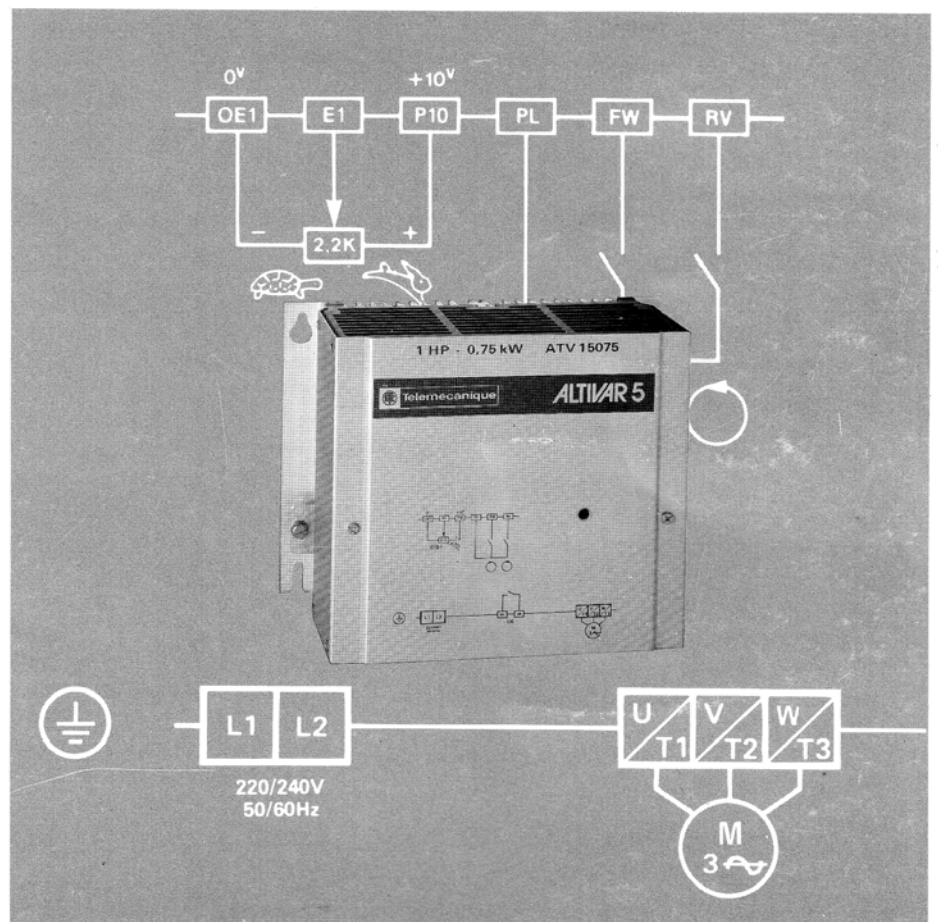# ALTIVAR®5 series 15

variable speed controllers
for asynchronous motors
fractionnal power

User's manual

90 to 750 W
220/240 V single phase supply

WARNING

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

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

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

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

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

It is important in such cases that the user should take appropriate steps to prevent such restarting possibilities. For example, by the use of an underspeed detector, causing the disconnection of the speed controller power supply in the event of a non-programmed motor stoppage.
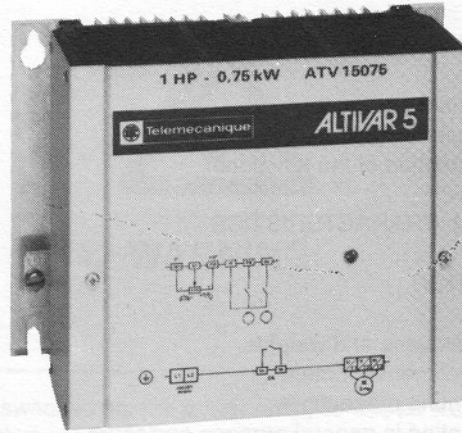
As a general rule, the speed controller power supply must always be switched off before carrying out any operation on either the electrical or the mechanical parts of the installation or the machine.
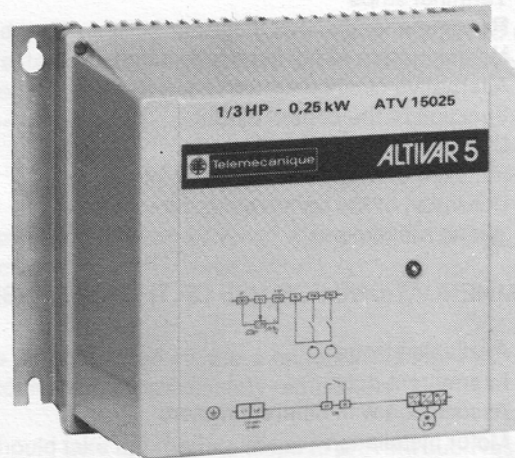
Contents

IP20 ATV-15...

1 HP - 0,75 kW   ATV 15075

Telemecanique   **ALTIVAR 5**

IP54 ATV-15...M5

1/3 HP - 0,25 kW   ATV 15025

Telemecanique   **ALTIVAR 5**

IP00 ATV-15...M0

- The ALTIVAR ATV-15 is a frequency inverter operating on the principle of synthesizing a sine wave by pulse width modulation (PWM).
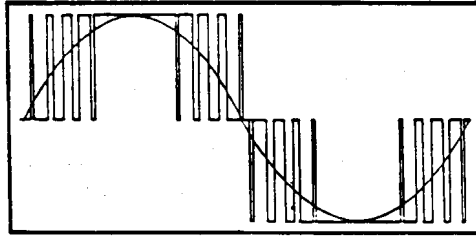
- The resulting waveform of the current in the motor is very close to a sine wave.
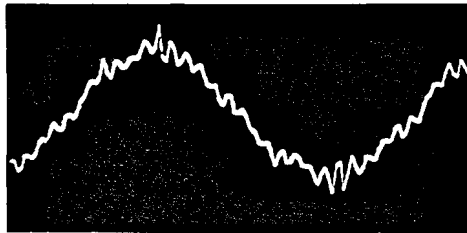
When associated with a standard three phase asynchronous squirrel cage motor, the ALTIVAR ATV-15 provides a simple and reliable motor/speed controller combination.

- In order to obtain the best possible results from the ALTIVAR ATV 15, read this guide carefully and apply all the relevant instructions and recommendations given.

Remove the ALTIVAR ATV-15 from its packing and check that it shows no sign of damage during transport.

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

DESIGN AND OPERATION

Technology

Functional block diagram

Description of the functions

1 Rectifier

2 Charge current limiting device

3 Filter capacitor

4 MOS transistorised inverter bridge

5 Control circuit transformer

6 Isolated inputs

7 Transistor control power board

8 Microprocessor control board

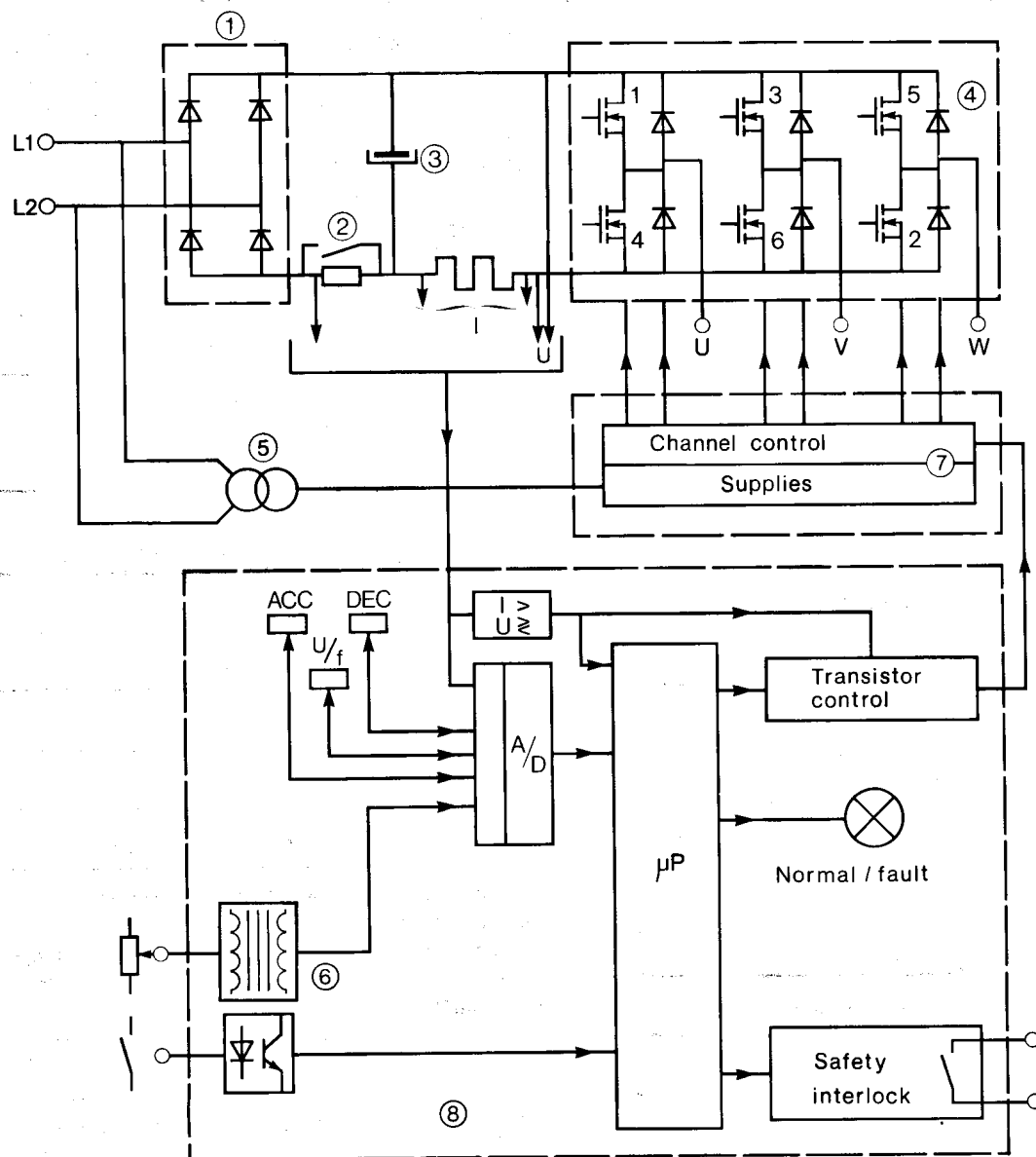| ALTIVAR reference	IP00 IP20 IP54	ATV-15025 M0 ATV-15025 ATV-15025 M5	ATV-15037 M0 ATV-15037 ATV-15037 M5	ATV-15075 M0 ATV-15075 ATV-15075 M5
Motor power		0,25 kW	0,37 kW	0,75 kW
Supply voltage		220 V -15 %, 240 V +6 %		
Supply frequency		50/60 Hz		
Output voltage		maximum value equal to the mains voltage		
Frequency range		1 to 67 Hz -1 to 110 Hz (see page 20)		
Rated current (A)		1,5	2,1	3,6
Transient current (A)		2,3	3,2	5,4
Total dissipated power at rated load (W)		25	30	50
Torque / overtorque		(see page 16)		
Speed set points		0-10 V / 0-20 mA / 4-20 mA		
Acceleration /deceleration ramps		0,2 to 20 seconds (see page 21)		
Reversing		control inputs (see page 13)		
Slow-down braking		by optional resistance (see page 25)		
Speed controller protection		against short-circuits between output phases against continuous overloads against mains supply undervoltage and overvoltage		
Operating temperature		0°C to +40°C		
Storage temperature		-25°C to +70°C		
Humidity		90% maximum without condensation or dripping water		
Maximum altitude		1000 m without derating (Derating by 3 % for each additional 1000 m)		
Vibration and shocks		Conforming to Bureau VERITAS level 1 and IEC 68-2-6: 2 mm peak to peak from 5 to 16 Hz, 1g peak up to 150 Hz		
Degree of protection		IP00 - IP20 - IP 54		

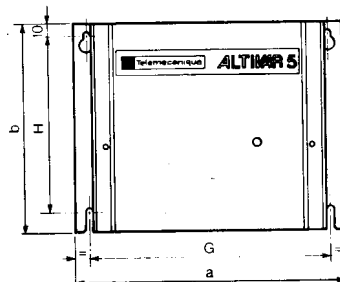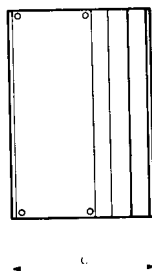Speed controllers in IP54 enclosures (ATV-15●●●M5) can be fitted with a local control station, reference VY1-A15105.

Dimensions
and weights
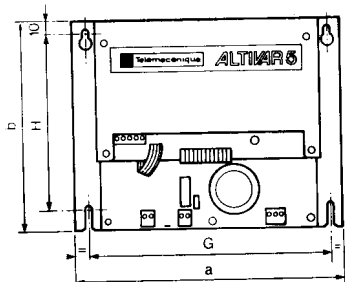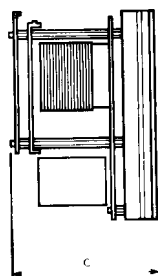
ATV-15...M0
IP00

ATV-15...
IP20
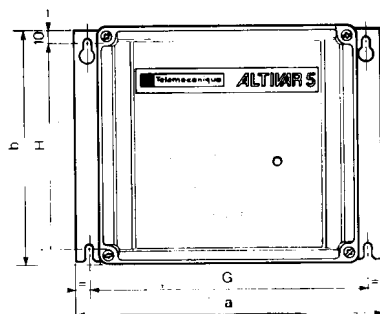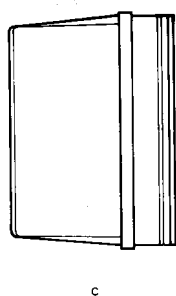
ATV-15...M5
IP54

Reference	a mm	b mm	c mm	G mm	H mm	Weight kg
ATV-15025M0	260	200	136	235	170	3,500
ATV-15025	260	200	136	235	170	3,900
ATV-15025M5	296	222	141	271	200	5,300
ATV-15037M0	260	200	136	235	170	3,500
ATV-15037	260	200	136	235	170	3,900
ATV-15037M5	296	222	158	271	200	5,300
ATV-15075M0	260	200	136	235	170	3,600
ATV-15075	260	200	136	235	170	4,000
ATV-15075M5	296	222	158	271	200	5,400

|	
Climatic environment	Temperature, humidity, vibrations and shocks, degree of protection : see technical characteristics, page 6. Pollution : protect the controller against the adverse effects of dust, corrosive gases, splashing liquid,... If the environmental conditions require, use the IP54 controllers (ATV-15●●●M5) or mount the IP00 or 20 controllers in dust and damp protecting metal enclosures, see below.
Mounting precautions	- Mount the controller vertically - Do not locate near heat radiating elements

Mounting of IP00 and IP20 controllers in general purpose metal enclosure

Degree of protection IP23

In order to ensure adequate air flow inside the controller:
- leave sufficient space around the unit:
  - $d \geq 50$ mm
  - $D \geq 100$ mm
- provide ventilation louvres
- verify that the ventilation is sufficient, if not fit a cooling fan with filter.
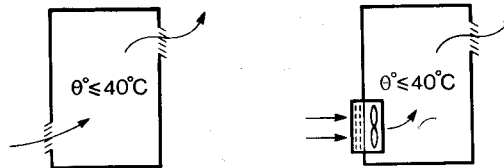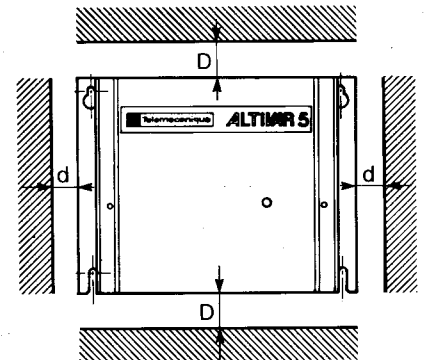
Mounting of IP00 and IP20 controllers in dust and damp protecting metal enclosures

Degree of protection IP54

• Provide a ventilating fan to circulate the air inside the enclosure and prevent hot spots in the controller:
- flow rate: 44 dm³/s
- mount the cooling **fan below the controller** at a distance of ≤ 50mm.
This arrangement enables the controller to be used in enclosures where the maximum internal temperature is 60°C.
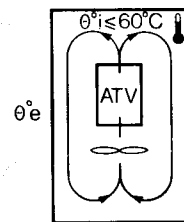
Fit a temperature sensor to ensure protection of the controller above 60°C.

• Calculation of the enclosure size:

- Maximum thermal resistance Rth (°C/W)

$$Rth = \frac{60 - \Theta°e}{P}$$

where $\Theta°e$ = maximum external temperature in °C
P = total power dissipated inside the enclosure in W.
Power dissipated in the controllers at rated power: see technical characteristics, page 6.

- Effective heat exchange surface area of the enclosure S (m²)

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

where K = thermal resistance of the enclosure per square metre
(K = 0,12 for type DE1-HB metal enclosures).

Insulated enclosures are not recommended due to their poor thermal conductivity.

- Calculation example:

ATV-15075 (750 W) mounted in a dust and damp protecting enclosure with forced ventilation.
Maximum external temperature : 30°C

- Power dissipated inside the enclosure : 50 W.
- Maximum thermal resistance :

$$Rth = \frac{60 - 30}{50} = 0{,}6°C/W$$

Minimum effective heat exchange surface area :

$$S = \frac{0{,}12}{0{,}6} = 0{,}2 \ m^2$$

Effective exchange surface area of a type DE1-HB422 wall mounted enclosure :
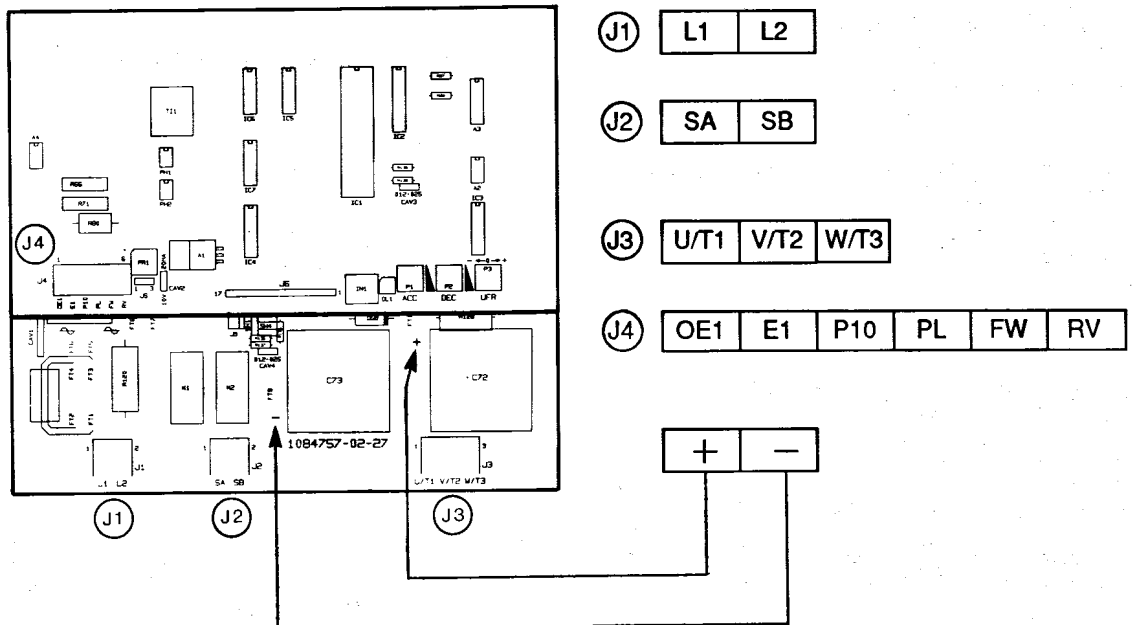
- height 500 mm
- width 300 mm
- depth 200 mm

$$S = (0{,}5 \times 0{,}3) + (0{,}2 \times 0{,}3) + 2 \ (0{,}5 \times 0{,}2) = 0{,}41 \ m^2$$

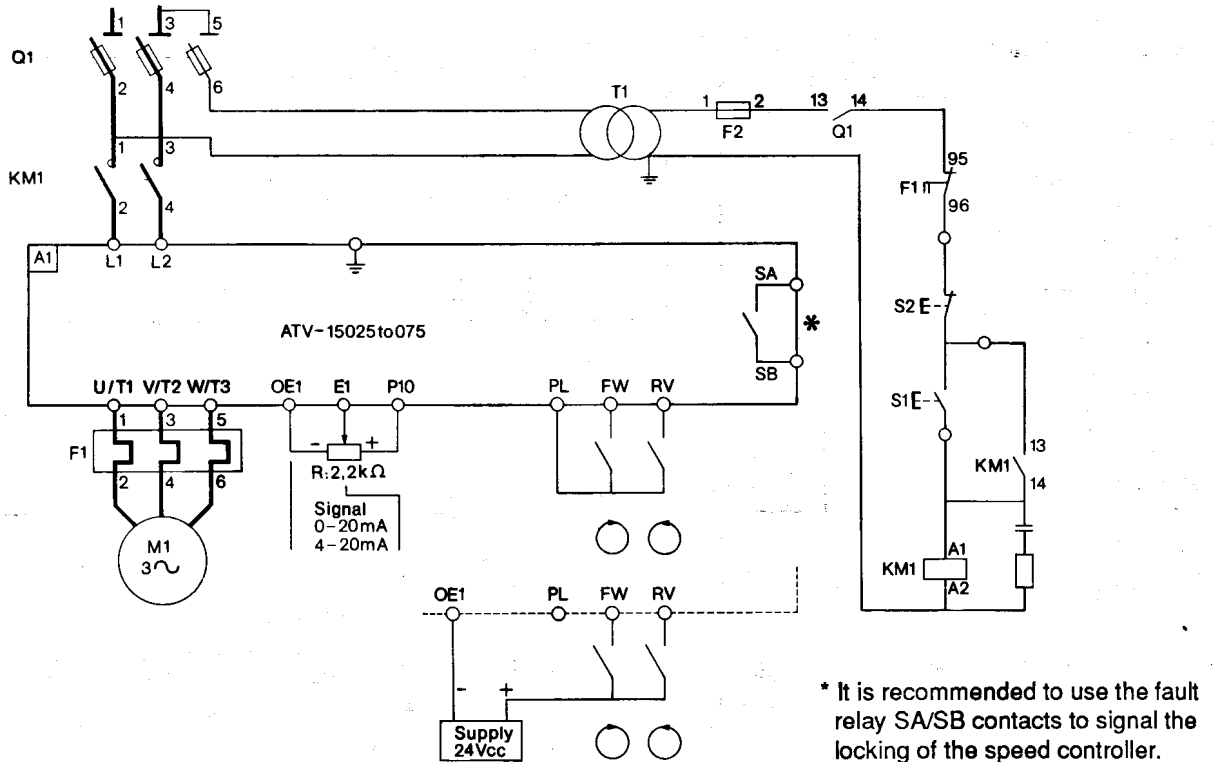In accordance with the basic assumptions, this enclosure is suitable.

Connections

Terminal strips

J1	L1	L2

J2	SA	SB

J3	U/T1	V/T2	W/T3

J4	OE1	E1	P10	PL	FW	RV

+	−

Item	Function		Characteristics
L1	Power supply - single phase		220 V -15 % 240 V +6 % 50/60 Hz
L2			
U/T1	Connections to the motor		220/240 V at 50/60 Hz
V/T2			
W/T3			
+	Filtered intermediate d.c. voltage		260 to 385 V
−			
OE1	Speed reference input common		0 V
E1	Speed reference input	Voltage	0-10 V / Ze = 33 kΩ
		Current	0-20 mA / 4-20 mA Ze = 100 Ω
P10	Output voltage		10 V/ iS = 10 mA
PL	Control input supply		15 V/ iS = 30 mA
FW	Forward control input		15-24 V / Ze = 1,5 kΩ
RV	Reverse control input		
SA	Fault relay output	- closes when supply is switched on - opens on fault	Voltage free contact 220/240 V - 50/60 Hz - 2 A
SB			

Recommended circuit diagram

Nomenclature of equipment required

* It is recommended to use the fault relay SA/SB contacts to signal the locking of the speed controller.

M1	Motor (kW)	0,12	0,25	0,37	0,75
A1	ALTIVAR ATV-15	025	025	037	075
Q1	Isolator + 2 power fuses, type g1 + 1 control fuse type aM	DF2-CN04	LS1-D2531A65 DF2-CN04	DF2-CN06 DF2-CA02	DF2CN10
KM1	Contactor LC1-D ••3•A65 Suppressor	09	09	09 LA9-D09980	09
F1	Thermal overload relay LR1-D093..A65 + moun- ting plate LA7-D0964A65	05	06	07	08
F2	Fuse, type g1 Fuse carriers		DF2-CN02 DF6-AB10		
T1	Single phase power transformer (VA)		63		
R	Potentiometer		SZ1-RV1202		
S1 S2	Start push-button Stop push-button		XB2-BA21 XB2-BA42		

N.B : The overload relay can be directly mounted on an LA7-D0964A65 mounting plate. It must be set to the motor full load current value. For continuous duty below 25 Hz this protection is inadequate for a self-ventilated motor. (Use PTC thermistor probes associated with an LT2-S thermistor protection relay).

Cabling	Terminals	For ALTIVAR	Recommended section in mm²
	PL/FW/RV/SA/SB	all ratings	1
	OE1/E1/P10	all ratings	1 (twisted cable)
	L1/L2/U/V/W	all ratings	1,5

Connections

Alternative circuit diagram

ATV-15025 to 075
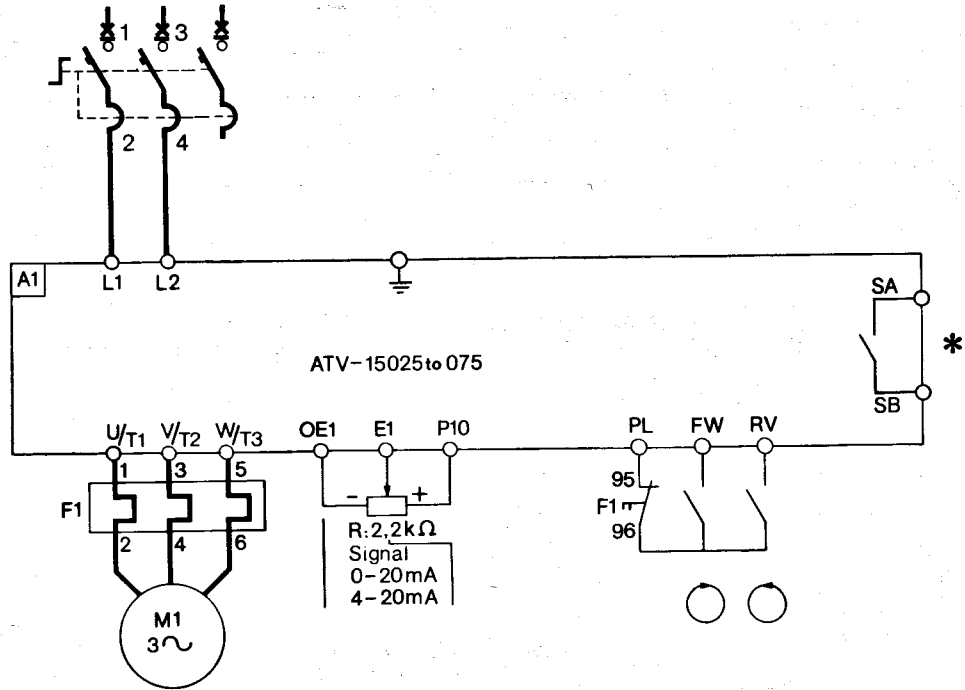
A1	ALTIVAR ATV 15...	025	037	075
Q1	Isolator - Circuit breaker Optimal 25	GK2-CF10	GK2-CF12	GK2-CF14
Other components, see page 11				

- It is recommended to use the fault relay for signalling any locking of the speed controller, (terminals SA-SB).

• **Alternative**

Replacement of the isolator/contactor by a circuit breaker.

Caution : - Avoid any on-load switching between the speed controller output and the motor. If, to meet essential operating requirements, a contactor must be fitted between the controller and the motor, a special sequence must be provided (see page 18).
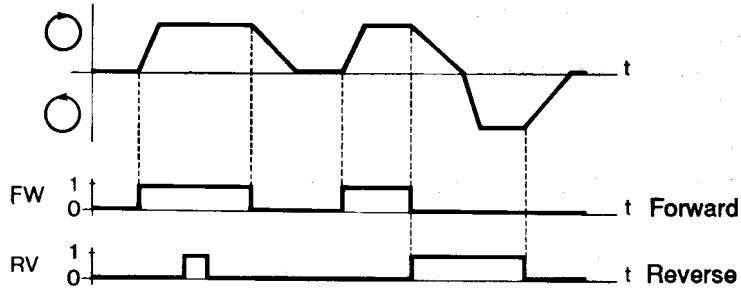
- A direct thermal protection using probes embedded in the motor windings must be provided for the operation in severe ambient conditions:

• high ambient temperature ($\theta° \geq 40 °C$),

• possible clogging of cooling fins,

• insufficient ventilation (self-ventilated motor operating at full load at low speed).

Connections

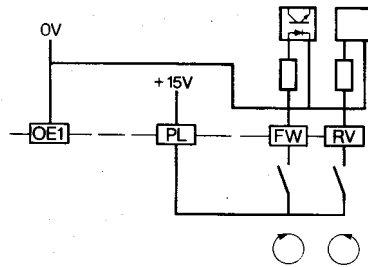|	
Function of the control inputs	Rotation direction

- the direction control selected first takes priority over the other,
- ramp deceleration,
- interlock at the low speed thereshold (≤ 1 Hz), and d.c. injection during 0,5 s,
- to stop on "free wheel", switch of the speed controller power supply.
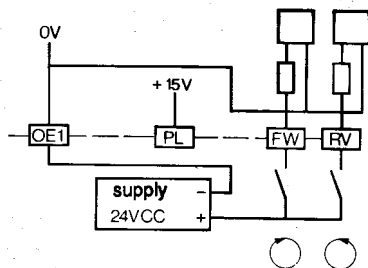
Utilization of the control inputs

• Operation on internal supply

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

• Operation on external supply

The control inputs:
- are isolated from the mains,
- the (-) of the supply is connected to the 0 V of the control.

Function of the speed reference inputs

- The set-point reference fixes the speed of the rotating field in the motor.
  The real speed remains dependent on the acceleration and deceleration ramps and on the torque capabilities of the motor/speed controller combination.
- The speed reference inputs are isolated from the mains.
- The 10 V internal supply (terminals OE1-P10) is protected against short-circuits.
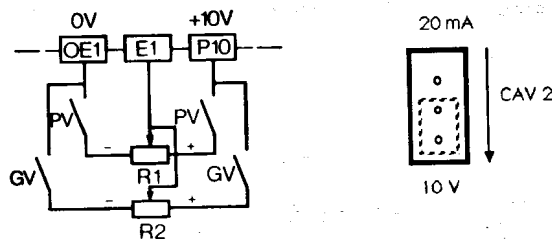
Utilization of the speed reference inputs

● Example 1 : manual reference selection
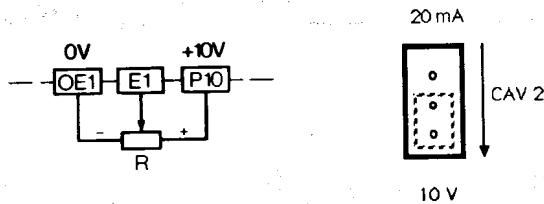
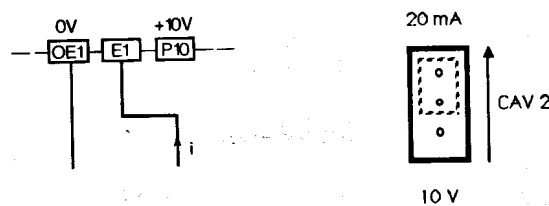Input impedance : 33 kΩ
2 kΩ ≤ R ≤ 10 kΩ

Link 2 : in 10 V position

● Example 2 : selection of two manual references

Input impedance : 33 kΩ
LS : low speed
HS : high speed

Link 2 : in 10 V position

● Example 3 : automatic reference from 0-20 mA or 4-20 mA sensor

Input impedance : 100 kΩ
Link 2 : in position 20 mA
INV1, see page 21

Connections

Wiring precautions

• Power circuit

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

This interference can be reduced by screening the motor cables, using a good earth connection, and by installing suppression filters on the supply side of the controller, see page 28.
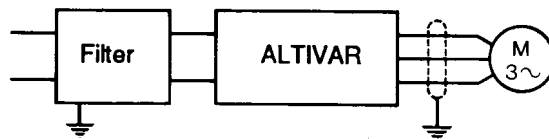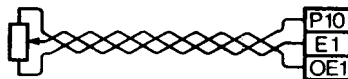

• Control circuit

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 circuit

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

Recommendations for use

of the motor / speed controller combination

Available torque

- Continuous duty : derating of the motor is due to two factors.

  - Although the current waveform is very close to a sine wave, motor heating is slightly greater than that caused when the motor is directly connected to the mains supply.
    The resulting reduction in torque is of the order of 5 %, which is slightly less then the tolerance limits for motor manufacture.

  - For self-ventilated motors, the ventilation necessary for cooling is linked to the motor speed. This results in motor derating, which occurs at approximatively half the rated speed.

  - For fractional power motors ≤ 250 W the derating can be less (e.g. 20 % instead of 50 % at very low frequencies).

- Transient operation

  Overtorque capability is linked to the maximum transient current which the controller can provide and to the repetition of the overloads.

- Overspeed operation (f ≥ 50/60 Hz)

  As the voltage can no longer change with frequency, the result is reduced induction in the motor, causing a loss of torque.
 The motor manufacturer can advise whether the motor is suitable for overspeed operation.
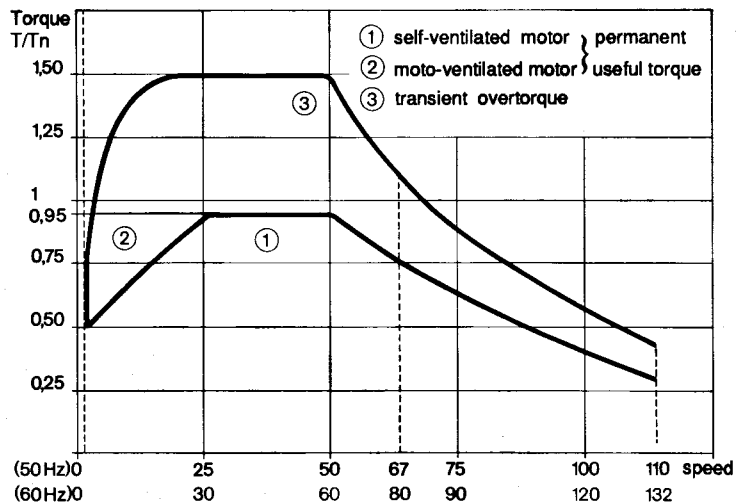
Intermittent duty

The rate 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 :
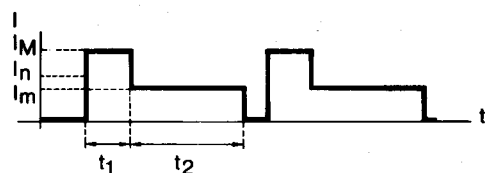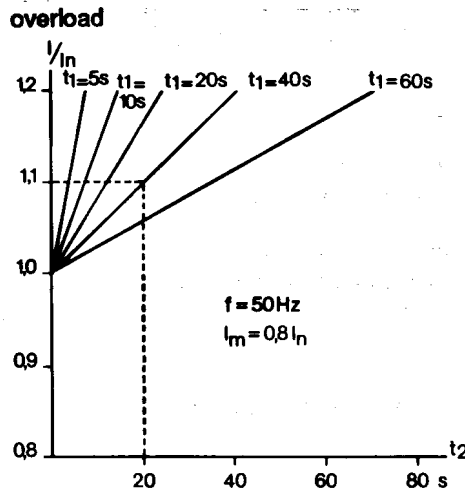

I_M overload current

I_n rated current

I_m normal running current

Recommendations for use

of the motor / speed controller combination

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.

overload

Graph: Vertical axis labeled $^I/_{In}$ with values 0,8 / 0,9 / 1,0 / 1,1 / 1,2. Horizontal axis labeled t2 with values 20, 40, 60, 80 s. Curves labeled $t_1=5s$, $t_1=10s$, $t_1=20s$, $t_1=40s$, $t_1=60s$. Notes on graph: $f = 50Hz$, $I_m = 0,8 I_n$.

Example : following an overload of 1,1 In for 40 seconds, it would require 20 seconds at 0,8 In to return to the previous thermal state.

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

Association with different motors

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

• Motor power ≤ rated power of the controller

This combination is possible.

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

• 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. The motor current must remain lower than or equal to the speed controller current rating.

• Motors in parallel

Diagram: ALTIVAR connected to motors I_{n1} (M1), I_{n2} (M2), I_{nx} (Mx).
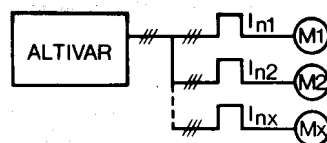
Speed controller selection :
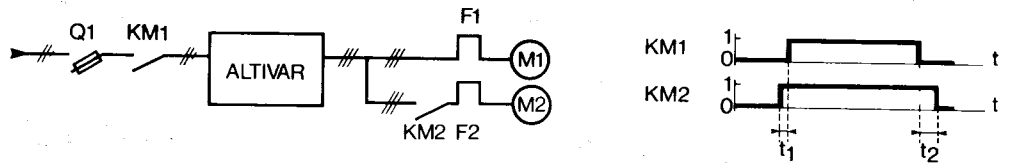Controller $I_n \geq I_{n1} + I_{n2} + ... I_{nx}$

Each motor should be protected by a thermal overload relay

Compensation is not optimised. Adjust the U/f ratio if necessary.
If the motors have different power ratings, the ratio adjustment can only be a compromise.

• Additional motor connected downstream of the speed controller.

- Comply with the sequence shown, where t1 = 20 ms

  t2 = 0,5 s (demagnetisation of the motor).

- If the power of the motor to be connected is low with respect to 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"
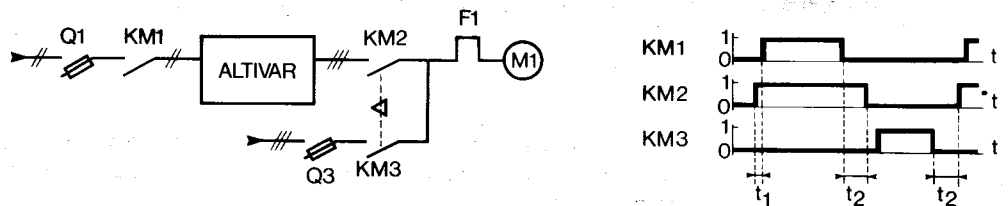
- Comply with the sequence shown, where t1 = 20 ms

  t2 = 0,5 s (demagnetisation of the motor).

• Use of a brake motor

- Electric brake
  Make sure that the brake winding is brought out to terminals
  The brake should be separately supplied at its rated voltage and switched simultaneously with the motor.

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

• Use of a synchronised asynchronous motor

Operation is possible

Recommendations for use

of the motor/speed controller combination

Motor installation

Mount and couple the motor with care so as to eliminate vibrations and resonance.

Adaptation to the driven machine

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

- overcome the load torque of the driven machine over the whole speed range used,

- supply the transient overtorque needed for the required accelerations, see available torque, p.16.

If braking is required for rapid deceleration, investigate the possibility of slow-down braking, p. 25.

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,

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

- transient driving load/high inertia :
  examine the braking possibilities.

Adaptation to the mains supply

If a 220 V single phase supply is not available, the controller can be fed via a single phase transformer or autotransformer rated as follows :

ATV-15025	0,6 kVA
ATV-15037	0,8 kVA
ATV-15075	1,6 kVA

The ALTIVAR ATV-15 is factory preset to meet most common utilization requirements. The preset
* values are marked below with an asterisk*.

Check that they are compatible with your requirements.

If so, after checking the connections (see recommended circuit diagram p.11 or alternative p.12), the speed controller can be switched on.
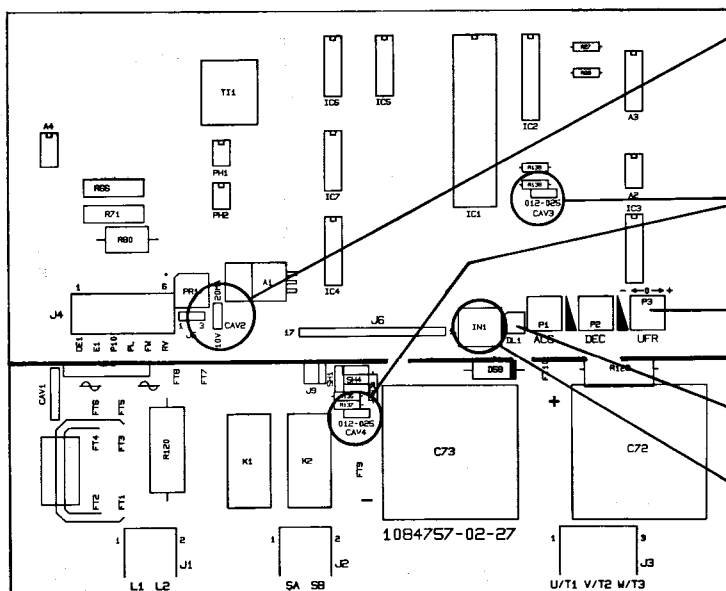
If not, readjust the settings.

The setting controls are grouped on the front side of the control board and are accessible after removing the front cover.

CAUTION : do not touch the components.

Layout of the setting controls

CAV2
speed reference

CAV3
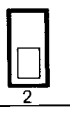CAV4 } Motor size (only with the ATV-15025)

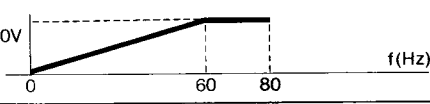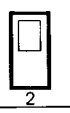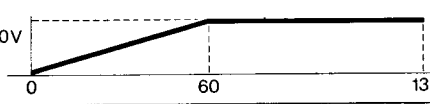Potentiometers

Normal / fault LED
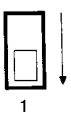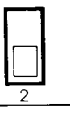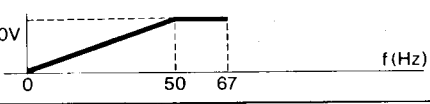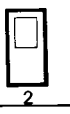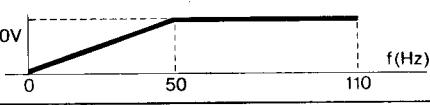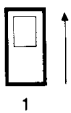
INV1
settings (see page 21)

Settings modification

The links and switches must only be touched with the power switched off.
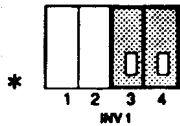
● Output frequency of the INV1 switches 1 and 2
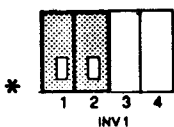
INV-1 Rated motor frequency (FRS)	INV-1 Maximum motor frequency (FR)	Voltage / frequency ratio		
* 50Hz * 1	* 67/80Hz * 2 ↓	U(V) 220/240V	0 50 67	f(Hz)
	110/132Hz 2 ↑	U(V) 220/240V	0 50 110	f(Hz)
60Hz 1 ↑	* 67/80Hz * 2 ↓	U(V) 220/240V	0 60 80	f(Hz)
	110/132Hz 2 ↑	U(V) 220/240V	0 60 132	

*
1 2 3 4
INV1

Initial setting-up

- Selection of speed range with switch 4 of INV1

- Selection of type of operation with switch 3 of INV1

| CAV2 \ INV-1 4	20 mA [diagram] 10 V	20 mA [diagram] 10 V
ON * 4 [diagram]	0-10 V	0-20 mA
ON 4 [diagram]		4-20 mA

* 3 [diagram]	Normal operation with automatic adaptation of the voltage/frequency ratio - N -
3 [diagram]	Special operation without automatic adaptation of the voltage/frequency ratio; see page 22. - S -

- Selection of the speed reference mode with the link 2 (page 14)

CAV2

20 mA [diagram] 10 V   * voltage 0-10 V

20 mA [diagram] 10 V   current 0-20 mA or 4-20 mA
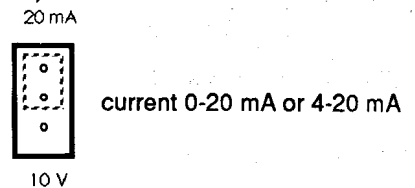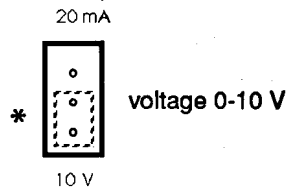
- Special case of 90 to 120 W motors.

Selection of the size of motor : applies only to ALTIVAR 5 ATV-15025

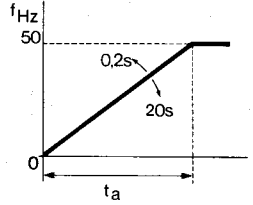| CAV3	* [diagram] 012 - 025	150 to 250 W	[diagram] 012 - 025	90 to 120 W
CAV4	* [diagram] 012 - 025	motors	[diagram] 012 - 025	motors

These two links must only be moved together and with the power switched off.
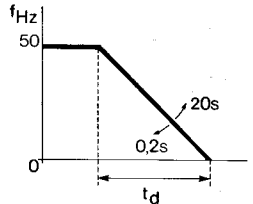
• Potentiometers

Acceleration

| ACC |

The acceleration ramp adapts itself automatically according to the overtorque capacity.
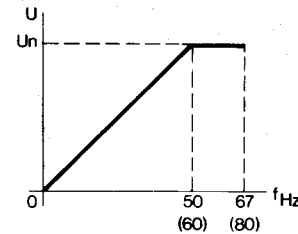
✱ preset value 2 s
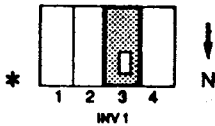
Deceleration

| DEC |

✱ preset value 2 s

voltage/frequency ratio

| UFR |

✱ 0 : factory setting suitable for most applications
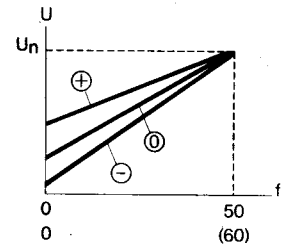
Modification of the voltage/frequency ratio

✱

• Selector switch 3 of INV1 in the bottom position "N" ✱

- Applications requiring a high torque at low speed.

  If the torque is inadequate,
  turn the potentiometer UFR from 0 towards (+)
  until correct operation is obtained.

- For utilization on a machine with low load
  at low speed (centrifugal pumps, fans...),
 turn the potentiometer UFR toward the (-)
  position.

• Selector switch 3 of INV1 in the top position "S"

- Special case of machines with fast transient cycles

  For this type of application the standard auto-adaptation of the voltage/frequency ratio cannot be used.
  The increase of torque, by turning the potentiometer UFR in the (+) direction, must be carried out making sure that the current, at low speed, does not cause excessive heating of the motor (see page 16), or an overcurrent trip of the controller.
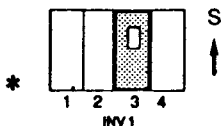
General

> Before carrying out any operation inside the controller, switch off the supply circuits and make sure that the capacitors are fully discharged (about 5 minutes after switch off).
> CAUTION : the d.c. voltage across the + and - terminals can reach 400 V on load.

- The ALTIVAR ATV-15 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 temperature around the controller remains at an acceptable level,
  • remove the dust from the controller if necessary.

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

Maintenance assistance facilities

The LED located on the front panel of the speed controller can indicate several states :

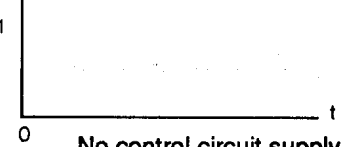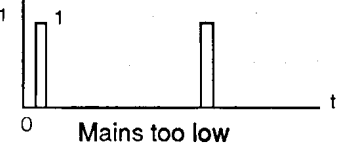|		
- illuminated	→ ALTIVAR "ON"	• ready to operate • operating normally
- extinguished	→ no voltage	• ALTIVAR "OFF"
- flashing	→ fault	• control voltage failure (see table page 24)
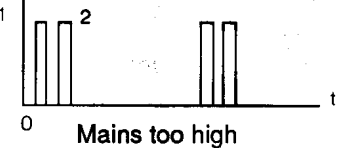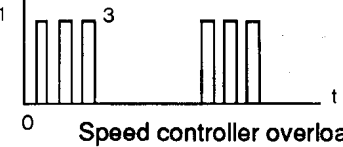
• Fault storage

The first detected fault is displayed and stored if the supply voltage remains "ON". The fault relay drops out.

• Erasure of stored fault

- Switch off the power supply to the controller.
- Determine the cause of the fault before resetting.
- Switch the supply back on; this will cause the fault memory to erase.

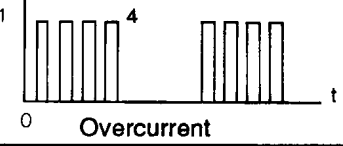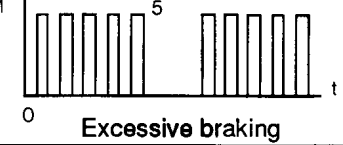| Fault signal signification	Probable cause	Trouble-shooting procedure
$\otimes$ — No control circuit supply	- control circuit absent - internal controller fault	→ check the voltage across L1/L2 terminals → check the upstream fuses
Mains too low (1)	- temporary mains failure - mains V too low (U ≤ 185 V) - temporary voltage drop (t ≤ 100 ms)	→ check the supply voltage → reset
Mains too high (2)	- mains too high (U ≥ 225 V) (when switching on the controller)	→ check the supply voltage → reset
Speed controller overload (3)	- thermal trip due to prolonged overload	→ check motor load
Overcurrent (4)	- short-circuit at speed controller output	→ switch off - check the cabling - check the motor
Excessive braking (5)	- capacitor overvoltage due to a too sudden deceleration, a driving load or an abnormal transient increase of the mains voltage.	→ increase deceleration time - add braking option if required → reset

Options

Presentation

- Flying leads are provided on the module for connection to the + and the - terminals.

- The braking resistance must be mounted and connected separately.

Dimensions
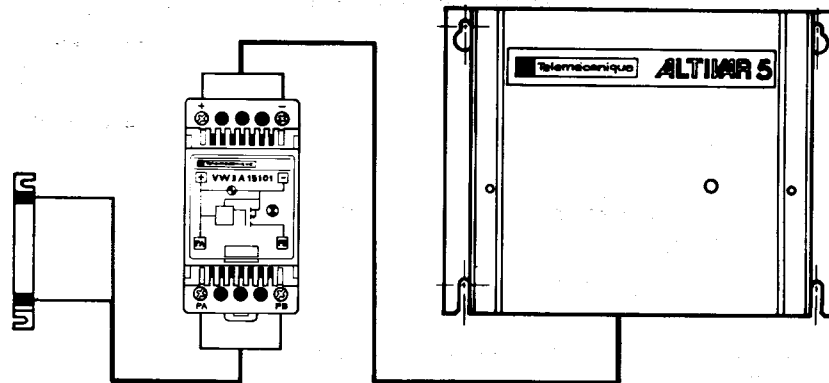
Operating principle

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. This energy depends on the rate of deceleration, the inertia of the moving mass and the resistive torque.

As the controller cannot feed this energy back into the supply, this causes an increase in the voltage of the filter capacitors, which limits the braking effect.

During the deceleration phase, the kinetic energy is dissipated in the motor. This enables high braking torque Tf to be obtained during the transitional phases $Tn < Tf < 1,5 Tn$ (which depend on the motor characteristics).

At synchronous speed and above, or with a driving load during normal operation, the braking option should be fitted.

Composition

The slow-down braking option comprises :
- a module containing :
  • a power transistor, ensuring the switching of the braking resistance across the filter capacitor terminals,
  • the control electronics.
- a separate braking resistance (100 Ω, 72 W)
- the module/speed controller connection cables.
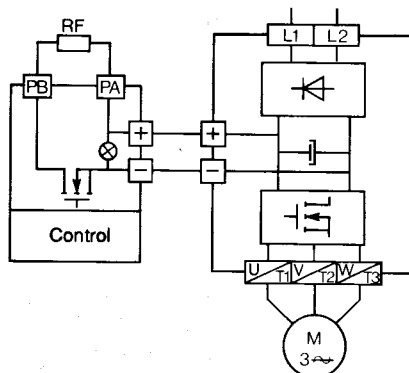
● Determination of braking resistance value

The braking resistance is characterized by its value and the power it is capable of dissipating.

- Braking resistance value : 100 ohms (1,5 mm² wiring).

- Resistance power rating :

  ● rated :   this is the power it is capable of dissipating in continuous operation; it must be greater than the mean braking power (Pfm).

  ● maximum : this is the power that can be dissipated during a very short period in intermittent duty; it must be greater than the braking power corresponding to this time.

● Calculation of braking power

- High inertia machine - non driving load

Braking torque on deceleration : Tf in Nm

$$Tf = J \frac{\Delta\omega}{\Delta t}$$

J   : total moment of inertia referred to the motor shaft in kg-m²,
$\Delta\omega$: angular speed difference in rd/s,
Δt : deceleration time in seconds.

Instantaneous braking power : Pf in W
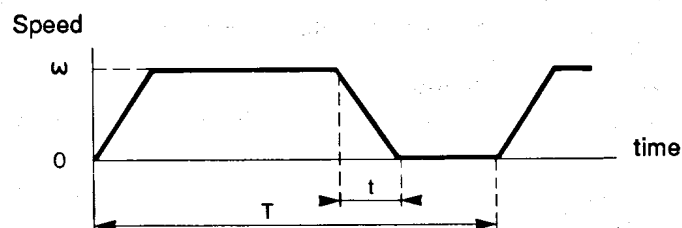$Pf = Tf\omega$

Mean braking power during deceleration : Pfd in W
$Pfd = 0,5 \ Tf\Delta\omega$

Mean braking power during one cycle : Pfm in W

$$Pfm = Pfd \ \frac{t}{T}$$

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

Speed

- driving load - continuous operation
  Braking is permanent.
  $Pf = Pfm = Tf\omega$

  Tf : braking torque in Nm
  ω : speed in rd/s

● Standard resistance characteristics

ALTIVAR ATV-15 all ratings	
Resistance in ohms	100
Rated power (W)	72
Maximum power (W)	360
Dimensions (mm)	153 x 20 x 60

The maximum power corresponds to a maximum operating time of 10 seconds. For a resistance with different characteristics, consult the relevant supplier directly.

● Resistance calculation example

Consider a motor having the following characteristics :

- power : 0,75 kW
- nominal speed : 1450 rpm
- moment of inertia : 0,002 kg m²

driving a machine whose :

- inertia is 10 times that of the motor,
- resistive torque is 1/10 of the rated torque of the motor.

It is desired to slow down from 3000 rpm to 1500 rpm, at a rate of 10 cycles per minute.

Nominal angular speed : $\omega n = \dfrac{2 \pi N}{60} = \dfrac{2\pi (300 - 1500)}{60} = 152$ rd/s

Rated motor torque : $Tn = \dfrac{Pn}{\omega n} = \dfrac{750}{152} = 4,9$ Nm

Resistive torque : $Tr = \dfrac{4,9}{10} = 0,49$ Nm

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

Braking torque : $Tb = J \dfrac{\Delta\omega}{\Delta t} = 0,022 \dfrac{152}{1} = 3,34$ Nm

Motor braking torque : $Tf = Tb - Tr = 3,34 - 0,49 = 2,85$ Nm

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

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

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

The resistance is suitable in this case.

● Special case of ATV-15075
In the case of high braking torque, the standard 100 Ω resistance, may be inadequate. This should therefore be replaced by a 68 Ω, 72 W resistance, ref. VY1-ADRO68W72 making sure that the rated power of 72 W, max. 360 W, is adequate. If not, use a 68 Ω resistance with a higher power rating.

Options

Radio interference attenuating input filter

- **Function**

The purpose of this input filter is to limit the propagation along the mains of spurious signals which may be emitted by an ALTIVAR controller and which could cause interference in a receiver (radio, television, interphone,...).

- **Characteristics**

The filter allows the speed controllers to conform with international standards (CISPR, VDE 0875N), relating to radio-electrical interference in conduction mode (approvals pending).

- **Installation / connections**

- Mount the filter close to the speed controller (distance ≤ 15 cm).

- Connect the protective conductor terminal of the filter and the speed controller together and connect them to earth. The connections must be as short as possible, with low impedance, and the earth of very good quality.

- To limit radiation effects, twist the wires at the input and the output of the filter, and use screened cables for all the connections with the speed controller (motor, reference, controls,...) with the screening connected to earth.

- **Note**

In order to limit the radiation of the ALTIVAR / motor connection cables, install the speed controller as close as possible to the motor.

- **References / Dimensions**

ALTIVAR Reference	Filter Reference	Dimensions (mm)
ATV-15025 ATV-15037 ATV-15075	VY1-A25107502	160 x 52 x 45