds has elapsed, for example), the parameter remains unchanged.

List of the parameters

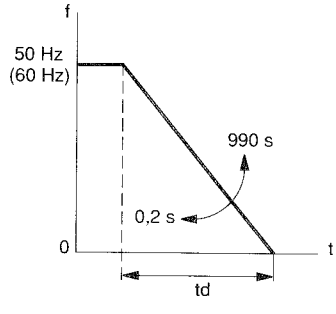
ACC Acceleration (0,2 to 990 s)



The acceleration time is increased automatically in the event of overtorque.

* Preset value 5 s

dEC Deceleration (0,2 to 990 s)



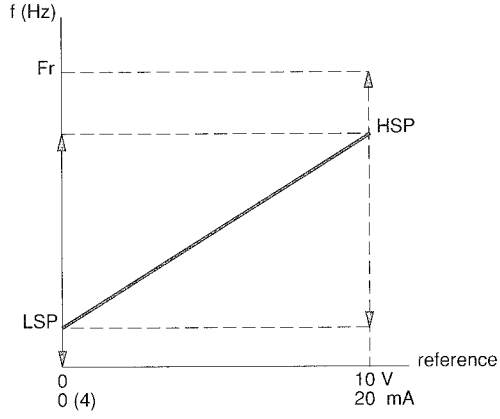
The deceleration time is increased automatically in the event of excessive braking (display of code **Obr**).

* Preset value 10 s

List of the parameters

[LSP] Low speed

[HSP] High speed



Fr : maximum selected frequency (p. 45)

When the low speed [LSP] is at minimum, the speed controller remains locked for reference values lower than 1 Hz.

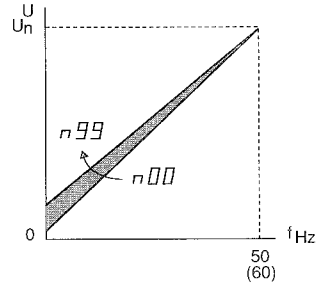
Preset values [LSP] minimum

[HSP] * 50 Hz for ATV-452•••M (220/240 V) and ATV-452••• (380/415 V)
** 60 Hz for ATV-452•••N (440/500 V) and ATV-452•••S (525/575 V)

Voltage / frequency ratio

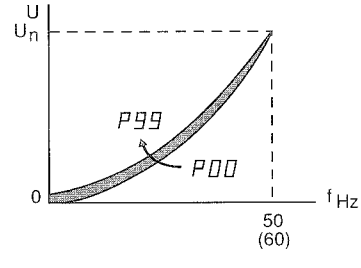
[UFr] * Preset value [n00] : setting corresponding to most applications.

– Applications needing high torque at low speed.



If torque is inadequate, increase gradually from [n00] to [n99] until correct operation is obtained.

– Operation with quadratic load torque : fans and centrifugal pumps.



In order to improve motor performance, adjust between [P00] and [P99] in such a way as to obtain the best and most silent operation with the minimum current.
This adjustment range is obtained via the – / OFF push-button.

List of the parameters

ItH Thermal motor protection (p. 30)

Setting range : from 0,45 to 1,05 of the speed controller's rated current (p. 10 and 11).
* Preset to 0,9 of the speed controller's rated current.

Set ItH to the rated motor current value to be found on the motor nameplate.

In order to cancel the thermal protection, keep the +/ON push-button pressed down (increasing the value of ItH) until the code nth appears.

This function is not suitable for the protection of force-ventilated motors. In this case, two possibilities are available :
– inhibit the internal protection and use an standard external protection (thermistor probes or thermal overload relays),
– ensure that the thermal protection is independent of the motor speed. Refer to part 2 of the document : "Special Applications" (p. 81).

StA Stability

In the event of instability, increase the value of parameter StA until correct operation is obtained.

* Preset value StA = 0

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 DC voltage across the + and – or PA and PB terminals can reach 400 to 1000 V when charged, depending on the supply voltage.

- The ALTIVAR ATV-45 2 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.

Assistance with maintenance

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

Fault codes: see table, pages 51 and 52.

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 page p. 21 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 

With this type of fault, it is essential to switch off the speed controller's power and control circuits, to check the connection cables and the motor insulation.
Carry out a self-diagnostic process before resetting (p. 53).

Fault codes

Codes - Signification	Probable cause	Trouble-shooting procedure
[ ] Displays off or partial display	- no control supply - control voltage too low	→ check : the control voltage the supply fuses the internal fuse the connectors (p. 56 to 59) → check : check the CL1-CL2 (CL21-CL22) control terminal connections
PhF Phase failure	- no supply to terminals L1-L2-L3 - power fuses blown - short mains failure (t ≥ 200 ms) - internal connections	→ check : the power supply the supply fuses → check the rectifier (p. 55) → reset → check the connectors (p. 56 to 59)
USF Undervoltage	- supply too low ATV-452•••M : U ≤ 185 V ATV-452••• : U ≤ 320 V ATV-452•••N : U ≤ 380 V ATV-452•••S : U ≤ 445 V (50 Hz) ATV-452•••S : U ≤ 490 V (60 Hz) - temporary voltage drop (t ≥ 200 ms) - internal connections	→ check the supply voltage → reset → check the connectors (p. 56 to 59)
OSF Overvoltage	- supply too high ATV-452•••M : U ≥ 265 V ATV-452••• : U ≥ 460 V ATV-452•••N : U ≥ 550 V (50 Hz) ATV-452•••N : U ≥ 510 V (60 Hz) ATV-452•••S : U ≥ 575 V (50 Hz) ATV-452•••S : U ≥ 630 V (60 Hz)	→ check the power voltage → check the parameter [FrS] ([50] or [60])
OhF Overtemperature	- heatsink temperature too high ≥ 75°C - ≤ 30 kW models : power board's J8 connector disconnected - ≥ 37 kW models : measurement board's link displaced - overheating of the braking resistance (if braking option fitted)	→ check the motor load, the fan and the climatic environment around the controller ; wait for it to cool down before resetting → check the J8 connector (p. 56 / 57) → check the link position (p. 70) → check the braking conditions and change the resistance if necessary
OLF OLF. Motor overload	- if [tHr] ≥ 118 % thermal trip owing to prolonged overload or phase failure - if [tHr] < 118 % phase U failure (≤ 30 kW models) or phase V failure (≥ 37 kW models) - motor power too low	→ check the [ItH] setting and compare with motor In - check the load and compare with the operating speed - check the motor connections (danger of single phase operation) - wait for approximately 7 mn before resetting → check the motor connections → cancel the internal protection

Fault codes

Codes - Signification	Probable cause	Trouble-shooting procedure
obF obF. Excessive braking	- overvoltage or overcurrent owing to excessive braking or a driving load (even with braking option)	→ increase the deceleration time - add the braking option if necessary - reset possible if : ULn ≤ 265 V - ATV-452•••M ≤ 460 V - ATV-452••• ≤ 550 V - ATV-452•••N ≤ 575 V - ATV-452•••S (50 Hz) ≤ 630 V - ATV-452•••S (60 Hz)
OcF OcF. Overcurrent	- short-circuit or earthing on the controller output - internal controller fault - excessive transient operation	→ switch off power and control - check the connecting cables and motor insulation, with the controller disconnected → use the self-diagnostic → increase the acceleration or deceleration time - reset
CrF Charge relay failure	- capacitor charge relay closure control fault	→ check the connectors (p. 56 to 59)
SPF SPF. Speed failure	- speed regulation incorrectly set - no TG feedback signal	→ reset ASP potentiometer on the braking option - check the motor load conditions (driving load) → check the tachogenerator wiring
SLF Serial link failure	- serial link communication fault (with communication option board)	→ check the connections between the speed controller and programmable controller (or micro-computer)
InF InF. Internal failure	- internal connection fault - EEPROM storage fault (operating with commissioning terminal) - AUTOTEST selector switch moved to the ON position during operation	→ check the internal connectors, with the supply switched off and capacitors discharged (≈ 5 minutes) → see page 104 → reset the selector switch to OFF - switch off the mains supply circuits - reset

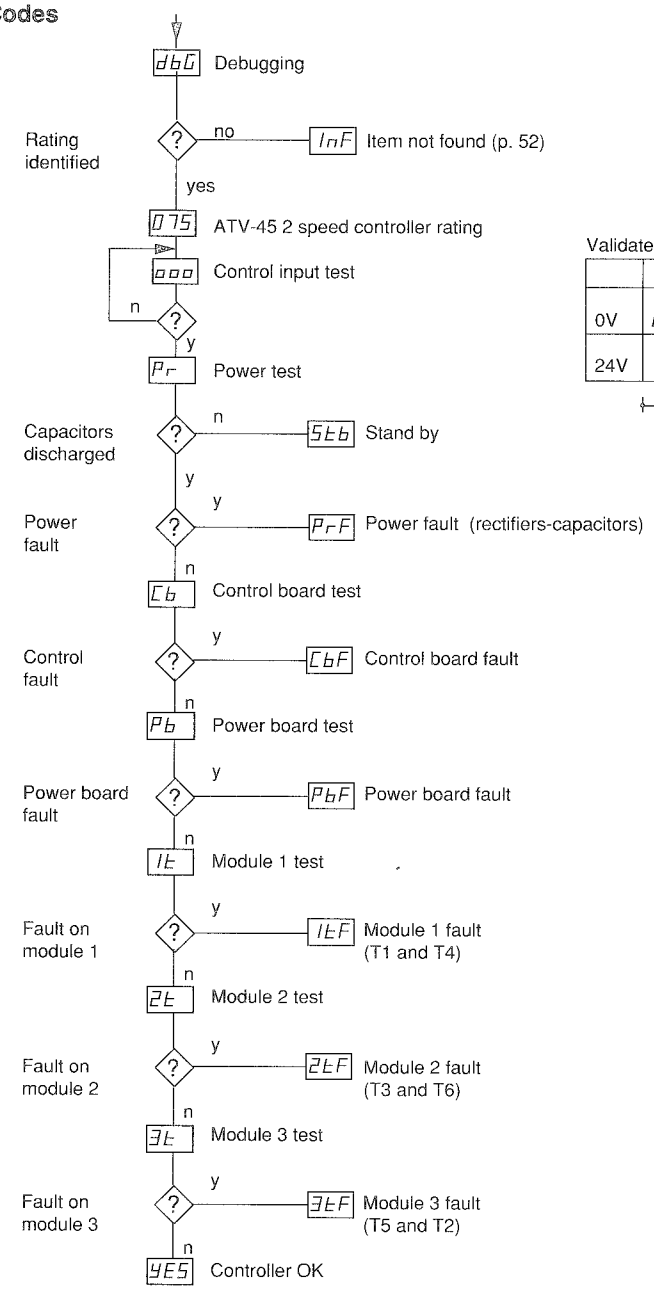
Self-diagnostic

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

Procedure

- Switch off power and control circuits.
- Wait for about 5 minutes for the capacitors to discharge.
- Disconnect the motor.
- Select the test sequence : selector switch AUTOTEST to ON.
- Switch the control supply back on.

Codes



Validate the inputs to test them

	FW	RV	DCB	LI1	LI2
0V	□	□	□	□	□
24V	ı	ı	ı	ı	ı

6 s 6 s

Time available

CAUTION

Do not switch the power supply back on during the test sequence, and do not move the AUTOTEST switch.

- Switch off the control supply 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 the AUTOTEST switch back to the OFF position before switching the power supply back on.

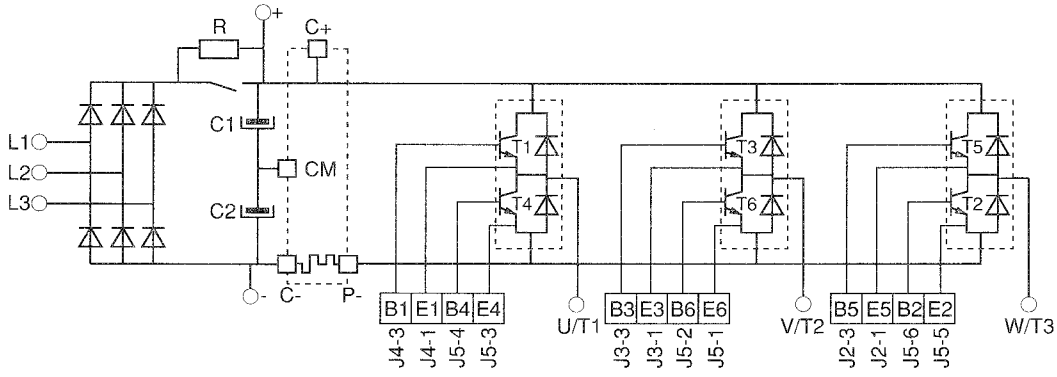
ALTIVAR 0,75 to 4 kW

ATV-452075M and U22M, ATV-452075 to U40, ATV-452075N to U40N

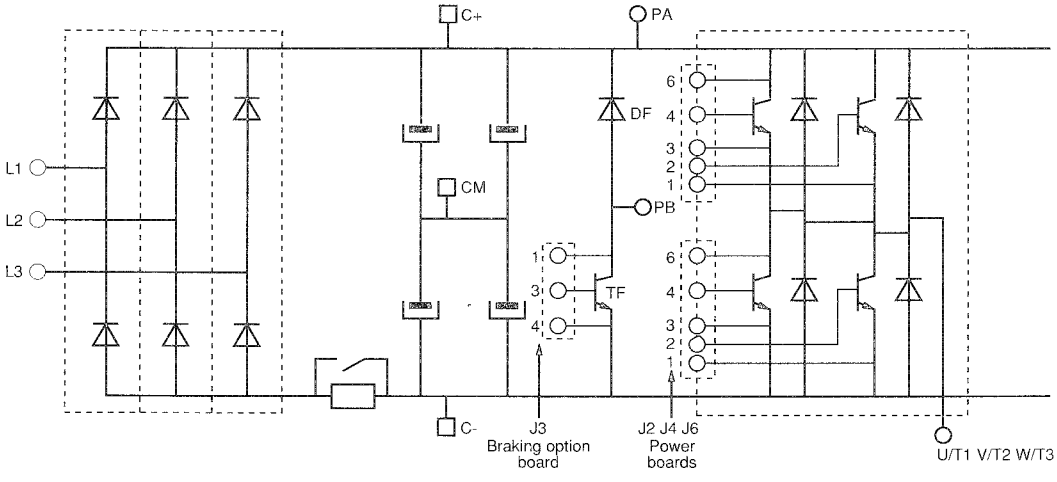
Change the power board or the rectifier if the self-diagnostic shows up one of the following faults :
[PrF] power fault (rectifier-capacitors), [PbF] power board fault,
[1LF] , [2LF] , [3LF] , module 1, 2 or 3 fault.

Checking the power components

ALTIVAR 4 to 30 kW (except ATV-452U40 and U40N)

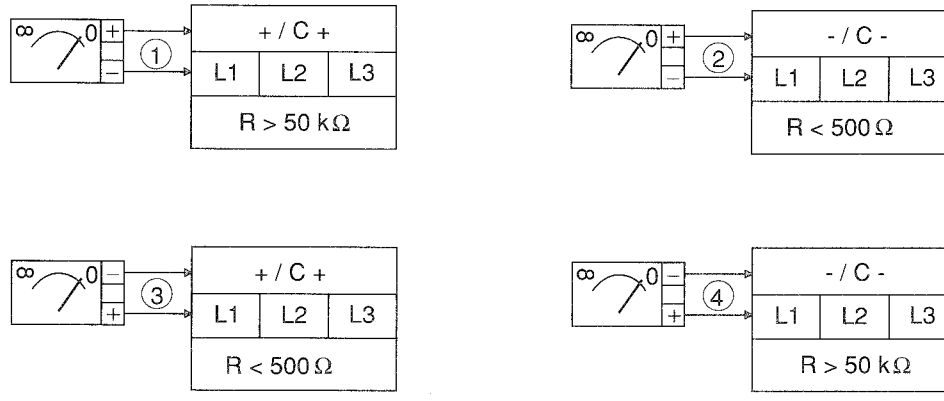


ALTIVAR 37 to 90 kW



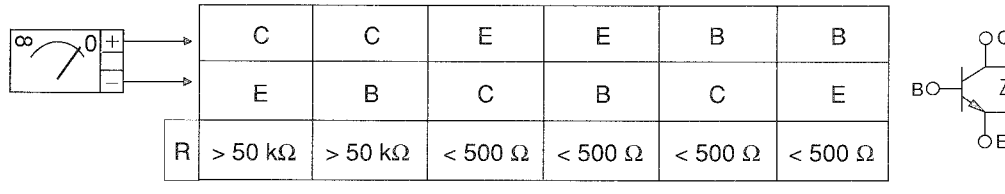
Checking the rectifiers

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 across the terminals.
Some tests are carried out using the load resistor; check that this resistance is good.

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 an assurance that the component is correct.

ALTIVAR 0,75 to 4 kW (except ATV-452U40M and U40S)

Connectors

ATV-452075M and U22M
ATV-452075 to U40
ATV-452075N to U40N

Control board

Connector	Conductors		Function	Interconnection
	number	colour		
J0	3	-	user terminals (p. 19)	control sequence
J1	12	-		
J2	2	-		
J3	4	-		speed regulation option
J4	9	-		serial link, terminal
J5	26	blue	control signals	power board
J6	4	red black green blue	control board supply	

Power board

J1	2	yellow	upper channel supply T5	transformer
J2	2	red	upper channel supply T3	
J3	2	blue	upper channel supply T1	
J4	2	grey	input circuit supply	
J5	26	blue	control signals	control board
J6	4	-	control board supply	
J7	3	green black green	lower channels and control supply	transformer
J8	10	-	control signals	braking option

ALTIVAR 4 to 30 kW (except ATV-452U40 and U40N)

Connectors

ATV-452U40M to D15M
ATV-452U55 to D30
ATV-452U55N to D30N
ATV-452U40S to D30S

Control board

Connector	Conductors		Function	Interconnection
	number	colour		
J0	3	-	user terminals (p. 19)	control sequence
J1	12	-		
J2	2	-		
J3	4	-		speed regulation option
J4	9	-		serial link, terminal
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 } T5	transistor 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 fully charged	vigitherm charge relay

Connectors

ATV-452D37 to D90
ATV-452D37N to D90N
ATV-452D55S

Control board

Connector	Conductors number	Function	Interconnection
J0	3	user terminals (p. 20)	control sequence
J1	12		
J2	2		
J3	3		speed regulation option
J4	9		serial link, terminal
J5	26	control signals	measuring board
J6	4	control board supply	

Measuring board

J1	3	supply	transformer
J2	2	power voltage measurement	power sub-assemblies
J3	9	measurement signals	
J4	3	supply	transformer
J5	3	load contactor control	contactor coil
J6	3	supply	transformer
J7	10	command signals	low channel power board
J8	26	control signals	control board
J9	10	command signals	high channel power board
J10	4	control board supply	control board
J13	7	command signals	braking option board
J14	2	measurement signals	power sub-assemblies

Power boards

Connector	Conductors number	Function	Interconnection
J1	2	supply	transformer
J2	3 or 5	transistor control	power transistor modules
J3	2	supply	transformer
J4	3 or 5	transistor control	power transistor modules
J5	2	supply	transformer
J6	3 or 5	transistor control	power transistor modules
J7	10	control signals	measuring board

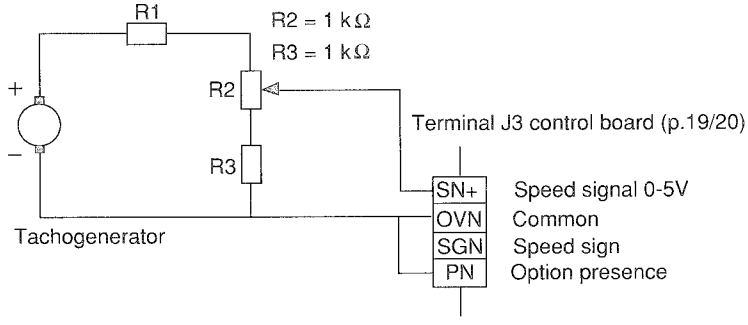
Braking and speed regulation option

J1	3	supply	transformer
J2	-	-	-
J3	3	braking transistor control	braking transistor module
J4	7	control signals	measuring board
J5	3	speed feedback signals	control board
J6	6	user terminals (p. 20)	
J7	2	option board resistance	power sub-assemblies
J8	1	measurement signals	

Unidirectional speed regulation

Measurement of the actual motor speed with a tachogenerator allows the speed to be regulated. This being the case, automatic slip compensation depending on the load incorporated in the ALTIVAR ATV-452 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.



Utilization safety measures

- Comply with the polarities shown for the tachogenerator connections.
- The SN+ terminal voltage must be ≤ + 5V.
- Link PN to OVN.
- 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 50/60.

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 the maximum speed using the reference potentiometer.
Turn R2 clockwise until the corresponding voltage is obtained.

Adaptation for ± 10V control

The interface module, reference VW3-A45108, changes the ± 10V into a 0-10V speed reference and a rotation direction (forward or reverse) control.

Dimensions : - height 96 mm,
- width 48 mm,
- depth 42 mm.

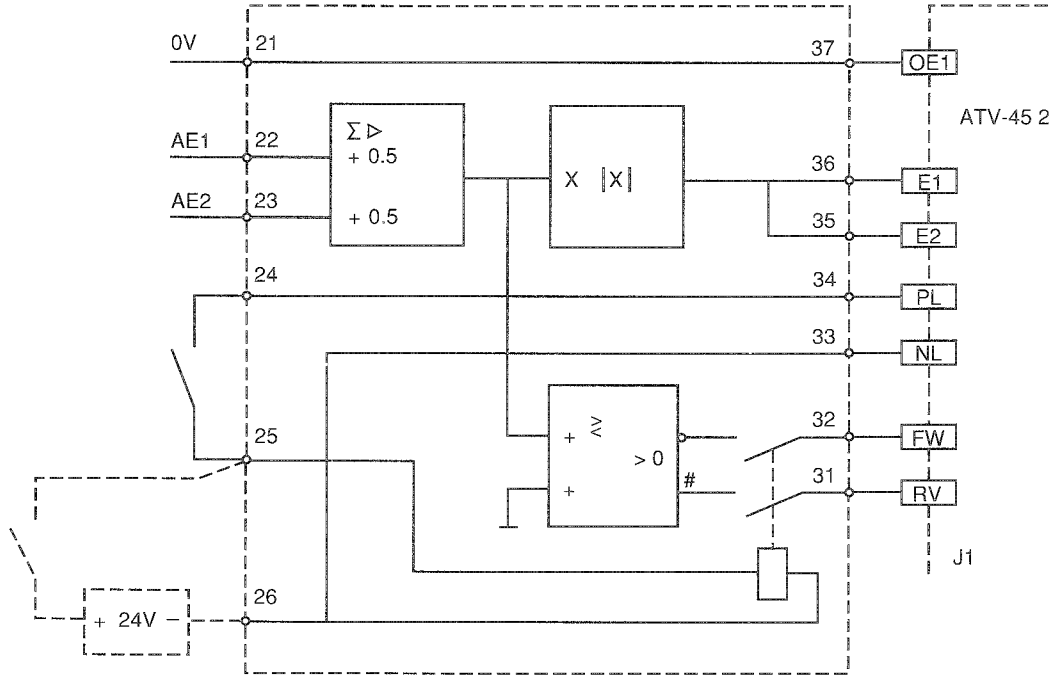
Clip-on fixing onto ⊓⊔ 35 mm omega rail.

Characteristics :

- 2 summing analogue inputs terminals 22 and 23 (Ze = 28 kΩ) : the resulting speed reference is equal to the absolute value of the sum of references AE1 and AE2,
- the (+ or –) sign of the sum of the references decides the direction of rotation.

Validation of the module :

- either by a normally open contact or a direct link between terminals 24 and 25,
- or by a 24V DC external supply between terminals 25 (+) and 26 (–).



Slow-down braking
Speed regulation

The two options are regrouped, and are available in two versions according to the power :

- a module :
  - reference VW3-A45101 for ATV-452•••M, ATV-452075 to D22, ATV-452075N to D22N,
  - reference VW3-A451011 for ATV-452U40S to D30S, ATV-452D30, ATV-452D30N,
- a board, reference VW3-A45201D90 for ATV-452 from 37 to 90 kW.

In both cases, the braking resistance is supplied separately.
For installation and connection of the resistance : see p. 66/68.

Module VW3-A45101 or VW3-A451011

This module is mounted on the left side of the speed controller by clip-on fixing. It is supplied with :

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

Two conductors pre-wired to the module enable linking to the + and – terminals of the speed controller.
Module VW3-A451011 : two conductors pre-wired to the module must be connected to the L1 and L2 terminals (see p. 68).

Environmental conditions identical to those of the ALTIVAR. Degree of protection IP20 (open).
Dimensions : VW3-A45101 : height 255 mm, width 55 mm, weight 1,2 kg.
VW3-A451011 : height 300 mm, widht 55 mm, weight 1,5 kg.

Board VW3-A45201D90

This board is supplied with the connection cable to the control board when used in conjunction with the speed regulation option. For mounting and connecting the board : see p. 70.

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 on overvoltage (code [DbF]).

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.

Composition

The slow-down braking option comprises :

- a power transistor which ensures the transfer of braking resistance onto the filter capacitor terminals,
- the control electronics,
- a separate braking resistance, supplied if required,
- a low speed relay, which will control a brake if necessary : pick up at $f > 5$ Hz and motor current $\geq 0,7$ rated speed controller current, drop out at $f \leq 5$ Hz. To modify these values refer to part 2 of this document : "Special applications" (p. 81).

For the ALTIVAR 0,75 to 30 kW, the VW3-A45101 and VW3-A451011 modules contain the elements making up the option, with a capacitor charge indicator on the front.

For the ALTIVAR 37 to 90 kW, the power transistor is incorporated directly into the speed controller, the other elements making up the option are located on the VW3-A45201D90 board.

Characteristics

Maximum admissible current in the resistance is linked to :

- the braking resistance value,
- the associated controller's current limitation,
- the maximum power transistor current :
  - 50 A for VW3-A45101 module,
  - 75 A for VW3-A451011 module,
  - 100 A for ATV-452D37 (N) and D55 (N) speed controllers,
  - 200 A for ATV-452D55S, ATV-452D75 (N) and D90 (N) speed controllers.

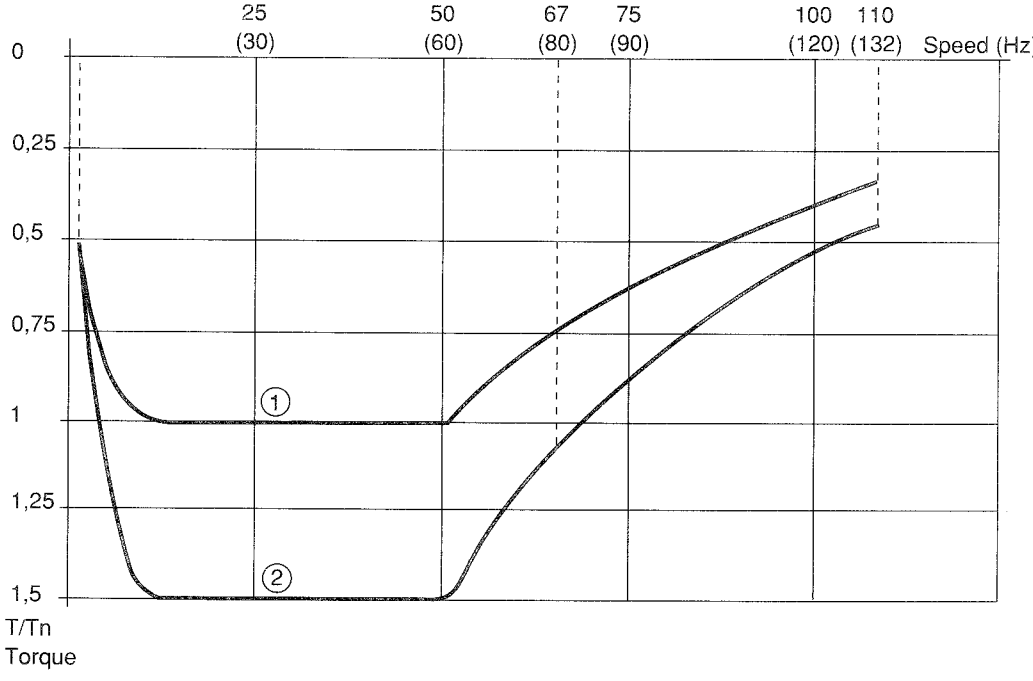
Protection

⚠ The power transistor is protected against short-circuits at the braking resistance terminals.

Available braking torque

Typical braking curves :

① Permanent braking torque (driving load)
② Maximum transient 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

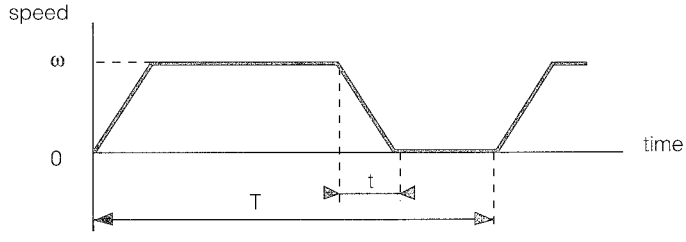
Braking torque on deceleration : $Cb = J\frac{\Delta\omega}{\Delta t}$ in N.m,

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 : $Pb = Cb\ \omega$ in W.
Average braking power during deceleration : $Pbd = 0{,}5\ Cb\ \Delta\omega$ in W.

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

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



- Driving load, continuous operation of unspecified duration

Braking is treated as continuous braking : $Pb = Pbm = Cb\ \omega$ in W,

Cb : 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 power of the speed controller.

Braking resistance selection

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

Ohmic value of the resistance

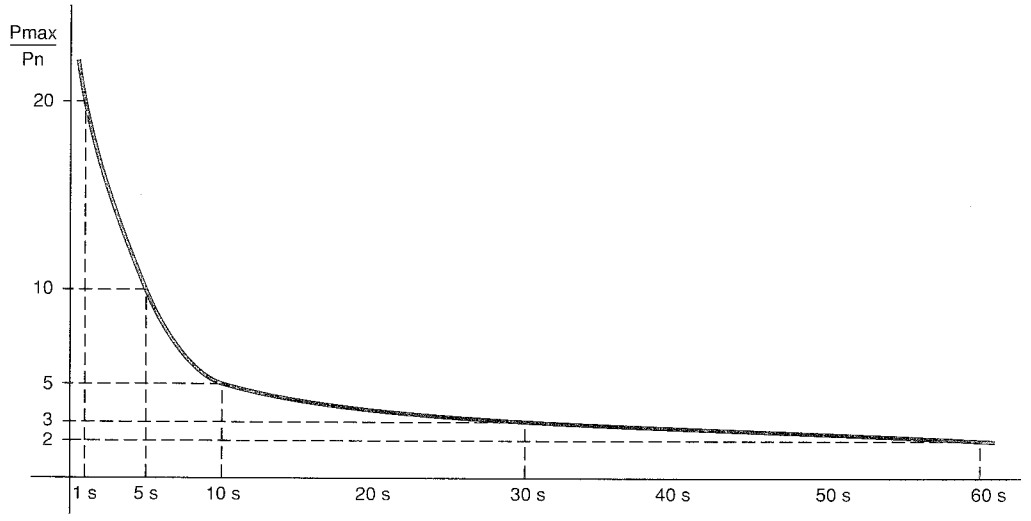
Reference **ATV-452**	U40S	075(M)(N) U15(N) U22(M)(N) U30 U40(N)	U55(N) U75(N)(S) D11(N) D15S	U40M D15(N) D30S	D18N D22(N) D30(N)	U55M U75M D11M D37N D55S	D15M D37 D55N	D55	D75N D90N	D75 D90
Minimum value of the resistance (Ω)	100	47	27	22	15	10	8	7	5	4

Power of the resistance:

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

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

Possibilities of overload according to braking time t



For a resistance of rated power Pn, a maximum power Pmax, equal to 10 times Pn would be acceptable if braking lasts 5 seconds, or twice Pn if the braking lasts 60 seconds.

Standardised resistances (for the most common operating conditions)

Reference **ATV-452**	075 (M) (N) U15 (N) U22 (M) (N) U30 U40 (M) (N) (S)	U55 (M) (N) U75 (M) (N) (S) D11 (M) (N) D15 (M) (N) (S)	D18N D22 (N) D30 (N) (S)	D37 (N) D55 (N) (S)	D75 (N) D90 (N)
Standardised resistance Ohmic value (Ω)	100	27	27	10	5
Rated power (W)	72	280	700	1800	3600
Reference VY1-AD	R100W072	R027W280	R027W700	R010W2000	2 x R010W2000
Dimensions (mm) H x W x D *	153 x 20 x 60	306 x 30 x 80	450 x 55 x 105	see p. 66	see p. 66
Cabling : recommended section (mm^2)	2,5 AWG 14	4 AWG 12	6 AWG 10	25 AWG 4	2 x 25 in // 2 x AWG 4

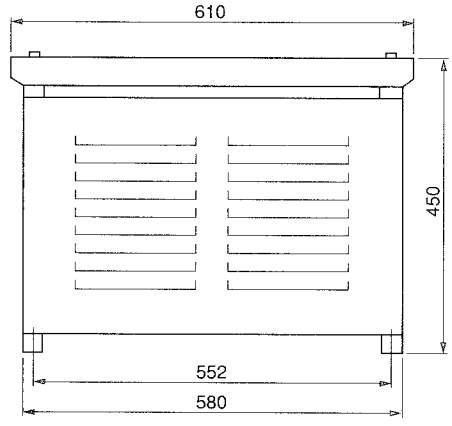
* Dimensions of resistance with thermocontact and fixing brackets, see p. 68.

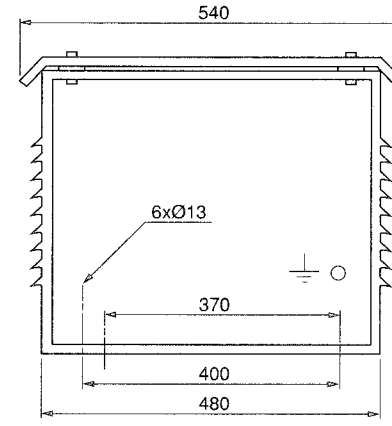
For dimensions in inches, multiply by 0,03937.

⚠ Standardised resistances may not be suitable for the application.
See example of calculation on p. 67.

Standardised resistances VY1-ADR010W2000

Presentation : louvred enclosure, with cover (painted in grey RAL 7032), weight 26 kg.





For dimensions in inches, multiply by 0,03937.

Composition : 12 stainless steel elements 1,7 Ω (cold state) and average power 250 to 300 W for a steady state temperature of the elements of about 300°C.

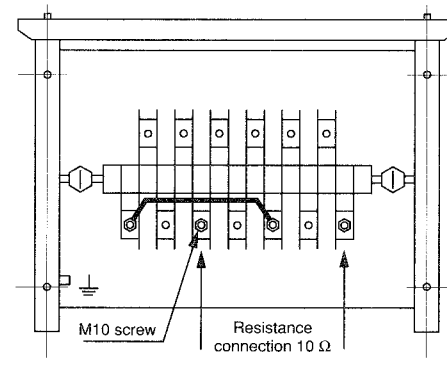
The elements are connected in series. A parallel connecting strip enables the following characteristics to be obtained :

- ohmic value when cold : 10 Ω,
- rated power : 1800 W,
- maximum power : 40 kW, 1s.

For connecting, take off the louvred cover on the same side as the earth terminal, fixed with 4 M6 screws.

Wiring precautions :

- the resistance terminals' DC voltage can reach 1000 V; use conductors with ≤ 1000 V insulation rating,
- recommended section : 25 mm² (AWG 4),
- connect the resistance to the PA-PB terminals, having removed the protection insulator.



Note

For ATV-452D75(N) and D90(N) speed controllers, if the average braking power is < 3000 W during one cycle, a single standardised resistance may prove sufficient. In that case, remove the connecting strip, and connect in parallel the 2 units of 6 elements to obtain 5 Ω - 3000 W.

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 10 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 : $Cn = \frac{Pn}{\omega n} = \frac{4000}{152} = 26,3$ N.m

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

Total inertia : $J = 0,0135 + 10 \times 0,0135 = 0,1485$ kg.m²

Braking torque : $C = J \frac{\Delta\omega}{\Delta t} = 0,1485 \times \frac{152}{5} = 4,52$ N.m

Motor braking torque : $Cb = C - Cr = 4,52 - 2,63 = 1,89$ N.m

Instantaneous braking power : $Pb = Cb\ \omega = 1,89 \times 152 = 287$ W

Average braking power during deceleration : $Pbd = 0,5\ Cb\ \Delta\omega = 0,5 \times 1,89 \times 152 = 144$ W

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

Average braking power during one cycle : $Pbm = Pbd \frac{t}{T} = 144 \times \frac{5}{30} = 24$ W

Standardised resistance VY1-ADR100W072 is suitable :

- rated power : Pn = 72 W, donc > Pfm,
- maximum power possible for 5 seconds (curve p. 65) :
  Pmax = 10 x 72 = 720 W, thus > Pf.

CAUTION

Precise calculation of the resistance, as shown in the example above, **is absolutely essential** for severe applications requiring high braking powers : hoisting (vertical movements), machines with very high inertia, driving loads, ...

If the required braking torque is high, choose a resistance with an ohmic value equal to, or slightly greater than the minimum value given in the table on table page 64.

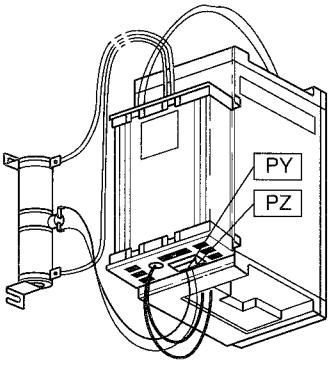
ALTIVAR 0,75 to 30 kW

Installation of the resistance

Supplied with the standardised 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 dissipation of the heat dissipated.

In order to avoid all accidental contact with the braking resistance (maximum DC voltage of 1000 V between terminals, and a high temperature, which may reach 350° C when operating), the installation of a protective cover is recommended. Provide openings for circulation of the air required for evacuating dissipated heat.



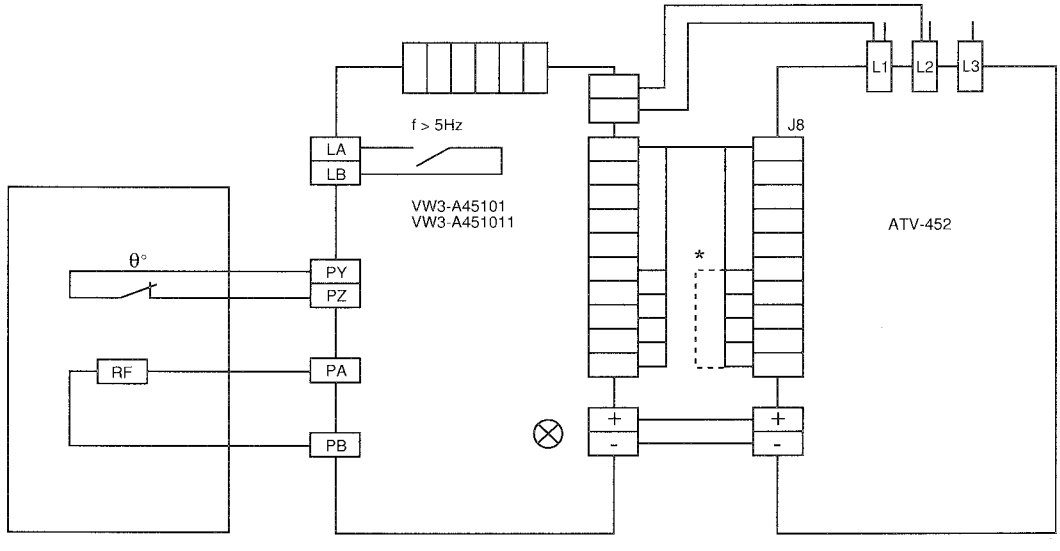
Installation and connection of the optional module

Follow the procedure described in the service instruction delivered with the module.

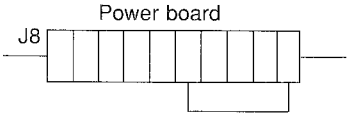
Safety precautions to take when wiring the resistance :

- as the DC voltage at the resistance terminals can reach 1000 V at the start of braking, use conductors with an insulation class of ≥ 1000V,
- ensure that the thermocontact is connected to the PY-PZ terminals of the braking module; if this is not done, the state "contact open" will cause the controller to lock when switched on, displaying the code [OHF] .

Specific connections with VW3-A451011 module



Braking resistance



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

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

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; contact characteristics : 220/240V - 50/60Hz - 2A.

Initial setting up

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

After checking the connections, and possibly adjusting the speed controller settings (see p. 38 and onwards), the ALTIVAR can be switched on.

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

- set a deceleration ramp time longer than the required braking time,
- start up the machine 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.

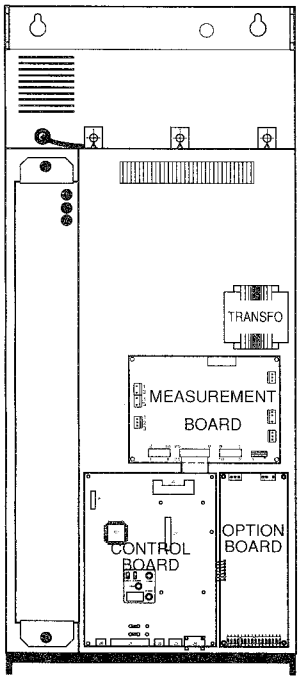
If the resistance heats up to an abnormal level, the thermocontact will open and the controller will lock, displaying the code [ObF].

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 code :

[Obr]	Deceleration ramp not followed	Increase the deceleration time
[ObF]	Capacitor overvoltage owing to excessive braking or a driving load	



Installing the VW3-A45201D90 option board

Switch off the power and control of the ALTIVAR and wait for the capacitors to discharge (about 5 minutes after switch off, when the LED on the front goes off).

Remove the speed controller's protective cover.

The location intended for the option board is to be found to the right of the control board. 3 internal links to J1, J2, J3 and J8 connectors on the option board are fixed to the support plate, and must be released before mounting the option board.

Unplug the removable J5 and J6 connectors from the option board.

Take the board, holding it so that the components face the operator, and the connectors face downwards; via the lower part, slide it onto the two positioning blocks situated in the bottom part of the location, and then click into position in the upper part.

Connections

Connect the option board's flying leads to the measuring board's J13 connector.
Connect the female connectors of the internal links to the corresponding male connectors on the board (J1, J2, J3 and J8).

WARNING : attach the connectors without forcing them, making sure that they have been fitted the right way around, then check that they are correctly fixed.

If the speed regulation option is not to be used, do not connect the wire between the option board's J5 connector and the control board's J3 connector.

Put the plug-in terminal block back on to the J6 connector.

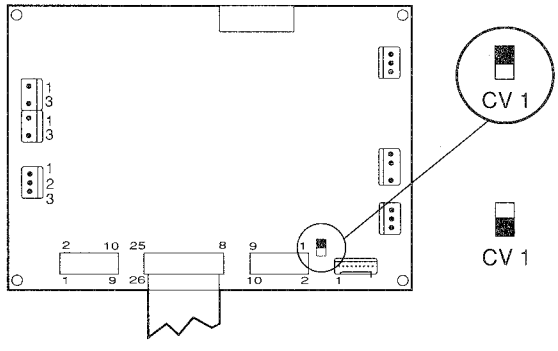
If the motor is fitted with a brake whose windings are accessible via terminals, connect the contact of the low speed relay available at LA-LB terminals into the control sequence.

If the resistance is protected by thermocontact (see following page) connect it to the PY-PZ terminals.

Preliminary checks

A CV1 switch on the measurement board allows the braking resistance thermal protection to be selected.

Measurement board



Use with resistance without thermocontact.
Factory setting.

Use with resistance protected by thermocontact.
Put the switch into this position.

Special case : braking resistance thermal protection.

The standard resistance does not have thermal protection.

The elements making it up can, without damage, reach temperatures higher than the steady state temperature of 300°C noted on page 66.

The ALTIVAR ATV-452, however, fitted with a braking option, enables the resistance to be protected against overheating, by using a normally closed thermocontact or overload relay.

This protection can be necessary in the following cases :

- utilization of resistances of a kind whose insulation risks being damaged or destroyed if heating is abnormally high,
- applications in which higher or more frequent braking than planned, can prove dangerous for the installation or the driven machine.

Choice of thermocontact :

- minimum DC electrical characteristics on resistive load : 10V - 5mA,
- tripping temperature : to be determined according to the resistance used and the selected location.

EXAMPLE : standardised resistance. Choose a 260° C thermocontact and, attach it to the upper metal band joining the two elements on the right.

Choice of thermal overload relay

Calculate the thermal overload relay rating using the formula $I = \sqrt{\frac{P}{R}}$, in which :

- P = rated power of the resistance,
- R = ohmic value of the resisitance.

Connect the thermal overload relay's N/C contact to terminals PY-PZ.

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 (see p. 38 onwards), 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 longer then the required braking time,
- start up the machine 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 real use.

Maintenance

In the event of overbraking, the speed controller may display the following codes :

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

Speed regulation

Measurement of the actual motor speed with a tachogenerator allows the speed to be regulated. This being the case, automatic slip compensation depending on the load incorporated in the ALTIVAR ATV-45 2 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 50/60.

Presentation

The speed regulation option is associated with the slow-down braking option (see p. 62), and is available in two versions according to the power :

- a module reference VW3-A45101, or VW3-A451011,
- a board reference VW3-A45201D90.

Installation and connections

ALTIVAR 0,75 to 30 kW : - installation and connection of the module : see p. 68,
- use the cable supplied with the option to connect the module to the J3 connector of the control board,

ALTIVAR 37 to 90 kW : - for mounting and connecting the board in the speed controller : see p. 70,
- use the cable supplied with the option to connect the option board's J5 connector to the J3 connector of the control board.

Connecting the tachogenerator :

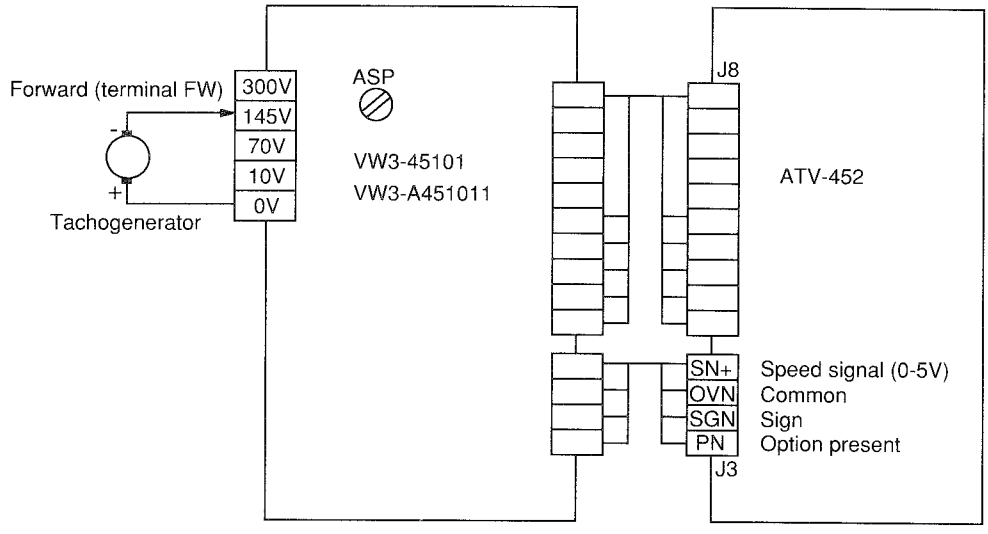
- calculate the maximum voltage provided by the tachogenerator :

EXAMPLE : motor 1800 rpm at 60 Hz
tachogenerator 0,06 V/rpm
frequency range 80 Hz

$$U = 0{,}06 \times 1800 \times \frac{80}{60} = 144 \text{ V}$$

- using twisted cable, connect the tachogenerator to the option module or board terminals (J6 connector), with values immediately above the value calculated, i.e. 0V-145V in the example above.

See following page for connection diagram for VW3-A45101 or VW3-A451011 module.



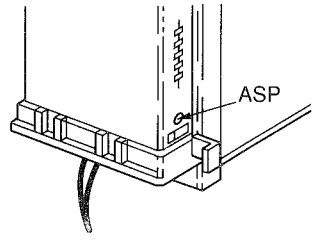
Adjustments

Connect a voltmeter to the tachogenerator terminals.
Turn the ASP potentiometer against the stop : - in the anti-clockwise direction on the module option,
- in the clockwise direction on the board option.
Start the motor and set maximum speed using the reference potentiometer.
Turn ASP until the corresponding voltage is obtained.

If the setting remains inoperative, reverse the tachogenerator connections.

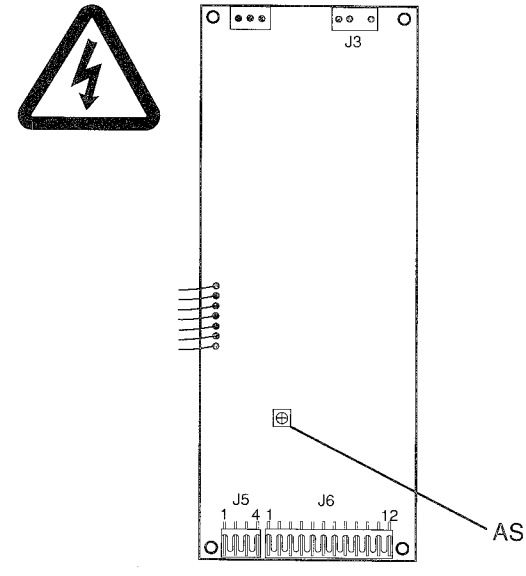
ALTIVAR 0,75 to 30 kW

The ASP potentiometer is accessible at the front of the option module.



ALTIVAR 37 to 90 kW

The ASP potentiometer is located on the option board.



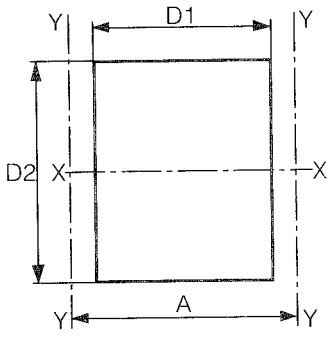
ALTIVAR 0,75 to 30 kW

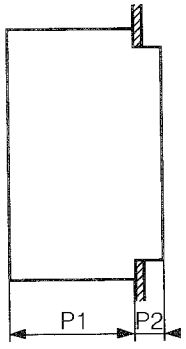
Mounting in dust and damp proof metal enclosure

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

Follow the mounting instructions given on pages 14 and 15.

Diagram of cut out to be made





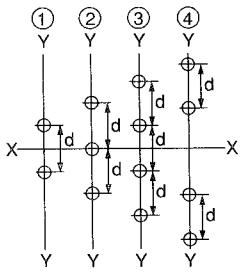
Provide sufficient free space at the back of the enclosure for ventilation.

Reference ALTIVAR	D1 mm	D2 mm	A mm	P1 mm	P2 mm	Drilling Dwg	Drilling d mm	Drilling Ø mm	Mounting kit reference
ATV-452075 (M) (N) ATV-452U15 (N)	194	278	212	160	0	①	160	7	VY1-A451U1501
ATV-452U22 (M) (N) ATV-452U30 ATV-452U40 (M) (N) (S)	172	342	212	165	25	②	150	7	VY1-A451U4001
ATV-452U55 (N)	172	382	212	165	25	②	150	7	VY1-A451U7501
ATV-452U55M ATV-452U75 (M) (N)	172	382	212	165	104	②	150	7	
ATV-452U75S ATV-452D11 (M) (N)	172	532	212	165	104	③	150	7	VY1-A451D1101
ATV-452D15 (M) (N) (S) ATV-452D18N ATV-452D22 (N)	172	572	212	165	104	③	150	7	VY1-A451D1501
ATV-452D30 (N) (S)	172	772	212	165	104	④	140	7	VY1-A451D3001

Composition of the kit according to drawings :

① - Self-adhesive flat gasket

② ③ ④ - Self-adhesive flat gaskets
- Dust and damp proof plates
- Screws and accessories



Each kit is supplied complete with mounting instructions.

WARNING : for the ATV-452U55M, U75 (M) (N) (S), D11 (M) (N), D15 (M) (N) (S), D18N, D22 (N), D30 (N) (S), the fan located outside the enclosure remains IP20.

Ventilation kit

This combination comprises a single phase fan with a protection grill and mounting accessories. It is fitted to the upper part of the upper controller.

This arrangment enables hot spots to be avoided and the speed controller to be used in an enclosure with a maximum internal temperature of 60°C (140°F).

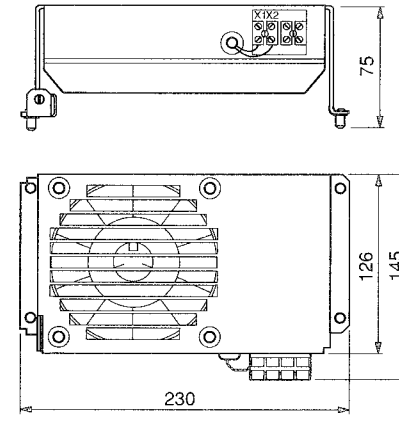
CAUTION : this combination should only be used if the speed controller is installed in a dust and damp proof enclosure : **degree of protection IP54.**

Combination reference : VY1-A05107.

The kit is delivered with mounting instructions.

Fixing to the upper part of the speed controller by 20 mm pillars, leaving an area free for wiring.

Overall thickness :
75 + 20 = 95 mm.
Provide a free space of 50 mm minimum above the fan for air flow.



Characteristics of fan :

- flow : 44 dm^3/s (100 CFM),
- supply (terminals X1-X2) : 208-240 V, 50/60 Hz,
- consumption : 125/105 mA.

To enable access to the speed controller, the kit can be pivoted once the right hand screws have been removed.

Enclosed speed controllers

The ALTIVAR ATV-45 2 speed controllers (**for 380/415V only**) are available in dust and damp proof 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.

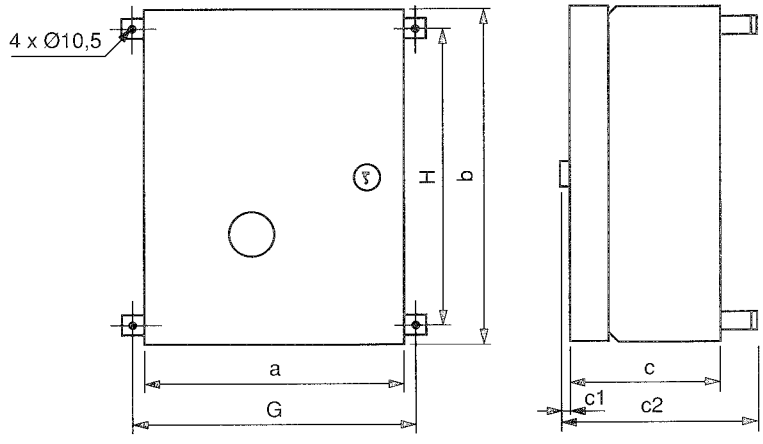
Characteristics: - degree of protection IP54,
- RAL 7032 grey paint finish,
- inspection window in door for displaying codes,
- lock with RONIS n°455 key.

Connections

The top and bottom of the enclosure contain holes with plugs for cable entries, allowing cable glands (which are not supplied) to be fitted.

Cable glands required
- ATV-452075Q5 to U40Q5 : 7 x N° 13
- ATV-452U55Q5 and U75Q5 : 4 x v13 + 3 x N°N°N°16
- ATV-452D11Q5 to D30Q5 : 4 x PE13 + 3 x PE21

Dimensions



Enclosed unit Reference	Sizes (mm) a	b	c	c1	c2	Fixing (mm) H	G	Weight (kg)
ATV-452075Q5 ATV-452U15Q5	300	500	200	6,3	230	462	324	16
ATV-452U22Q5 ATV-452U30Q5 ATV-452U40Q5	400	500	250	6,3	280	462	424	21,5
ATV-452U55Q5	400	600	250	6,3	280	562	424	25,2
ATV-452U75Q5*	400	600	250	6,3	357	562	424	27,7
ATV-452D11Q5* ATV-452D15Q5* ATV-452D22Q5*	600	800	300	6,3	407	762	624	44,2 46,7 48,2
ATV-452D30Q5*	800	1000	300	6,3	407	962	824	69

* The external heatsink fan retains IP20 degree of protection.

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 controller 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-452U55M (220/240V) and ATV-452D11 (380/415V).

Installation, connections

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

Join the filter and speed controller earth 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 earth connection is required.

To limit the radiation effect, twist the input and output 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-452075 (M) ATV-452U15	Input	VY1-A451U1502	150 x 125 x 65	1,5
ATV-452U22 (M) ATV-452U30 ATV-452U40 ATV-452U55	Input	VY1-A451U5502	250 x 150 x 65	2
ATV-452U40M ATV-452U55M ATV-452U75 ATV-452D11	Input	VY1-A451D1102	350 x 220 x 70	2,5
ATV-452... (M)	Control	VY1-A05102	48 x 48 x 30	0,1

* The dimensions are given as a guide and may be liable to change.
For dimensions in inches, multiply by 0,03937.

Communication by multidrop bus

Designed for incorporation in modern automated system architectures, the ALTIVAR ATV-45 2 variable speed controllers can be connected to a an RS 485 standard multidrop bus.

This arrangment necessitates the addition of an option board for each speed controller.

Option reference : **VW3-A45503**.

The board is supplied complete with mounting accessories, which enable its clip-on fixing to the speed controller's control board, and a special user's manual.

This option enables data exchange, according to the protocols :

- UNI - TELWAY, for communication with the TSX 7 range of programmable controllers,
- MODBUS® / J BUS®.

Via a single asynchronous serial link, a programmable controller or a micro-computer can control and monitor up to 28 ALTIVAR ATV-45 2 speed controllers.

Transmissible data :

- operating mode (read and write) : LOCAL or LINE,
- speed controller configuration and settings (read and write) : ramp times, speed limits voltage/frequency ratio, thermal protection, ...
- commands (read and write) : run, frequency reference, braking, ...
- signalling (read only) : state and fault recording, motor current, thermal state, ...

Special software for high speed motors (200 Hz)

Option reference : **VW3-A45511**.

Use of the special software with the ALTIVAR ATV-45 2, by replacing the standard speed controller memory, enables control of special, high speed motors.

Applications :

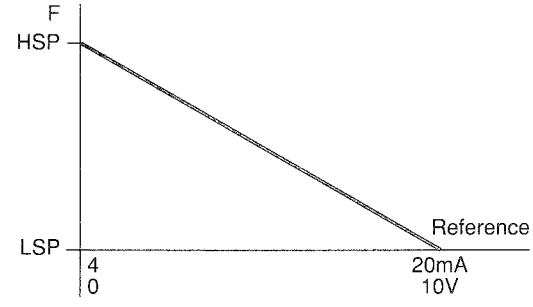
- high speed spindles : textile machines, machine-tools, wood working machines,
- high frequency vibrators : metallurgy, buildings, public works,...
- screw compressors.

Description	Characteristics	For ALTIVAR	Reference
Boards	Control board	all models	VX4-A455
	Mesurement board	ATV-452U40M	VX4-A45115
		ATV-452U55M	VX4-A45116
		ATV-452U75M	VX4-A45117
		ATV-452D11M	VX4-A45118
		ATV-452D15M	VX4-A45119
		ATV-452U55	VX4-A45106
		ATV-452U75	VX4-A45107
		ATV-452D11	VX4-A45108
		ATV-452D15	VX4-A45109
		ATV-452D22	VX4-A45110
		ATV-452D30	VX4-A45141
		ATV-452U55N	VX4-A45106
		ATV-452U75N	VX4-A45107
		ATV-452D11N	VX4-A45112
		ATV-452D15N	VX4-A45113
		ATV-452D18N, D22N	VX4-A45114
		ATV-452D30N	VX4-A45142
		ATV-452U40S	VX4-A45131
		ATV-452U75S	VX4-A45132
		ATV-452D15S	VX4-A45133
		ATV-452D30S	VX4-A45134
		ATV-452D55S	VX4-A45135
		ATV-452D37 (N), D55 (N), D75 (N), D90 (N)	VX4-A45101
	Power board	ATV-452075M	VX5-A452075M02
		ATV-452U22M	VX5-A452U22M02
		ATV-452U40M, U55M, U75M, D11M, D15M	VX5-A451D15M
		ATV-452075	VX5-A45207502
		ATV-452U15	VX5-A452U1502
		ATV-452U22	VX5-A452U2202
		ATV-452U30	VX5-A452U3002
		ATV-452U40	VX5-A452U4002
		ATV-452U55, U75	VX5-A451U75
		ATV-452D11, D15	VX5-A451D15
		ATV-452D22, D30	VX5-A451D22
		ATV-452075N	VX5-A452075N02
		ATV-452U15N	VX5-A452U15N02
		ATV-452U22N	VX5-A452U22N02
		ATV-452U40N	VX5-A452U40N02
		ATV-452U55N, U75N	VX5-A451U75N
		ATV-452D11N, D15N	VX5-A451D15N
		ATV-452D18N, D22N, D30N	VX5-A451D22N
		ATV-452U40S, D30S	VX5-A451D30S
		ATV-452U75S	VX5-A451U75S
		ATV-452D15S	VX5-A451D15S
		ATV-452D55S	VX5-A451D55S
		ATV-452D37 (N), D55 (N), D75 (N), D90 (N)	VX5-A451D90

Description	Characteristics	For ALTIVAR	Reference
Rectifier (6 diodes)	25A-1200V	ATV-452075M, U22M	VZ3-DM6025M1201
	30A-1200V	ATV-452U40 (M), U55	VZ3-DM6030M1201
	30A-1200V	ATV-452075, U15, U22, U30, U40	VZ3-DM6030M1202
	60A-1200V	ATV-452U55M, U75 (M), D11, D15	VZ3-DM6060M1201
	100A-1200V	ATV-452D11M, D15M, D22	VZ3-DM6100M1201
	30A-1600V	ATV-452075N, U15N, U22N, U40N	VZ3-DM6030M1602
	30A-1600V	ATV-452U55N	VZ3-DM6030M1601
	60A-1600V	ATV-452U75N, D11N, D15N	VZ3-DM6060M1601
	100A-1600V	ATV-452D18N, D22N	VZ3-DM6100M1601
	30A-2000V	ATV-452U40S, U75S, D15S	VZ3-DM6030M2001
Rectifiers (2 diodes)	80A-1200V	ATV-452D30, D37	VZ3-DM2080M1201
	160A-1200V	ATV-452D55, D75	VZ3-DM2160M1201
	200A-1200V	ATV-452D90	VZ3-DM2200M1201
	80A-1600V	ATV-452D30N, D37N	VZ3-DM2080M1601
	160A-1600V	ATV-452D55N, D75N	VZ3-DM2160M1601
	200A-1600V	ATV-452D90N	VZ3-DM2200M1601
	50A-2000V	ATV-452D30S, D55S	VZ3-DM2050M2001
Modules with 2 transistors	50A-600V	ATV-452U40M	VZ3-BM2050M0601
	75A-600V	ATV-452U55M	VZ3-BM2075M0601
	100A-600V	ATV-452U75M	VZ3-BM2100M0601
	150A-600V	ATV-452D11M	VZ3-BM2150M0601
	200A-600V	ATV-452D15M	VZ3-BM2200M0601
	50A-1000V	ATV-452U55, U75	VZ3-BM2050M1001
	75A-1000V	ATV-452D11	VZ3-BM2075M1001
	100A-1000V	ATV-452D15	VZ3-BM2100M1001
	150A-1000V	ATV-452D22	VZ3-BM2150M1001
	200A-1000V	ATV-452D30	VZ3-BM2200M1001
	300A-1000V	ATV-452D37	VZ3-BM2300M1001
	200A-1000V	ATV-452D55	*VZ3-BM2200M1002
	300A-1000V	ATV-452D75, D90	*VZ3-BM2300M1002
	50A-1200V	ATV-452U55N, U75N	VZ3-BM2050M1201
	75A-1200V	ATV-452D11N	VZ3-BM2075M1201
	100A-1200V	ATV-452D15N	VZ3-BM2100M1201
	150A-1200V	ATV-452D18N, D22N	VZ3-BM2150M1201
*the reference corresponds to 1 set of 2 modules	200A-1200V	ATV-452D30N	VZ3-BM2200M1201
	300A-1200V	ATV-452D37N	VZ3-BM2300M1201
	200A-1200V	ATV-452D55N	*VZ3-BM2200M1202
	300A-1200V	ATV-452D75N, D90N	*VZ3-BM2300M1202
	30A-1400V	ATV-452U40S	VZ3-BM2030M1401
	75A-1200V	ATV-452U75S	VZ3-BM2075M1201
	150A-1200V	ATV-452D15S	VZ3-BM2150M1201
	200A-1200V	ATV-452D30S	VZ3-BM2200M1201
	200A-1200V	ATV-452D55S	*VZ3-BM2200M1202
Braking transistor module	100A-1000V	ATV-452D37 (N), D55 (N)	VZ3-BM1100M1001
	200A-1000V	ATV-452D75 (N), D90 (N)	VZ3-BM1200M1001
	200A-1200V	ATV-452D55S	VZ3-BM1200M1202
Control fuse (sold in lot of 10)	2A gl (8,5 x 31,5)	ATV-452075M, U22M, U40M, U55M, U75M, D11M, D15M	DF2-BN0200
	1A gl (8,5 x 31,5)	ATV-452075, U15, U22, U30, U40, U55, U75, D11, D15, D22, D30	DF2-BN0100
	2A aM (8,5 x 31,5)	ATV-452D37, D55, D75, D90	DF2-BA0200
Fan	Flow 44 dm^3/s	ATV-452U75N, D11N, D15N, D18N, D22N, D30N	SZ1-XH23
	Flow 100 dm^3/s	ATV-452U55M, U75 (M) (S), D11 (M), D15 (M) (S), D22, D30 (S)	SZ1-XH07
	Flow 210 dm^3/s	ATV-452D37 (N), D55 (N) (S), D75 (N), D90 (N)	VZ3-V002

The aim of this chapter is to specify the significance of each of the configuration and adjustment parameters, and to provide detailed information about the special functions. **These possibilities are only available via the software, or the commissioning terminal, and via the serial link.**

Configuration

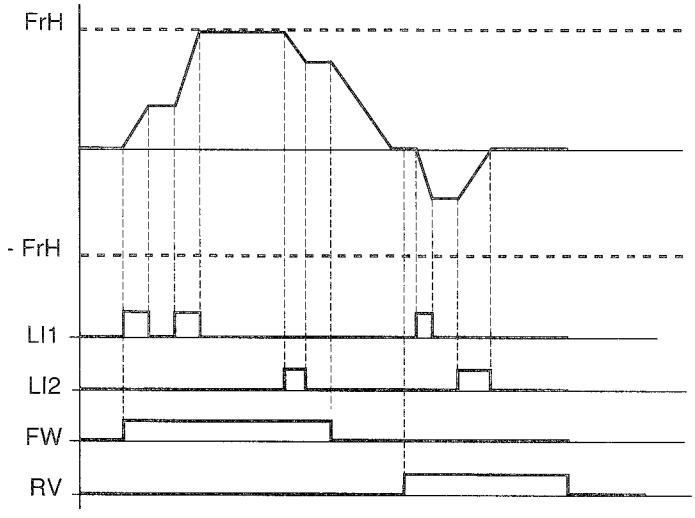
Parameters	Selection	Factory setting	Description
Rated frequency	50 / 60 Hz	ATV-452•••M : 50 Hz ATV-452••• : 50 Hz ATV-452•••N, S : 60 Hz	Identical with [FrS]. Output frequency selection at rated motor voltage (table p. 46).
Current input	0-20 / 4-20 mA 20-4 mA*	0-20 mA	Identical with [rE]. Speed reference input selection at terminal EC.
	* Special case : current input = 20-4 mA. Inputs E1 and E2 thus become 10-0V inputs (high speed HSP obtained for 4 mA or 0V reference).		
Voltage / frequency	Coupling 1 (high) Coupling 2 (low)	Coupling 1	Identical with [UF]. Voltage/frequency selection (table p. 46).
Maximum frequency	67 / 87 / 110 Hz 80,4 / 132 Hz 104 / 120 / 132 Hz	ATV-452•••M : 67 Hz ATV-452••• : 67 Hz ATV-452•••N, S : 80,4 Hz	Identical with [Fr]. Frequency range selection (table p. 46).
Slip compensation	Yes / No	Yes	Identical with [SLP]. Possibility of cancelling automatic slip compensation.
Factory preset speeds	No 2 4 8	No	The initial setting up of this function causes inputs LI1, LI2, DCB, to be assigned to the selection of 2, 4 or 8 preset frequency values. According to the validation of the logic inputs, these frequency values are given in the following table.

LI1	LI2	DCB	Frequency value
0	0	0	Reference
1	0	0	Preset speed 1
0	1	0	Preset speed 2
1	1	0	High speed
0	0	1	Preset speed 3
1	0	1	Preset speed 4
0	1	1	Preset speed 5
1	1	1	Preset speed 6

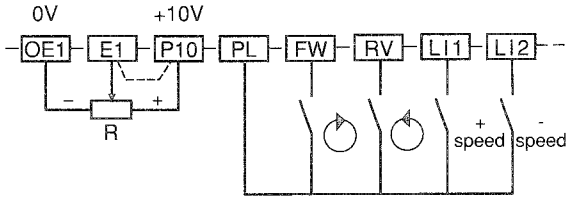
Adjustments : see "High speed" and "Preset speeds 1 to 6" p. 92.
Special case : jog function. The selection of 2 preset speed levels corresponds to jog function operation.
LI1 = 0 : standard operation at the speed reference.
LI1 = 1 : operation at preset speed 1. The acceleration and deceleration ramp times are therefore equal to "Acceleration 2" and "Deceleration 2" (p. 92).
Time delay between stopping and the next start of operation : 500 ms.

Configuration

Parameters	Selection	Factory setting	Description
+ speed / – speed	No / Yes	No	During + speed / – speed operation, the logic inputs are assigned to the following functions.

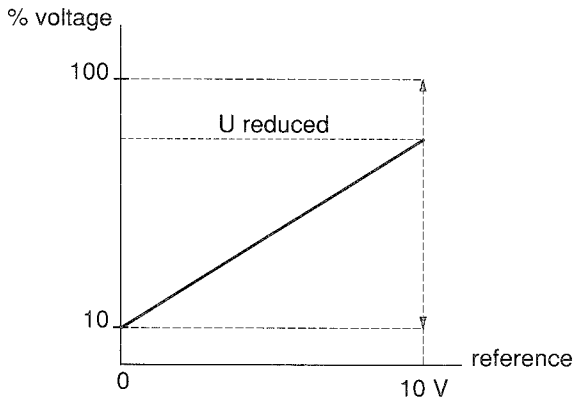


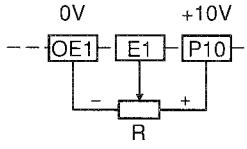
LI1 : "+ speed", frequency increases in absolute value in line with the acceleration ramp, the maximum frequency is determined by the speed reference.
LI2 : "– speed ", frequency decreases in absolute value in line with the deceleration ramp.
Validation of the controller and selection of rotational direction are controlled by inputs FW (forward) and RV (reverse).
Low speed LSP can be adjusted, and is validated by FW or RV.



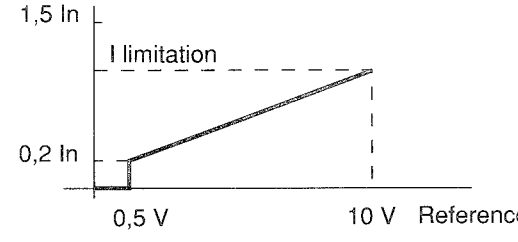
The + speed / – speed mode cannot be used when preset speeds are selected (2, 4 or 8 levels).

Reduce voltage in FW direction	No / Yes Logic input Remote	No	Enables reduced voltage to be applied to the motor. **Yes** : motor voltage reduced in permanent operating mode. During acceleration and deceleration, voltage is normal. **Logic input** : motor voltage is reduced for FW operation when one of the logic inputs assigned to this function is validated. The rate of voltage reduction applied to the motor in permanent operating mode is adjustable : ◦ 100 % : full voltage applied, ◦ 10 % : 10 % of the voltage applied. **Applications** : reduction of motor current on machines with low loads and high inertia, improved stability. **Remote** : the voltage reduction applied to the motor is systematically reduced for FW and RV operation to a value determined by the reference input reassigned to this function. The speed reference is then provided by the preset speeds, or HSP, or "+ speed / – speed". This function should not be used together with RV voltage reduction nor with remote current limitation reduction. **Applications** : squirrel cage motors.





Configuration

Parameters	Selection	Factory setting	Description
Reduce voltage in RV direction	No / Yes Logic input	No	Identical to FW (see previous page). **Logic input** : motor voltage is reduced for reverse operation when one of the logic inputs assigned to the function is validated. The rate of reduction can be adjusted from 100 % to 10 % of the voltage applied. **Other application** : reduction of motor current for off-load lowering on a hoisting system.
Reduce current limitation	No Remote Local	No	The initial setting up of this function enables reduction of the current limitation value. **Remote** : the current limitation is systematically reduced to a value fixed by the reference input, reassigned to this function. The speed reference is therefore equal to "high speed". **Local** : the value is reduced when one of the logic inputs assigned to the function is validated. The value is fixed by the "I limitation" parameter.  In : speed controller rated current. I limitation : adjustable limit.
Acceleration torque	No / Yes	No	When the current limitation reduction has been validated, in Local or Remote, acceleration torque can be maintained by selecting Yes. In this case, the current limitation stays at its maximum value during acceleration.

Assignments of the inputs / outputs

Logic inputs are assigned in factory to following functions :

LI1 : freewheel stop.
LI2 : fast stop.
DCB : braking to standstill by DC injection.

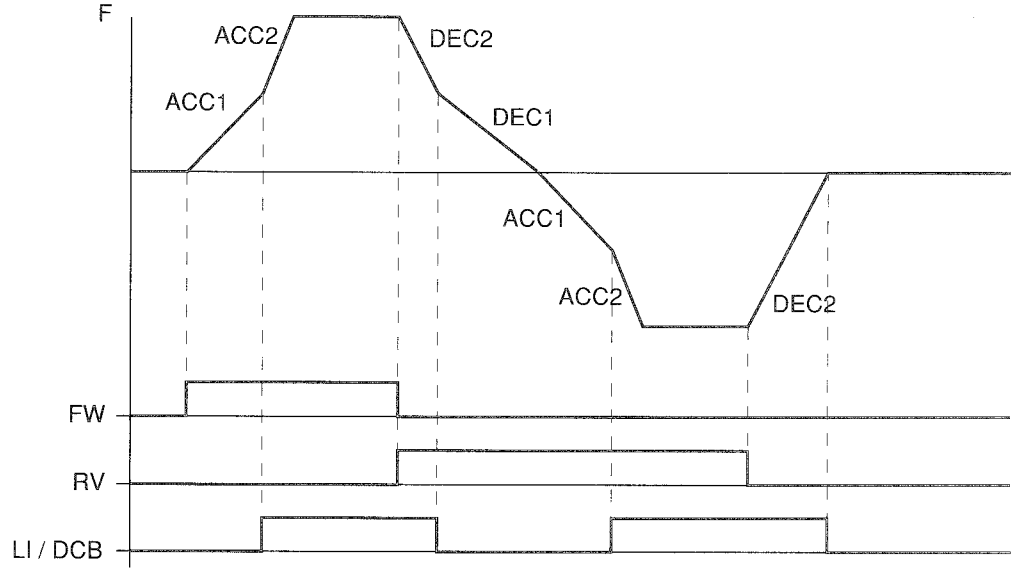
Assignments of logic inputs LI1, LI2, DCB can be changed, and depend on the selections made during "configuration". The following table gives the priority functions, in descending order of importance.

Preset speeds	**8 levels** : logic inputs LI1, LI2 and DCB are assigned to this function. **4 levels** : logic inputs LI1 and LI2 are assigned to this function. **2 levels** : logic input LI1 is assigned to this function.
+ speed / – speed	Logic inputs LI1 and LI2 are assigned to functions "+ speed" and "– speed".
Reduce voltage **Reduce current limitation** **Switch to ramp 2** **Store reference** **Local control** **Remote PBU** **Fault reset** **Selection of motor 2**	Each of the three logic inputs can be assigned to these functions, except where they are assigned to one of the previous functions.

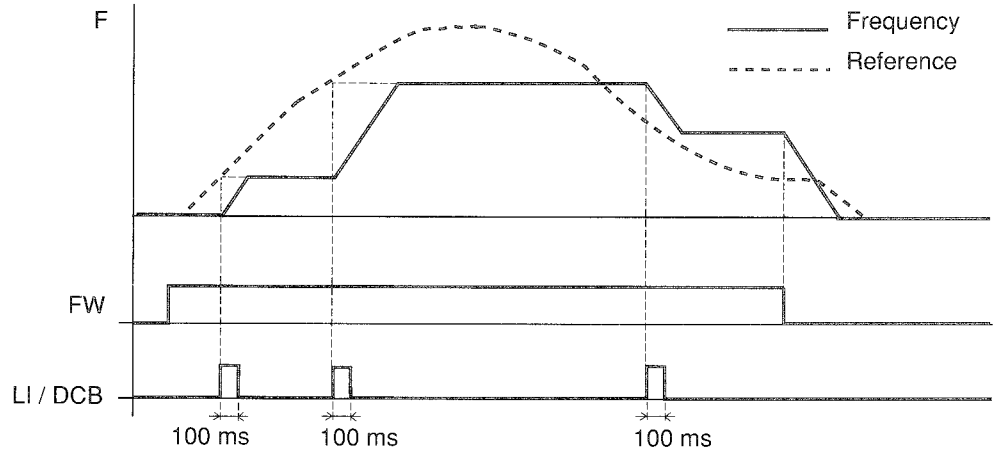
Description of the functions assignable to the logic inputs.

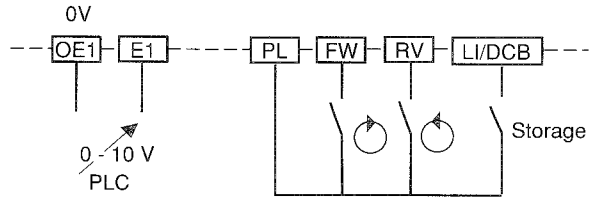
Possible assignment	**Description**
Preset speeds **+ speed / – speed** **Reduce voltage** **Reduce current limitation**	See "configuration" paragraph (p. 81 to 83).

Possible assignment	Description
Switch to ramp 2	When the logic input assigned to this function is validated, the acceleration and deceleration ramp values are equal to "Acceleration 2" and "Deceleration 2" (p. 92). The shape of the ramp remains the same. Example of chronogram :

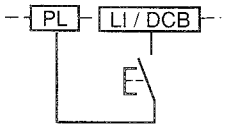
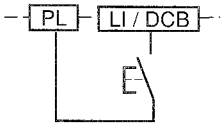
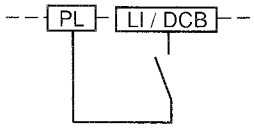


Store reference	If the logic input assigned to this function is validated by a pulse of at least 100 ms, the frequency reference is stored and remains independent of signals at the reference inputs. The storage is retained until the following validating pulse or until devalidation of the FW or RV inputs.





Assignments of the inputs / outputs

Possible assignment	Description
Local control	Concerns control of the speed controller by serial link (point to point or multidrop). When the logic input assigned to this function is validated, the speed controller is no longer controlled by the serial link, but by its logic inputs (local control).
Remote PBU 	Validation of the logic input assigned to this function has the same effect as pressing the PBU push-button on the dialogue unit (see p. 40 onwards). • Prolonged pressing causes the scrolling of the parameters on the displays. • Short pressing recalls the parameter type.
Fault reset 	Validation of the logic input assigned to this function causes the stored fault to be erased and the controller to be reset if the cause of the fault has disappeared. Erasable faults : [OSF], [OLF], [OLF.], [ObF], [ObF.], [OhF], [SPF], [SPF.], [SLF]. Note : faults [PhF] and [USF] are not stored. Other faults cannot be erased by this function, as they require monitoring of the controller and of the installation.
Selection of motor 2 	Validation of the logic input assigned to this function allows configuration of a second motor thermal protection value (0,2 to 1,05 In, preset 0,9 In). This alternative can only be selected when the controller is locked. DC braking level current, DC stop level current, and brake control threshold are also adapted according to the ItH1 / ItH2 ratio (p. 93). **Applications** : • alternating multiaxis control of two types of motors with different power ratings, • operating two-speed motors with separate windings, • controlling two different numbers of motors in parallel.

Assignments of the inputs / outputs

The A01 and A02 analogue outputs can be modified, and assigned according to the data in the following table below.

	Values	Factory setting	Description
Analogue outputs	0-20 mA 4-20 mA	0-20 mA	Output signals A01 and A02 varying from 0 to 20 mA or from 4 to 20 mA according to selection.
Assignment of output A01 or A02	Motor frequency	A01	Analogue output A01 assigned to Motor frequency signal. **Scale factor** : 20 mA = high speed.
	Motor current	A02	Analogue output A02 assigned to Motor current signal. **Scale factor** : 20 mA = 1,82 times the rated current of the speed controller (p. 10 and 11).
	Motor thermal state		Analogue output A01 or A02 assigned to Motor thermal state signal. **Scale factor** : 20 mA = 150 %.
	Motor load		Analogue output A01 or A02 assigned to Motor load signal. **Scale factor** : 20 mA = 200 %.
	* HSP attained		Analogue output A01 or A02 assigned to HSP attained logic function. **Logic level 0** : 0 or 4 mA. **Logic level 1** : 20 mA.
	* LSP attained		Analogue output A01 or A02 assigned to LSP attained logic function.
	* Reference attained		Analogue output A01 or A02 assigned to reference attained logic function.
	* Current limitation		Analogue output A01 or A02 assigned to I limit logic function.
	* Motor thermal state ≥ 100 %		Analogue output A01 or A02 assigned to Motor thermal state ≥ 100 % logic function (thermal pre-alarm).
	* Motor thermal state ≥ 118 %		Analogue output A01 or A02 assigned to Motor thermal state ≥ 118 % logic function (thermal alarm).

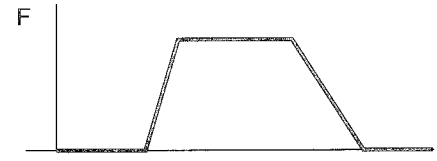
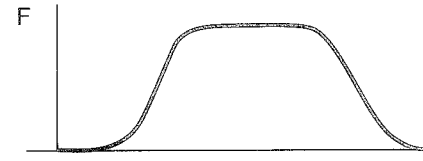
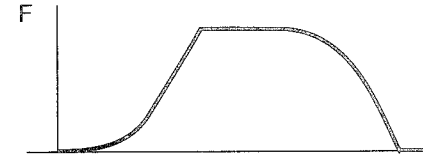
* Analogue output A01 or A02 assigned to a logic function : use a reference LA4-DWB interface to control an LC1-D contactor or a CA2-DN control relay.

Special functions

The following functions enable adaptation of the speed controller to certain special applications.

Functions	Selection	Factory setting	Description
U/F law	Linear N Quadratic P Linear F Linear L	Linear N	Selection of the voltage / frequency ratio. **Linear** : ratio adapted to loads at constant torque with self-adaptation to the motor load. N : standard applications . F : machines with fast cycles, machines with stop positioning, machines with high inertia. L : special motors (tapered rotor motors, pole change motors, high torque motors), hoisting movements. **Quadratic** : ratio adapted to quadratic torque loads (fans or centrifugal pumps). Enables reduction of current and motor noise.
Rated motor voltage	Automatic 220/240 V 380/415 V 440/460/500 V 525/575 V	Automatic according to mains supply	Selection of rated motor voltage, at 50 or 60 Hz. **ATV-452•••M** : 220 V or 240 V **ATV-452•••** : 380 V or 415 V **ATV-452•••N** : 440 V, 460 V or 500 V **ATV-452•••S** : 525 V or 575 V
Motor thermal protection	Yes / No Moto-ventilated motor	Yes	**Function enabled** : normal operation of the thermal protection. **Function disabled** : the tripping of the thermal protection is cancelled, the thermal state calculation is maintained. **Moto-ventilated motor** : the thermal protection is validated and does not take into account the derating depending on the speed.
Frequency loop	Yes / No	Yes	Frequency loop disabled enables reduction of the time constants during transient phases, and improvement of the torque performances. **Caution** : inhibiting of this function can lead to the motor stalling if the required torque is too high.

Special functions

Functions	Selection	Factory setting	Description
Ramps	Linear S Parabolic	Linear	Types of acceleration and deceleration ramps . The use of ramps S (rounded ramps) or parabolic ramps increases the real acceleration and deceleration times. **Linear**  **S**  **Parabolic**  Adjustments : see acceleration and deceleration parameters, p. 92.
Deceleration ramp adaptation	Yes / No No braking module	Yes	Deceleration ramp adaptation automatically increases the deceleration time, if the latter was set to too low taking into account the load inertia. This function can be disabled in the event of a braking option being used, to obtain maximum braking performance. In the event of there being no braking option, the selection of No braking module enables, in most cases, avoiding locking due to overbraking ([dbF]), even if the deceleration ramp is not adapted to the load.
Skip frequencies	No 2 Hz / 5 Hz	No	It is possible to skip two 2 or 5 Hz frequency bands. **Aim** : to stop the motor from operating permanently at machine or installation resonant frequencies. **Positioning** of the 2 frequency bands : see "Skip frequencies 1 and 2" p. 93.

Special functions

Functions	Selection	Factory setting	Description
DC stop	Yes / No	Yes	DC injection braking when the output frequency becomes < 1 Hz (otherwise, locking). Current and duration adjustable (p. 93).
Low speed freewheel	No / Yes	No	Validation of this function causes the speed controller to lock should the frequency drop to below the low speed value. **Applications** : tapered rotor motors.
Catching a spinning load (see recommendations following page)	No / Yes	No	This function avoids, in the event of a short mains failure (> 20 ms), a break in the motor speed. **Function off :** when restarted, the output frequency develops from zero to the reference value. **Function on :** when restarted, the output frequency is immediately equal to the reference value, the voltage develops progressively so as not to cause an overcurrent. **CAUTION** : when operating, this function requires a special control sequence : - maintaining power and control supply, - maintaining the speed reference and the operating direction signal (FW or RV). If one of these signals is only validated after restoration of the voltage, speed returns to the required value according to the ramp (reset to zero). Motor brakes in order to pull into the ramp, and there is a risk of [obF] fault (excessive braking). **Applications** : machines for which loss of speed is slight during short mains failures.
Automatic restart (see recommendations on following page)	No / Yes	No	Activation of this function enables automatic restarting of the speed controller, following an excessive braking fault or a motor overload fault. **In the event of locking**, following excessive braking, the speed controller remains locked for 1 minute with display of code [obF] and restarts automatically if the fault has disappeared, and if the other operating conditions allow this. **If overvoltage occurs again**, the "locking for one minute and restart command" sequence is repeated 4 times (that is a maximum of 5 sequences) before the speed controller locks permanently. **In the event of locking**, following motor overload, the speed controller remains locked for as long as the thermal state stays higher than 100 % (about 7 minutes). Restarting is possible if the other operating conditions allow this. For both these faults, the safety relay (contact to terminals SA-SB) remains closed. **Applications** : machines or installations operating without supervision.

Special functions

Recommendations

To ensure that the speed controller is restarted when power returns, fit a circuit breaker or a special line contactor control sequence (e.g. via selector switch). Only use the safety relay contact (terminals SA-SB) to signal the locking of the speed controller, if necessary.

⚠ WARNING : these arrangements can only be used for machines or installations which present no danger in the event of automatic restarting, either for personnel or for the equipment (local safety regulations).

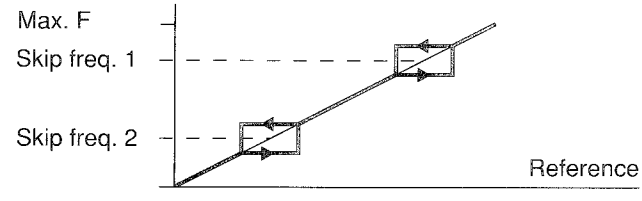
Functions	Selection	Factory setting	Description
Mains fault validation	Yes / No	Yes	Devalidation of the mains fault enables the safety relay to remain closed (contact to terminals SA-SB) when the speed controller is on stop and the power supply is off.
Tachogenerator feedback function	Regulation-safety Regulation Safety	Regulation-safety	Selection of this function provides the choice of : ◦ the speed regulation with the safety, ◦ only the speed regulation, ◦ only the safety. Validation of the safety function enables the controller to be locked in the case of a speed regulation fault (incorrect setting, overspeed or lack of tachogenerator feedback signal).

Settings

The various settings accessible are listed in the table below. Depending on the selections made during configuration, inputs-outputs, or special functions, some parameters are not always available.
Example : "Acceleration 2" only appears if a logic input has been assigned to "Switch to ramp 2".

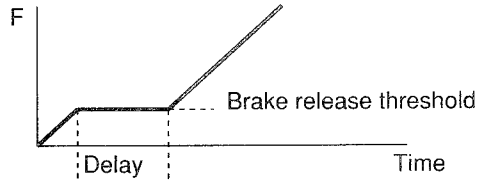
Parameters	Values	Factory setting	Description
Acceleration	0,2 to 990 s	5 s	Identical with [ACC]. Acceleration time is automatically increased in the event of overtorque.
Deceleration	0,2 to 990 s	10 s	Identical with [dEC]. Deceleration time is automatically increased in the event of overbraking (display of code [Obr]).
Low speed	0 to high speed	0	Identical with [LSP]. When low speed is at zero, the speed controller remains locked for as long as the reference is less than 1 Hz.
High speed	From low speed to max. frequency	ATV-452•••M : 50 Hz ATV-452••• : 50 Hz ATV-452•••N, S : 60 Hz	Identical with [HSP].
U/F adjustment	N00 to N99 P00 to P99 F00 to F99 L00 to L99	N00	Identical with [UFr]. Adjustment of the auto-adaptation of the U/F ratio to the motor load.If the torque supplied by the motor at low speed is inadequate, increase the setting gradually.
I thermal	0,45 to 1,05 In No protection	0,9 In	Moteur thermal protection. Identical with [ItH]. Adjustment of the electronic thermal protection. Value in amps to be adjusted to the current value shown on the motor nameplate
Stability	0 to 100	0	Adjustment of motor stability. Identical with [StA]. In the event of instability, increase the value of the parameter until correct operation is obtained.
Slip compensation	0 to 5 Hz	According to rating	Adjust the slip compensation so as to obtain constant speed in permanent operating mode, whatever the motor load. **Precaution** : over compensation can lead to unstable operation.
Preset speeds 1 to 6	From low speed to high speed	Low speed	Preset speed levels in Hz. 6 different levels possible.
Reduce motor voltage	100 % to 10 %	100 %	Reduction of the voltage taken by the motor in permanent operating mode. 100 % : full voltage applied. 10 % : 10 % of the voltage applied.
Reduce current limitation	150 % to 5 %	150 %	Current limitation reduction factor as % of the speed controller's rated current.
Acceleration 2	0,2 to 990 s	5 s	
Deceleration 2	0,2 to 990 s	10 s	

Settings

Parameters	Values	Factory setting	Description
Frequency loop gain	0 to 100	33	Only with voltage / frequency ratio set on F or L. Enables adjustment of the speed controller's response time. - 0 to 33 : longer response time. - 33 : factory setting. - 33 to 100 : shorter response time. **Applications** : - machines with high resistive torque or high inertia : adjust the frequency loop gain in the 0 to 33 zone. - machines with fast cycles, low resistive torque or low inertia : adjust the gain in the 33 to 100 zone. **Precaution** : excessive gain can lead to unstable operation.
Skip frequency 1 **Skip frequency 2**	0 to high speed	High speed	**Adjustment** : affects the speed reference in order to determine the 1 or 2 critical frequencies, (noise or mechanical vibrations). Adjust the skip frequencies 1 (and 2) on the value (or values) read. If resonance persists, widen the skip frequency band from 2 to 5 Hz, see special function "Skip frequencies" p. 89. 
I thermal 2	0,2 to 1,05 In	0,9 In	
DC braking level current	0,2 to 1,5 In	0,5 In	DC injected permanently when the DCB input is validated (after impulse of 1,5 In for 3 seconds). Value in amps, variable according to the speed controller rating.
DC stop level current	0,5 to 1,5 In	In	DC injected permanently when the frequency drops to < 1 Hz. Value in amps, variable according to the speed controller rating.
DC stop time	0,5 to 4 s	0,5 s	DC injection time when the frequency drops to < 1 Hz.
Brake control threshold	0 to In	0	Current threshold authorizing closing of the brake control relay (on braking and speed regulation option).

In : speed controller rated current (p. 10 and 11).

Settings

Parameters	Values	Factory setting	Description
Brake release threshold	From 0 to LSP	0 Hz	Motor frequency threshold authorizing closing of the brake control relay (on braking option and speed regulation).
Brake engage threshold	From 0 to LSP	0 Hz	Motor frequency threshold authorizing opening of the brake control relay (on braking option and speed regulation).
Brake release time delay	0 to 4 s	0	Time delay for brake release. **Application** : hoisting, vertical movements. The time delay causes a step in the frequency increase. 

Summary

CONFIGURATION

Rated frequency
* 50 Hz , ** 60 Hz

Current input
0 - 20 mA, 4 - 20 mA, 20 - 4 mA

Voltage / frequency
Coupling 1 (high), coupling 2 (low)

Maximum frequency
* 67, 87, 110 Hz
** 80,4, 104, 120, 132 Hz

Slip compensation
Yes, no

Preset speeds
No, 2, 4, 8

+ speed / - speed
No, yes

Reduce voltage in FW direction
No, yes, logic input, remote

Reduce voltage in RV direction
No, yes, logic input

Reduce current limitation
No, remote, local

Acceleration torque
No, yes

* ATV - 452 ••• M
ATV - 452 •••

** ATV - 452 ••• N
ATV - 452 ••• S

The underlined values are the factory settings.

INPUTS - OUTPUTS

Assignment LI1
Freewheel stop
Fast stop
DC braking
Reduce voltage
Reduce current limitation
Switch to ramp 2
Store reference
Local control
Remote PBU
Fault reset
Selection of motor 2
Preset speeds
+ speed

Assignment LI2
Freewheel stop
Fast stop
DC braking
Reduce voltage
Reduce current limitation
Switch to ramp 2
Store reference
Local control
Remote PBU
Fault reset
Selection of motor 2
Preset speeds
- speed

Assignment DCB
Freewheel stop
Fast stop
DC braking
Reduce voltage
Reduce current limitation
Switch to ramp 2
Store reference
Local control
Remote PBU
Fault reset
Selection of motor 2
Preset speeds

Analogue outputs
0 - 20 mA, 4 - 20 mA

Assignment A01
Motor frequency
Motor current
Motor thermal state
Motor load
HSP attained
LSP attained
Reference attained
Current limitation
Motor thermal state ≥ 100 %
Motor thermal state ≥ 118 %

Assignment A02
Motor frequency
Motor current
Motor thermal state
Motor load
HSP attained
LSP attained
Reference attained
Current limitation
Motor thermal state ≥ 100 %
Motor thermal state ≥ 118 %

SPECIAL FUNCTIONS

U/F law
Linear N, quadratic P,
linear F, linear L

Rated motor voltage
Automatic, 220/240 V,
380/415 V, 440/460/500 V,
525/575 V

Motor thermal protection
Yes, no, moto-ventilated motor

Freqency loop
Yes, no

Ramps
Linear, S, parabolic

Deceleration ramp adaptation
Yes, no, no braking module

Skip frequencies
No, 2 Hz, 5 Hz

DC stop
Yes, no

Low speed freewheel
No, yes

Catching a spinning load
No, yes

Automatic restart
No, yes

Mains fault validation
Yes, no

TG feedback function
Regulation - Safety
Regulation
Safety

SETTINGS

Acceleration
0,2 to 990 s (5 s)

Deceleration
0,2 to 990 s (10 s)

Low speed
0 to HSP (0)

High speed
LSP to "max. frequency"
(* 50 Hz , ** 60 Hz)

U / F adjustment
N / P / F / L from 00 to 99 (N00)

I thermal
0,45 to 1,05 In (0,9 In)

Stability
0 to 100 (0)

Slip compensation
0 to 5 Hz (acc. to rating)

Preset speeds 1 to 6
LSP to HSP (LSP)

Reduce motor voltage
100 % to 10 % (100 %)

Reduce current limitation
150 % to 5 % (150 %)

Acceleration 2
0,2 to 990 s (5 s)

Deceleration 2
0,2 to 990 s (10 s)

Freq loop gain
0 to 100 (33)

Skip frequency 1
0 to HSP (* 50 Hz , ** 60 Hz)

Skip frequency 2
0 to HSP (* 50 Hz , ** 60 Hz)

I thermal 2
0,2 to 1,05 In (0,9 In)

DC braking level current
0,2 to 1,5 In (0,5 In)

DC stop level current
0,5 to 1,5 In (In)

DC stop time
0,5 to 4 s (0,5 s)

Brake control threshold
0 to In (0)

Brake release threshold
0 Hz to LSP (0 Hz)

Brake engage threshold
0 Hz to LSP (0 Hz)

Brake release time delay
0 to 4 s (0)

Presentation

The compatible microcomputer software supplied with the ATV-45 2 provides all the variable speed controller configuration, adjustment and control possibilities wihch can be carried out with the initial setting up terminal .
In addition, it enables :

- preparation of the job in the design office, without the ATV-45 2 being connected to the micro-computer
- saving of configurations and adjustments on floppy disk or hard disk, as well as their down-loading into the speed controller
- to provide a printout of documents which can be included in a contract file.

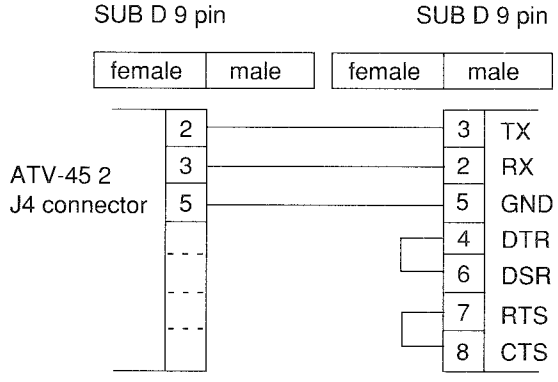
The software can be run on any microcomputer, with a minimum of the following features :

- a 3"1/2 disk drive
- 256 K bytes RAM
- a COM series communication port
- a DOS operating system, version 3.1 minimum.

Initial setting up

The ALTIVAR ATV-45 2 must be connected to the microcomputer's COM port by RS232C serial link, using a 10 metre cable, maximum.
Follow one of the connection diagrams shown below. The COM port is on a SUB D 25 pin or SUB D 9 pin connector, depending on the compatible microcomputer model.

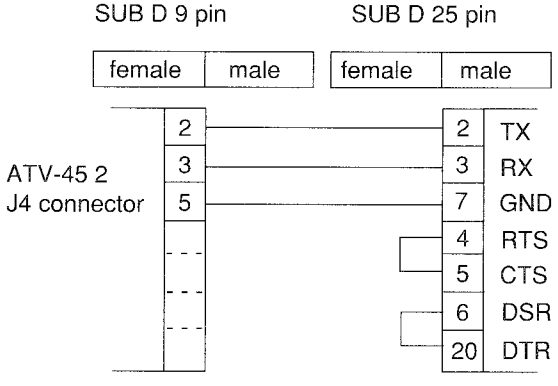
Diagram 1



The cable (l = 2,5 m), fitted with its connectors, is available in the TELEMECANIQUE catalogue.

Reference : VY1-A45509

Diagram 2



The cable (l = 2,5 m), fitted with its connectors, is available in the TELEMECANIQUE catalogue.

Reference : VY1-A45525

Installation of the software

The software can be used via the floppy disk supplied with the speed controller :

– insert the floppy disk in unit A,

– take up position on A with the command A : ↵,

– start the software with ATV45 ↵,

– wait for the presentation page to be displayed, then press any key in order to continue.

In order to protect the floppy disk, installation and use of the software on a hard disk is recommended :

– insert the floppy disk in unit A,

– copy all the files on the floppy disk onto the hard disk via COPY A : * ° * C : ↵,

– start the software from unit C via ATV45 ↵,

– wait for the presentation page to be displayed, then press any key in order to continue.

Selecting the language

Available languages : Danish - Dutch - English - Finnish - French - German - Italian - Norwegian - Portuguese - Spanish - Swedish.

The choice of a particular language from the ones available is made as follows :

– start up the software via ATV45 / L ↵,

– wait for the presentation page to be displayed, then press any key,

– using the keys ↑ and ↓ , select the language,

– validate by pressing ↵ in order to continue.

Selection of the language is recorded, and this operation is thus no longer necessary on any future occasion the software is used.

Adaptation to the microcomputer

The software can be adapted to the type of screen, and to the COM port to which the ATV-45 2 is connected. For this :

– start up the software via ATV45 / C ↵,

– wait for the presentation page to be displayed, then press any key,

– select the type of screen and validate by pressing ↵,

– select the page set up and file destination, then validate by pressing ↵,

– select the COM port used and validate by pressing ↵ in order to continue.

All the selections made are recorded, and this operation is thus no longer necessary on any future occasion the software is used.

Keys used

Use of the software only requires a few keys, described below :

– Help window : appears when [F1] is pressed, disappears when [F1] is pressed a second time.

– To select a menu : press [ALT] and the corresponding letter, shown in the required menu in a different shade, simultaneously.

– To select a sub-menu : place the cursor, using [↑] and [↓], on the sub-menu required, then validate by pressing [ENTER], or simply by keying in the sub-menu selection letter required.

– To cancel, or to revert to the previous menu : press [ESC].

– To modify a value in the configuration : place the cursor, using [↑] and [↓], on the required value, then key in [ENTER].

– To modify a numerical value : place the cursor, using [TAB], in the value to be modified using [↑] and [↓], press [ENTER], enter the new numerical value, validate by pressing [ENTER].

Various menus

The five main menus always appear in the upper band. Each of them is subdivided into sub-menus, the functions of which are listed below :

FILE : to create, modify, record, and print out the speed controller's configuration and its adjustments.

- NEW : to create a new configuration.
- OPEN : to call up and modify a configuration which is already in the memory.
- SAVE : to save the modified configuration on the open file.
- SAVE AS : to save the modified configuration on another file, or to save a new configuration.
- PRINT : to start printing the file.
- CONCERNING : gives the number of the software version.
- QUIT : to quit the software and revert to the operating system.

NOTE : the names of the files do not have to be entered with an extension. This is added automatically by the software : • CFV for a configuration file,
• DOC for a documentation file.

MODE :

- LOCAL : for operation without the speed controller.
- CONNECT : for operation with the speed controller. When a file is opened, or modifications are made, all the data is recorded automatically in the ATV-45 2 memory.

NOTE : when started up, the software is automatically in CONNECT mode if the speed controller is connected with a correct link, in LOCAL mode if the opposite is true.

CONFIGURATION / ATV : to define the speed controller configuration and settings.

- CONFIGURATION : basic speed controller configuration.
- SPECIAL FUNCTIONS : additions to the configuration.
- INPUTS / OUTPUTS : to assign all the speed controller inputs / outputs to the available functions.
- PARAMETERS : to enter all the required setting values.
- RECORDING IN EEPROM MEMORY : to save the configuration and the settings in the speed controller.

COMMAND / DISP : to control the ATV-45 2.

- COMMANDE / VISU : enables command and control of the ATV-45 2, as well as modification of the main settings.
- PAST FAULTS : enables obtaining of the chronological list of the 8 most recent past faults.

SYSTEM :

- COMMUNICATION : for selection of the COM port to which the ATV-45 2 is connected.
- SCREEN : to adapt the software to the type of screen used.
- SAVE : to record the two previous selections made.

When the commissioning terminal is connected to the speed controller, the dialogue unit, located on the control board, is cancelled. Modification of a variable or a parameter can only be carried out via the terminal.
Before switching on the speed controller, check on the dialogue unit : selector switch CONFIG to 1 and selector switch AUTOTEST to OFF.

Introduction

The commissioning terminal enables clear display, and modification of the various operation and adjustment parameters, also extending the speed controller's functionalities.

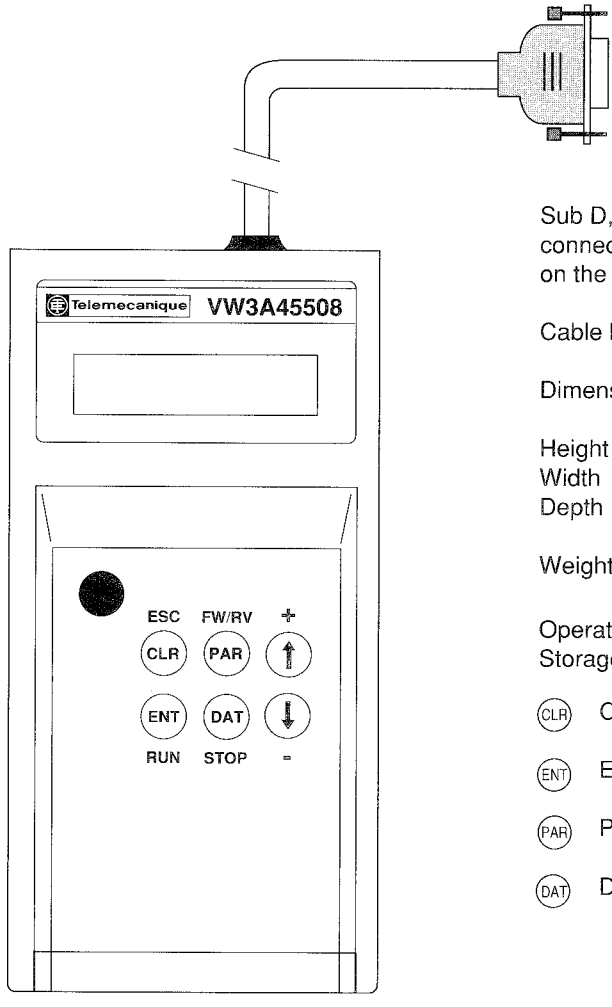
Connection

The terminal is connected to the J4 connector on the control board (Sub D, 9 pin connector).
Connection can be established whether the speed controller is on or off.

Dialogue

The terminal comprises :
- a 2 line, 16 character liquid crystal display,
- 6 keys enabling display and adjustment of the various quantities,
- 1 key enabling locking of the speed controller when controlled by the terminal (terminal control mode).

Characteristics



Sub D, 9 pin connector for connection to the J4 connector on the control board

Cable length : 1,5 m

Dimensions :

Height : 185 mm
Width : 90 mm
Depth : 35 mm

Weight : 0,650 kg

Operation θ : 0 to +40°C
Storage θ : -25 to +70°C

(CLR) Clear

(ENT) Enter

(PAR) Parameter

(DAT) Data

When the speed controller is switched on or the terminal is connected up, the speed controller's identification appears on the screen.

Example :

ATV452 15kW 380/415V V1.1

Identification - Rating
Mains supply - Software version

If the autotest has been selected (AUTOTEST switch on the dialogue unit in position ON when switched on), the identification of the speed controller is followed by the messages :

Autotest Running

then

Drive Healthy

or signals
a fault, for example :

Trans short-circ - 1 -

Selection of the language

Identification of the speed controller once displayed on the screen, press the key (CLR) .

It is now possible to select the dialogue language : English - French - German - Italian - Portuguese - Spanish by pressing keys (↓) (↑) successively.

Validation of the language selected is obtained by pressing the key (ENT) .

Normal operation

Having chosen the language, or immediately after identification of the speed controller, access to the terminal's normal operation is obtained by pressing (ENT) .

The various messages which appear on the screen have four hierarchical levels :

1) Electrical quantities.
2) Choice of control or adjustment modes.
3) Choice of the variables to be modified.
4) Modification of a variable or a parameter.

Electrical quantities

These appear in pairs, in 3 tables; movement from one table to another is achieved by pressing keys (↑) and (↓).

- Setspeed and motor current.
- Thermal state of the motor and mains supply.
- Motor load and motor frequency.

Example :

Setspeed 38.3Hz Current 15.9A

Choice of control or adjustment modes

This choice is accessible from the previous level by pressing the key (ENT) .

There are 8 of these modes, accessible by scrolling down using the keys (↓) (↑) .

- CONFIGURATION
- INPUTS-OUTPUTS
- SPEC. FUNCTIONS
- ADJUSTMENTS

Configuration

- PAST FAULTS
- FACTORY SETTINGS
- CUST. SETTINGS
- TERMINAL CONTROL

Reversion to the previous level is obtained by pressing (CLR) .

NOTE : if the multidrop serial link communication option board is being used, an additional mode exists : SERIAL LINK. Refer to the user's manual supplied with the option.

Choice of variables to be modified

A control or adjustment mode having been chosen, access to the list of variables is obtained by pressing (ENT) and scrolling down of the variables by pressing (↑) (↓).

Reversion to the previous level is obtained by pressing (CLR) .

Modification of a variable or a parameter

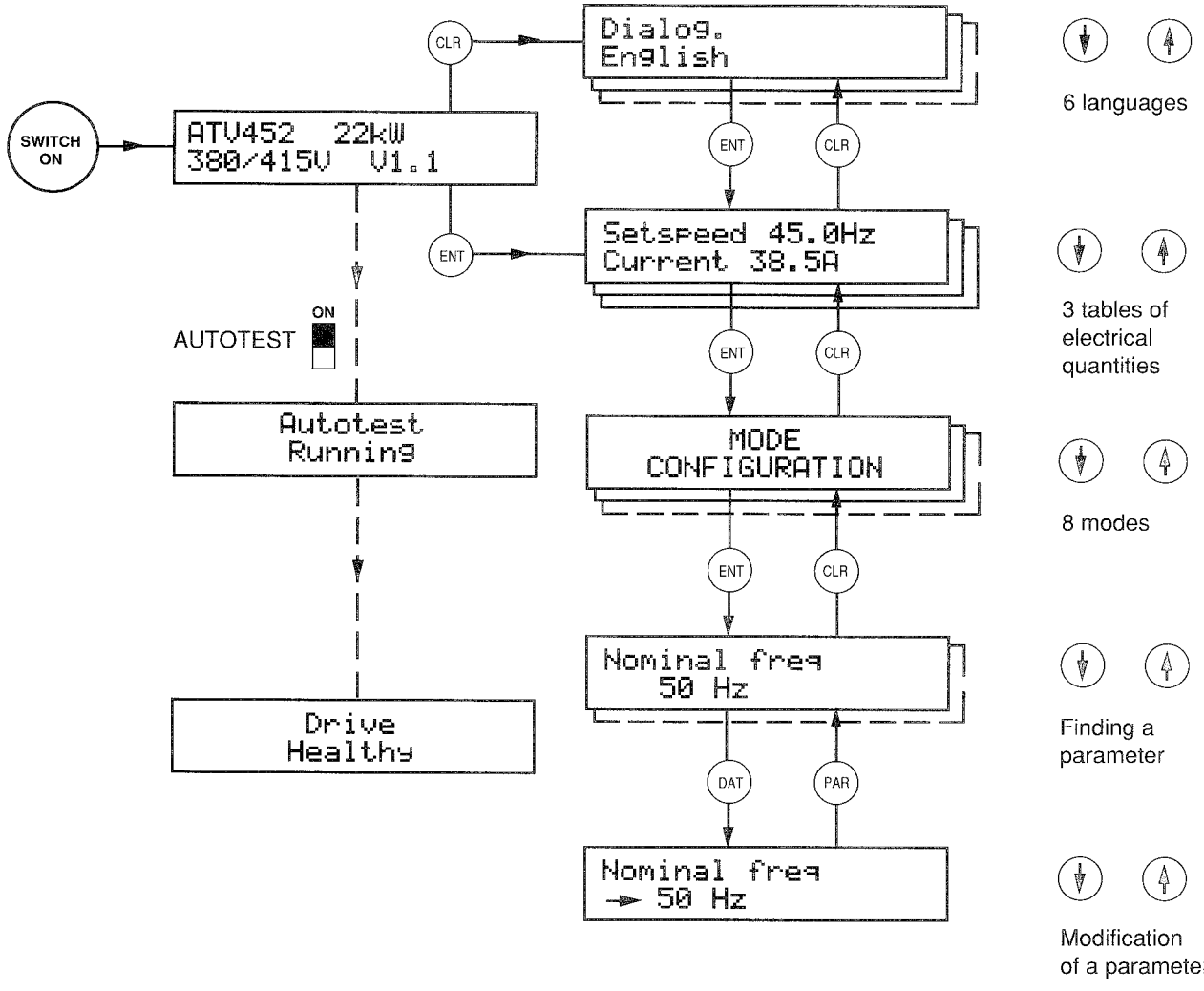
Access to adjustment is obtained by pressing (DAT) , an arrow appears at the start of the 2nd line, modification of the variable is obtained by pressing (↓) (↑).

Example :

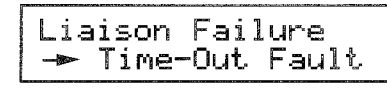
```
Acceleration
→ 12.3 s
```

Recoding of the new value is obtained by reversing to the list of variables, key (PAR) .
Key (CLR) enables reversion to the list of parameters, without taking into account the modification.

Simplified diagram of the terminal's operation



In the event of a speed controller-terminal connection fault, the message opposite appears on the screen.
To cancel the fault, disconnect the terminal, then reconnect it.



Fault display

In the event of the speed controller locking, the nature of the fault appears on the screen. However, the display of electrical quantities remains possible by pressing keys ↓ and ↑.

Faults which may appear on the screen	Speed controller code	Explanations
Phase failure	PhF	Mains phase failure
Undervoltage	USF	Mains supply too low
Overvoltage	OSF	Mains supply too high
Overtemperat.	OhF	Speed controller overheated
Motor overload	OLF	Motor overload, thermal protection tripped
Motor phase	OLF.	Current loss in a motor phase
Overbraking U	ObF	Overbraking (overvoltage)
Overbraking I	ObF.	Overbraking (overcurrent)
Overcurrent 1	OcF	Transient overcurrent or short-circuit
Overcurrent 2	OcF.	Transient overcurrent or short-circuit
Cap. relay	CrF	Capacitor charge relay closure command fault
Overspeed	SPF	Speed regulation fault, incorrect setting or overspeed
Tacho failure	SPF.	No TG feedback signal
Serial link	SLF	Serial link communication fault
Intern	InF	Internal connection fault
Store fault	InF	EEPROM memory storage fault : recall the factory settings (p. 110) or the customer settings (p. 111)
Autotest inval	InF.	Autotest invalid : the AUTOTEST switch has been moved to the ON position during speed controller operation

Description of the control and adjustment modes

1-CONFIGURATION

This mode enables display and adjustment of the configuration parameters.
The parameters can only be modified when the speed controller is on stop.

List of the parameters which appear on the screen	Speed controller code	Explanations
Nominal freq	FrS	Nominal motor frequency
Current input	rE	
Volts/Freq	UF	Voltage / frequency
Max frequency	Fr	Maximum fequency
Slip compens.	SLP	Slip compensation
Preset speeds		Preset speeds
+speed/-speed		Faster / slower
Reduce volts FW		Reduction of voltage (forward)
Reduce volts RV		Reduction of voltage (reverse)
Reduce I lim.		Reduction of current limitation
Accel. torque		Reduction of current limitation, only when not accelerating (the torque is not reduced during acceleration)

A detailed description of these parameters can be found in the chapter "Configuration, special functions, settings" (pages 81 to 83).

2 - INPUTS-OUTPUTS

This mode enables assignment of the speed controller's logic inputs and outputs to functions other than the ones to which they are assigned.
The assignment of the inputs-outputs can only be modified when the speed controller is on stop.

List of the possibilities which appear on the screen	Explanations
Function LI1 I/P	Assignment of logic input LI1
Function LI2 I/P	Assignment of logic input LI2
Function DCB I/P	Assignment of logic input DCB
Analog outputs	Selection of 0-20 mA / 4-20 mA analogue outputs
Function A01 O/P	Assignment of analogue output A01
Function A02 O/P	Assignment of analogue output A02

The various input / output assignment possibilities are described in the chapter "Configuration, special functions, settings" (pages 84 to 87).

3-SPEC. FUNCTIONS

This mode (special functions) enables the employment of a certain number of functions specifically adapted to special applications.
The enabling and disabling of these functions can only be carried out with the speed controller on stop.

List of the functions which appear on the screen	Explanations
Volt-freq law	Selection of the U/f ratio
Nom motor volt.	Selection of the nominal motor voltage
Motor therm prot	Tripping of the motor thermal protection
Frequency loop	Frequency regulation loop
Ramps	Acceleration-deceleration ramp shapes
Dec ramp adapt.	Adaptation of the deceleration ramp
Skip frequencies	Frequency skipping
DC brake to stop	Injection of DC at standstill
Fr. wheel < LSP	Freewheel stop for frequency < low speed
Catching a load	Automatic catching of a load while running
Auto restart	Automatic restarting after a fault
Phase fail. val.	Validation of the supply fault "phase failure"
TACHO FEEDBACK	Regulation-safety witch tachogenerator

A detailed description of these functions can be found in the chapter "Configuration, special functions, settings" (pages 88 to 91).

4 - ADJUSTMENTS

This mode enables display and adjustment of all the speed controller's setting parameters. All the parameters can be adjusted at any moment, whether the speed controller is on stop or running. Depending on the selections made in CONFIGURATION, INPUTS-OUTPUTS and SPEC. FUNCTIONS modes, some parameters in the list below may not appear on the terminal screen.
Parameters which are always present are marked with an asterisk *.

Parameters which appear on the screen	Speed controller code	Explanations
*Acceleration	ACC	Acceleration time
*Deceleration	dEC	Deceleration time
*Low speed	LSP	Low speed
*High speed	HSP	High speed
*U/F adjustment	UFr	Adjustment of the U/f ratio
*I thermal	ItH	Motor thermal current
*Stability	StA	Stability
Slip comp.		Slip compensation
Preset speed 1		Preset speed n° 1
Preset speed 2		Preset speed n° 2
Preset speed 3		Preset speed n° 3
Preset speed 4		Preset speed n° 4
Preset speed 5		Preset speed n° 5
Preset speed 6		Preset speed n° 6
Reduce volts		Reduction of motor voltage

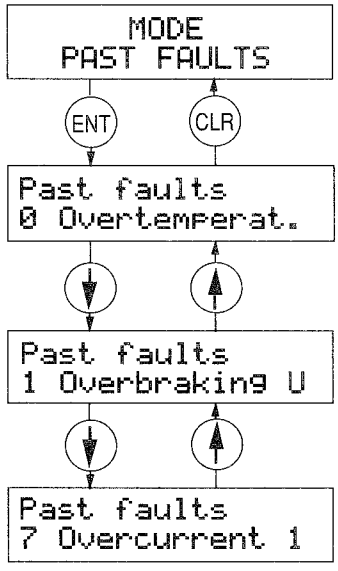
Parameters which appear on the screen	Explanations
Reduce I lim	Reduction of the current limitation
Acceleration 2	Acceleration time, ramp 2
Deceleration 2	Deceleration time, ramp 2
Freq loop gain	Frequency loop gain
Skip freq. 1	Skip frequency n° 1
Skip freq. 2	Skip frequency n° 2
I thermal 2	Motor thermal current, value 2
DC brake current	DC brake current value
DC stop current	DC standstill current value
DC stop time	DC current injection time on stop
Brake release I	Current threshold for mechanical brake control
Brake release F	Frequency threshold for mechanical brake release
Brake engage F	Frequency threshold for mechanical brake engage
Brake rel. delay	Time delay for mechanical brake release

A detailed description of these parameters can be found in the chapter "Configuration, special functions, settings" (pages 92 to 94).

5 - PAST FAULTS

This mode enables display at any time of the 8 latest faults to appear during speed controller operation. The faults "PHASE FAILURE" and "UNDERVOLTAGE" are not included in this list (faults which appear when the power of the speed controller is switched off).

Example :



Latest fault to appear

Penultimate fault to appear

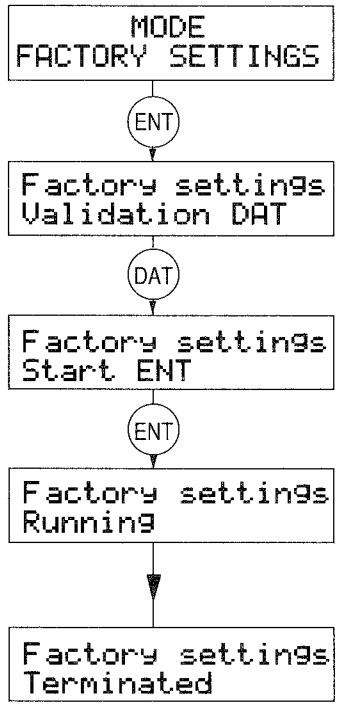
.
.
etc
.
.

End of list

6 - FACTORY SETTINGS

This mode enables recall and validation of the speed controller's factory settings.

Procedure :



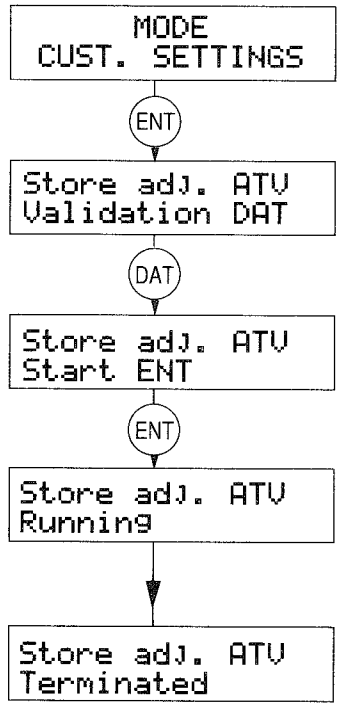
Factory setting validated

7-CUST. SETTINGS

This mode enables the following settings, but only when the speed controller is on stop.

Store adj. ATV	Storage of customer adjustments, adapted, for example, to a particular machine. In the event of a setting being altered for tests, or by mistake, these settings can be recalled by the following procedure.
Recall adj. ATV	Recall customer adjustments.
Store adj. term.	Storage of speed controller settings in the permanent memory of the terminal. These settings can also be transferred to another speed controller of the same type by carrying out the following actions.
Recall adj. term.	Recall the settings present in the terminal.
Lock	Locking the settings present in the speed controller. The speed controller's terminal and dialogue unit no longer allow modification of the settings. Unlocking of the settings can be obtained by deactivating the locking.

Example of the procedure :



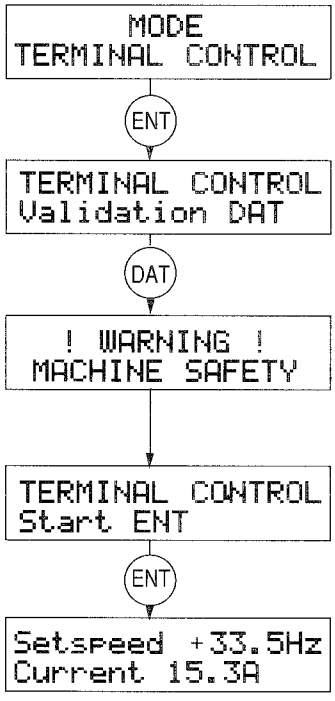
Storage validated

8 - TERMINAL CONTROL

The terminal control mode enables the speed controller to operate independently from its logic or analogue inputs.
The speed controller must be on stop for the terminal control to be validated.

⚠ CAUTION : check that the motor drive presents no danger for personnel, as the speed controller does not take into account the driven machine's safety devices.

Procedure :



Display time : 4 seconds

Validation of terminal control

In this case, the terminal's keys are reassigned as follows :

ENT	→	RUN	Run command
PAR	→	FW/RV	Change rotation direction
DAT	→	STOP	Stop with deceleration ramp
↑	→	+	Increase the setspeed
↓	→	–	Decrease the setspeed
STP			Locking the speed controller, freewheel stop
CLR	→	ESC	Escape : - Cancellation of terminal control when the speed controller is on stop. - Display of electrical quantities (setspeed, current, thermal state, frequency, load, mains supply), when the speed controller is operating.

Presentation

Incorporated in the ALTIVAR ATV-45 2 is a point to point serial link operating either via 20 mA current loop, or RS232C link. This function enables connection of the ATV-45 2 to a programmable controller or a microcomputer with a single link.

The data exchanges are programmed according to the very simple protocol, described below, and enable :
– adjustment of speed controller setting parameters,
– control of the speed controller,
– access to all control and signalling data.

More sophisticated applications can also be carried out by connecting the ATV-45 2 to a multidrop bus, given the addition of an optional board, which ensures, in addition, control of the industrial protocols, UNI-TELWAY® and MODBUS / J BUS®.

Link characteristics

– Asynchronous serial link.
– Isolated transmission interfaces : 20 mA current loop, RS232C.
– Speed : 9600 bauds.
– Character format : 1 start bit,
8 data bits,
1 odd parity bit,
1 stop bit.
All these parameters are fixed.

– The link is of the master-slave type, the speed controller being the slave, and operating in half-duplex (a single station transmits at any given moment).
– Speed controller response time : 10 ms ≤ Tr ≤ 50 ms.

Connection

– Use of the 20 mA current loop is strongly recommended in industrial applications in environments with high levels of interference, or long distances.
Use a screened cable with 2 twisted pairs, with conductor cross sections of more than 0,5 mm², maximum length = 500 metres.

– While isolated from the controller, the RS232C link, because of its electrical characteristics, is much more sensitive to interference and should not be used over distances longer than ten metres.

Transmission interfaces :

– These are available on the J4 connector of the ATV-45 2 : a SUB D, 9 pin type, female connector, located in the lower part of the device.

– One of these interfaces only should be used for any given application.

– There is no links or switches needing to be set to a position.

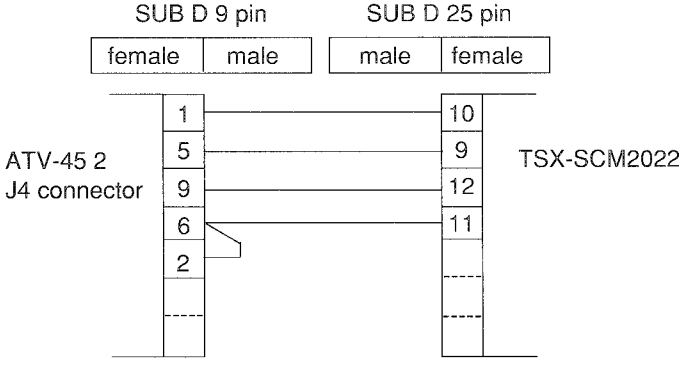
Connector pins :

6	REC +
2	RX (RS232C)
3	TX (RS232C)
1	REC -
4	Reserved
7	Reserved
8	Reserved
9	EMI +
5	GND (RS232C) et EMI -

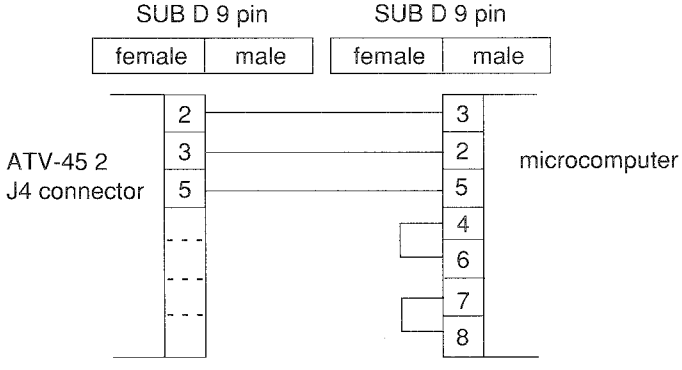
NOTE

To use with a current loop, connect terminals 6 and 2.

– Example of 20 mA current loop connection with a TSX7 programmable controller, fitted with a TSX-SCM2022 communication module.



– Example of RS232C connection with compatible microcomputer.



Structure of the ATV-45 2 data

The adjustment, command, control, and monitoring of the ATV-45 2 by serial link is carried out via the exchange of data or (objects) which are specific to that product.

Essentially, these comprise :

– BITS, called Bi (i = bit number) enabling the carrying out of logic commands (2 possible states : 0 or 1).
Example : B7 = braking command bit.

– WORDS (16 bits) called Wi (i = word number) used to exchange complete numerical values (- 2768 to +32767), or, where necessary, a group of 16 independent logic states (these words are therefore known as registers).
Examples : W19 = frequency reference,
W21 = fault register (16 fault bits).
Notation : W21,2 assigns the row 2 bit for register W21.

Access to the data

Some data is accessible in read and write : this comprises the bits and words corresponding to settings, references and commands. As a general rule, this is the data used by the ATV-45 2.
On the other hand, data developed by the ATV-45 2 (signalling data, fault data, ...) is only accessible in read. Writing of this data is illogical and will be refused.

Description of the protocol

The protocol is based on the exchange of data comprising ASCII characters, exclusively.
For the rest of this document, all characters are considered to be encoded in ASCII (see ASCII codes table, page 120).
The exchanges are of the question-answer type.
The master (programmable controller or microcomputer) sends a question to the speed controller and waits for its answer which should arrive within 50 ms, maximum. If this time is exceeded, the master must repeat the question.
Failure to respond by the speed controller occurs in the following cases :
– incorrect question format,
– parity error detected in the characters,
– faulty, or interrupted link.

Message format

The messages are delimited by a start character :
? for a question,
> for an answer,
and two end characters : LF followed by CR.

Question :

Start	Question code	Data 1	Separator *	Data 2 *	End
?	see table	number of word or bit	1or 2 characters <SP> or <@>	value	<LF> <CR>

* These 2 symbols only exist to carry out writing, they are empty if a read request is made.

Answer:

Start	Question code	Data 3 **	End
>	see table	value	<LF> <CR>

* * This value only exists in answer to a read request, it is empty if a write request is made.

Data 1 : bit or word number between 0 and +32767,
the + is optional, as are the leading zeros.
Example : for word W19, either 19 or +00019.

Data 2 : value of word or bit to be written.

For 1 word : whole number between –32768 and +32767,
the + is optional, as are the leading zeros.
Examples : 25 or +00025, –168 or –00168.

For 1 bit : 0 or 1.

Data 3 : value of word or bit to be read.

For 1 word : 6 characters, fixed format.
Examples : +00034, –21254.

For 1 bit : 0 or 1.

Question and answer code table

FUNCTION	QUESTION CODE	POSITIVE ANSWER CODE	NEGATIVE ANSWER CODE
Read bit	A	A	N
Write bit	B	Y	N
Read mot	C	C	N
Write mot	D	Y	N
Read table of 10 consecutive words	E	E	N
Mirror	M	M	N

Case of a negative answer :
– bit or word number not present in the ATV-45 2,
– non-existent question code,
– incorrect question format (but with first character : ?).

Examples of messages :

Reading of bit B6 (frequency reference signal)
question : ? A6 <LF> <CR> or ? A +00006 <LF> <CR>
answer : > A0 <LF> <CR> si B6 = 0 (positive reference)
> A1 <LF> <CR> si B6 = 1 (negative reference)

Writing of bit B5 (ATV-45 2 run / stop command)
question : ? B5 <SP> 1 <LF> <CR> for run
? B5 <SP> 0 <LF> <CR> for stop
answer : > Y <LF> <CR>

Reading of W22 (motor current)
question : ? C22 <LF> <CR>
answer : ? C + 00128 <LF> <CR> (motor current 12,8 A)

Writing of word W19 (frequency reference)
question : ? D19 <SP> 385 <LF> <CR> (reference : 38,5 Hz)
answer : > Y <LF> <CR>

Reading of 10 consecutive words starting at W5
question : ? E 5 <LF> <CR>
answer : > E +00002 <SP> +00007 <SP> +00128..... <LF> <CR>
word W5 = +00002
word W6 = +00007
word W7 = +00128
etc... up to W14 inclusive

Mirror : this function can be used for the communication test. It sends back the succession of characters sent (from 1 to 16 numbers)
question : ? M12345 <LF> <CR>
answer : > M12345 <LF> <CR>

List of ATV-45 2 variables

Definition of the bits

BIT	NAME	DESCRIPTION
B0	TST	Tripping of safety relay
B1	RST*	Resetting of speed controller
B2	CLO*	Assigning of LOCAL commands
B3	CLI*	Assigning of LINE commands
B4	NTO	Cancellation of communication control
Commands (read and write)		
B5	RUN	Run / stop command
B6	REV	Frequency reference sign
B7	DCB	DC braking command
B8	CAL	Freewheel stop command
B9	CAR	Fast stop command
B10	RTM	Motor voltage reduction command

* These bits cause the action given when written at 1. They are reset to zero by the speed controller. Writing them at 0 has, therefore, no effect and they will always read 0.

TST (B0) — Causes the ATV-45 2's safety relay to open, and as a result, the switching off of the controller, if the relay contact is used to maintain the line contactor.

RST (B1) — Causes fault acceptance and resetting of the ATV-45 2 safety relay only if the fault could be corrected and has dispappeared.

CLO (B2) — Puts the ATV-45 2 in LOCAL mode, this can only be controlled from its terminal (logic and analogue inputs).

CLI (B3) — Puts the ATV-45 2 in LINE, this waits for its commands from the serial link.

NTO (B4) — When the speed controller is in LINE mode exchange monitoring is carried out permanently; if the ATV 45 2 does not receive at least one character every second, the SLF fault will appear.
The setting to state 1 of bit B4 cancels this control. This possibility is reserved for fine adjustment phases and is not recommended during operation for safety reasons.

RUN (B5) — 1 = run, 0 = stop.

REV (B6) — Frequency reference signal : 0 = positive, 1 = negative.
Reversing the rotation direction can be achieved by changing the bit state, or by supplying an opposite frequency reference sign in word W19.

DCB (B7) — Brake control by positioning the bit at 1. Has priority over RUN bit.

CAL (B8) — Freewheel stop control as soon as the bit is set to 1. Has priority over RUN bit.

CAR (B9) — Fast stop control (deceleration ramp divided by 4). Has priority over RUN and CAL bit.

RTM (B10) At state 1, reduces the voltage taken by the motor in normal operating mode. This bit is only active if the ATV-45 2 was configured with this function; the reduction factor can be adjusted in word W5.

Important : when the ATV-45 2 is switched on, it is always in local mode. In order to control it by serial link, the first command to carry out is to change it to LINE mode (writing of value 1 in bit B3.

Definition of the words

WORD	NAME	UNIT	DESCRIPTION
Adjustments and commands (read and write)			
W0	-	-	Reserved
W1	-	-	Reserved
W2	CGL	0,1 %	Slip compensation (*)
W3	STA	0 à 1000	Stability
W4	RLI	0,1 %	Current limitation reduction (*)
W5	FTM	0,1 %	Motor voltage reduction (*)
W6	IBR	0,1 A	Braking current value
W7	IAR	0,1 A	Stop current value (*)
W8	TAR	0,1 s	DC injection stop time (*)
W9	UFR	0 à 99	Voltage / frequency ratio
W10	ITH	0,1 A	Thermal current
W11	GBF	0 à 1000	Frequency loop gain
W12	FR1	0,1 Hz	Skip frequency 1 (*)
W13	FR2	0,1 Hz	Skip frequency 2 (*)
W14	LSP	0,1 Hz	Low speed
W15	HSP	0,1 Hz	High speed
W16	ACC	0,1 s	Acceleration
W17	DEC	0,1 s	Deceleration
W18	COM	-	Command register
W19	FRH	0,1 Hz	Frequency reference
Signalling (read only)			
W20	STR	-	State register
W21	FLT	-	Fault register
W22	LCR	0,1 A	Motor current
W23	RFR	0,1 Hz	Rotation frequency
W24	THR	0,1 %	Thermal state
W25	ULN	0,1 V	Line voltage
W26	CHM	% of rated value	Motor load

(*) These parameters are not active unless the corresponding function has been confingured in the speed controller.

Detailed information on registers

Command register COM (W18). Read and write

W18,0	RST	Resetting of speed controller
W18,1	DLI	Assigning of logic commands in LINE mode
W18,2	FLI	Assigning of the frequency reference in LINE mode
W18,3	-	Reserved
W18,4	NTO	Cancellation of communication control
W18,5	RUN	Run / stop command
W18,6	DCB	DC injection braking command
W18,7	–	Reserved
W18,8	CAL	Freewheel stop command
W18,9	CAR	Fast stop command
W18,A	RTM	Motor voltage reduction command
W18,B	–	Reserved
W18,C	–	"
W18,D	–	"
W18,E	–	"
W18,F	–	"

These bits are active at state 1, and have the same function as the bits described previously.

Bits DLI and FLI provide the possibility of partially assigning the ATV-45 2's commands :

DLI (WI8,1) : at state 1 the logic commands (run, stop, brake etc...) can be carried out in LINE mode. At state 0, these are only taken into account on the ATV-45 2 logic inputs.

FLI (W18,2) at state 1 the frequency reference is read in word W19. At state 0, this is taken into account on the ATV-45 2 analogue input.

Reading and writing of value 1 in bit B3 (CLI) leads to these two bits being reset to 1; the writing of bit B2 at 1 (CLO) sets them systematically at 0.

Note : these 2 bits must be correctly positioned each time the COM register is written. In an application where the ATV-45 2 is completely controlled by serial link, they should always be at state 1.

State register STR (W20). Read only

W20,0	LOC	All commands assigned in LOCAL
W20,1	RDY	Speed controller ready (RDY or SLC)
W20,2	FAI	Fault present
W20,3	REN	Resetting authorised
W20,4	BCR	Brake engage relay closed
W20,5	FLO	Speed controller overridden in LOCAL control
W20,6	NTO	Communication control cancelled
W20,7	CFA	Fault present, can be corrected
W20,8	RNG	Operating (motor rotating)
W20,9	RVE	Direction (0 = forward, 1 = reverse)
W20,A	BRE	DC injection braking
W20,B	SST	Normal operating mode
W20,C	OVL	Thermal overload alarm
W20,D	OBR	Overbraking alarm
W20,E	LIM	In current limitation
W20,F	PWD	Power voltage failure

These bits are significant at state 1.

Fault register FLT (W21). Read only

W21,0	INF	Internal speed controller fault (*)
W21,1	SLF	Communication fault
W21,2	–	Reserved
W21,3	SRF	Fault following a TST command
W21,4	USF	Mains too low
W21,5	OSF	Mains too high
W21,6	PHF	Mains phase (s) failure
W21,7	OHF	Speed controller overtemperature
W21,8	SPF	Overspeed (operating with TG)
W21,9	OCF◦	Overcurrent(*)
W21,A	OBF	Overbraking
W21,B	OBF◦	Overhauling load current
W21,C	OLF	Motor overload
W21,D	OLF◦	Current too low or motor phase failure (*)
W21,E	–	Reserved
W21,F	CRF	Load relay fault (models ≥ 37 kW)

(*) These faults cannot be corrected and are not accepted by the serial link.

Table of ASCII characters used

DEC	HEX	CHARACTERS
10	0A	LF line feed
13	0D	CR carriage return
32	20	SP space
43	2B	+
45	2D	–
48	30	0
49	31	1
50	32	2
51	33	3
52	34	4
53	35	5
54	36	6
55	37	7
56	38	8
57	39	9
62	3E	>
63	3F	?
64	40	@
65	41	A
66	42	B
67	43	C
68	44	D
69	45	E
77	4D	M
78	4E	N
89	59	Y

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