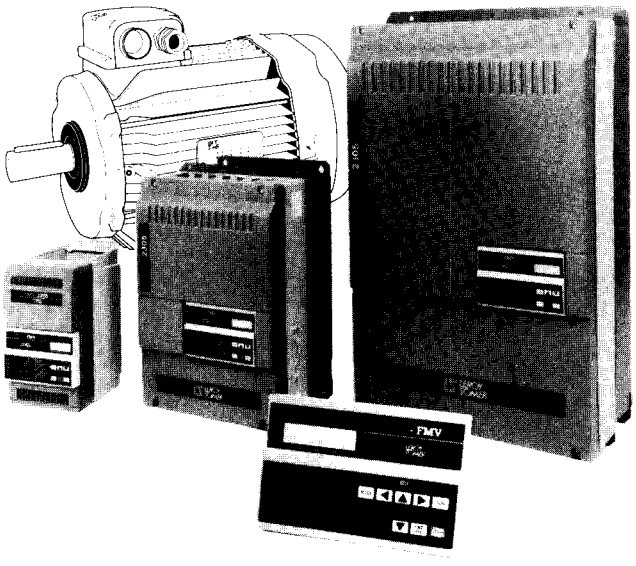
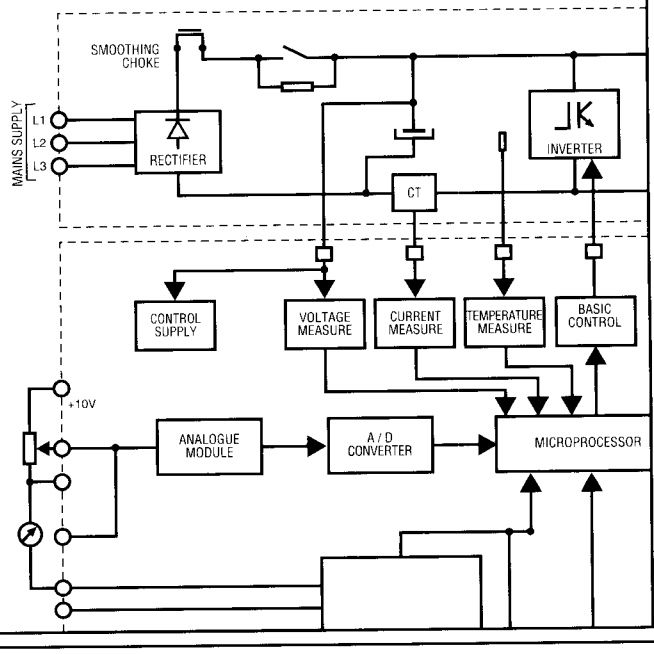
LEROY SOMER

Ref. 1384 - 033 / a - 4.93





FMV 2305/2305A

Digital frequency inverter for induction motors

Installation and maintenance

ADDENDUM to
FMV 2305/FMV 2305 A manual (1384 O33/a - 4.93)

HE/AF 300993

- FMV 2305 1.5T to 11T and FMV 2305 A 1.5T to 11T. (Page 2)
Following an update in software to version 2.3.1, new parameters have been added.
Inverters manufactured from 10/02/93 (date is given on the name plate) have this modification.

- FMV 2305 16T to 100T and FMV 2305A 16T to 120T. (Page 3)
Following an update in software to version 5.3.1, the control board IN 40 has changed to Iss.3.
Inverters manufactured from 07/06/93 (date is given on the nameplate) have this modification.

REMINDER :
The earthing terminal of the motor (⏚) must imperatively and exclusively be connected to the PE terminal of the frequency inverters FMV 2305 and FMV 2305 A for all ratings 1.5T to 120T.

ADDENDUM

FMV 2305 1.5T to 11T and FMV 2305 A 1.5T to 11T

Section 3.3.2

b21 - b23 : Selection - standard acceleration and deceleration ramps or specific ramps

Adjustment range : 0 or 1.
Factory setting : 0.
The combination of b21 and b23 allows selection of specific ramps for the preset speeds or to programme specific ramps for the frequency reference (via A10, A11 and A12).

b21	b23	
0	0	Preset speeds use Pr02 and Pr03.
1	0	Preset speeds use Pr30 to Pr36 and Pr40 to Pr46.
1	1	Preset speeds use Pr30 to Pr36 and Pr40 to Pr46.
0	1	The frequency reference uses the following ramps :

A12	A11	A10	Ramps used
0	0	0	Pr02 and Pr03
0	0	1	Pr30 and Pr40
0	1	0	Pr31 and Pr41
0	1	1	Pr32 and Pr42
1	0	0	Pr33 and Pr43
1	0	1	Pr34 and Pr44
1	1	0	Pr35 and Pr45
1	1	1	Pr36 and Pr46

If b20 = 1 : all ramps in the table are available.
If b21 = 0 : only the first 4 lines are available and terminal A12 is available for jogging.

b24 : Configuration of terminal 19

Adjustment range : 0 or 1.
Factory setting : 0.
b24 = 0 : indication of inverter output current (from 0 to ± 10 VDC).
b24 = 1 : logic output giving 0V when the load is less than Pr05, +10V when the load is greater or equal to Pr05.

b26 : Disable " Ac UU " detection

Adjustment range : 0 or 1.
Factory setting : 0.
b26 = 0 : " Ac UU " detection operates normally.
b26 = 1 : " Ac UU " detection is no longer taken into account.

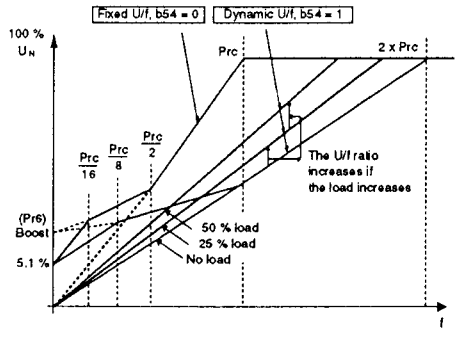
b27 : Specific braking

Adjustment range : 0 or 1.
Factory setting : 0.
b27 = 0 : motor braking for a change in speed reference is following the ramp type b2 = b7 = 0 (for free-wheel and injection stopping modes).
b27 = 1 : motor braking for a change in speed reference is following the ramp type b2 = b7 = 1 (independant of the type of stopping mode selected).
During " Ac UU " detection, motor braking is as per the following table :

b27	b2	b7	Type of braking
0	0	0	Ramp stop or prolongation of the ramp (identical to b2 = b7 = 0)
0	0	1	
0	1	0	
0	1	1	Ramp stop with optional braking resistance (identical to b2 = b7 = 1)
1	0	0	
1	0	1	
1	1	0	
1	1	1	

b54 : Selection - fixed or dynamic U/f characteristic

Adjustment range : 0 or 1.
Factory setting : 0 - **FMV 2305**,
1 - **FMV 2305 A**.
b54 = 0 : the U/f ratio is fixed and set via Prc.
b54 = 1 : the voltage applied to the motor is automatically reduced depending on the motor load. This enables a saving in energy and a reduction of noise with low and variable loads (eg. : centrifugal pump).
This automatic modification of the U/f characteristic will also modify the frequency at which the maximum voltage frequency (MVF) is reached, and the BOOST action (Pr6).
See diagram below.



Value of Prc applied when b54 = 1 :

$$(2 - \frac{\%\ load}{0.7 \times Pr5}) \times Prc, \text{ for a load} \leq Pr5.$$

Note : If the motor is at no load, the maximum voltage frequency (MVF), set via Prc, will be reached for a frequency which is twice a high.
If the load increases, the voltage increases up to the fixed U/f ratio, MVF = Prc (adjusted).

b55 : Mains loss ramps

Adjustment range : 0 or 1.
Factory setting : 0.
b55 = 0 : braking is according to Pr3 ramp, restart according to Pr2.
b55 = 1 : braking is according to Pr46 ramp, restart according to Pr36.

b56 : Treatment of non-important trips

Adjustment range : 0 or 1.
Factory setting : 0.
b56 = 0 : all trips free-wheel stop the inverter.
b56 = 1 : non-important trips (" Et ", " cL ", " Oh " and " th ") stop the inverter following the relevant ramp at the time of the trip. If b50 = 0, the relay will change state as soon as the fault is detected.

ADDENDUM

FMV 2305 16T to 100T and FMV 2305 A 16T to 120T

Section 2.2.2

(1) If a PTC motor sensor is used, move the LK11 link to position 1 (on the left).

If the motor does not have a PTC sensor do not connect anything to terminal 9 and leave LK11 link in position 2 (on the right).

Caution, the factory setting is with the PTC sensor input disabled.

Section 3.3.2

b23 : Enable filtering of analogue inputs

Adjustment range : 0 or 1.

Factory setting : 0.

b23 = 0 : the filter is disabled.

b23 = 1 : analogue inputs (terminals 5, 8, A7) and display values are filtered to avoid oscillations at the inverter output.

Note : If b23 = 1, the inverter response time is increased.

NOTE

LEROY-SOMER reserves the right to modify its product characteristics at any time to incorporate the latest technological developments. The information contained in this document may therefore be changed without prior warning.

LEROY-SOMER gives no contractual guarantee whatsoever concerning the information published in this document and cannot be held responsible for any errors it may contain, nor for any damage arising from its use.

CAUTION

- For the user's own safety, this frequency inverter must be connected to an approved earth (⏚ terminal).
- Safety devices are incorporated in the frequency inverter which, in the event of a fault, can cause the frequency inverter to cut out and consequently the motor to stop. This motor may also be brought to a halt by a mechanical blockage. In addition, voltage variations, especially power breaks, can also cause stoppages.
- Removal of the cause of the stoppage may initiate a restart with subsequent danger for some types of machines or installations, particularly those which have to conform to national safety standards.

In such cases, it is essential that the user takes appropriate precautions against restarting when the motor makes an unscheduled stop.

Although this equipment complies with current construction standards, it may cause interference. The user must then take any necessary steps to suppress it.

- The frequency inverter is designed to power a motor over and above its rated speed (up to 19 times with some settings).

If the motor is not mechanically capable of operating at such speeds, the user risks serious damage arising from mechanical deterioration of the motor.

Before programming a high speed, it is essential that the user ensures that the motor can tolerate it.

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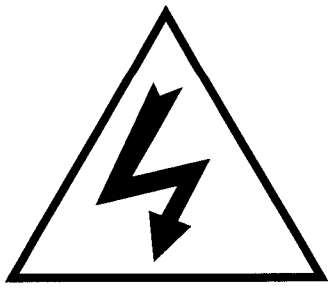


DANGER

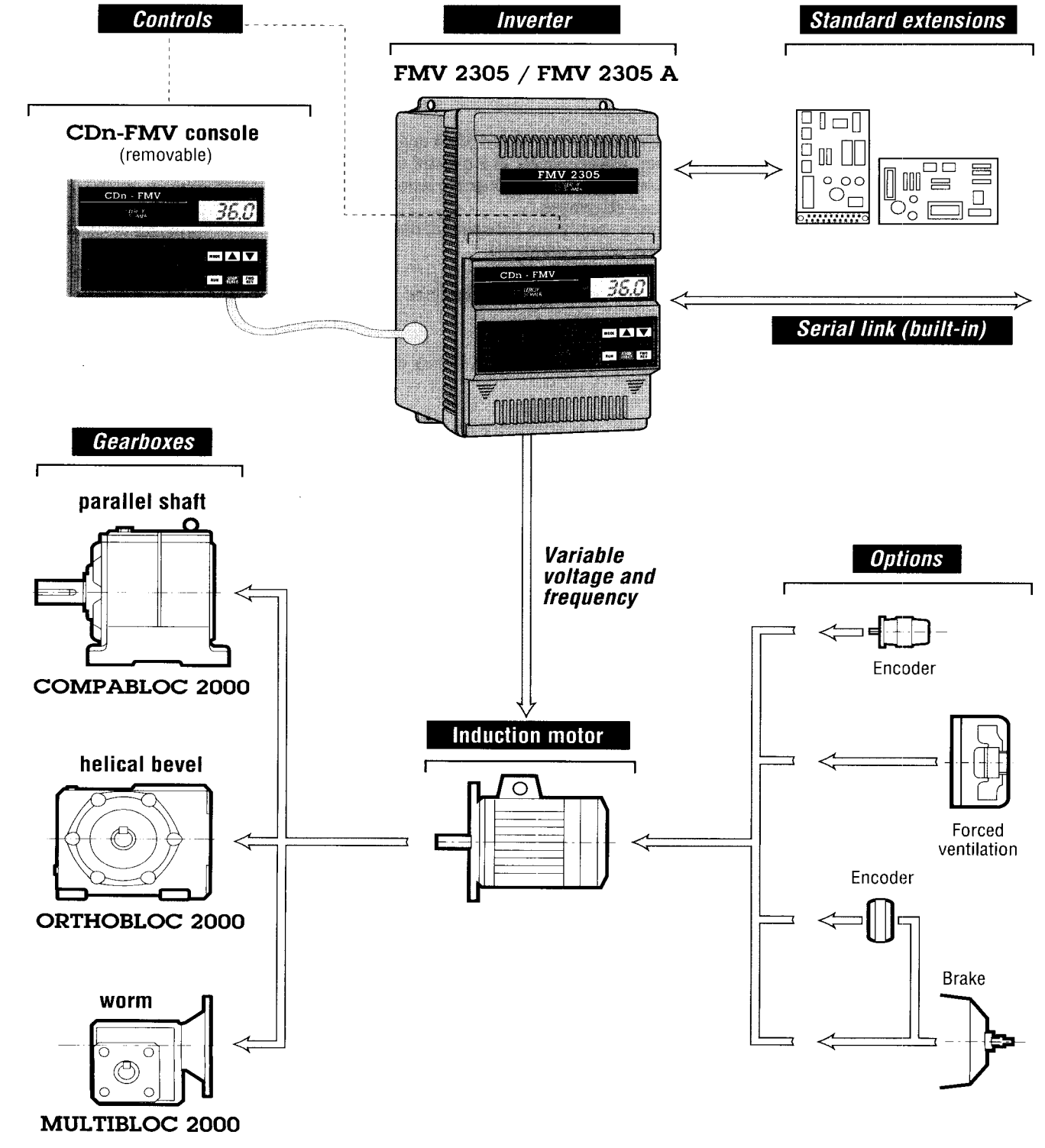
IMPORTANT

Before any intervention, whether to do with the electrics or the mechanics of the installation or machine :
- ensure that the power to the inverter has been switched off (fuse isolator or circuit-breaker) and locked manually (key),
- wait 7 minutes before working on the inverter.

PREFACE

This manual describes how to commission the **FMV 2305 and FMV 2305A** digital frequency inverter. It gives details of all procedures which should be adopted when working on the inverter and shows extension options.

FMV 2305 refers to the frequency inverter to be used on constant torque applications.
FMV 2305 A refers to the frequency inverter to be used on centrifugal torque applications.
The main difference between these two ranges is the overload capacity : **- 150 % of In for 60 s for the FMV 2305**
- 120 % of In for 60 s for the FMV 2305A



CONTENTS

1 - GENERAL INFORMATION

1.1 - General operating principle

The synchronous speed (min^{-1}) of a cage induction motor is a function of the number of poles (P) it has and the frequency (F) of its power supply. These values are related by the equation :

$$N = \frac{120 \times F}{P}$$

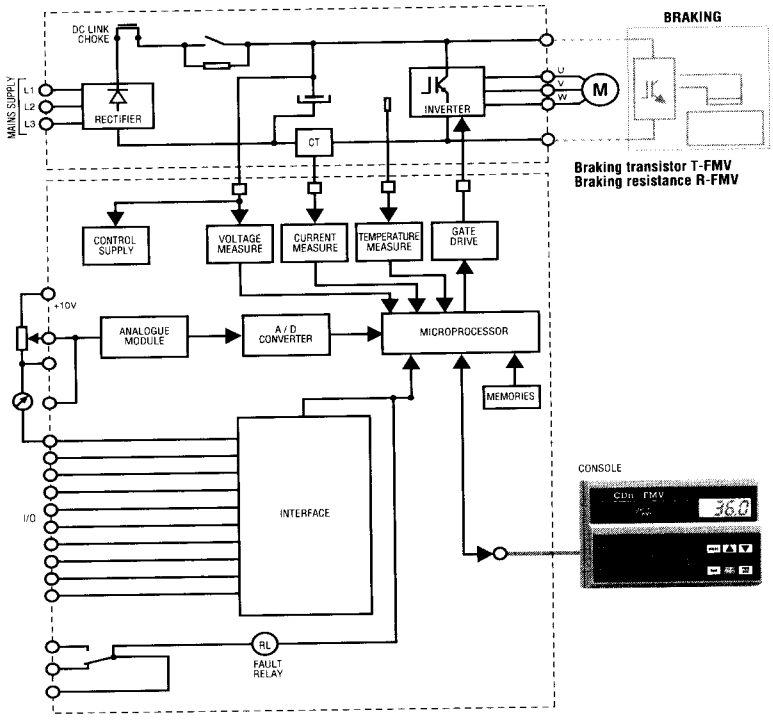
Thus, changing the frequency (F) also changes the synchronous speed (N) of a given motor.
However, changing the frequency without changing the supply voltage varies the density of magnetic flux in the motor. **FMV 2305 / FMV 2305 A inverters** cause the VOLTAGE and FREQUENCY of the output to vary simultaneously. This allows optimisation of the motor torque curve and prevents overheating.
FMV 2305 / FMV 2305 A inverters power the motor by means of a voltage generated from a steady internal D.C. voltage. Voltage modulation is achieved using the principle of pulse width modulation.
This provides the motor with a current close to a sine wave with few harmonics.
LS FMV motors are designed for use with a frequency inverter. Their magnetic circuits and windings have been adapted for use with **FMV 2305 / FMV 2305 A inverters.** Thus the motor-inverter unit provides guaranteed torque performances in all types of operating conditions.

1.1.1 - Functional description of the variable speed controller

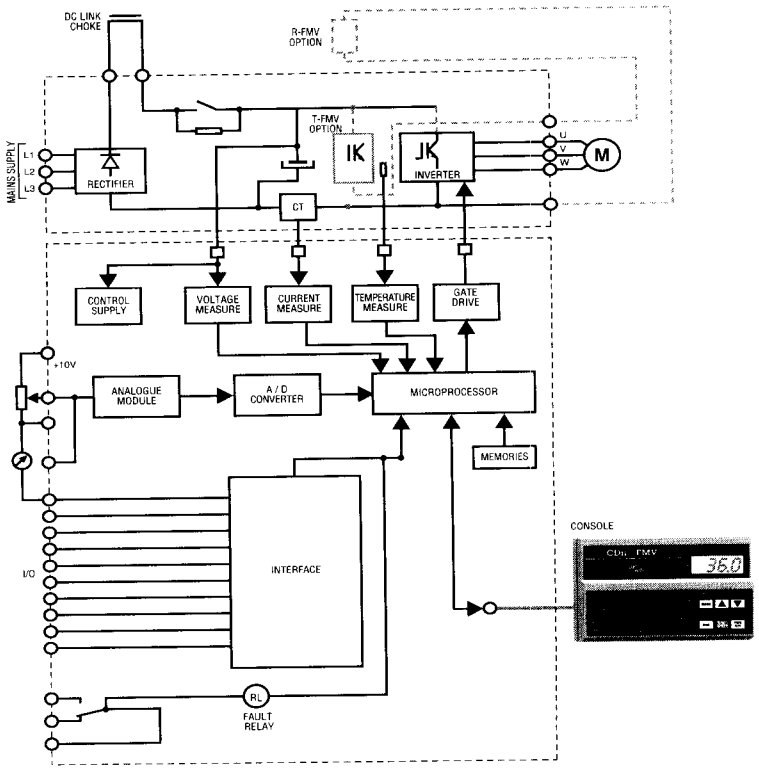
The variable speed controller comprises :
• **A RECTIFIER** for the mains supply voltage, along with a **SMOOTHING CAPACITOR** to provide a steady D.C. voltage which depends on the mains supply voltage.
• **AN INVERTER :** this D.C. voltage supplies power to the 6-transistor inverter (IGBT). The inverter converts the D.C. voltage to an A.C. voltage which is modulated in voltage and frequency.
• **AN INTERNAL CURRENT MEASUREMENT.**
• **AN ELECTRONIC CONTROL BOARD**
comprising : the microprocessor, the ASIC circuit which generates PWM and the circuits which amplify the power control signals.

1.1.2 - Operating diagrams

- FMV 2305 : 1.5 T to 11 T
- FMV 2305 A : 1.5 T to 11 T



- FMV 2305 16 T to 100 T
- FMV 2305 A : 16 T to 120 T



1.2 - Product designation

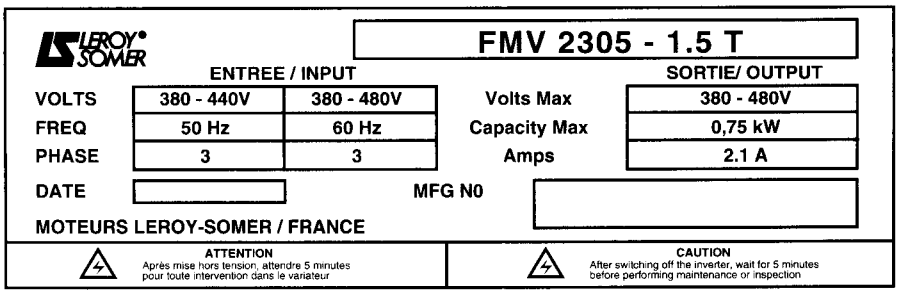
Examples : **FMV 2305 - 1.5 T and FMV 2305 A - 120T**

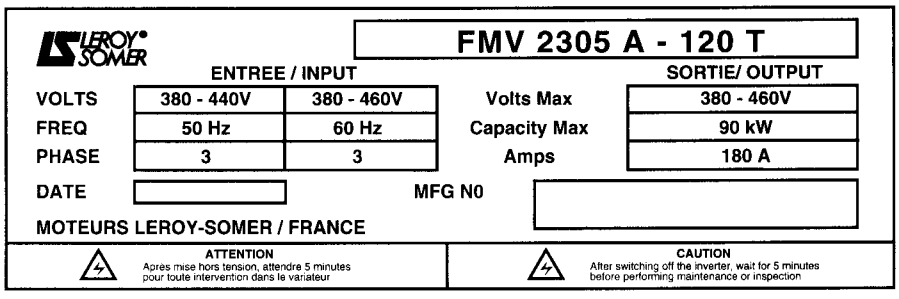
FMV 2305 : inverter for use with constant torque applications.

FMV 2305 A : inverter for use with quadratic torque applications.

1.5 = Rating in kVA at 380 V.
T = 3-phase supply.

This designation is shown on the identification plate.





1.3 - Main characteristics

The functions and characteristics of both the FMV 2305 and FMV 2305A inverter ranges are the same, especially for :

- FMV 2305 1.5 T to 11 T and FMV 2305 A 1.5 T to 11 T,

- FMV 2305 16 T to 40 T and FMV 2305 A 16 T to 50 T,

- FMV 2305 50 T to 100 T and FMV 2305 A 60 T to 120 T.

FMV 2305 1.5 T to 11 T refers to ratings : 0.75 - 1.1 - 1.5 - 2.2 - 4 - 5.5 - 7.5 kW at 380 V,

FMV 2305A 1.5 T to 11 T refers to ratings : 0.75 - 1.1 - 1.5 - 2.2 - 4 - 5.5 - 7.5 kW at 380 V,

FMV 2305 16 T to 40 T refers to ratings : 11 - 15 - 18.5 - 22 - 30 kW at 380 V,

FMV 2305A 16T to 50 T refers to ratings : 11 - 15 - 18.5 - 22 - 30 - 37 kW at 380 V,

FMV 2305 50 T to 100 T refer to ratings : 37 - 45 - 55 - 75 kW at 380 V,

FMV 2305A 60 T to 120 T refers to ratings : 45 - 55 - 75 - 90 kW at 380 V.

1.3.1 - Electrical characteristics

- FMV 2305

FMV 2305	INVERTER CAPACITY (output)		* MAXIMUM MOTOR OUTPUT POWER (4-POLE)		CONTINUOUS RATED INVERTER CURRENT (output) (A)
	kVA	kVA	kW	kW	
	380 V 50 / 60 Hz	460 V 50 / 60 Hz	380 V 50 / 60 Hz	460 V 50 / 60 Hz	
1.5 T	1,4	1,7	0,75	0,9	2.1
2 T	1,8	2,2	1,1	1,3	2.8
2.5 T	2,5	3,0	1,5	1,8	3.8
3.5 T	3,7	4,5	2,2	2,7	5.6
5.5 T	6,2	7,6	4	4,8	9.5
8 T	7,9	9,6	5,5	6,7	12.0
11 T	10,5	12,7	7,5	9,1	16.0
16 T	16,5	19,9	11	13,3	25
22 T	20,4	24,7	15	18,2	31
27 T	25,0	30,3	18,5	22,4	38
33 T	30,2	36,6	22	26,6	46
40 T	38,8	47,0	30	36,3	59
50 T	50,0	60,5	37	44,8	76
60 T	59,9	72,5	45	54,5	91
75 T	72,4	87,6	55	66,6	110
100 T	98,7	119,5	75	90,8	150

- FMV 2305 A

FMV 2305A	INVERTER CAPACITY (output)		* MAXIMUM MOTOR OUTPUT POWER (4-POLE)		CONTINUOUS RATED INVERTER CURRENT (output) (A)
	kVA	kVA	kW	kW	
	380 V 50 / 60 Hz	460 V 50 / 60 Hz	380 V 50 / 60 Hz	460 V 50 / 60 Hz	
1.5 T	1,4	1,7	0,75	0,9	2.1
2 T	1,8	2,2	1,1	1,3	2.8
2.5 T	2,5	3,0	1,5	1,8	3.8
3.5 T	3,7	4,5	2,2	2,7	5.6
5.5 T	6.2	7.6	4	4,8	9.5
8 T	7,9	9,6	5,5	6,7	12.0
11 T	10,5	12,7	7,5	9,1	16.0
16 T	16,5	19,9	11	13,3	25
22 T	21,0	25,5	15	18,2	32
27 T	25,0	30,3	18,5	22,4	38
33 T	30,2	36,6	22	26,6	46
40 T	40,8	49,4	30	36,3	62
50 T	46,0	55,8	37	44,8	70
60 T	59,9	72,5	45	54,5	91
75 T	72,4	87,6	55	66,6	110
100 T	94,8	114,7	75	90,8	144
120 T	118,5	143,4	90	108,9	180

* Always ensure that the rated motor current is lower than the continuous rated inverter current.

1.3.2 - Characteristics and functions

MODEL	FMV 2305 1.5 T to 11 T FMV 2305A 1.5 T to 11 T	FMV 2305 16 T to 40 T FMV 2305A 16 T to 50 T	FMV 2305 50 T to 100 T FMV 2305A 60 T to 120 T
CHARACTERISTICS SUPPLY VOLTAGE (3-phase)	380 to 440V ±10 % - 50 Hz ± 2 Hz 380 to 480V ±10 % - 60 Hz ± 2 Hz	380 to 460V ±10 % - 50/60 Hz ± 2 Hz	
REGULATION MODE	Voltage/Frequency characteristic		
REGULATION	Frequency Reference. " Torque " Reference : current regulation in the motor. Speed regulation if encoder feedback is used on the motor		
CHARACTERISTIC Voltage (U) / Frequency (f)	U/f ratio may be adjusted by the base frequency. Fixed U/f ratio : constant torque, or dynamic U/f ratio : variable torque.		
SWITCHING FREQUENCY (Adjustment)/ OUTPUT FREQUENCY (Maximum range)	Adjustment / Maximum range 2.9 kHz / 0 to 240 Hz 5.9 kHz / 0 to 480 Hz 8.8 kHz / 0 to 480 Hz 11.7 kHz / 0 to 960 Hz	Adjustment / Maximum range 2.9 kHz / 0 to 240 Hz 5.9 kHz / 0 to 480 Hz	Adjustment / Maximum range 2.9 kHz / 0 to 240 Hz
	The frequency range shown above may be reduced for a given switching frequency : Eg : 0 to 120 Hz for switching f = 11.7 kHz.		
FREQUENCY PRECISION	±0.01 % of the maximum adjusted range for a digital reference : serial link or CDn.FMV console.		
FREQUENCY RESOLUTION	± 0.1 Hz, F_{output} = 0 to 120 Hz ± 0.2 Hz, F_{output} = 0 to 240 Hz ± 0.4 Hz, F_{output} = 0 to 480 Hz ± 0.8 Hz, F_{output} = 0 to 960 Hz	± 0.1 Hz, F_{output} = 0 to 120 Hz ± 0.2 Hz, F_{output} = 0 to 240 Hz ± 0.4 Hz, F_{output} = 0 to 480 Hz	± 0.1 Hz, F_{output} = 0 to 120 Hz ± 0.2 Hz, F_{output} = 0 to 240 Hz
SLIP COMPENSATION (Open loop)	Adjustment : 0 to 5 Hz, $F_{output} \leq$ 120 Hz 0 to 10 Hz, $F_{output} \leq$ 240 Hz 0 to 20 Hz, $F_{output} \leq$ 480 Hz 0 to 25 Hz, $F_{output} \leq$ 960 Hz	Adjustment : 0 to 5 Hz, $F_{output} \leq$ 120 Hz 0 to 10 Hz, $F_{output} \leq$ 240 Hz 0 to 20 Hz, $F_{output} \leq$ 480 Hz	Adjustment : 0 to 5 Hz, $F_{output} \leq$ 120 Hz 0 to 10 Hz, $F_{output} \leq$ 240 Hz
OVERLOAD CAPACITY	FMV 2305 : 150% I_N for 60 s.		
	FMV 2305A : 120% I_N for 180 s.	FMV 2305A : 120% I_N for 60 s.	
BRAKING	Hypersynchronous braking. D.C. injection braking. Braking with resistances (optional).		
TORQUE AT LOW SPEED (Boost)	Manual or automatic adjustment of output voltage.		

MODEL	FMV 2305 1.5 T to 11 T FMV 2305A 1.5 T to 11 T	FMV 2305 16 T to 40 T FMV 2305A 16 T to 50 T	FMV 2305 50 T to 100 T FMV 2305A 60 T to 120 T
CONTROL INVERTER CONTROL	Via CDn-FMV console (removable). Via terminal block. Via serial link.		
FREQUENCY REFERENCE	Analogue setpoint : – 0 to 10 V D.C. (input impedance 110 kΩ) : voltage source or 10kΩ potentiometer, – -10 to +10 V D.C. (input impedance 110 kΩ) : voltage source, – 4 to 20 mA – 20 to 4 mA – 0 to 20 mA } Input impedance 100 Ω. Digital setpoint : – programmable via CDn-FMV console, – programmable via serial link.		
TORQUE REFERENCE	Analogue setpoint : 0 to +10 V D.C. (input impedance 27 kΩ) : voltage source or 10 kΩ potentiometer. Digital setpoint : programmable via serial link.	Analogue setpoint : 0 to +10 V D.C. (input impedance110 kΩ) : voltage source or 10 kΩ potentiometer. Digital setpoint : programmable via serial link.	
ENCODER FEEDBACK	Closed loop control of real speed using encoder : 15 pulses per motor pole per revolution.		
FWD/REV OPERATION	Via CDn-FMV console (removable). Via terminal block. Via serial link.		
OPERATION ACCELERATION/ DECELERATION RAMPS	Separate adjustments from 0.2 to 600 s : linear characteristic.		
PRESET SPEEDS	Either : 4 programmable speeds + jog (inch) function. Or : 8 programmable speeds.		
ACCELERATION/ DECELERATION RAMPS WITH PRESET SPEEDS	Each preset speed has an associated acceleration and deceleration ramp.		
FREQUENCY LIMITATION Minimum / Maximum	0 Hz ≤ F min ≤ F max ≤ F maximum range.		
FREQUENCY SKIPPING	3 frequency skips with adjustable skip band, to prevent mechanical resonance phenomena.		
JOGGING (INCHING)	Adjustable speed : 0 to 15 Hz. Acceleration and deceleration ramps : 0.2 to 600 s.		
STOPPING MODE	Freewheel stop : instantaneous break of motor power supply. Ramp. D.C. injection braking.		
D.C. INJECTION BRAKING	Braking torque : - FMV 2305 : 40 to 150 % I_N - FMV 2305 A : 40 to 120 % I_N. Braking until motor stop and holding torque for 1 second.		
AUTOMATIC RESTART	Power on : starting after 120 ms. Power cut : restart after 120 ms. After a trip : - wait 1 second for RESET, - immediate restart after RESET. After a " STOP " command : restart as soon as run command is received.		
FLYING RESTART	Possibility of starting the inverter when the motor is rotating.		

MODEL	FMV 2305 1.5 T to 11 T FMV 2305A 1.5 T to 11 T	FMV 2305 16 T to 40 T FMV 2305A 16 T to 50 T	FMV 2305 50 T to 100 T FMV 2305A 60 T to 120 T
TRIPS LOSS OF CURRENT REFERENCE (4-20 / 20-4 mA)	Setpoint value < 3.5 mA.		
CPU FAULT	Internal inverter fault at power up.		
EXTERNAL TRIP	Trip forced by the terminal block or via the serial link.		
OVERLOAD (I x t)	Electronic thermal relay.		
AMBIENT TEMPERATURE OUT OF RANGE	–	-10 °C > $T_{ambient}$ +50°C < $T_{ambient}$	
OVERHEATED INVERTER	–		Inverter protected by thermal probes on the heatsink.
OVERHEATED MOTOR (PTC)	PTC resistance > 3 kΩ (motor too hot). PTC resistance < 100 Ω (PTC short-circuit protection).		
OVERCURRENT	185 % of the rated current.		
SHORT-CIRCUIT PHASE - PHASE PHASE - EARTH	Protection against short-circuits between phases and earths.		
PHASE LOSS / PHASE IMBALANCE	A phase voltage less than 380V - 15 % or phase imbalance.		
WARNING OF LOW SUPPLY	Power < 380V -15 % : ramp down to zero speed. Trip on phase loss if the voltage does not rise above 380V -15 % before the motor-inverter reaches zero speed.		
UNDERVOLTAGE	D.C. bus voltage below its operating range.		
OVERVOLTAGE	For an inappropriate deceleration time or for too high a voltage on the mains supply.		
INTERNAL SUPPLY FAULT	Monitoring of inverter internal power supplies.		
RESET	Trip reset : " STOP / RESET " key on the console or terminal 13 on the terminal block.		

MODEL	FMV 2305 1.5 T to 11 T FMV 2305A 1.5 T to 11 T	FMV 2305 16 T to 40 T FMV 2305A 16 T to 50 T	FMV 2305 50 T to 100 T FMV 2305A 60 T to 120 T
INDICATIONS DISPLAY	On the CDn-FMV console : - output frequency in Hz, or - output current as a % of the rated current I_N.		
PROGRAMMABLE RELAY	240 V A.C. relay - 7A (resistive load).		
	Activated when : – the inverter is healthy, or – at speed.	Activated when : – the inverter is running, or – at speed.	
MINIMUM SPEED RELAY	–	240 V A.C. - 7A (resistive load). Activated when the speed is greater than the minimum speed.	
INVERTER STATUS RELAY	Programmable relay.	240 V A.C. - 7A (resistive load). Activated when inverter healthy.	
PROGRAMMABLE LOGIC OUTPUT	Open collector : – 30 mA, internal source 24V, – 250 mA, external source to 0V.		
	Activated when : - the inverter is running, or - the speed is at its minimum.	Activated when : - there is an overload alarm, or - the inverter is healthy.	
FREQUENCY OUTPUT : DIGITAL SIGNAL	–	Open collector + 24 / 0 V ±10 mA Square wave signal with same frequency as U/f output.	
FREQUENCY OUTPUT : ANALOGUE SIGNAL	0 to +10V, 5 mA, precision ± 2 %, 0V = the minimum adjusted frequency, 10V = the maximum adjusted frequency.		
LOAD OUTPUT : ANALOGUE SIGNAL	0 to ± 10 V, 5 mA, precision ± 10 % for speeds above 15 Hz. 0 V : no load. +10 V : FMV 2305 150 % I_N (driven load), FMV 2305A 120 % I_N (driven load). -10 V : FMV 2305 150 % I_N (driven motor), FMV 2305A 120 % I_N (driven motor).		
DIAGNOSTICS	The last 10 trip codes are stored.		
SERIAL LINK	Communication : PLC, PC, etc. RS 485, RS 422 and RS 232. Protocol ANSI x 3.28 - 2.5 - A4.		
OPTIONS RFI FILTER FLT - FMV	Reduction of high frequency interference on the supply. This filter fits inside the inverter.	Please consult LEROY-SOMER	Please consult LEROY-SOMER
RESISTANCE BRAKING	Transistor external to the inverter : T - FMV 30. Resistance unit external to the inverter : R - FMV 320, R - FMV 640, R - FMV 1000.	Transistor within the inverter : T - FMV 25, T - FMV 50, T - FMV 75. Resistance unit external to the inverter : R - FMV 320, R - FMV 640, R - FMV 1000, R - FMV 2000.	Transistor within the inverter : T - FMV 150. Resistance unit external to the inverter : R - FMV 1000, R - FMV 2000, R - FMV 3000, R - FMV 4000.

1.4 - Environmental characteristics

1.4.1

	FMV 2305 1.5 T to 11 T FMV 2305 A 1.5 T to 11 T	FMV 2305 16 T to 100 T FMV 2305 A 16 T to 120 T
Casing protection	IP 10	IP 00
Storage temperature	- 40°C to + 50°C.	
Operating temperature	- 10°C to + 50°C.	
Altitude	• ≤ 1000 m. • Derating from 1000m to 4000m : 1 % of I_N per 100 m above 1000m.	
Humidity	Non condensing.	95 % of relative humidity at 40°C non condensing.
Vibration	1g (5 to 150 Hz)	0.5 g (5 to 150 Hz)

1.4.2 - Installation in a cubicle

Installing the inverter in a cubicle calls for special precautions with regard to the size of the enclosure. It is important to check that there is sufficient heat dissipation.

a - Table of losses in Watts (W)

- FMV 2305

Switching frequency	Rating															
	1.5 T	2 T	2.5 T	3.5 T	5.5 T	8 T	11 T	16 T	22 T	27 T	33 T	40 T	50 T	60 T	75 T	100 T
2.9 kHz	72	72	117	117	170	286	286	358	404	490	572	698	934	1106	1322	1897
5.9 kHz	82	82	132	132	195	346	346	440	498	615	724	886	–	–	–	–
8.8 kHz	92	92	147	147	220	401	401	–	–	–	–	–	–	–	–	–
11.7 kHz	102	102	162	162	250	456	456	–	–	–	–	–	–	–	–	–

- FMV 2305 A

Switching frequency	Rating																
	1.5 T	2 T	2.5 T	3.5 T	5.5 T	8 T	11 T	16 T	22 T	27 T	33 T	40 T	50 T	60 T	75 T	100 T	120 T
2.9 kHz	72	72	117	117	170	286	286	368	442	491	593	761	834	1124	1357	1774	2323
5.9 kHz	82	82	132	132	195	346	346	455	544	606	742	961	1068	–	–	–	–
8.8 kHz	92	92	147	147	220	401	401	–	–	–	–	–	–	–	–	–	–
11.7 kHz	102	102	162	162	250	456	456	–	–	–	–	–	–	–	–	–	–

b - Installation in a non-ventilated cubicle

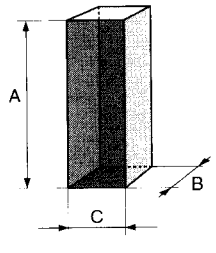
The minimum required surface area for heat exchange is calculated from the following equation : $S = \frac{Pi}{k\,(Tj - Tamb)}$

where : Pi = loss from all heat-producing equipment (W).
Tj = maximum permissible ambient operating temperature (°C).
Tamb = maximum ambient external temperature (°C).
k = thermal transmission cœfficient.
S = heat exchange area (m^2).

Table of k cœfficients

Materials	k cœfficient
2 mm sheet steel	5,5

Example : installation of an FMV 2305 16T in a non-ventilated IP 54 cubicle (cubicle placed against a wall).
Pi = 440W.
Tj = 50°C (FMV 2305 and FMV 2305 A).
Tamb = 25 °C for example.
k = 5.5.
The calculated heat exchange area is S = 3.2 m^2 and S =2 (AB) + AC + BC.
Taking the following values for A and B :
A = 1.8 m (height) - B = 0.5 m (depth),
the minimum calculation for C = 0.61 m.



c - Installation in a ventilated cubicle

If it is possible to use forced ventilation (FV), the size of cubicle can be reduced. A minimum space of 100 mm should be left around the inverter.
The flow rate of FV in m^3/h is calculated using the formula $V = \frac{3.1\ Pi}{Tj - Tamb} = 55 m^3/h$ for the previous example (non IP 54 cubicle).

1.5 - Dimensions and weight

1.5.1 - Weight

FMV 2305	Weight (kg)
1.5 T	4.4
2 T	4.4
2.5 T	5.65
3.5 T	5.65
5.5 T	5.65
8 T	6.4
11 T	6.4
16 T	22.3
22 T	22.3
27 T	22.3
33 T	24.0
40 T	24.0
50 T	54.0
60 T	56.0
75 T	56.0
100 T	56.0

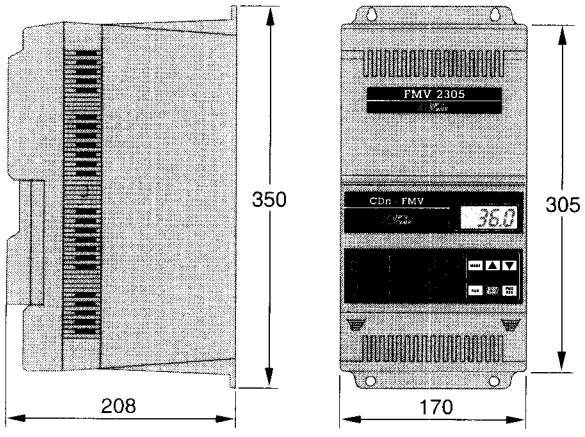
FMV 2305 A	Weight (kg)
1.5 T	4.4
2 T	4.4
2.5 T	5.65
3.5 T	5.65
5.5 T	5.65
8 T	6.4
11 T	6.4
16 T	22.3
22 T	22.3
27 T	22.3
33 T	24.0
40 T	24.0
50 T	24.0
60 T	56.0
75 T	56.0
100 T	56.0
120 T	58.0

1.5.2 - Dimensions

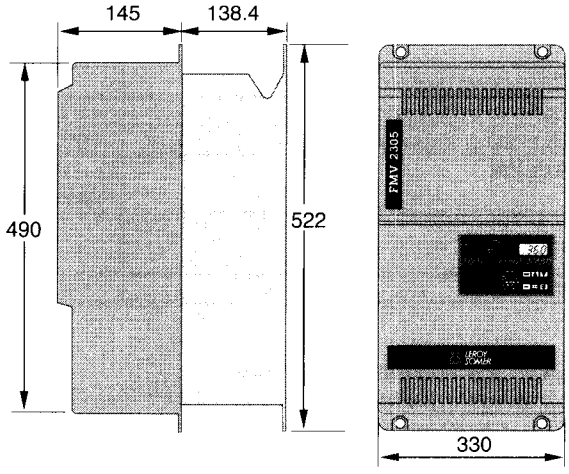
These are identical for inverters :

- **FMV 2305 1.5 T to 11 T and FMV 2305 A 1.5 T to 11 T**
- **FMV 2305 16 T to 40 T and FMV 2305 A 16 T to 50 T**
- **FMV 2305 50 T to 100 T and FMV 2305 A 60 T to 120 T**

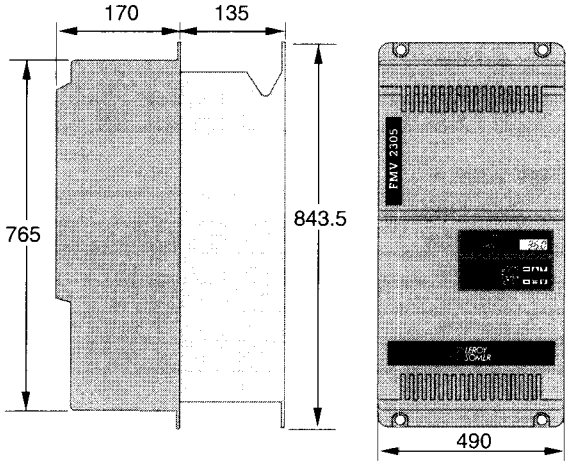
FMV 2305 1.5 T to 11 T
FMV 2305A 1.5 T to 11 T



FMV 2305 16 T to 40 T
FMV 2305A 16 T to 50 T



FMV 2305 50 T to 100 T
FMV 2305A 60 T to 120 T



1.6 - Installations

1.6.1 - Checks

Before installing the inverter, ensure that :
- the inverter has not been damaged in transit,
- the identification plate corresponds to the power supply and the motor.

1.6.2 - Mounting instructions

FMV 2305 and **FMV 2305A** inverters must be installed in a risk-free atmosphere, away from conductive dust, corrosive gases and water leaks.
Should this not be the case, it is recommended that they be installed in an enclosure or a cubicle. (See section 1.4.2 for cubicle dimensions).
Mount the inverter upright, allowing 100 mm all round it.
To prevent overheating problems, install the inverters side by side and not on top of each other.
Never obstruct the inverter ventilation louvres.

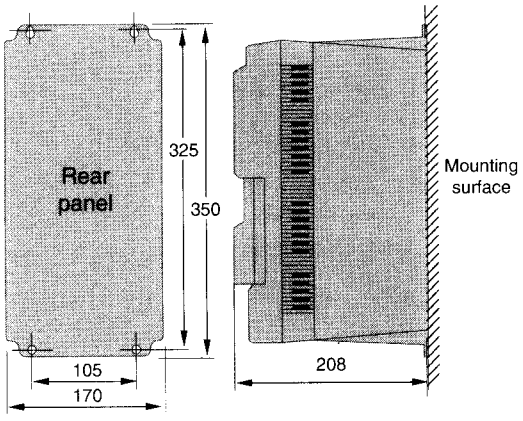
1.6.3 - Mounting dimensions showing the rear of the inverter

These are identical for inverters :

- **FMV 2305 1.5 T to 11T and FMV 2305 A 1.5 T to 11T**
- **FMV 2305 16 T to 40 T and FMV 2305 A 16 T to 50 T**
- **FMV 2305 50 T to 100 T and FMV 2305 A 60 T to 120 T**

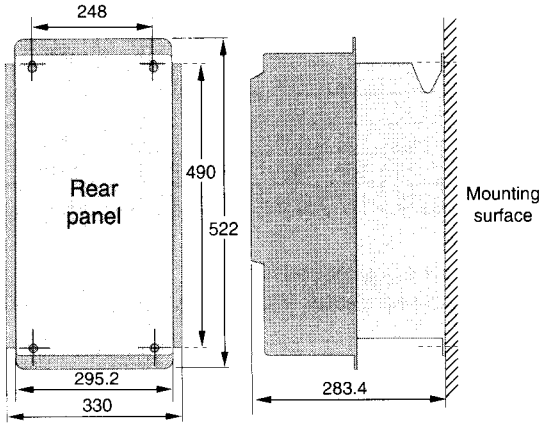
FMV 2305 1.5 T to 11 T
FMV 2305 A 1.5 T to 11 T

Fixed using 4 Ø 6.5 mm holes on the rear panel.



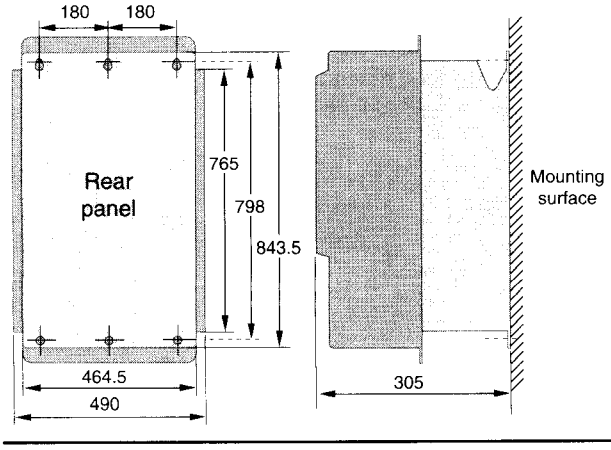
FMV 2305 16 T to 40 T
FMV 2305 A 16 T to 50 T

Fixed using 4 Ø 6 mm (M6) holes on the rear panel.



FMV 2305 50 T to 100 T
FMV 2305 A 60 T to 120 T

Fixed using 6 Ø 8 mm (M8) holes on the rear panel.



1.6.4 - Dimensions for heatsink through-panel mounting (IP 54 cubicle)

These are identical for inverters :

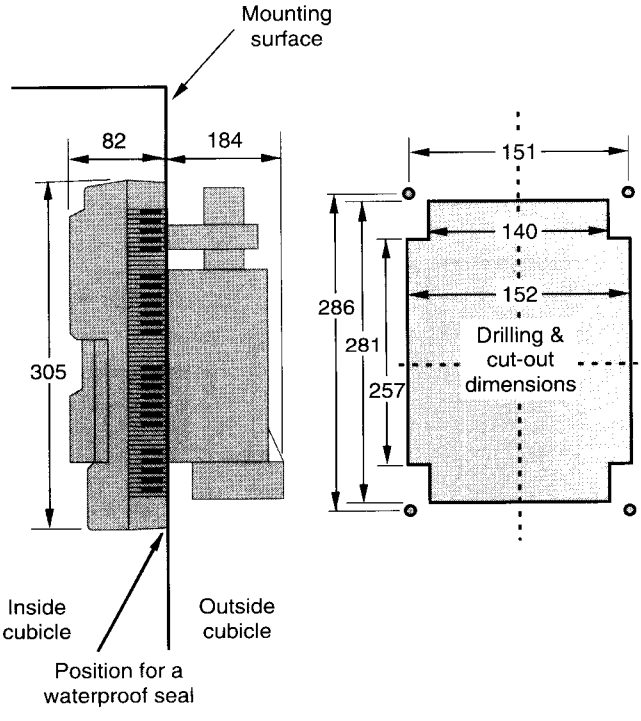
- **FMV 2305 1.5 T to 11T and FMV 2305 A 1.5 T to 11T**
- **FMV 2305 16 T to 40 T and FMV 2305 A 16 T to 50 T**
- **FMV 2305 50 T to 100 T and FMV 2305 A 60 T to 120 T**

FMV 2305 1.5 T to 11 T
FMV 2305 A 1.5 T to 11 T

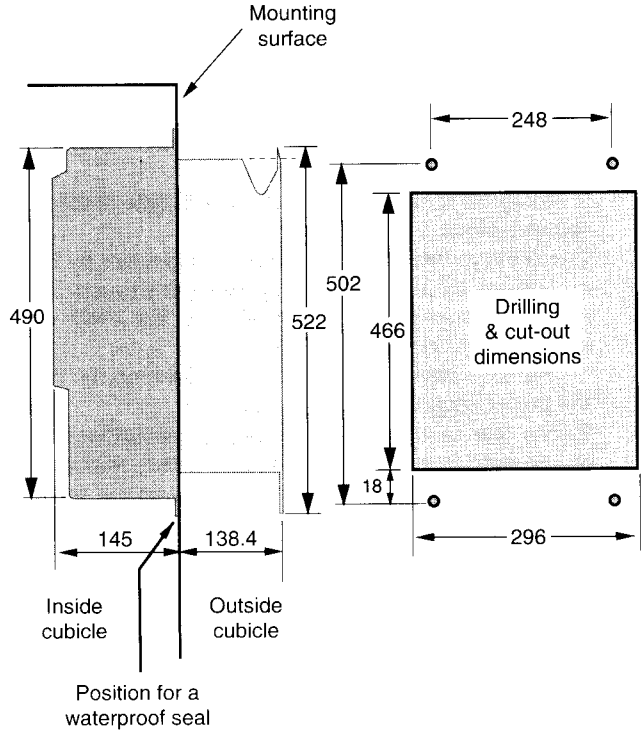
The moulded plastic rear case should be removed :

1 - Remove the terminal block cover.
2 - Undo the 2 M4 x 10 screws on each side of the power terminal block.
3 - Lift the terminal block edge of the top cover by 30 °.
4 - Unhook the top cover on the other side (upper side).
5 - This releases the top cover and the IN50 control board, which can be removed.
6 - Remove the 4 M4 x 10 screws in each corner holding the power section to the rear case.
7 - The rear case is released, and is of no further use.
8 - Repeat steps 5 to 1 in reverse order, replacing the IN 50 control board on the top cover, then the top cover on the power section.

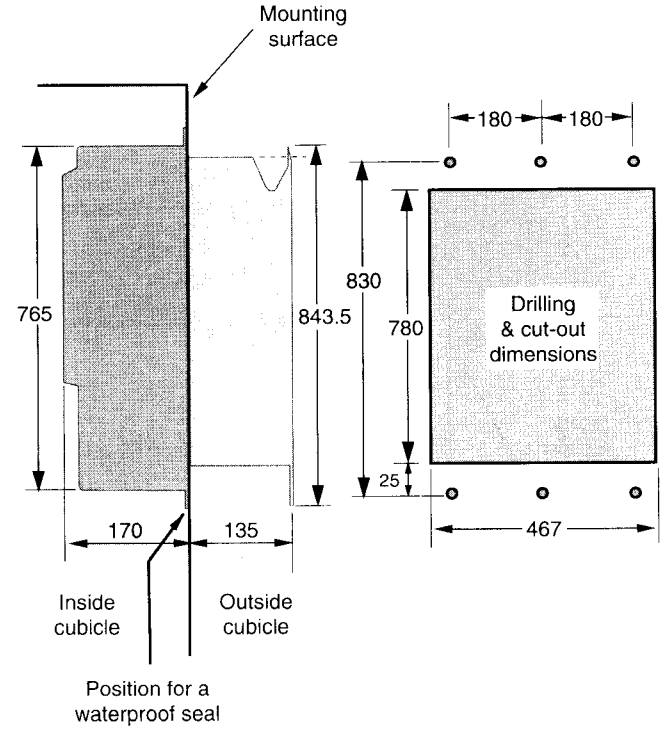
Fixed using 4 Ø 6.5 mm holes.



FMV 2305 16 T to 40 T
FMV 2305 A 16 T to 50 T
Fixed using 4 Ø 6 mm (M6) holes on the front panel heatsink mounting surface.

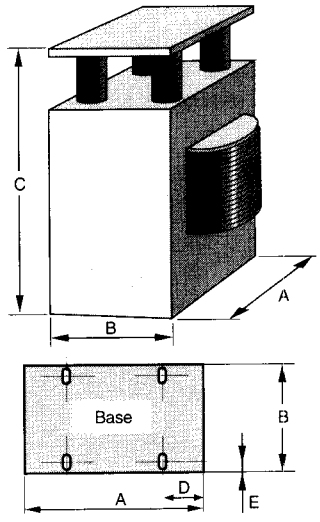


FMV 2305 50 T to 100 T
FMV 2305 A 60 T to 120 T
Fixed using 6 Ø 8 mm (M8) holes on the front panel heatsink mounting surface.



1.6.5 - Installation of dc link choke
FMV 2305 16T to 100T - FMV 2305 A 16T to 120T
The dc link choke is mounted externally to the inverter module (see section 2.5.4 for wiring instructions).

Dimensions and fixing



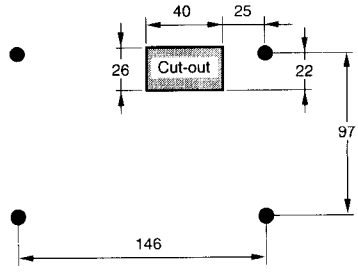
FMV 2305 FMV 2305 A	A	B	C	D	E	Fixing screw Ø
16 T	118	70	155	27	7	M8
22 T	118	82	155	27	7	M8
27 T	137	84	175	24	10	M8
33 T	118	95	155	27	7	M8
40 T	137	116	175	24	10	M8
50 T	167	132	200	39	8	M8
60 T	167	119	197	39	8	M8
75 T	195	138	230	46	11	M10
100 T	215	166	254	51	13	M10
120 T	215	177	254	51	13	M10

Note :
- Dimensions are expressed in mm.
- The total width is greater than measurement B because of the coil.

1.6.6 - Remote installation of the CDn-FMV console
This is mounted :
- either directly onto the inverter top cover,
- or remotely on the cubicle front panel. The distance must be less than 100 metres.

It is connected via a SUB-D 9-pin plug located at the rear of the console.

Mounting on cubicle front panel
Fixed using 4 Ø 4.0 mm holes.
Diagram for cut-out and drilling :

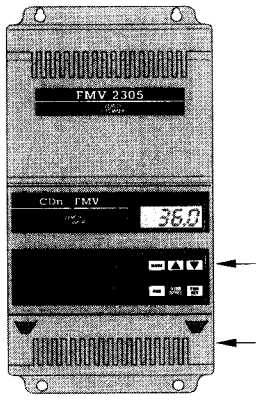


2 - CONNECTIONS

Connection is identical for inverters :
- **FMV 2305 1.5T to 11T** and **FMV 2305 A 1.5T to 11T**.
- **FMV 2305 16T to 100T** and **FMV 2305 A 16T to 120T**.

• FMV 2305 1.5T to 11T and FMV 2305 A 1.5T to 11T.
To gain access to the control and power terminal blocks, remove the lower cover by sliding it downwards (see illustration below) :

Inverter top cover

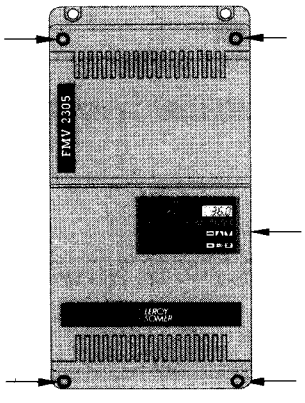


CDn-FMV console

Lower cover

• FMV 2305 16T to 100T and FMV 2305 A 16T to 120T.
To gain access to the control and power terminal blocks, remove the top cover which is held in place by 4 captive Phillips screws, one in each corner (see illustration below) :

Inverter top cover

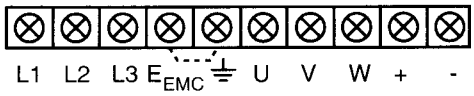


Phillips screw

CDn-FMV console

2.1 - Power terminal block

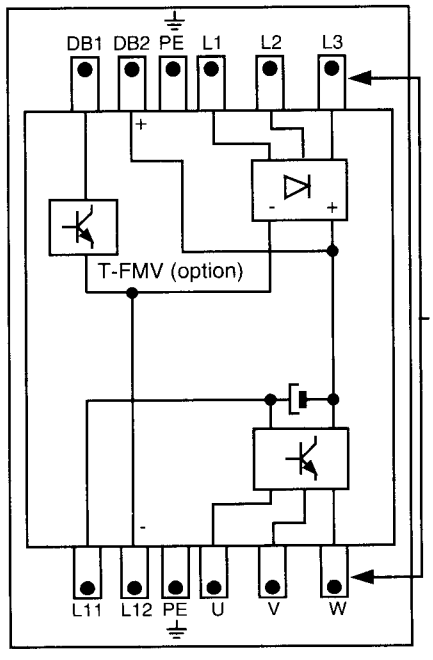
2.1.1 - FMV 2305 1.5T to 11T and FMV 2305 A 1.5T to 11T
Located at the bottom of the inverter, the terminal block comprises 10 cross-head screw terminals.



Reference	Function
L1 - L2 - L3	Inverter 3-phase supply.
U - V - W	Motor power supply.
+, -	Braking unit connection.
⏚	Earthing connections to power supply and motor.
E_{EMC}	Connection to earth (⏚) for the internal RFI filter.

Caution :
- Never connect a circuit such as a bank of capacitors between the inverter output and the motor.
- Never connect the A.C. supply to the inverter U.V.W. terminals.

2.1.2 - FMV 2305 16T to 100T and FMV 2305 A 16T to 120T
Located at the top and bottom of the inverter, the terminal block comprises 12 M8 screw clamp terminals (tightening torque = 8.5 Nm).



Power terminals

Reference	Function
L1 - L2 - L3	Inverter 3-phase supply.
U - V - W	Motor power supply.
L11 - L12	Connection for dc link choke (supplied with the inverter).
DB1 - DB2	Connection for R-FMV braking resistances.
PE ⏚	Earth connection (mains supply and motor).

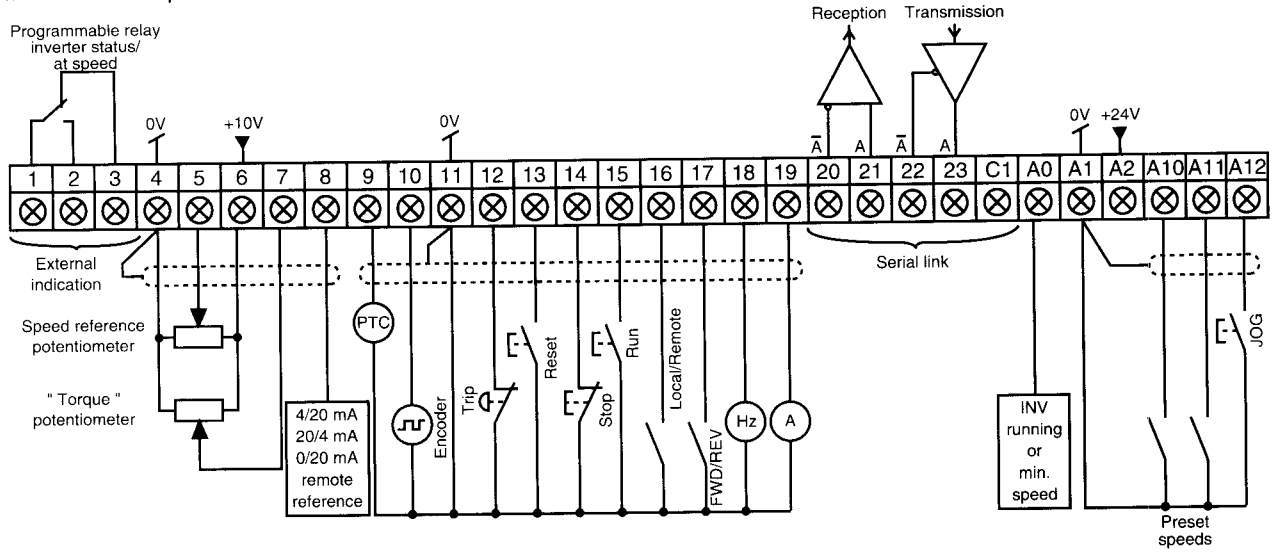
Note : The inverter D.C. bus can be accessed between terminals L12 (-) and DB2 (+).

Caution :
- Never connect a circuit such as a bank of capacitors between the inverter output and the motor.
- Never connect the A.C. supply to the inverter U.V.W. terminals.

2.2 - Control terminal block

2.2.1 - FMV 2305 1.5T to 11T and FMV 2305 A 1.5T to 11T

Located above the power terminal block, on the control board (IN 50), this comprises 30 screw terminals.



Terminal	Function	Electrical characteristic
1 2 3	Programmable relay : inverter status / at speed 1 - common point, 2 - normally open contact, 3 - normally closed contact.	240V A.C., 7A, resistive load. Contact 1 - 2 closed when : - the inverter is switched on and is not tripped (b50 = 0), or - the set speed has been reached (b50 = 1).
4	0V common to terminals 11 and A1.	0V floating.
5	Local frequency reference	Input impedance = 110 kΩ : - 0 to 10V D.C. : voltage source or 10 kΩ potentiometer, - ±10V D.C. : external voltage source.
6	Power supply for frequency or torque reference potentiometers.	+ 10V D.C., ± 2 %, 5mA maximum.
7	" Torque " reference (b0 = 0) or " torque " limitation (b0 = 1).	Input impedance = 27 kΩ : - 0 to 10V D.C. : voltage source or 10 kΩ potentiometer.
8	Remote frequency reference.	Input impedance = 100 Ω. Current signal : - 4 to 20 mA, - 20 to 4 mA, - 0 to 20 mA.
9	Motor probe input (PTC type).	U output < 2.5V (possibility of 1 to 6 PTCs, 250 Ω in series). Trip threshold : 3 kΩ, ± 15 %. Reset threshold : 1.8 kΩ, ± 15 %. Short-circuit protection : resistance ≤ 100 Ω. (1)
10	Encoder feedback input.	Encoder signal : - 0/+ 5V, 16 mA, open collector (maximum voltage = 24V), - rise/fall time ≤ 50 µs, - 15 pulses per motor pole per revolution.
11	0V common to terminals 4 and A1.	0V floating.
12	External trip.	0V interrupt* = external fault. (2)
13	Reset.	0V pulse* = trip reset. (2)
14	Stop.	0V interrupt* = stop command. (2)
15	Run.	0V pulse* = run command. (2)
16	Selection of frequency reference : local or remote.	Connection to 0V = remote reference (current). Not connected = local reference (voltage). (2)
17	Selection of direction of rotation : Forward / Reverse.	Connection to 0V = reverse. Not connected = forward. (2)
18	Frequency output signal.	0 to + 10V D.C., 5 mA, ± 2 % precision, 0V = minimum frequency (Pr 0), 10V D.C. = maximum frequency (Pr 1).

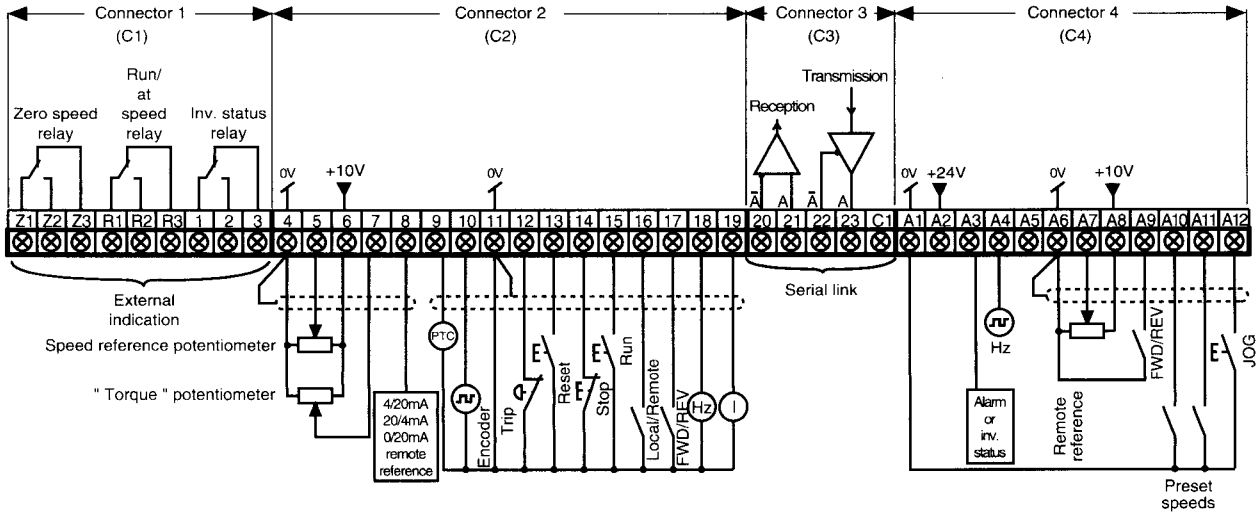
Terminal	Function	Electrical characteristic
19	Current output signal.	0 to +10V D.C., 5 mA, ± 10 % precision (frequency > 15 Hz), 0V = no load, +10V = 150 % I_N (operating as a motor), -10V = 150 % I_N (operating as a generator).
20	Serial link, $\overline{A}$ or B reception	Two cables for differential reception. (See section 2.4) Differential input : - Input impedance = 3.5 kΩ, - 0 to 5V D.C., - U (A - $\overline{A}$) > + 0.2V = high logic level, - U (A - $\overline{A}$) < - 0.2V = low logic level.
21	Serial link, A reception	
22	Serial link, $\overline{A}$ or B transmission	Two cables for differential transmission. (See section 2.4) Differential output : - 0 to 5V D.C., - current capability ± 60 mA, - high logic level A = 5V, $\overline{A}$ = 0V, - low logic level A = 0V, $\overline{A}$ = 5V.
23	Serial link, A transmission	
C1	Serial link, 0V.	0V isolated from terminals 4, 11 and A1.
A0	Programmable logic output : inverter running/minimum speed.	Output at 0V (2) when : - the inverter is running (b53 = 0), or - the speed is at minimum (b53 = 1). Open collector : 0 / + 24V D.C. 30 mA, internal source. 250 mA, external source.
A1	0V common to terminals 4 and 11.	0V floating.
A2	General power supply (encoder, external relay).	+ 24 V D.C., ± 10 %, 100 mA.
A10 A11	Logic inputs for the selection of preset speeds.	Selection via a binary combination of 3 preset speeds plus the setpoint. (2)
A12	Programmable logic input : inching (JOG) or extension for preset speeds.	Input used for : - the inching command (JOG), (b20 = 0). or - selection via a binary combination (of A10, A11 and A12) of 7 preset speeds plus the setpoint, (b20 = 1). (2)

* Momentary state ≥ 16 ms.
(1) If the PTC probe is being used, set jumper PL6 on the IN 50 board between 2 and 3.
(2) It is possible to have positive control logic (+24V) on terminals 12, 13, 14, 15, 16, 17, A10, A11 and A12 by setting jumper PL5 between 2 and 3.

Note : Control signal connections may be affected by interference (keep them away from power cables). We recommend the use of shielded cables with one end of the shielding connected to the 0V on the inverter.

2.2.2 - FMV 2305 16T to 100T - FMV 2305 A 16T to 120T

Located at the bottom of the control board (IN 40), the terminal block comprises 42 screw terminals in 4 removable connectors.



	Terminal	Function	Electrical characteristic
C1	Z1 Z2 Z3	Relay : minimum speed. Z1 : common point, Z2 : normally open contact, Z3 : normally closed contact.	• 240V A.C., 7A, resistive load. Contact 1 - 2 closed when : the speed is at minimum.
C1	R1 R2 R3	Programmable relay : inverter running / at speed. R1 : common point, R2 : normally open contact, R3 : normally closed contact.	• 240V A.C., 7A, resistive load. Contact 1 - 2 closed when : - the inverter is running (b50 = 0), or - at speed (b50 = 1).
C1	1 2 3	Relay : inverter status. 1 : common point, 2 : normally open contact, 3 : normally closed contact.	• 240V A.C., 7A, resistive load. Contact 1 - 2 closed when : the inverter is switched on and not tripped.
C2	4	0V common to terminals 11, A1 and A6.	0V floating.
C2	5	Local frequency reference	Input impedance = 110 kΩ : - 0 to 10V D.C. : voltage source or 10 kΩ potentiometer, - ±10V D.C. : external voltage source.
C2	6	Power supply for frequency and torque reference potentiometers.	+10V D.C., ± 2 %, 10 mA maximum. (Terminal 6 connected to terminal A8).
C2	7	" Torque " reference (b0 = 0) or " torque " limitation (b0 = 1).	Input impedance = 110 kΩ : 0 to 10V D.C. : voltage source or 10 kΩ potentiometer.
C2	8	Remote frequency reference.	Input impedance = 100 Ω. Current signal : - 4 to 20 mA, - 20 to 4 mA, - 0 to 20 mA.
C2	9	Motor probe input (PTC type).	U output < 2.5V (possibility of 1 to 6 PTCs, 250 Ω in series). - Trip threshold : 3 kΩ, ± 15 %. - Reset threshold : 1.8 kΩ, ± 15 %. Short-circuit protection : resistance ≤ 100 Ω. (1)
C2	10	Encoder feedback input.	Encoder signal : - 0 / +5V, 16 mA open collector (maximum voltage = 24V), - rise/fall time ≤ 50 µs, - 15 pulses per motor pole per revolution.
C2	11	0V common to terminals 4, A1 and A6.	0V floating.
C2	12	External trip.	0V interrupt* = external trip. (2)
C2	13	Reset.	0V pulse* = trip reset. (2)
C2	14	Stop.	0V interrupt* = stop command. (2)
C2	15	Run.	0V pulse* = run command. (2)
C2	16	Selection of frequency reference : local or remote.	Connection to 0V = remote reference (current). Not connected = local reference (voltage). (2)
C2	17	Local selection of direction of rotation : Forward / Reverse.	Connection to 0V = reverse. Not connected = forward. (2)
C2	18	Frequency output signal.	0 to ± 10V D.C., 5 mA, ± 2 % precision, 0V = minimum frequency (Pr 0), 10V D.C. = maximum frequency (Pr 1).
C2	19	Current output signal.	0 to + 10V D.C., 5 mA, ± 10 % precision (frequency > 15 Hz). 0V = no load, + 10V = 150 % I_N (operating as a motor), - 10V = 150 % I_N (operating as a generator).

	Terminal	Function	Electrical characteristic
C3	20	Serial link, $\overline{A}$ or B reception	Two cables for differential reception. Differential input : - 0 to 5V D.C., - Input impedance = 3.5 kΩ, - U (A - $\overline{A}$) > + 0.2V = high logic level, - U (A - $\overline{A}$) < - 0.2V = low logic level. (3)
	21	Serial link, A reception	
	22	Serial link, $\overline{A}$ or B transmission	Two cables for differential transmission. Differential output : - 0 to 5V D.C., - current capability ± 60 mA, - high logic level A = 5V, $\overline{A}$ = 0V, - low logic level A = 0V, $\overline{A}$ = 5V. (3)
	23	Serial link, A transmission	
	C1	Serial link, 0V.	0V isolated from terminals 4, 11, A1 and A6.
C4	A1	0V common to terminals 4, 11 and A6.	0V floating.
	A2	General power supply (encoder, external relay etc).	+ 24V D.C., ± 10 %, 100 mA.
	A3	Programmable logic output : overload alarm or inverter status.	Output at 0V (2) when : - inverter overloaded (b53 = 0), or - the inverter is not tripped (b53 = 1). Open collector : 0 / + 24V D.C. 30 mA : internal source. 250 mA : external source.
	A4	Output frequency signal.	Open collector + 24/0V ± 10 mA. Square wave frequency signal : inverter output frequency.
	A5	Output frequency signal X30.	Open collector +24/0V, ± 10 mA. Square wave frequency signal : inverter output frequency X30.
	A6	0V common to terminals 4, 11 and A1.	0V floating.
	A7	Frequency reference (remote).	Input impedance : 110 kΩ : - 0 to 10V D.C. : voltage source or 10 kΩ potentiometer, - ±10V D.C. : external source.
	A8	Power supply for the speed reference potentiometer (remote).	+ 10V D.C., ± 2 %, 10 mA maximum. (Terminal A8 connected to terminal 6).
	A9	Direction of rotation : Forward / Reverse (remote).	Connection to 0V = reverse (operating direction reversed). Not connected = forward . (2)
	A10 - A11	Logic inputs for selection of preset speeds.	Selection via a binary combination of 3 preset speeds plus the setpoint. (2)
	A12	Programmable logic input : inching (JOG) or extension for preset speeds.	Input used for : - the inching command (JOG) (b20 = 0), or - selection via a binary combination (of A10, A11 and A12) of 7 preset speeds plus the setpoint (b20 = 1). (2)

* Momentary state ≥ 16 ms.

(1) If the motor PTC probe is being used, disconnect resistor R462 (1.5 kΩ) mounted on pins on the IN 40 board.
If no PTC probe is being used, do not connect anything to terminal 9.

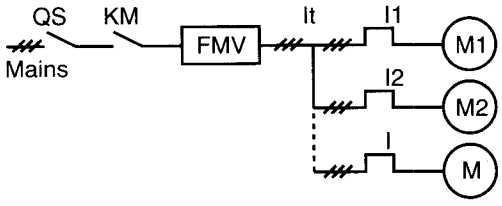
(2) It is possible to have positive control logic (+24V) at terminals 12, 13, 14, 15, 16, 17, A10, A11 and A12 by moving the jumper from LK1 to LK2.

(3) See section 2.4 for the specific serial link connections.

Note : Control signal connections may be affected by interference (keep them away from power cables). We recommend the use of shielded cables with one end of the shielding connected to the 0V on the inverter.

2.3 - Special connections

2.3.1 - Combination of motors in parallel

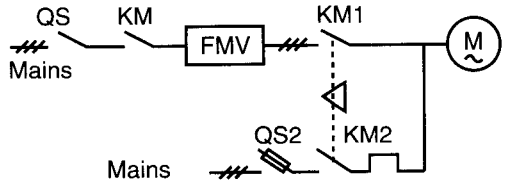


Several motors with different power ratings can be supplied by a single frequency inverter. Each motor must be protected by a thermal relay.

Calculation of the inverter rating :

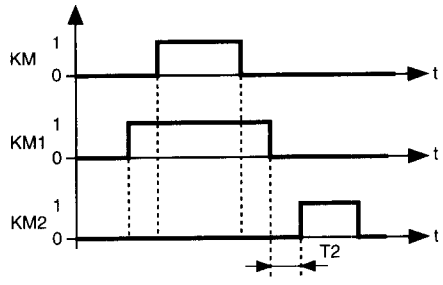
I_N inverter > I1 + I2 + ... + I

2.3.2 - Connecting the motor directly to the mains supply (by-pass)



Sequence to follow :
- KM1 must be activated before KM,
- mechanical locking between KM1 and KM2.

The time T2 = 1.5s must be strictly adhered to. This corresponds to demagnetization of the motor.



2.3.3 - Parallel D.C. bus connection of inverters

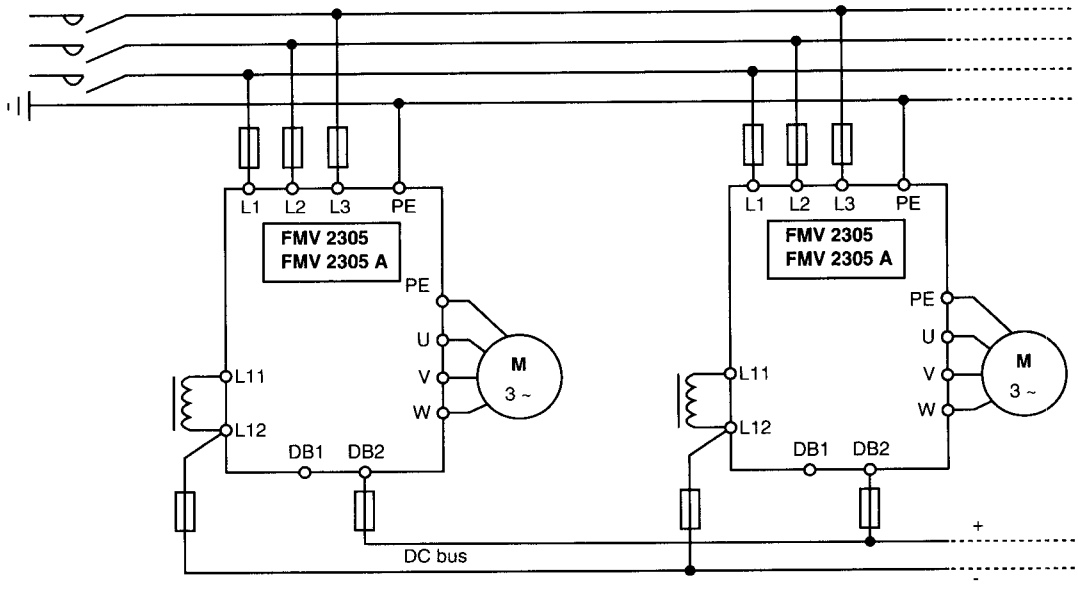
a) General

Only inverters **FMV 2305 16T to 100T** and **FMV 2305 A 16T to 120T** can be connected in this way. Inverters which are connected in parallel should have the **same rating** and should be switched on simultaneously.

The D.C. bus of each inverter should be fitted with fuses.

This type of assembly is used in applications where the inverters brake one after the other. It avoids the need to use optional braking units.

b) Connection diagram



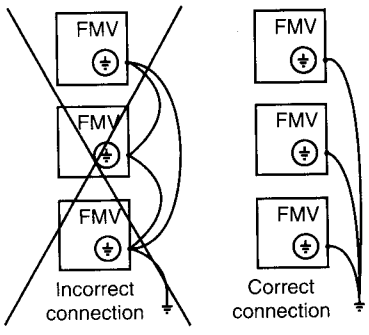
c) D.C. bus current and protection

- The value of current shown is the value at rated power.
- The fuses used in the D.C. bus should be type gI.

FMV rating	16T	22T	27T	33T	40T	50T	60T	75T	100T	120T *
I_N bus (A)	22	30	37	44	60	74	90	110	150	180
gI fuse (A)	32	40	50	63	80	100	125	160	200	250

* **FMV 2305 A** only.

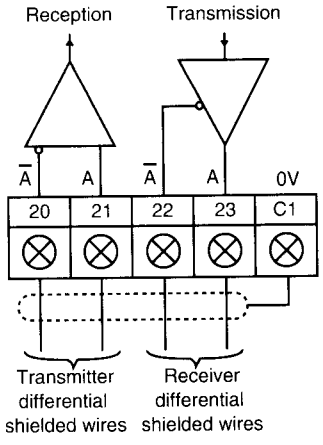
2.3.4 - Connecting the earths of several inverters



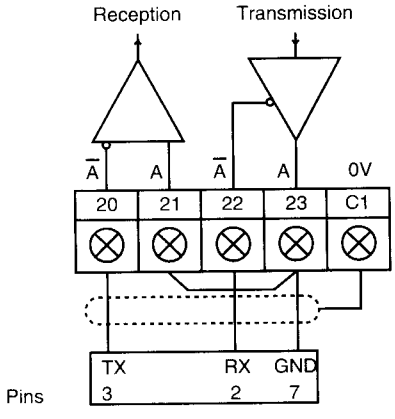
2.4 - Connecting the serial link

There are two standards for the serial link :
- the RS 485/RS 422 standard, which provides differential data transmission and reception using 4 wires,
- the RS 232 standard, where data transmission and reception with respect to ground is achieved using 2 wires.

Standard RS 485/RS 422 :



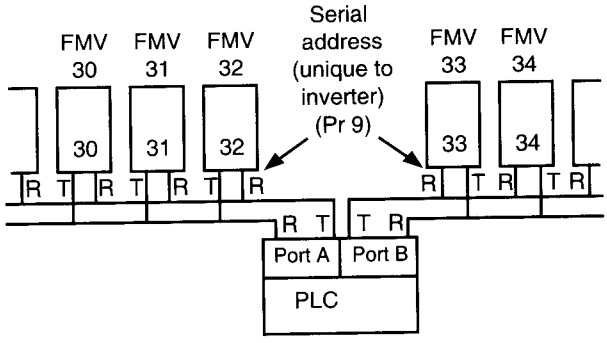
Standard RS 232 :



- RS 485 : 2 pairs of twisted shielded wires,
- characteristic impedance = 120 Ω,
- impedance matching resistance = 120 Ω,
- maximum cable length = 120 m.
- RS 422 : 2 pairs of twisted shielded wires,
- characteristic impedance = 100 Ω,
- impedance matching resistance = 100 Ω,
- maximum cable length = 120 m.
- RS 232 : shielded 3-core cable,
- no impedance matching resistance,
- maximum cable length = 15m.

Note : With the RS 485 standard, it is possible to communicate with up to 32 inverters connected on the same line from a single PLC (or PC). Each inverter has a unique serial address.

RS 485 serial link with 32 inverters per port



R : receiver input
T : transmitter output

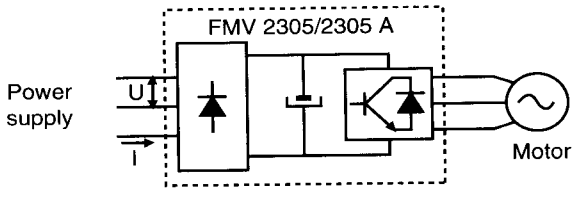
2.5 - Definition of cables and protective devices

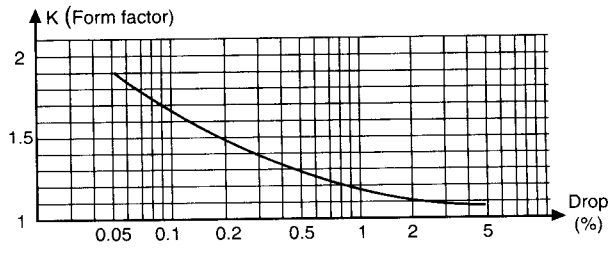
2.5.1 - General

The current consumed by the inverter is not a sine wave. It comprises a fundamental at 50 or 60 Hz and some harmonics. The fundamental I1 determines the active power. **Pact = I1 x U x √3.**
The sum of the fundamental and the harmonics gives the rms value (I) of the current and determines the apparent power. **PS = I x U x √3.**

2.5.2 - Form factor K = I / I1

This is the calculation of the coefficient for oversizing the power supply and the protective devices. All these values depend essentially on the power supply impedance, and hence on the inductive voltage drop of the mains referred to the power of the inverter.





Source inductive voltage drop referred to the power of the inverter expressed as a %.

2.5.3 - Calculating the value of the current I

$$I = \frac{P(mot) \times K}{\sqrt{3} \times U \times \eta\ (inv) \times \eta(mot)}$$

I = rms current (mains supply).
U = rms voltage (mains supply).
K = form factor (read from the curve on the previous page).
P(mot) = motor power rating.
η(inv) = inverter efficiency (around 95 % at rated load).
η(mot) = motor efficiency.

Comment : if the power of the installation is not known, and hence the inductive voltage drop, take the motor current (see table on next page) and apply a multiplying coefficient of 1.5.

Note : This calculation is used to determine the minimum diameter of a cable for continuous operation. The voltage drop produced by this cable should then be taken into account.

2.5.4 - Wiring precautions

a) Control cables

These should be made of copper, shielded, and have a minimum diameter of 0.5 mm^2.

b) Power cables

These should be multi-core, made of copper, and should be insulated to 600V for A.C. voltages and 1000V for D.C. voltages.

2.5.5 - Inverter protection

Caution :

• In no way do the tables on the next page replace current standards and information.

• 3-phase supply choke.
It is not essential to use these chokes, particularly if the inverter has a smoothing (D.C. link) choke on the D.C. bus. However, if you wish to isolate the inverter from the power supply, select the values recommended in the following tables.

• Very long motor cables.
1) We recommend reducing the switching frequency (b14) to 2.9 kHz because of the capacitive effects produced in the cables.
2) Under 100 metres, no precautions are necessary prior to installation, however for distances of 50 to 100 metres, it may be necessary to install 3-phase motor chokes.
Over 100 metres, we recommend the installation of 3–phase chokes as close as possible to the inverter, between the inverter and the motor, ideally using the values recommended in the following tables.

3) When 3-phase chokes are used, the switching frequency should be reduced in order to reduce joule losses in these chokes.

Protection of FMV 2305 1.5T to 100T inverters

FMV 2305 rating	Motor rating (kW)	Motor current (A)	Line current (A)	gl type mains supply fuses (A)	Power cable diameter (mm2)	Supply choke Motor choke (mH)
1.5T	0,75	2,1	5,4	6,0	1,5	5
2T	1,1	2,8	5,9	6,0	1,5	5
2.5T	1,5	3,8	5,3	6,0	1,5	5
3.5T	2,2	5,6	7,1	10	1,5	2,5
5.5T	4	9,5	9,5	12	2,5	2,5
8T	5,5	12	13,7	16	2,5	1,5
11T	7,5	16	16,3	20	4	1,5
16T	11	25	26,5	32	6	1
22T	15	31	29,5	40	6	0,65
27T	18,5	38	36,4	40	6	0,65
33T	22	46	49,1	63	10	0,4
40T	30	59	57,9	63	10	0,4
50T	37	76	72,7	80	25	0,28
60T	45	91	90	100	35	0,28
75T	55	110	106	125	50	0,19
100T	75	150	144	160	70	0,14

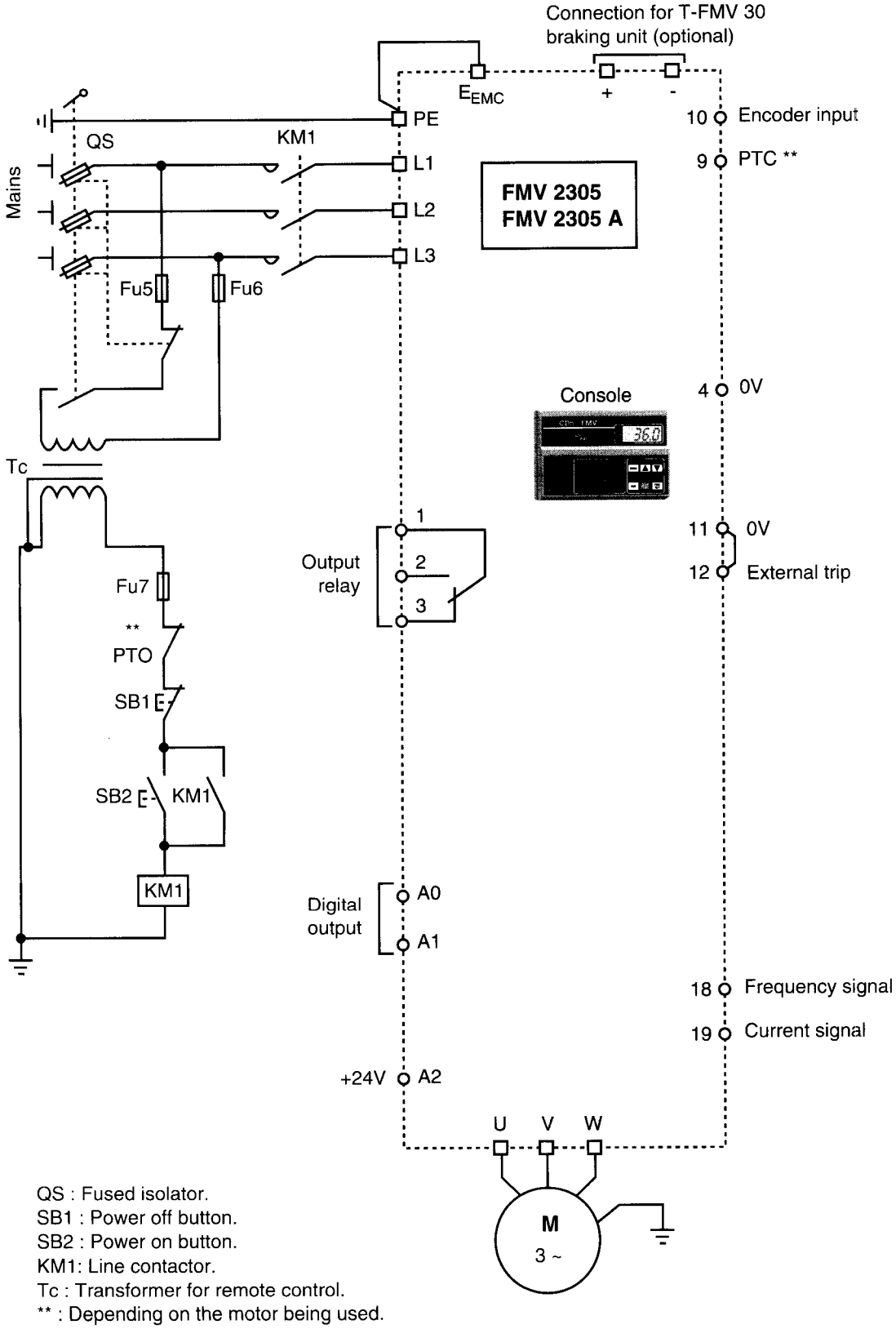
Protection of FMV 2305 A 1.5T to 120T inverters

FMV 2305 A rating	Motor rating (kW)	Motor current (A)	Line current (A)	gl type mains supply fuses (A)	Power cable diameter (mm2)	Supply choke Motor choke (mH)
1.5T	0,75	2,1	5,4	6,0	1,5	5
2T	1,1	2,8	5,9	6,0	1,5	5
2,5T	1,5	3,8	5,3	6,0	1,5	5
3.5T	2,2	5,6	7,1	10	1,5	2,5
5.5T	4	9,5	9,5	12	2,5	2,5
8T	5,5	12	13,7	16	2,5	1,5
11T	7,5	16	16,3	20	4	1,5
16T	11	25	25,6	32	6	1
22T	15	32	31,8	40	6	0,65
27T	18,5	38	35	40	6	0,65
33T	22	46	49,1	63	10	0,4
40T	30	62	61	80	25	0,4
50T	37	70	67	80	25	0,28
60T	45	91	90	100	35	0,28
75T	55	110	106	125	50	0,19
100T	75	144	139	160	70	0,14
120T	90	180	173	200	95	0,14

2.6 - Connection diagrams

2.6.1 - FMV 2305 1.5T to 11T and FMV 2305 A 1.5T to 11T

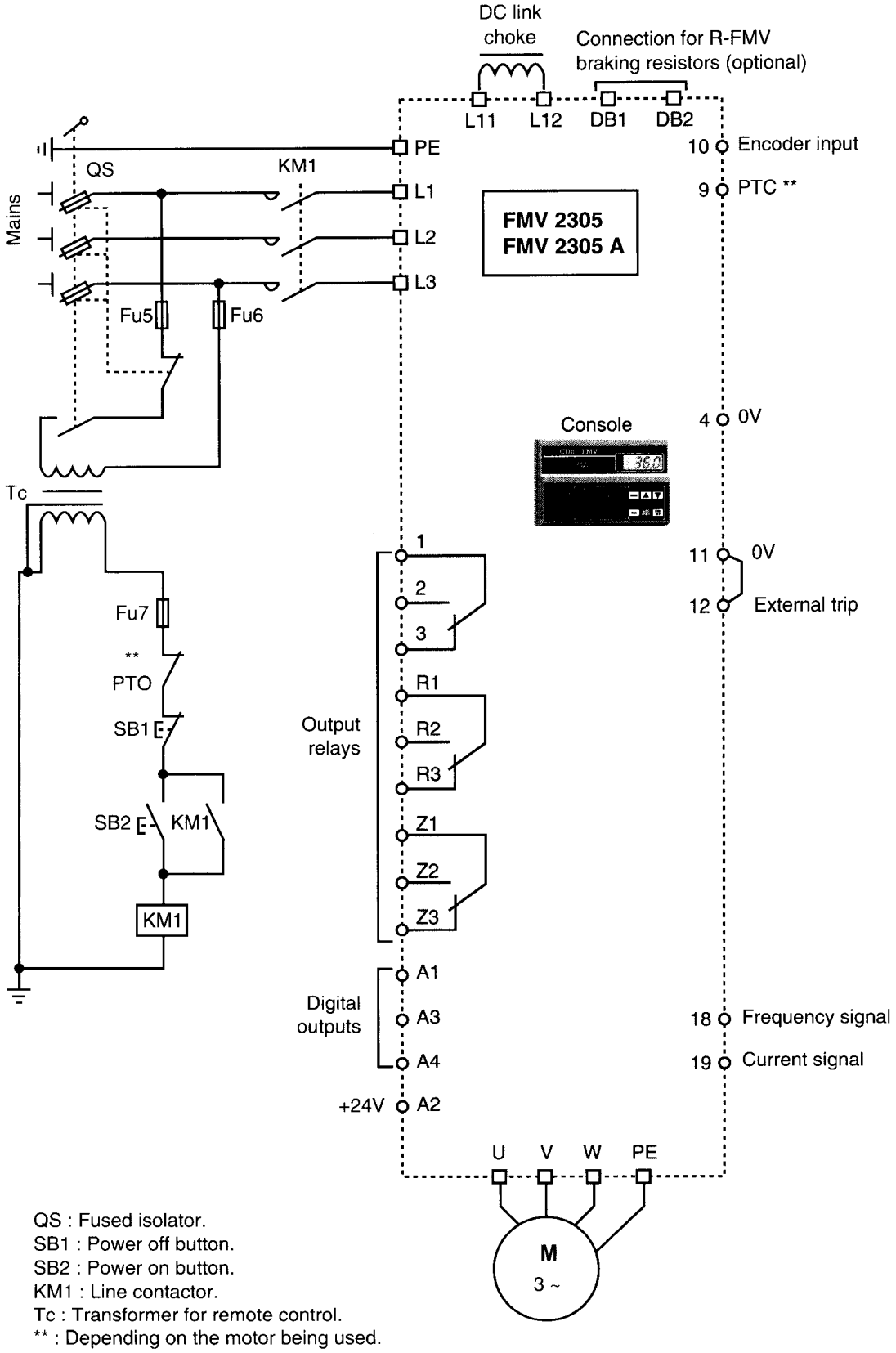
Controlled via **CDn-FMV** console.



QS : Fused isolator.
SB1 : Power off button.
SB2 : Power on button.
KM1: Line contactor.
Tc : Transformer for remote control.
** : Depending on the motor being used.

Note : The contactor coil should be fitted with an RC circuit.

2.6.2 - FMV 2305 16T to 100Tet FMV 2305 A 16T to 120T
Controlled via **CDn-FMV** console.

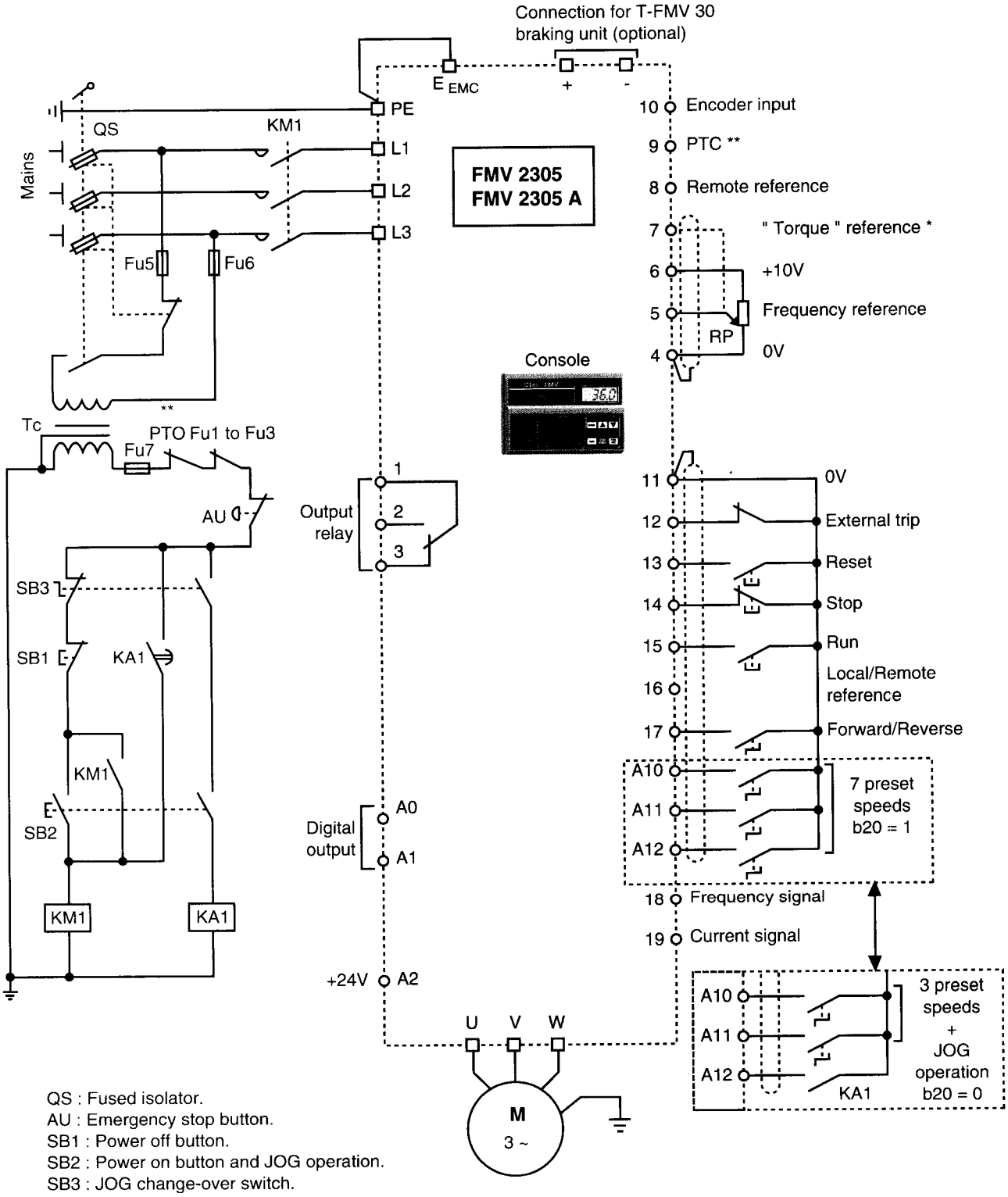


QS : Fused isolator.
SB1 : Power off button.
SB2 : Power on button.
KM1 : Line contactor.
Tc : Transformer for remote control.
** : Depending on the motor being used.

Note : The contactor coil should be fitted with an RC circuit.

2.6.3 - FMV 2305 1.5T to 11T and FMV 2305 A 1.5T to 11T

Controlled via terminal block.

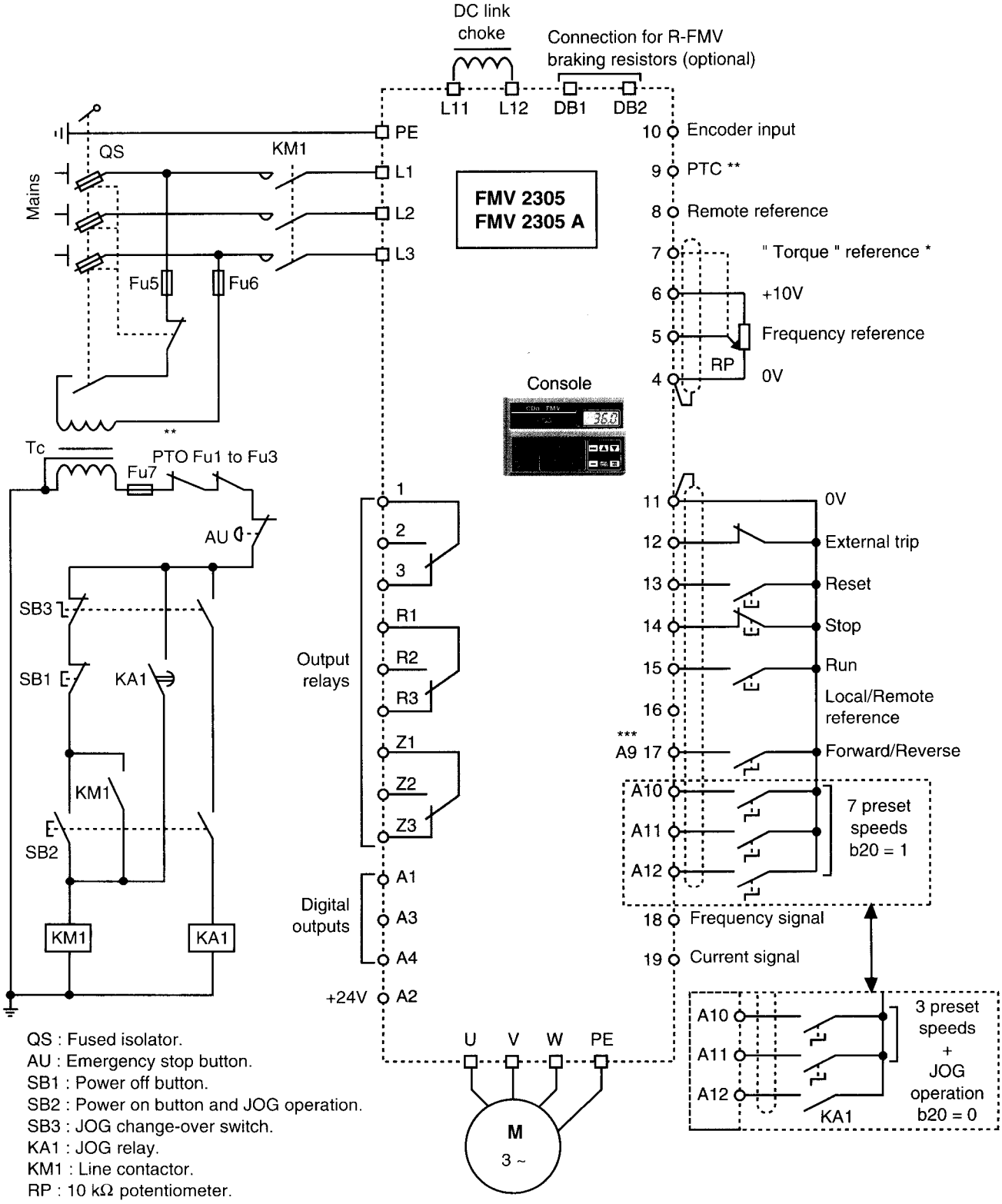


QS : Fused isolator.
AU : Emergency stop button.
SB1 : Power off button.
SB2 : Power on button and JOG operation.
SB3 : JOG change-over switch.
KA1 : JOG relay.
KM1 : Line contactor.
RP : 10 kΩ potentiometer.
Tc : Transformer for remote control.
* : " Torque " limitation if controlled by frequency.
** : Depending on the motor being used.

Note: The contactor coil should be fitted with an RC circuit.

2.6.4 - FMV 2305 16T to 100T and FMV 2305 A 16T to 120T

Controlled via terminal block.

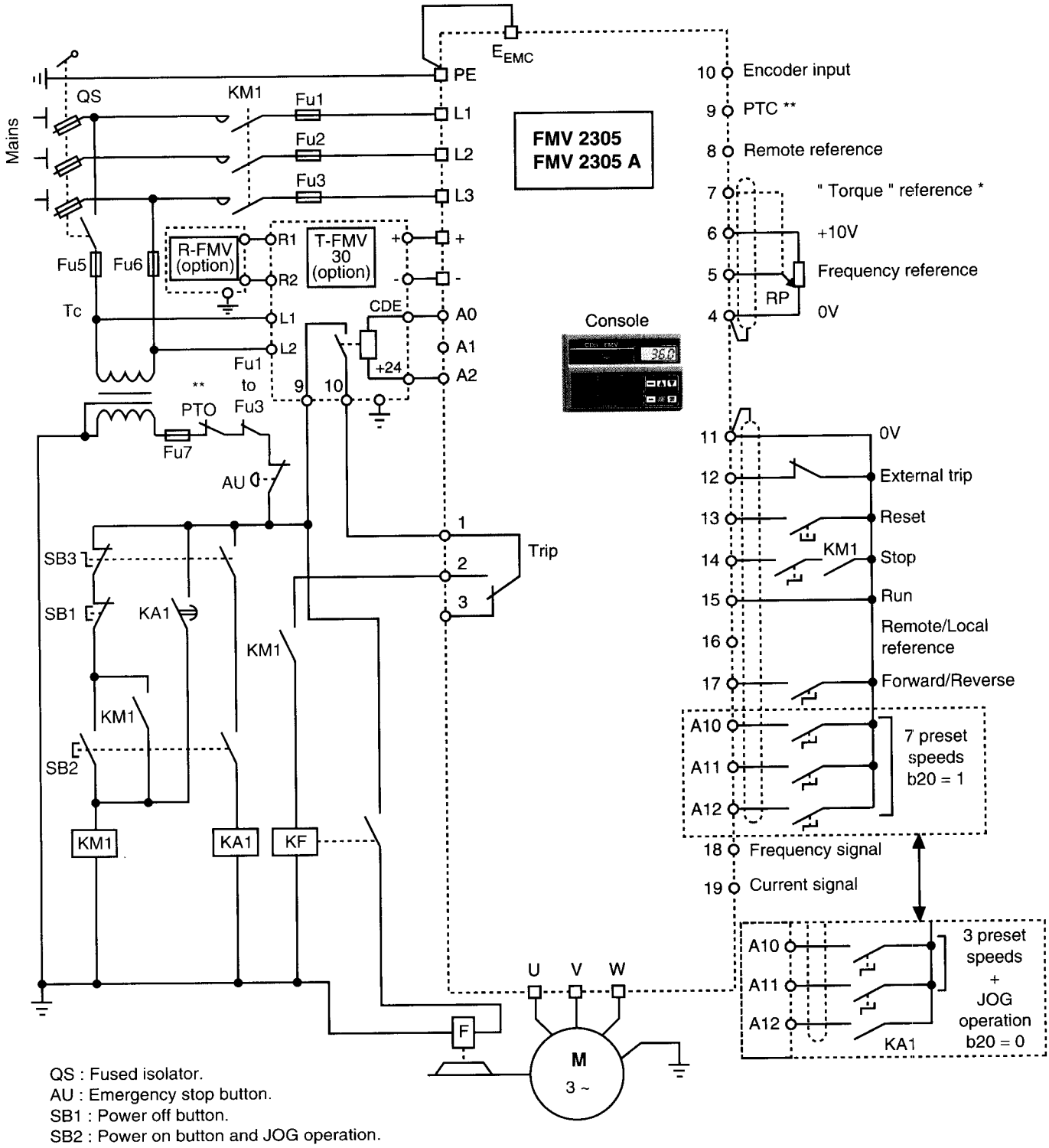


QS : Fused isolator.
AU : Emergency stop button.
SB1 : Power off button.
SB2 : Power on button and JOG operation.
SB3 : JOG change-over switch.
KA1 : JOG relay.
KM1 : Line contactor.
RP : 10 kΩ potentiometer.
Tc : Transformer for remote control.
* : " Torque " limitation if controlled by frequency.
** : Depending on the motor being used.
*** : If terminal 16 at 0V (remote).

Note: The contactor coil should be fitted with an RC circuit.

2.6.5 - FMV 2305 1.5T to 11T and FMV 2305 A 1.5T to 11T

Controlled via terminal block and electromechanical braking.

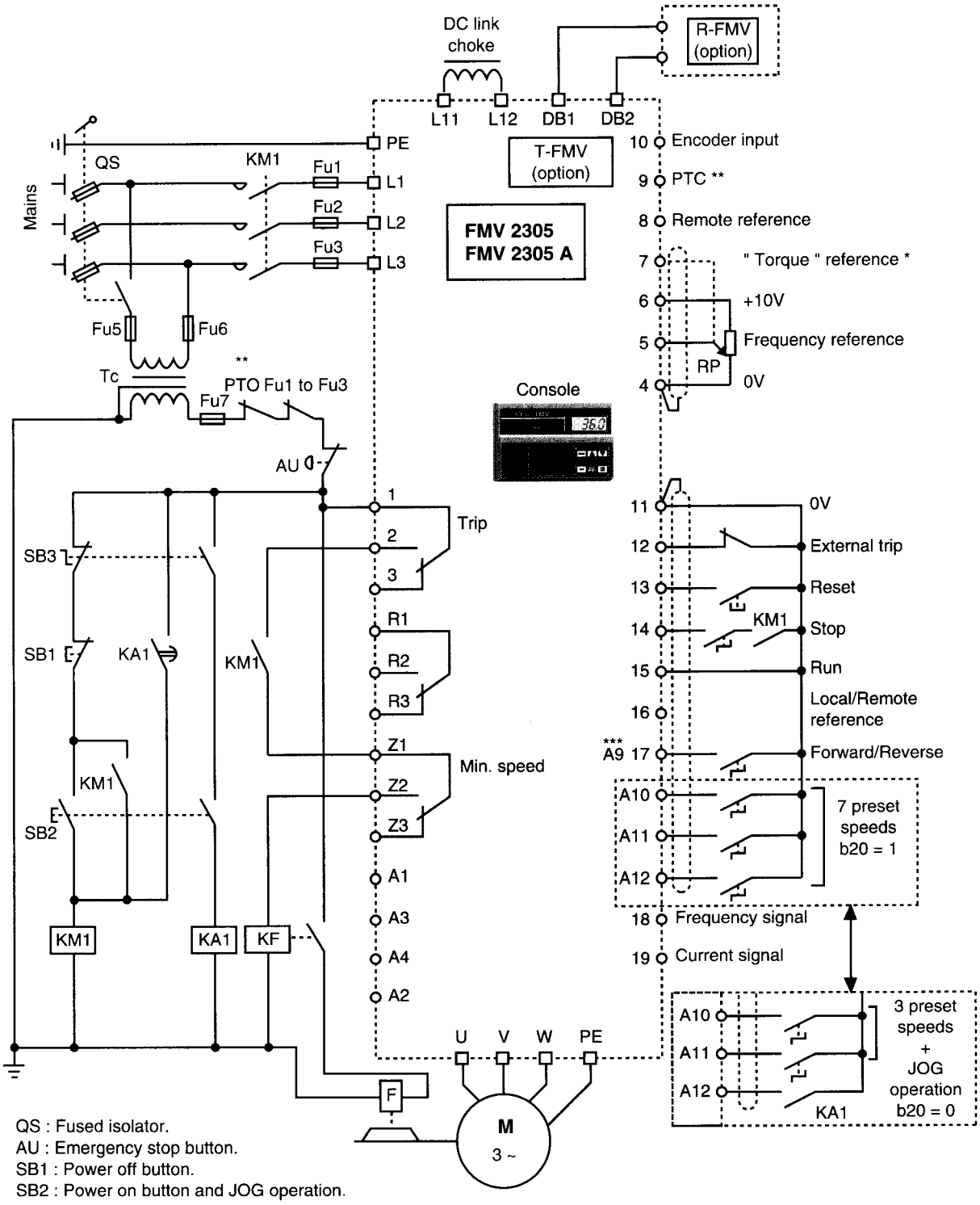


QS : Fused isolator.
AU : Emergency stop button.
SB1 : Power off button.
SB2 : Power on button and JOG operation.
SB3 : JOG change-over switch.
KA1 : JOG relay.
KM1 : Line contactor.
RP : 10 kΩ potentiometer.
Tc : Transformer for remote control.
KF : Braking contactor.
F : Brake coil (same voltage as relays).
* : " Torque " limitation if controlled by frequency.
** : Depending on the motor being used.

Note :
- Pr0 will be programmed to 0.
- b53 will be programmed to 1.
- b1 will be programmed to 1.
- The relay and contactor coils should be fitted with RC circuits.

2.6.6 - FMV 2305 16T to 100T and FMV 2305 A 16T to 120T

Controlled via terminal block and electromechanical braking.



QS : Fused isolator.
AU : Emergency stop button.
SB1 : Power off button.
SB2 : Power on button and JOG operation.
SB3 : JOG change-over switch.
KA1 : JOG relay.
KM1 : Line contactor.
RP : 10 kΩ potentiometer.
Tc : Transformer for remote control.
KF : Braking contactor.
F : Brake coil (same voltage as relays).
* : " Torque " limitation if controlled by frequency.
** : Depending on the motor being used.
*** : If terminal 16 at 0V (remote).

Nota : • The relay and contactor coils should be fitted with RC circuits.
• b1 will be programmed to 1.

3 - COMMISSIONING

3.1 - Procedure for using the CDn - FMV console

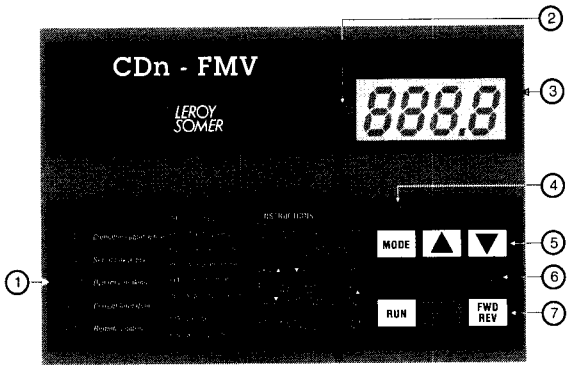
3.1.1 - Presentation

All inverter consoles are identical, and provide access to adjustment parameters and control of the inverter.

• Connection

The console can be unplugged and used remotely.
Remote connection is via a shielded cable with Sub-D type connectors (9 female pins on the console, 9 male pins on the inverter).
Maximum cable length = 100 m.
The console can be removed during operation (the inverter will come to a stop if it was being controlled via the console.

• Description



① 5 red LEDs for indicating inverter status.

② 1 red LED for indicating negative values.

③ 4 7-segment displays for reading : parameters, inverter status or the output frequency/current measurement.

④ 1 green LED " PAR " indicating that the " MODE " key has been pressed and that the display is showing the number of a parameter (" Pr - - " or " b - - ") alternately with its contents.

⑤ 2 keys for scrolling parameters and modifying their value.

⑥ 1 red LED " FWD " indicates that the inverter is in forward operation.

⑦ 3 keys for initiating the commands : Run, Stop (" RESET ") and direction of rotation, after a command from the console.

• Initial display

When switched on, the four 7-segment displays show the "Initial display", indicating the inverter status.

Inverter status	Initial display	
	Controlled via CDn-FMV	Controlled via TERM. BLOCK
Stopped	**"rdY"** <--> **"0"** : inverter ready signal **"rdY"** displayed alternately with the frequency reference **"0"**.	**"rdY"** : inverter ready.
Running	Frequency reference	- either output frequency (Hz), - or output current (% IN). *
Tripped	"Trip code" flashing alternately with the frequency setpoint.	Trip code flashing.

* Whichever value is displayed, the other can be seen by pressing both [△] and [▽] keys simultaneously.

• 5 LED status indicators

Information about the inverter status and control is provided by 5 LEDs.

LED ref	Status	Information
Inverter output active	On	The inverter is running (possibly at zero speed). The "FWD" LED is also lit if a forward movement command has also been given.
Serial comms active	On	The inverter is receiving or sending data via the serial link.
Dynamic brake active	On	Indicates that the maximum voltage threshold of the D.C. bus has been exceeded (inverter regenerating power).
Current limit active	On	The inverter is in current limitation, the load exceeds : - the overload current value (Pr4), or - the torque limitation set at terminal 7.
Remote control of drive	On	Indicates that the inverter is being controlled via : - a current signal speed reference, - or the serial link.

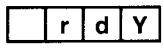
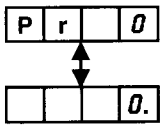
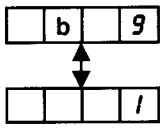
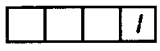
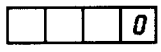
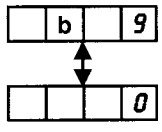
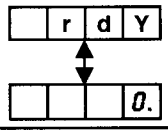
3.1.2 - Adjustment parameters

The inverter is configured for any given application by programming the parameters. This is performed either via the console or via the serial link.
There are two types of parameter :
- numerical parameters ("Pr X X") which are used to adjust the current and frequency, etc. Apart from Prc, they can be modified while the inverter is running.
- logic or bit parameters ("b Y Y"), which are used to select or enable functions. They can only be modified if the inverter output is not active.

a) Manipulating parameters using the CDn-FMV console
• Parameter selection

Step	Action on the keypad	Display	Remarks
POWER ON		r d Y	The inverter will start if the automatic starting function is selected.
SELECTION OF A PARAMETER	Press MODE once.	P r 0 ↕ 0 — Parameter n° / Parameter value	The "PAR" LED lights up. The parameter number is displayed alternately with its value. Pr 0 = minimum output frequency.
	8 seconds pause.	r d Y	If no key is pressed in the next 8 seconds, the "Initial display" reappears. The "PAR" LED goes out.
SCROLLING OF PARAMETERS	Press MODE once.	P r 0 ↕ 0.	The "PAR" LED lights up. The parameter number is displayed alternately with its value.
	Press △ once.	P r 1 ↕ 5 0. 0	The next parameter number is displayed alternately with its value. Pr 1 = maximum output frequency. All the main parameters can be selected using this procedure.
	8 seconds pause.	r d Y	If no key is pressed in the next 8 seconds, the "Initial display" reappears. The "PAR" LED goes out.
SELECTION OF A PARAMETER	Press MODE once.	P r 1 ↕ 5 0. 0	The "PAR" LED lights up. The number of the last selected parameter is displayed alternately with its value.

• **Parameter modification** (example : programming for console (keypad) control).

Step	Action on the keypad	Display	Remarks
POWER ON			
SELECTION OF PARAMETER b9	Press MODE once.		The "PAR" LED lights up.
	Press △ or ▽ several times to select parameter b9.		b9 = selection of type of control. b9 = 1 : control via terminal block, b9 = 0 : control via keypad.
MODIFICATION OF THE SETTING	Press MODE once.		The "PAR" LED goes out. The value of parameter b9 is fixed. If the value is flashing, see (*).
	Press △ or ▽.		The value of parameter b9 changes to 0. Control of the inverter is via the keypad.
	Press MODE once.		The "PAR" LED lights up. The new value of parameter b9 is stored.
	8 seconds pause.		**Note :** The 3 keys on the bottom of the RUN STOP RESET FWD REV keypad are now enabled and can be used for activating : Run, Stop/Reset, Forward/Reverse. If no key is pressed in the next 8 seconds, the "Initial display" reappears. The "PAR" LED goes out.

Note :

• If no key is pressed for 8 seconds during the course of the above procedure, the display returns to the "Initial display". By pressing MODE the number of the last selected parameter is displayed alternately with its value.

• Before modifying the adjustment parameters, check the inverter status via the display and the five LED status indicators.

Numerical type **Pr** parameters can be modified during operation, except for parameter **Prc** which is used to adjust the base frequency (nominal point).

(*) : Logic parameters **b** and **Prc** can only be modified if the inverter output is not active (see indicator LED).

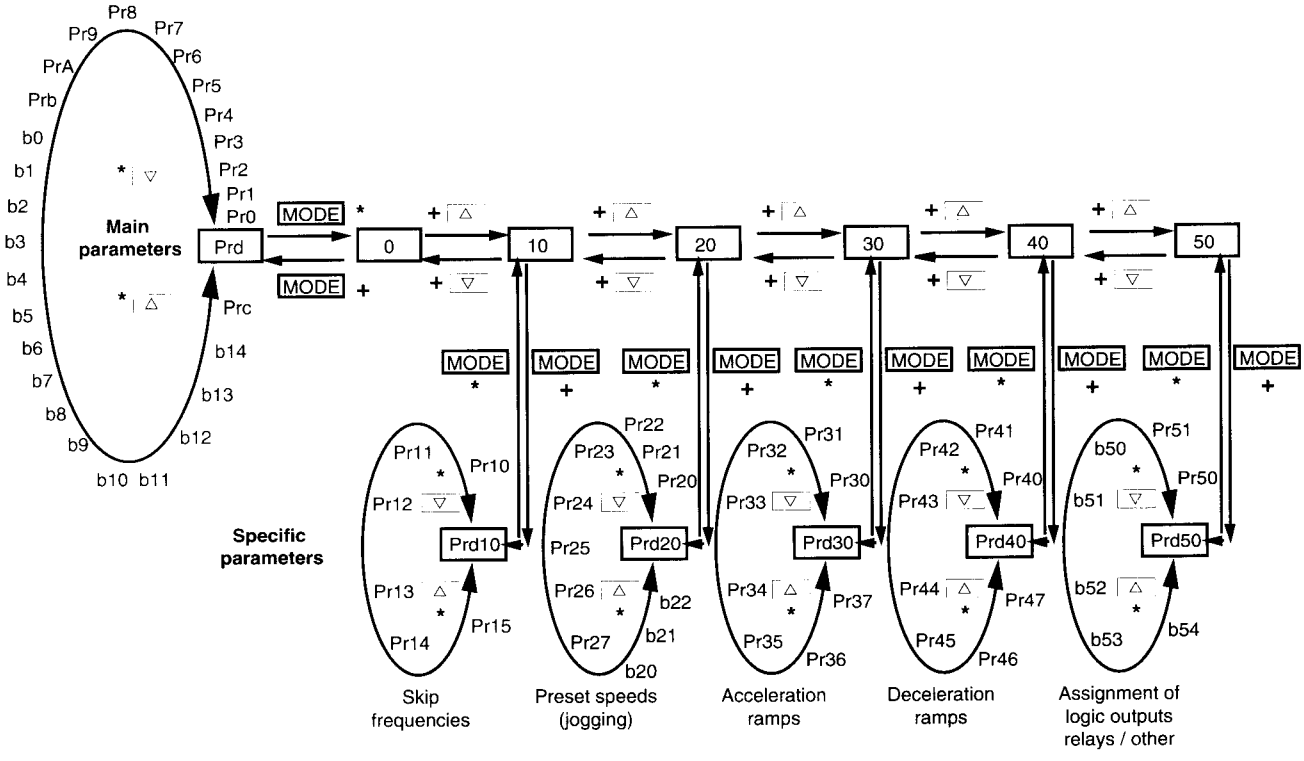
• Once a parameter has been modified, its new value is stored automatically (even after a power break).

• The display may flash for the following reasons :

- the inverter is tripped and the trip code is flashing,
- a parameter has been adjusted to the limit of its range,
- decimal points (not being used) flash to indicate that the inverter is overloaded (I x t).

b) Parameter organisation

Access to the main parameters is gained simply by using △ and ▽ when the "PAR" LED is lit.
Parameters which are specific to functions : frequency skips, preset speeds and their associated acceleration/deceleration ramps, jogging and assigning logic outputs, are organised into five groups which can be accessed by programming values 10, 20, 30, 40 and 50 in the Prd parameter.



* △ : Press △ when the " PAR " LED is on.
\+ △ : Press △ when the " PAR " LED is off.
* ▽ : Press ▽ when the " PAR " LED is on.
\+ ▽ : Press ▽ when the " PAR " LED is off.

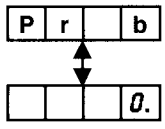
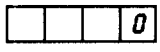
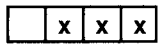
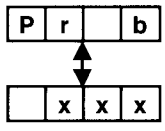
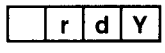
MODE * : Press MODE when the " PAR " LED is on.
MODE + : Press MODE when the " PAR " LED is off.

c) Reverting to factory settings

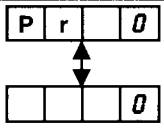
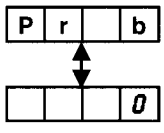
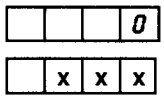
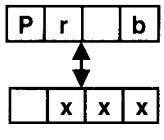
Step	Action on the keypad	Display	Remarks
PARAMETER SELECTION	Press MODE once and then press △ or ▽ several times to select parameter b13.	rdY b13 0.	The "PAR" LED lights up. b13 = 0 : inactive, b13 = 1 : revert to factory settings.
PARAMETER MODIFICATION	Press MODE once. Press △ or ▽.	0 1	The "PAR" LED goes out. The value of parameter b13 is fixed. If the value is flashing, check that the inverter is not active or see the section **Security code**.
	Press MODE once.	b13 0	Parameter b13 is automatically reset to zero. All parameters revert to their original value.

d) Security code

Access to the inverter can be restricted by programming a personalized code.

Step	Action on the keypad	Display	Remarks
INSTALLING THE CODE VIA THE KEYPAD	Press MODE once and press △ or ▽ several times to select parameter Prb.		The "PAR" LED lights up. Prb = 0 : open access to all parameters, Prb = 100 to 255 : no parameter can be modified unless the correct code is programmed. (*)
	Press MODE once.		The "PAR" LED goes out.
	Hold down △ or ▽ to choose the code.		
	Press MODE once.		The "PAR" LED lights up.
POWER OFF			
POWER ON			Parameters can no longer be modified unless the correct code is programmed.

(*) The security code may be programmed via the serial link with a value between 0 and 255 inclusive.

ACCES TO PARAMETERS	Press MODE once.		The "PAR" LED lights up.
	Press △ or ▽ several times to select parameter Prb.		The security code is no longer visible.
	Press MODE once. Hold down △ or ▽ to select the code.		The "PAR" LED goes out.
	Press MODE once.		Any parameter can be modified.

3.2 - Setting up the motor-inverter

3.2.1 - Control via the console (keypad)

• Wiring the motor-inverter

Refer to the diagrams in section 2.6.1 or 2.6.2.

• Connecting a PTC probe

Position jumper PL6 (on the IN 50 board) between 2 and 3 for models FMV 2305 1.5T to 11T and FMV 2305 A 1.5T to 11T or disconnect resistor R 462 on the IN 40 board for models FMV 2305 16T to 100T and FMV 2305 A 16T to 120T.

• External trip

Do not forget to link terminals 11 and 12, or the inverter will display "Et" when switched on.

• Switching the inverter on

Close the isolator and switch on using SB2. The display indicates "rdY" and the "FWD" LED lights up.

• Programming

Program the parameters one after another.

Parameter	Remarks
b9 = 0	Control via the keypad.
b14	Selection of the switching frequency and the upper limit frequency depending on the desired motor frequency.
Prc	Selection of the maximum voltage frequency depending on b14 and the required torque.
Pr1	Selection of the maximum motor frequency.
Pr5	Adjustment of maximum continuous motor current (as % of I_N).
Pr4	Adjustment of maximum motor overload current (as % of I_N).
Pr6	Adjustment of the torque required for starting.
Pr2	Adjustment of acceleration ramp.
Pr3	Adjustment of deceleration ramp.

• Run command

Press [RUN], and the "Inverter output active" LED lights up.

• Adjustment of the output frequency

Press [△], the display shows the inverter output frequency.

Release [△] when the desired frequency has been reached.

• Slip compensation

Load the motor and program Pr7 so that it retains its no-load speed.

• Stopping the motor

Press [STOP RESET].

The value shown on the display decreases to 0, then it indicates "rdY" alternately with the frequency requested previously and the "Inverter output active" LED goes out.

• Switching the inverter off

Switch off using SB1.

3.2.2 - Control via the terminal block

• Wiring the motor-inverter

See diagrams in section 2.6.3 or 2.6.4.

• Connecting a PTC probe

Position jumper PL6 (on the IN 50 board) between 2 and 3 for models FMV 2305 1.5T to 11T and FMV 2305 A 1.5T to 11T, or disconnect resistor R 462 from the IN 40 board for models FMV 2305 16T to 100T and FMV 2305 A 16T to 120T.

• External trip

Do not forget to link terminals 11 and 12, or the inverter will display "Et" when switched on.

• Switching the inverter on

Close the isolator and switch on using SB2. The display shows "rdY" and the "FWD" LED lights up.

• Programming

Program the parameters one after another.

Parameter	Remarks
b14	Selection of switching frequency and the upper limit frequency depending on the desired motor frequency.
Prc	Selection of the maximum voltage frequency depending on b14 and the required torque.
Pr1	Selection of the maximum motor frequency.
Pr5	Adjustment of maximum continuous motor current (as % of I_N).
Pr4	Adjustment of maximum motor overload current (as % of I_N).
Pr6	Adjustment of the torque required for starting.
Pr2	Adjustment of acceleration ramp.
Pr3	Adjustment of deceleration ramp.

• Run command

Provide a pulsed run command to terminal 15, the "Inverter output active" LED lights up.

• Adjustment of the output frequency

Provide a frequency setpoint to terminal 5, the display indicates the inverter output frequency.

• Slip compensation

Load the motor and program Pr7 so that it retains its no-load speed.

• Stopping the motor

Provide a pulsed stop command to terminal 14.

The value shown on the display decreases to 0, then it indicates "rdY" and the "Inverter output active" LED goes out.

• Switching the inverter off

Switch off using SB1.

3.3 - List of parameters

The list of parameters for **FMV 2305 and FMV 2305 A** inverters is provided below.
The tables are followed by an explanation of the function of each parameter.
Numerical parameters are preceded by "**Pr**".
Logic parameters are preceded by "**b**".

3.3.1 - Table of parameters

Main parameters (Prd = 0)

Parameter	Description	Adjustment range	Unit	Factory setting
Pr0	Minimum output frequency	0 to Pr1	Hz	0
Pr1	Maximum output frequency	Pr0 to ULF ① (ULF = Upper Limit Frequency).	Hz	50
Pr2	Acceleration ramp	0.2 to 600	s	- FMV 2305 1.5T to 40T : 5.0 - FMV 2305 50T to 100T : 10.0 - FMV 2305 A 1.5T to 120T : 100
Pr3	Deceleration ramp	0.2 to 600	s	- FMV 2305 1.5T to 40T : 10.0 - FMV 2305 50T to 100T : 20.0 - FMV 2305 A 1.5T to 120T : 100
Pr4	Maximum overload current : - FMV 2305 - FMV 2305 A	 Pr5 to 150 Pr5 to 120	% I_N (inverter rating)	 150 120
Pr5	Maximum continuous current	10 to 105 (≤ Pr4)	% I_N	100
Pr6	Torque at low speed (BOOST)	0 to 25.5	% U_N (supply voltage)	5,1
Pr7	Slip compensation : - FMV 2305 1.5T to 11T FMV 2305 A 1.5T to 11T - FMV 2305 16T to 40T FMV 2305 A 16T to 50T - FMV 2305 50T to 100T FMV 2305 A 60T to 120T	 0 to 5 (ULF = 120) 0 to 10 (ULF = 240) 0 to 20 (ULF = 480) 0 to 25 (ULF = 960) 0 to 5 (ULF = 120) 0 to 10 (ULF = 240) 0 to 20 (ULF = 480) 0 to 5 (ULF = 120) 0 to 10 (ULF = 240)	Hz	0
Pr8	Level of braking by D.C. injection : - FMV 2305 - FMV 2305 A	 40 to 150 40 to 120	 % I_N % I_N	 150 120
Pr9	Inverter address - serial link	0 to 99	-	11
PrA	Log of last 10 faults	0 to 9	-	-
Prb	Security code - via keypad - via serial link	 100 to 255 0 to 255	 - -	 0 0
b0	Selection : " torque " or frequency reference	b0 = 0 : torque b0 = 1 : frequency	-	1
b1	Selection : automatic or controlled starting	b1 = 0 : automatic b1 = 1 : controlled	-	- FMV 2305 1.5T to 11T FMV 2305 A 1.5T to 11T : 1 - FMV 2305 16T to 100T FMV 2305 A 16T to 120T : 0

① ULF = Upper Limit Frequency. This is the highest frequency that the inverter is able to provide.
Its value can be adjusted, but is limited by the selected switching frequency (see b14).

3.3.1 - Continued

Parameter	Description	Adjustment range	Unit	Factory setting
b2 - b7	Selection : mode of stopping b2 b7 0 0 Stopping following ramp or prolongation of the ramp if the upper voltage limit of the D.C. bus is reached 0 1 Freewheel stop 1 0 D. C. injection 1 1 Stopping following ramp (with optional braking module)	b2 = 0 or 1 b7 = 0 or 1	- -	0 0
b3	Selection : automatic or manual BOOST.	b3 = 0 : automatic b3 = 1 : manual	-	0
b4	Selection : reference polarity.	b4 = 0 : ± 10V b4 = 1 : 0 to +10V	-	1
b5	Selection : speed feedback.	b5 = 0 : with encoder b5 = 1 : without feedback	-	1
b6	Selection : master or slave mode.	b6 = 0 : master, controlled via the terminal block b6 = 1 : slave, controlled via the serial link	-	0
b7	See parameter b2.	b7 = 0 or 1	-	0
b8	Selection : display of output current or frequency.	b8 = 0 : frequency (Hz) b8 = 1 : current (% In)	-	0
b9	Selection : control via the keypad or terminal block.	b9 = 0 : keypad b9 = 1 : terminal block	-	1
b10	Selection : parity (serial link).	b10 = 0 : even b10 = 1 : odd	-	0
b11	Selection : remote speed reference. - FMV 2305 1.5T to 11T FMV 2305 A 1.5T to 11T - FMV 2305 16T to 100T FMV 2305 A 16T to 120T	 b11 = 4.20 : 4 to 20 b11 = 20.4 : 20 to 4 b11 = 0.20 : 0 to 20 b11 = 4.20 : 4 to 20 b11 = 20.4 : 20 to 4 b11 = Ur : 0 to 10 or ± 10 b11 = 0.20 : 0 to 20	 mA mA mA mA mA V mA	4.20 4.20
b12	Selection : speed of data exchange via the serial link.	b12 = 4.8 : 4800 b12 = 9.6 : 9600	baud baud	4.8
b13	Selection of the original parameters (factory settings).	b13 = 0 : not active b13 = 1 : factory setting	-	0
b14	Selection : Switching frequency and ULF (Upper Limit Frequency). - FMV 2305 1.5T to 11T FMV 2305 A 1.5T to 11T - FMV 2305 16T to 40T FMV 2305 A 16T to 50T - FMV 2305 50T to 100T FMV 2305 A 60T to 120T	Fswitching/ULF b14 = 2.9/120 or 240 b14 = 5.9/120 or 240 or 480 b14 = 8.8/120 or 240 or 480 b14 = 11.7/120 or 240 or 480 or 960 b14 = 2.9/120 or 240 b14 = 5.9/120 or 240 or 480 b14 = 2.9/120 or 240	 kHz/Hz kHz/Hz kHz/Hz kHz/Hz kHz/Hz kHz/Hz kHz/Hz	 2.9/120 2.9/120 2.9/120
Prc	Maximum voltage frequency : MVF	ULF/16 to ULF	Hz	50
Prd	Access to specific parameters	0 to 50	-	0

• **Specific parameters**

Prd = 10 : skip frequencies.

Parameter	Description	Adjustment range	Unit	Factory setting
Pr10	Skip frequency - 1	Pr0 to Pr1	Hz	0
Pr11	Skip frequency - 2			
Pr12	Skip frequency - 3			
Pr13	Skip width - 1	± 0.5 to ± 5.0	Hz	± 0.5
Pr14	Skip width - 2			
Pr15	Skip width - 3			

Prd = 20 : preset speeds/inching (JOG).

Parameter	Description	Adjustment range	Unit	Factory setting
Pr20	Preset speed - 1	Pr0 to ± Pr1	Hz	0
Pr21	Preset speed - 2			
Pr22	Preset speed - 3			
Pr23	Preset speed - 4			
Pr24	Preset speed - 5			
Pr25	Preset speed - 6			
Pr26	Preset speed - 7			
Pr27	Jog frequency	0 to 15	Hz	1.5
b20	Selection : Jog + 3 preset speeds or 7 preset speeds.	b20 = 0 : 3 speeds + JOG, b20 = 1 : 7 speeds.	-	0
b21	Selection : Standard acceleration/ deceleration ramps or specific preset speed ramps.	b21 = 0 : standard, b21 = 1 : specific (Pr30 to 36 and Pr40 to 46).	-	0
b22	Selection : Reversal of direction via terminal 17 or via the preset speed sign.	b22 = 0 : terminal 17, b22 = 1 : sign.	-	0

Prd = 30 : acceleration ramps (preset speeds).

Parameter	Description	Adjustment range	Unit	Factory setting
Pr30	Acceleration preset speed - 1	0.2 to 600	s	FMV 2305 : 5.0 FMV 2305 A : 100
Pr31	Acceleration preset speed - 2			
Pr32	Acceleration preset speed - 3			
Pr33	Acceleration preset speed - 4			
Pr34	Acceleration preset speed - 5			
Pr35	Acceleration preset speed - 6			
Pr36	Acceleration preset speed - 7			
Pr37	Acceleration - jogging	0.2 to 600	s	0.2

Prd = 40 : deceleration ramps (preset speeds).

Parameter	Description	Adjustment range	Unit	Factory setting
Pr40	Deceleration preset speed - 1	0.2 to 600	s	FMV 2305 : 10.0 FMV 2305 A : 100
Pr41	Deceleration preset speed - 2			
Pr42	Deceleration preset speed - 3			
Pr43	Deceleration preset speed - 4			
Pr44	Deceleration preset speed - 5			
Pr45	Deceleration preset speed - 6			
Pr46	Deceleration preset speed - 7			
Pr47	Deceleration - jogging	0.2 to 600	s	0.2

Prd = 50 : assignment of logic outputs / other functions.

Parameter	Description	Adjustment range	Unit	Factory setting
Pr50	Number of automatic resets.	0 to 5	-	0
Pr51	Delay of automatic resets.	1 to 5	s	1
b50	Selection of the relay function, terminals 1 - 2 - 3 : inverter status or at speed. - FMV 2305 1.5T to 11T FMV 2305 A 1.5T to 11T Selection of the relay function, terminals R1 - R2 - R3 : inverter running or at speed. - FMV 2305 16T to 100T FMV 2305A 16T to 120T	b50 = 0 : inverter status, b50 = 1 : at speed. b50 = 0 : running, b50 = 1 : at speed.	- -	0 0
b51	Enable "FWD/REV" key.	b51 = 0 : disabled, b52 = 1 : enabled.	-	0
b52	Enable flying restart.	b52 = 0 : disabled, b52 = 1 : enabled.	-	FMV 2305 : 0 FMV 2305 A : 1
b53	Selection of logic output A0 : inverter running or minimum speed. - FMV 2305 1.5T to 11T FMV 2305A 1.5T to 11T Selection of logic output A3 : alarm overload or inverter status. - FMV 2305 16T to 100T FMV 2305 A 16T to 120T	b53 = 0 : running, b53 = 1 : minimum speed. b53 = 0 : alarm, b53 = 1 : no trip.	- -	0 0
b54	Selection : fixed or dynamic U/f characteristic.	b54 = 0 : fixed, b54 = 1 : dynamic.	-	FMV 2305 : 0 FMV 2305 A : 1

3.3.2 - Explanation of parameters

Pr0 : Minimum output frequency.
Adjustment range : 0 to (Pr1) Hz.
Factory setting : 0 Hz.
In increments of 0.1 Hz to 0.8 Hz depending on b14.
In increments of 1 Hz for Pr0 ≥ 100 Hz.
This is the lowest operating frequency.
When the reference is at minimum, the output frequency is Pr0.

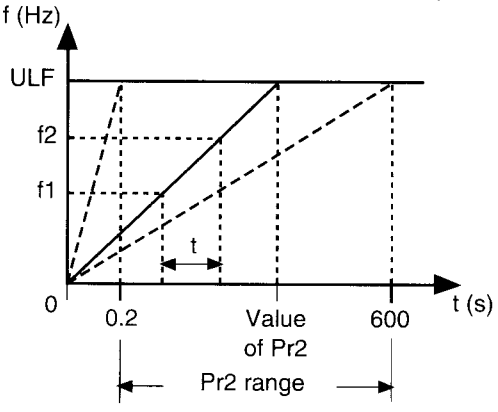
Pr1 : Maximum output frequency.
Adjustment range : (Pr0) to (ULF) Hz.
Factory setting : 50 Hz.
In increments of 0.1 Hz to 0.8 Hz depending on b14.
In increments of 1 Hz for Pr1 > 100 Hz.
This is the highest operating frequency.
When the reference is at maximum, the output frequency is Pr1.

Note : The frequency reference can be set directly from the keypad by using the keys [△] and [▽] when the display is showing the "Initial display".
The reference value will be between Pr0 and Pr1.

Important :
The maximum frequency (Pr1) can be set as high as 960 Hz (for some inverters) corresponding to more than 19 times the speed of a standard motor.
Check that the motor being used is capable of tolerating this value mechanically; if not, use a motor with special characteristics (please consult LEROY-SOMER).

Pr2 : Acceleration ramp

Adjustment range : 0.2 to 600s.
Factory setting : 5.0 s - FMV 2305 1.5T to 40T
10s - FMV 2305 50T to 100T,
100s - FMV 2305 A 1.5T to 120T.
In increments of 0.1s.
Adjustment of the time for acceleration from 0 Hz to the Upper Limit Frequency (ULF) defined by b14.
Calculation of acceleration time from frequency f1 to f2 :

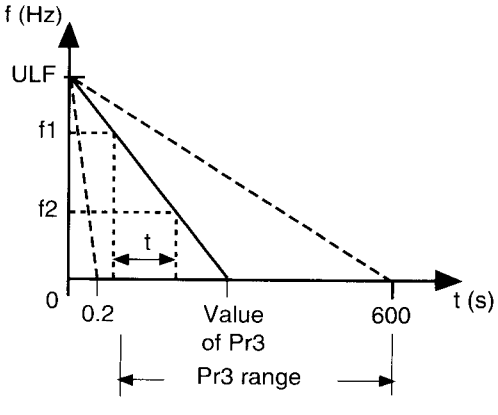


$$t = (f2 - f1) \times \frac{Pr2}{ULF}$$

Note : The ramp time is only maintained when the inverter is not in current limitation.

Pr3 : Deceleration ramp

Adjustment range : 0.2 to 600s.
Factory setting : 10s -FMV 2305 1.5T to 40T
20s - FMV 2305 50T to 100T,
100s - FMV 2305 A 1.5T to 120T.
In increments of 0.1s.
Adjustment of the deceleration time from the Upper Limit Frequency (ULF) defined by b14 to 0 Hz.
Calculation of the deceleration time from frequency f1 to frequency f2 :



$$t = (f1 - f2) \times \frac{Pr3}{ULF}$$

Note : The ramp time is only maintained when the energy regenerated by the motor can be absorbed by the D.C. bus, otherwise a braking unit should be used.

Pr4 : Maximum overload current

Adjustment range : Pr5 to 150 % I_N - FMV 2305
Pr5 to 120 % I_N - FMV 2305A.
Factory setting : 150 % I_N - FMV 2305.
120 % I_N - FMV 2305 A.
In increments of 0.1 % for Pr4 < 100 and 1 % for Pr4 ≥ 100.
This is the maximum permissible output current for a period defined by Pr4 and Pr5 (I x t overload).

Note : The internal current limitation is scaled in relation to the "torque" reference V_{REF} on terminal 7 :

$$\text{Internal current limitation } t = \left(Pr4 \times \frac{V_{REF}}{10V}\right) + 10\ \%$$

Pr5 : Maximum continuous current

Adjustment range : 10 to 105 % I_N (≤Pr4).
Factory setting : 100 % I_N.
In increments of 0.1 % for Pr5 < 100 and 1 % for Pr5 ≥ 100.
This is the allowed continuous current for adapting the inverter to the motor :

$$Pr5 = \frac{\text{nominal motor current}}{\text{nominal inverter current}} \times 100$$

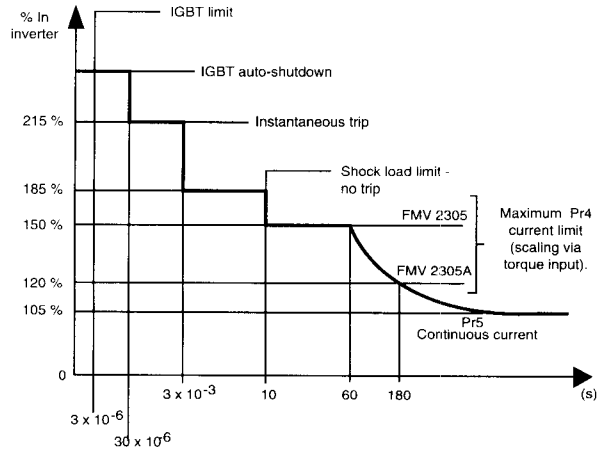
Pr5 adjusts the threshold over which the overload protection I x t starts to integrate the current excess. The decimal points on the display flash when this protection is activated. Should this condition persist, the inverter will trip after a period of time (t) defined as follows :

$$t = \frac{k \times Pr5}{(\%\ \text{output current} - Pr5)^2}$$

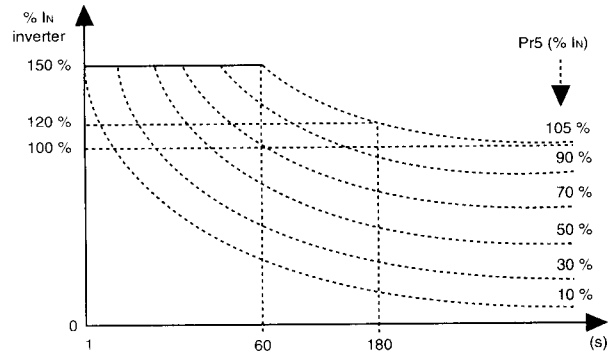
k = 25.7 - FMV 2305 1.5T to 100T,
FMV 2305 A 1.5T to 11T.
k = 8.57 - FMV 2305 A 16T to 120T.

See the next two diagrams for the various levels of protection and for current limitation.

Overcurrent levels



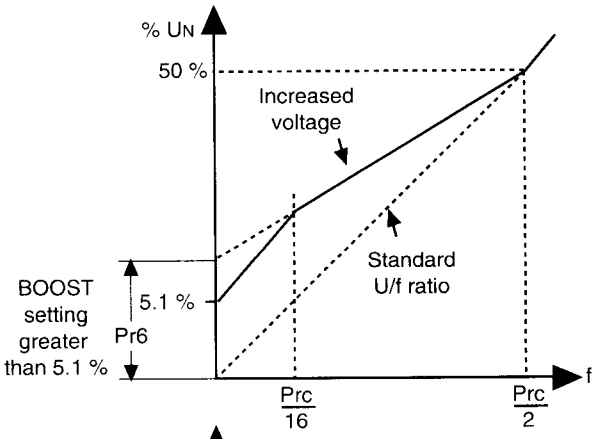
I x t characteristics depending on the value of Pr5

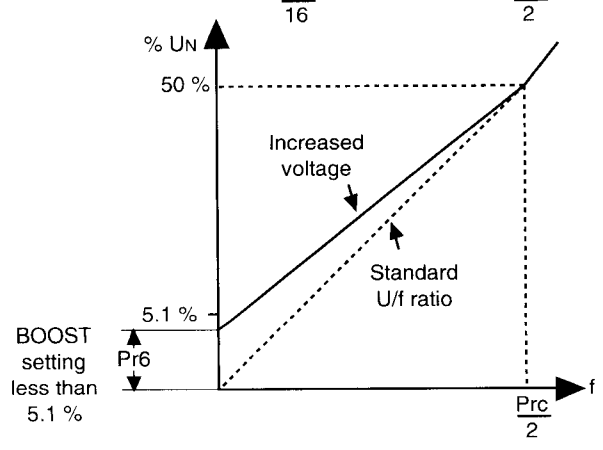


Pr6 : Torque at low speed (BOOST)
Adjustment range : 0 to 25.5 % UN (supply voltage).
Factory setting : 5.1 % UN.
In increments of 0.4 %.
Pr6 increases the U/f ratio between 0 Hz and PrC/2 (base frequency/2), increasing the voltage and hence the torque at low speed.
An "automatic BOOST" for variable loads can be selected (see b3) so that :

$$\text{applied BOOST} = \text{Pr6} \times \frac{\text{load (\% I}_N\text{)}}{\text{Pr5}}$$

Note : It is important to increase the BOOST value gradually, to start the motor smoothly and without any delay. Too high a value can stall the motor.
See the diagrams below for the distribution of the additional voltage.



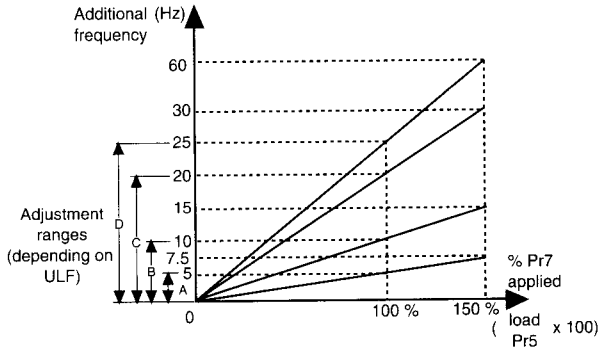


Pr7 : Slip compensation
Adjustment range : 0 to 5 Hz (ULF = 120 Hz) A
0 to 10 Hz (ULF = 240 Hz) B
0 to 20 Hz (ULF = 480 Hz) * C
0 to 25 Hz (ULF = 960 Hz) * D
* ULF = 480 or 960 Hz is not available on all inverters (see b 14).
Factory setting : 0 Hz.
In increments of 0.1 Hz to 0.8 Hz depending on b14.
Pr7 increases the inverter output frequency above the reference point, as a function of the load. Pr7 can be used to minimise the difference in motor speed between a motor at no load and a motor with load.

$$\text{Compensation (Hz)} = \text{Pr7} \times \frac{\text{output current}}{\text{Pr5}} \text{ \%}.$$

At full load, the additional frequency is the value which is set in Pr7.

Note : Pr7 is not active if the inverter is in encoder feedback mode (b5 = 0).



Pr8 : Level of braking by D.C. injection
Adjustment range : 40 to 150 % IN - FMV 2305.
40 to 120 % IN - FMV 2305 A.
Factory setting : 150 % IN - FMV 2305.
120 % IN - FMV 2305 A.
This is the adjustment of the maximum level of braking current by D.C. injection.
The braking torque is a function of the value of Pr8. The injection time is calculated automatically by the inverter and a holding torque is applied to the motor for one second when the motor reaches a speed close to zero. The level of the holding torque is a proportion of Pr8.

Note :
- This type of braking is only activated after a stop command and if : b2 = 1 and b7 = 0. (See b2, b7).
- If it is being used for constant torque applications, check that Pr8 ≥ 1.15 Pr5.

Pr9 : Inverter address - serial link
Adjustment range : 0 to 99.
Factory setting : 11.
In increments of 1.
This address, unique to the inverter, is used for communication between several inverters and a PLC (computer) connected on the same line.

PrA : Fault log

The last 10 faults are recorded in the order in which they appeared. Access to the log is gained as follows :

Step	Action on the keypad	Display	Remarks
POWER ON		r d Y	
SELECTION OF PrA	Press MODE once. and press △ or ▽ to select PrA.	P r 0 0. P r A 0 x x x	The "PAR" LED lights up.
SELECTION OF THE LAST TRIP	Press MODE once.	0 x x x	The "PAR" LED goes out. " 0 " is the number of the last trip. " x x x " is the associated trip code. (See section 5.2 for an explanation of codes).
SELECTION OF THE LAST TRIP BUT ONE	Press ▽ once.	- 1 Y Y Y	"- 1" is the number of the last trip but one. "Y Y Y" is the associated trip code.
SCROLLING OF TRIPS IN ORDER OF OCCURRENCE	Press ▽.	- 2 Z Z Z - 9 W W W	" - 9 " is the 10th and oldest trip in the memory.

Note :

- The 10 last faults remain in the memory even if the inverter is switched off.
- The trip "UU" or "Ph" when the unit is switched off (D.C. bus voltage outside the range) is not recorded if the inverter is already tripped before power down.

Prb : Security code

Adjustment range : 0, 100 to 255 (controlled via the keypad),
0 to 255 (controlled via the serial link).
Factory setting : 0.
In increments of 1.
It is possible to prevent modification of all parameters by programming a value other than 0.
Access to parameters is then only possible if the personalised code is entered into Prb. See section 3.1.2.

b0 : Selection - "torque" or frequency reference

Adjustment range : 0 or 1.
Factory setting : 1.
b0 = 0 : the motor is current controlled (the speed reference is not active). The "torque" reference is provided via terminal 7 (or via the serial link if the inverter is remotely controlled and b6 = 1).
0V = 10 % I_N.
+ 10V = Pr4.
The speed is limited to the value of Pr1.

b0 = 1 : the motor is frequency controlled. The frequency reference is set either via :
- the △ and ▽ keys on the console if b9 = 0,
- the terminal block if b9 = 1,
- the serial link (if the inverter is being remotely controlled and b6 = 1).

The torque is limited via its reference point terminal 7.

Note : If terminal 7 is not connected, the "torque" reference (b0 = 0), or the torque limitation (b0 = 1) is set automatically to Pr4.

b1 : Selection - automatic or controlled starting

Adjustment range : 0 or 1.
Factory setting : 1 - FMV 2305 1.5T to 11T
FMV 2305A 1.5T to 11T.
Factory setting : 0 - FMV 2305 16T to 100T
FMV 2305A 16T to 120T.

b1 = 0 : automatic starting.
120 ms after power up, the motor starts, provided no stop command is given and no trip is registered. After a power cut the motor restarts - whatever its status - 120 ms after the power returns.
b1 = 1 : controlled starting.
A run command is required in all situations. If the inverter is tripped, press RESET followed by a run command.

b2 - b7 : Selection - mode of stopping
Adjustment range : 0 or 1.
Factory setting : 0.
Four modes of stopping can be selected by using a binary combination of b2 and b7 as shown below :

b2	b7	Mode	Display (during the stopping phase)
0	0	Stopping following ramp or prolong-ation of the ramp if the upper voltage limit of the D.C. bus is reached.	Frequency or current (depending on b8).
0	1	Freewheel stop.	" **Inh** "
1	0	D.C. injection.	" **dc** ".
1	1	Stopping following ramp (with optional braking resistance).	Frequency or current (depending on b8).

Note : Depending on the selected stopping mode, "Freewheel stopping" and "D.C. injection" modes are only active after a stop command. Both ramp modes are permanently active.

Stopping following ramp or ramp prolongation : deceleration according to the ramp (linear) set via Pr3 (or Pr30 to 36 if the preset ramp speeds are selected : b21 = 1).
If the load has a significant inertia, resulting in the energy which is regenerated by the motor to the inverter D.C. bus being too high, the ramp time is prolonged so that the inverter does not trip on overvoltage.

Freewheel stopping : the inverter output is deactivated after a stop command. The motor stops in freewheel mode. 1 second after the stop command, "**rdY**" appears on the display and restarting is possible.

D.C. injection : the motor is quickly brought to a low speed by D.C. injection, then a holding current is applied for one second (restarting is only possible after this time). See also Pr8.

Stopping following ramp (with braking resistance option) : Linear deceleration according to the ramp. A very short braking time is obtained due to the braking resistances. If the motor inertia and its load are too high, the inverter trips and indicates " OU ".

b3 : Selection - automatic or manual BOOST
Adjustment range : 0 or 1.
Factory setting : 0.
b3 = 0 : automatic BOOST, for variable loads with low starting torque, the inverter automatically applies a fraction of Pr6 depending on the current demand from the motor (see Pr6).
b3 = 1 : manual BOOST, for fixed loads with higher starting torque. (See Pr6).

b4 : Selection - reference polarity
Adjustment range : 0 or 1.
Factory setting : 1.
b4 = 0 : bidirectional reference -10V to +10V.
-10V = maximum reference (backwards),
+10V = maximum reference (forwards).
Terminal 17 (FWD/REV command) is not active.
b4 = 1 : unidirectional reference 0 to +10V.
The direction of rotation is controlled via terminal 17.
Note : A reference < 0V is regarded as 0V.

b5 : Selection - speed feedback
Adjustment range : 0 or 1.
Factory setting : 1.
b5 = 0 : operation in closed loop with encoder feedback. Slip compensation (Pr7) is no longer active. If the encoder feedback is lost, then the inverter operates in open loop with a fixed slip compensation defined as follows :

ULF (Hz)	120	240	480 *	960 *
Additional frequency (Hz)	7,6	15,2	33	60,6

* Not available on all inverters (See b14).
b5 = 1 : operation in open loop. Slip compensation Pr7 is active.

b6 : Selection - master mode or slave mode controlled remotely : terminal 16 connected to 0V
Adjustment range : 0 or 1.
Factory setting : 0.
b6 = 0 : master mode, both speed and torque are controlled via the console or the terminal block.
b6 = 1 and controlled remotely : slave mode, speed and torque are controlled via the serial link.

Note : Parameter modification via the serial link is only possible in this mode. In all other modes, parameters can be displayed but not modified.

b7 : see b2.

b8 : Selection - display of output frequency or current
Adjustment range : 0 or 1.
Factory setting : 0.
b8 = 0 : displays the frequency supplied to the motor when controlled via the terminal block (b9 = 1).
b8 = 1 : displays the current supplied to the motor when controlled via the terminal block (b9 = 1). ±10% precision above 15 Hz.

Note : Whichever way b8 is programmed, the alternative information can be obtained by pressing the [△] and [▽] keys at the same time.

b9 : Selection - control via the keypad or terminal block
Adjustment range : 0 or 1.
Factory setting : 1.

b9 = 0 : the inverter is controlled via the keypad :
- [△] and [▽] gives the frequency reference,
- Pr4 adjustment gives the torque,
- [RUN] gives the run command,
- [STOP RESET] gives the command to stop and reset,
- [FWD REV] (b51 = 1) gives the forward/reverse command.

b9 = 1 : the inverter is controlled via the terminal block or via the serial link (see b6).

b10 : Selection - checking parity on the serial link
Adjustment range : 0 or 1.
Factory setting : 0.
b10 = 0 : even parity.
b10 = 1 : odd parity.
b10 must be correctly adjusted for the serial link of the controlling device (PC, PLC, etc).

b11 : Selection - remote speed reference
Adjustment range : - FMV 2305 1.5T to 11T,
FMV 2305 A 1.5T to 11T,
4.20 or 20.4 or 0.20 (Ur is not available).
- FMV 2305 16T to 100T,
FMV 2305 A 16T to 120T,
4.20 or 20.4 or Ur or 0.20.
Factory setting : 4.20.

During remote control the speed reference is applied to terminal 8 (or terminal A7*).

b11	Reference range	Speed range
4.20	4 to 20 mA	Pr0 to Pr1
20.4	20 to 4 mA	Pr0 to Pr1
Ur*	0 to +10V or (see b4) -10V to +10V	Pr0 to Pr1 -Pr1 to +Pr1
0.20	0 to 20 mA	Pr0 to Pr1

* Only for **FMV 2305** 16T to 100T and **FMV 2305 A** 16T to 120T.

Note : Remote references are only active if b6 = 0 and b9 = 1.

b12 : Selection - data transmission speed over the serial link
Adjustment range : 4.8 or 9.6.
Factory setting : 4.8.
b12 = 4.8 : 4800 baud.
b12 = 9.6 : 9600 baud.
b12 must be correctly adjusted to the data transmission speed via the serial link of the controlling device (PC, PLC, etc).

b13 : Selection - original parameters (factory settings)
Adjustment range : 0 or 1.
Factory setting : 0.
b13 = 0 : function not active.
b13 = 1 : all parameters are reset to their original value or factory setting. See section 3.1.2 for procedure.

b14 : Selection - switching frequency and Upper Limit Frequency ULF
1. Switching frequency in kHz.
2. Maximum output frequency limit (ULF) in Hz.

- FMV 2305 - 1.5T to 11T,
FMV 2305 A- 1.5T to 11T.

	Fswitching	ULF
Adjustment range	2.9	120 - 240
	5.9	120 - 240 - 480
	8.8	120 - 240 - 480
	11.7	120 - 240 - 480 - 960
Factory setting	2.9	120

- FMV 2305 - 16T to 40T,
FMV 2305 A - 16T to 50T.

	Fswitching	ULF
Adjustment range	2.9	120 - 240
	5.9	120 - 240 - 480
Factory setting	2.9	120

- FMV 2305 - 40T to 100T,
FMV 2305 A - 60T to 120T.

	Fswitching	ULF
Adjustment range	2.9	120 - 240
Factory setting	2.9	120

Switching frequency.
For applications which require high torque at low speed (high inertia, intermittent duty), selection of a low switching frequency is preferable.
If operation with reduced acoustic noise is desired, a high frequency should be chosen.
The selected switching frequency also limits the choice of maximum possible frequency (ULF) and, in consequence, the operating range.

Upper limit frequency : ULF.
This is the highest possible frequency at the inverter output. Any adjustment of ULF must take into account the desired maximum operating frequency (Pr1).

Note :
- Changing the value of ULF may change other parameters automatically (Pr0, Pr1, Pr7, Prc, Pr 10 to 12, Pr20 to 26).
- The frequency resolution depends on the selected value of ULF :
- ULF = 120 Hz - 0.1 Hz ,
- ULF = 240 Hz - 0.2 Hz ,
- ULF = 480 Hz* - 0.4 Hz,
- ULF = 960 Hz* - 0.8 Hz .

* if available

Procedure for adjusting b14 :

Step	Action on the keypad	Display	Remarks
POWER ON		rdY	
SELECTION OF b14	Press MODE once.	P r 0	The"PAR" LED lights up.
	and press △ or ▽ several times to select b14.	0. / b14 / 2.9 / 120	b14 is displayed alternately with the value of : - the switching frequency : part 1, and - ULF : part 2.
* MODIFICATION OF PART 1	Press MODE once	2.9	The"PAR" LED goes out.
	Press △ and ▽ to change the value.	8.8	The switching frequency is modified from 2.9 kHz to 8.8 kHz.
	Press MODE twice.	b14 / 8.8 / 120	The"PAR" LED lights up.
* MODIFICATION OF PART 2	Press MODE twice.	8.8	The"PAR" LED goes out.
		First press: 120 Second press	
	Press △ and ▽ to change the value.	240	ULF is modified from 120 Hz to 240 Hz.
	Press MODE once.	b14 / 8.8 / 240	The"PAR" LED lights up.

* b14 can only be modified if the inverter output is not active.

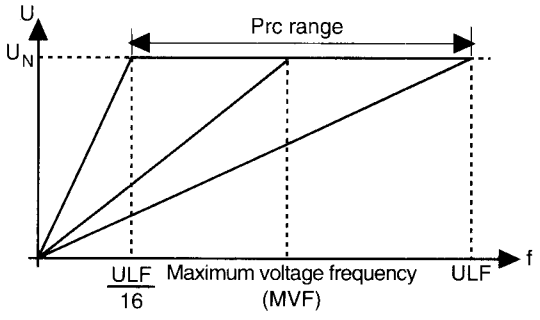
Prc : Maximum voltage frequency (MVF)

Adjustment range : $\frac{ULF}{16}$ to ULF (Hz)

Factory setting : 50 Hz.

In increments of 0.1 to 0.8 Hz according to b14, and 1 Hz for Prc ≥ 100 Hz.

This is the frequency at which the inverter output voltage reaches its maximum (U_N). See diagram below.



From 0 to Prc, it is the output voltage which increases with frequency (operation at constant torque) then from Prc to ULF, the output frequency increases at constant voltage (operation at constant power).

Note : Prc can be modified automatically during operation if the dynamic U/f function is selected (see b54).

Important :
Modification of the maximum voltage frequency (Prc) causes a significant variation in flux in the motor, which may be over-saturated (Prc value too low) or under-saturated (Prc value too high). It may then be necessary to use a motor with special characteristics (please consult LEROY-SOMER).

Prd : Access to specific parameters

Adjustment range : 0 to 50.

Factory setting : 0.

In increments of 10.

Provides access to specific groups of parameters (see section 3.1.2 - Parameter organisation).

Prd = 0 : main parameters.

Prd = 10 : skip frequencies.

Prd = 20 : preset speeds and jogging.

Prd = 30 : acceleration ramps (preset speeds and jogging).

Prd = 40 : deceleration ramps (preset speeds and jogging).

Prd = 50 : configuring logic outputs / miscellaneous functions.

Pr10 to Pr12 : Skip frequencies 1 to 3

Adjustment range : Pr0 to Pr1 (Hz).

Factory setting : 0 Hz.

In increments of : see Pr0 and Pr1.

Allows skipping over 3 frequencies which may harm operation (noise, vibration, resonance). The skip points (1 to 3) are set via Pr10 to Pr12 respectively. They act on the frequency rise or fall.

Note :

- If one of the set skips corresponds to Pr0 or Pr1, it is ignored.
- Skip frequencies are modified, if Pr0 and Pr1 are modified.
- Skip frequencies are ignored during inching operation.

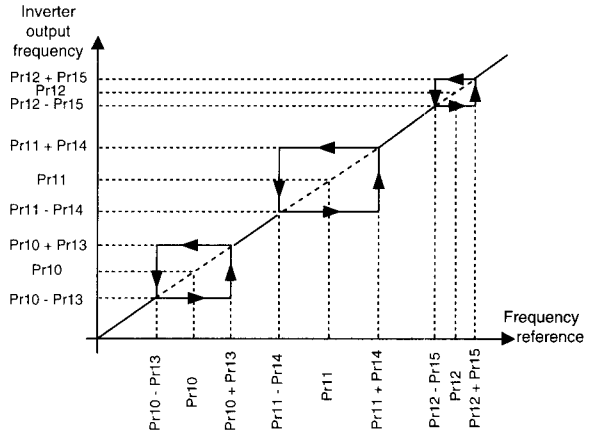
Pr13 to Pr15 : Skip width 1 to 3

Adjustment range : ± 0.5 to ± 5.0 Hz.

Factory setting : ± 0.5 Hz.

Incrementation depending on Pr0 and Pr1.

Each skip point, Pr10 to Pr 12, has an associated skip band, set via Pr13 to Pr15 respectively. Three adjustable frequency zones can be avoided during operation. (See diagram below).



Note :

- These frequency zones can overlap, giving a greater skip band.
- The output frequency will always be within the limits defined by Pr0 and Pr1 whatever the skip frequency zone.

Pr20 to Pr26 : Preset speeds

Adjustment range : Pr0 to Pr1 (Hz).

Factory setting : 0 Hz.

Incrementation depending on Pr0 and Pr1.

Allows selection of user speeds which will be enabled via terminals A10, A11 and A12 during operation (run command enabled).

Values of the preset speeds 1 to 7 are set via Pr20 to Pr26 respectively.

Note :

- if b20 = 0 : 3 preset speeds are available,
- if b20 = 1 : 7 preset speeds are available.

Pr27 : Jogging frequency

Adjustment range : 0 to 15 Hz.

Factory setting : 1.5 Hz.

Incrementation depending on Pr0 and Pr1.

Allows adjustment of the speed during inching operation which will be enabled via terminal A12 (inverter in "rdY" state) if b20 = 0.

b20 : Selection - inching operation (JOG) with 3 preset speeds or 7 preset speeds

Adjustment range : 0 or 1.
Factory setting : 0.

b20 = 0 : preset speeds 1 to 3 can be selected (plus the frequency reference) via a combination of terminals A10, A11, as can the inching operation function via terminal A12.

b20 = 1 : preset speeds 1 to 7 can be selected (plus the frequency reference) via a combination of terminals A10, A11, A12.

Note : With the inverter in ready state " rdY ", the inching operation function (JOG) is enabled when b20 = 0 and terminal A12 is linked to A1. The motor turns at the speed set via Pr27 until the link A12 - A1 is opened.

b20	A12	A11	A10	Function available	Associated parameter
0	0	0	0	Frequency reference	-
0	0	0	1	Preset speed 1	Pr20
0	0	1	0	Preset speed 2	Pr21
0	0	1	1	Preset speed 3	Pr22
0	1	0	0	Inching operation (JOG)	Pr27
1	1	0	0	Preset speed 4	Pr23
1	1	0	1	Preset speed 5	Pr24
1	1	1	0	Preset speed 6	Pr25
1	1	1	1	Preset speed 7	Pr26
1	0	0	0	Frequency reference	-

Note (A10, A11, A12) :
- 0 = terminal not connected to A1 (0V),
  1 = terminal connected to A1 (0V).
- Terminals A12, A11 and A10 are not active if the inverter is in " slave " mode (terminal 16 at 0V and b6 = 1, see b6).

b21 : Selection - standard acceleration and deceleration ramps or specific preset speed ramps

Adjustment range : 0 or 1.
Factory setting : 0.

b21 = 0 : The acceleration and deceleration ramps for the different preset speeds are adjusted via Pr2 and Pr3 (except for jogging. See Pr37 and Pr47).

b21 = 1 : The acceleration and deceleration ramps for the different preset speeds are adjusted via Pr30 to 36 and Pr40 to 46.

b22 : Selection - reversing direction via terminal block or via polarity of preset speeds

Adjustment range : 0 or 1.
Factory setting : 0.

b22 = 0 : the direction of preset speeds and jogging is controlled via terminal 17.

b22 = 1 : the direction of preset speeds is determined by the polarity of Pr20 to Pr26 settings.

• Example : setting Pr22 = - 40.0 Hz.

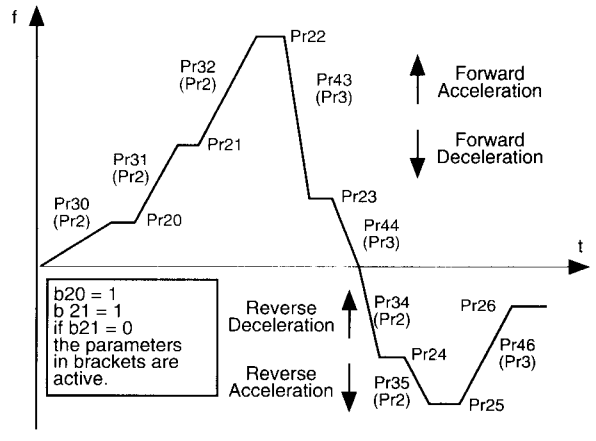
Step	Action on the keypad	Display	Remarks
POWER ON		rdY	
SELECTION OF Prd	Press MODE once,	PrA 0	The"PAR" LED lights up.
	and press △ or ▽ to select Prd.	0. / PrA d / 0	
ACCESS TO SPECIFIC PARAMETERS Prd = 20	Press MODE once.	0	The"PAR" LED goes out.
	Press △ twice.	20	
	Press MODE once.	PrA d	The"PAR" LED lights up. Access to the specific parameters for preset speeds (Prd = 20).
SELECTION OF Pr 22	Press △ or ▽ several times to select Pr22.	20 / PrA 22 / 0	
MODIFICATION OF Pr 22	Press MODE once.	0	The"PAR" LED goes out.
	Press and hold down △ to set the value of Pr22.	40.0	Pr22 = 40 Hz.
CHANGE OF POLARITY OF THE VALUE OF Pr 22	Press FWD REV once.	- 40.0 / PrA 22 / - 40.0	Pr22 = -40 Hz, the negative value is shown by the LED on the left of the display.
	Press MODE once.		

Pr30 to Pr36 : Acceleration ramps for preset speeds 1 to 7
Adjustment range : 0.2 to 600s.
Factory setting : 5.0s - FMV 2305,
100s - FMV 2305 A.
In increments of 0.1s.
With b21 = 1, each preset speed, Pr20 to Pr26, has an associated acceleration ramp, set via Pr30 to Pr36 respectively.
Eg. : the acceleration ramp for reaching preset speed Pr22 is set via Pr32.
See the Pr47 diagram.

Pr37 : Acceleration ramp for inching operation
Adjustment range : 0.2s to 600s.
Factory setting : 0.2s.
In increments of 0.1s.
The inching operation function always has an associated acceleration ramp, set via Pr37.

Pr40 to Pr46 : Deceleration ramps for preset speeds 1 to 7
Adjustment range : 0.2s to 600s.
Factory setting : 10s - FMV 2305,
100s - FMV 2305 A.
In increments of 0.1s.
With b21 = 1, each preset speed, Pr20 to Pr26, has an associated deceleration ramp, set via Pr40 to Pr46 respectively.
Eg. : the deceleration ramp for reaching preset speed Pr26 is set via Pr46.
See the Pr47 diagram.

Pr47 : Deceleration ramp for inching operation
Adjustment range : 0.2s to 600s.
Factory setting : 0.2s.
In increments of 0.1s.
The inching operation function always has an associated deceleration ramp, set via Pr47.



Eg. : Pr43 calculation to obtain a time t between Pr22 and Pr23.

$$Pr43 = t \times \frac{ULF}{Pr22 - Pr23}.$$

Where t is in s and ULF, Pr22, Pr23, Pr43 in Hz.

Pr50 : Number of automatic resets after a trip
Adjustment range : 0 to 5.
Factory setting : 0.
In increments of 1.

The inverter resets automatically after a trip. If the automatic starting function is enabled (b1 = 0), the inverter can then restart the motor automatically.
If b1 = 1 : the inverter remains in the ready state (RdY) and waits for a run command.
Pr50 sets the number of "RESETs" which the inverter will perform before remaining tripped due to a persistent fault. If Pr50 = 0, the function is disabled.
Each time an automatic "RESET" is performed (Pr50 ≠ 0), the number of resets still available is displayed together with the trip code.

Note :
• The counter for number of remaining "RESETs" is reset to Pr50 :
- if the cause of the trip disappears before all the "RESET" attempts have occurred,
- when the power is switched on,
- if the value of Pr50 is modified.
• The trip is only registered in the fault log when all the attempts to "RESET" have been performed without success.
• The forced trip "Et" cannot be reset by this function.

Pr51 : Automatic reset delay
Adjustment range : 1 to 5s.
Factory setting : 1s.
In increments of 0.1s.
Allows adjustment of the time between the trip condition and its automatic reset.

b50 : Selection - programmable relay function
Adjustment range : 0 or 1.
Factory setting : 0.
- **FMV 2305** 1.5T to 11T
FMV 2305 A 1.5T to 11T] relay 1, 2, 3
b50 = 0 : the relay is active when the inverter is switched on and not tripped.
b50 = 1 : the relay is active when the inverter output speed reaches the speed reference.
See also sections 2.2.1 - terminals 1 - 2 - 3.

- **FMV 2305** 16T to 100T,
FMV 2305 A 16T to 120T.] relay R1, R2, R3
b50 = 0 : the relay is active when the inverter is active ("Inverter output active" LED lit), the motor may be at zero speed.
b50 = 1 : the relay is active when the inverter output speed reaches the speed reference.
See also sections 2.2.2 - terminals R1 - R2 - R3.

b51 : Enable the [FWD REV] key
Adjustment range : 0 or 1.
Factory setting : 0.
b51 = 0 : the direction of rotation (Forward/Reverse) cannot be controlled via the [FWD REV] key.

b51 = 1 : the direction of rotation (Forward/Reverse) can be controlled via the [FWD REV] key, if b9 = 0.

b52 : Enable flying restart
Adjustment range : 0 or 1.
Factory setting : 0 for **FMV 2305**,
1 for **FMV 2305 A**.
b52 = 0 : the function is disabled.
b52 = 1 : allows an inverter run command when the motor shaft is turning.
The inverter searches for the motor frequency from Pr1 to 0 Hz in the last direction of rotation and then in the other ("SCAN" appears on the display during this operation). After synchronisation, the motor accelerates until it reaches the speed reference. Depending on the dynamic conditions of the system, this operation may take up to 5 seconds.

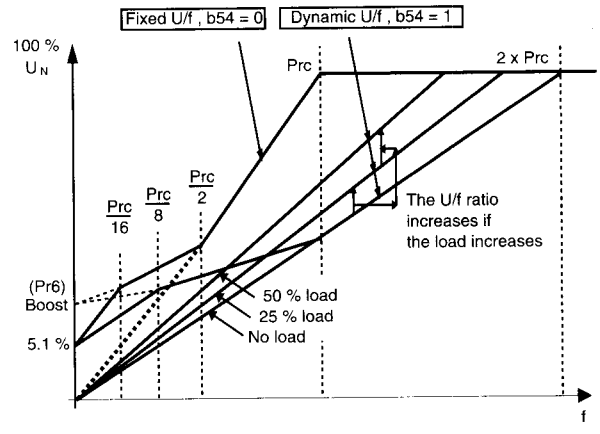
CAUTION
- Do not open the line contactor during this operation.
- Systems without a mechanical load in these conditions can change speed or turn slowly in both rotational directions before starting during this operation.

b53 : Selection - logic outputs (A0) and (A3)
Adjustment range : 0 or 1.
Factory setting : 0.
- **FMV 2305** 1.5T to 11T
FMV 2305 A 1.5T to 11T } A0
b53 = 0 : the logic output is active when the inverter output is active ("Inverter output active" LED lit), the motor may be at zero speed.
b53 = 1 : the logic output is active when the inverter output speed is at its minimum (Pr0).
See also section 2.2.1 - terminal A0.

- **FMV 2305** 16T to 100T
FMV 2305 A 16T to 120T } A3
b53 = 0 : the output is active when the overload protection I x t is active (the decimal points on the display flash). The output remains active if the inverter trips on I x t ("I t").
b53 = 1 : the logic output is active when the inverter is not tripped.
See also section 2.2.2 - terminal A3.

b54 : Selection - fixed or dynamic U/f characteristic
Adjustment range : 0 or 1.
Factory setting : 0 - **FMV 2305**,
1 - **FMV 2305 A**.
b54 = 0 : the U/f ratio is fixed and set via Prc.
b54 = 1 : the voltage applied to the motor is automatically reduced depending on the motor load. This enables a saving in energy and a reduction of noise with low and variable loads (eg. : centrifugal pump).

This automatic modification of the U/f characteristic will also modify the frequency at which the maximum voltage frequency (MVF) is reached, and the BOOST action (Pr6). See diagram below.



Value of PrC applied when b54 = 1 :

$(2 - \frac{\%\ load}{Pr5}) \times Prc$, for a load $\leq Pr5$. r

Note : If the motor is at no load, the maximum voltage frequency (MVF), set via Prc, will be reached for a frequency which is twice as high.
If the load increases to 150 %, the voltage increases up to the fixed U/f ratio, MVF = Prc (adjusted).

3.4 - Guide to settings

This guide to settings is designed to help you customise your inverter and to highlight functions which are described in detail in section 3.3.

PRINCIPAL SETTINGS

Selecting inverter commands

Run, reverse, stop the motor.	•Via terminal block if b9 = 1. •Via keypad if b9 = 0.
Adjustment of the speed.	• Via terminal block if b9 = 1 : - local : terminal 16 not connected to 0V, - remote : terminal 16 connected to 0V. •Via keypad if b9 = 0.
Adjustment of the torque.	•Via terminal block if b9 = 1.
Stop the motor in the event of a fault.	• Automatic restarts : number depending on Pr50, delay depending on Pr51. • Restart after reset if Pr50 = 0.

Starting

Adjustment of the acceleration time.	•Acceleration ramp : via Pr2.
Adjustment of the acceleration torque.	•manual BOOST (torque optimisation at low speed) via Pr6. - fixed value if b3 = 1, - automatic adjustment if b3 = 0.

Running : selecting operating frequencies

Selection of the inverter frequency range.	• Selection of the maximum frequency range : b14.
Selection of minimum and maximum operating speeds.	• Selection of the maximum motor frequency : Pr1. • Selection of the minimum motor frequency : Pr0.
Maintain the frequency under load.	• Slip compensation : via Pr7.

Running : displaying inverter operation

Display of the inverter frequency or load (b9 = 1).	•Output frequency if b8 = 0. •Inverter load (as a % In) if b8 = 1.
Display of the direction of rotation.	•red FWD LED on during forward operation. •red FWD LED off during reverse operation.
Display of the inverter status.	•Via LEDs on the left side of the console.
Display of faults.	• The last 10 trips are stored in PrA.

Running : optimising the quality of the drive system

Motor protection.	•Maximum overload current : Pr4. •Maximum continuous current : Pr5. •PTC motor probe connected to terminal 9.

Running the motor

Selection of the mode of stopping.	•4 modes available depending on b2 and b7.
Controlled stop.	•Adjustment of the deceleration ramp : Pr3.
Freewheel stop.	•On external trip "Et". •On power cut.

SPECIFIC SETTINGS

Selecting inverter commands

Run, reverse, stop the motor.	• Via RS 485, RS 422 or RS 232 serial link : b9 = 1, terminal 16 (remote), b6 = 1. • Via terminal block : b6 = 0. • Via keypad : b9 = 0. • Option to prohibit changing direction by pressing key on the keypad via b51. FWD REV
Adjustment of the frequency.	• Via RS 482, RS 422 or RS 232 serial link : b6 = 1. • Via keypad if b9 = 0. • Via terminal block if b9 = 1, (b6 = 0). • Selection of local or remote operation via terminal 16 : - local if terminal 16 is not connected to 0V, select reference polarity via b4, - remote if terminal 16 is connected to 0V.
Selection of the regulation mode.	• Regulation by torque or by frequency via b0. • Operation in master or slave mode via b6.
Stop the motor in the event of a fault.	• Automatic restart via Pr50. • Time delay before restart via Pr51. • Flying restart if b52 = 1.
Lock programmed instructions.	• By security code in Prb. • By disconnecting the console.

Starting

Initiate commands.	• Via RS 485, RS 422 or RS 232 serial link. • Via terminal block : run, stop, reverse. • Via keypad : run, stop, reverse.
Adjust the acceleration torque.	• Manually via Pr6, if b3 = 1. • Automatically if b3 = 0.

Running : selecting operating frequencies

Selection of the operating frequency range.	• The maximum frequency is determined by b14.
Use of the preset speeds.	• Control via terminal block : - of 3 speeds plus the reference if b20 = 0, - of 7 speeds plus the reference if b20 = 1. • Adjustment of the level via Pr20 to Pr26. • Selection of acceleration and deceleration ramps : - standard and common to all speeds if b21 = 0, - specific to each speed if b21 = 1.
Use of inching operation (JOG).	• Enable via b20 = 0. • Adjustment of the level via Pr27. • Adjustment of acceleration and deceleration ramps via Pr37 and Pr47.

Running : measuring operating parameters

Selection of the type of display (b9 = 1).	• The output frequency (in Hz) if b8 = 0. • The output current as % I_N if b8 = 1.
Analogue signals.	• Of the output frequency (in Hz) at terminal 18. • Of the output current (as % I_N) at terminal 19.
Indication of frequency reached.	• Available at the terminal block : - terminals 1, 2, 3 for FMV 2305 1.5T to 11T and FMV 2305 A 1.5T to 11T if b50 = 1, - terminals R1, R2, R3 for FMV 2305 16T to 100T and FMV 2305 A 16T to 120T if b50 = 1.

Running : optimising the inverter - motor drive system

Adjustment of the switching frequency.	• Adjust b14.
Vibration : prohibit critical frequencies.	• 3 skip frequencies programmed in Pr10 to Pr12. • Skip band adjustable via Pr13 to Pr15.
Precision of speed under load.	• Open loop control when b5 = 1, Manual compensation via Pr7. • Closed loop control (encoder feedback) when b5 = 0, no compensation necessary.
Motor protection and torque limitation.	• Adjustment of the maximum overload current via Pr4. • Adjustment of the maximum continuous current via Pr5. • Integration of I x t overload depends on Pr4 and Pr5. • Manual limitation of the torque via terminal 7.
Slip compensation.	• Variable depending on the load via Pr7.

Stopping the motor

Selection of the mode of stopping.	• Following ramp (with prolongation depending on the inertia) : b2 = 0, b7 = 0. • Freewheel : b2 = 0, b7 = 1. • With D.C. injection : b2 = 1, b7 = 0 : level adjustable via Pr8. • Following ramp (with optional braking module) b2 = 1, b7 = 1.
Ramp adjustment.	• Time adjusted via Pr3.
Control of an electro-mechanical brake.	• For FMV 2305 1.5T to 11T and FMV 2305 A 1.5T to 11T via the logic output A0 with b53 = 1. • For FMV 2305 16T to 100T and FMV 2305 A 16T to 120T using the minimum speed relay (terminals Z1, Z2, Z3). See section 2.6.5, 2.6.6.

4 - OPERATING EXTENSIONS

5 - FAULTS - DIAGNOSTICS

• Information about the inverter status is provided by 5 LEDs, and by the display (see below).
• Faults are shown in mnemonic form flashing on the display.

The last ten faults are stored in the memory (even after a mains power break) in parameter PrA.
• Information about the inverter status is also provided by the display unit.
• Some inverter states are provided by the logic outputs (relays and open collector transistors).

5.1 - Indication via LEDs

LED ref	Status	Information provided
Inverter output active	On	The inverter is running (possibly at zero speed).The "FWD" LED is also on if a Forward run command has been given.
Serial comms active	On	The inverter is receiving or sending data via the serial link.
Dynamic brake active	On	Indicates that the maximum voltage threshold on the D.C.bus has been exceeded during a motor deceleration phase.
Current limit active	On	The inverter is in current limitation because the load exceeds : - the maximum motor overload (parameter - Pr4), - or the torque limitation set at terminal 7.
Remote control of drive	On	Indicates that the inverter is controlled via - a current signal speed reference, or - the serial link.

Note : The inverter will trip if the "Current limitation" LED stays on for a period determined by the setting of Pr4 and Pr5.

5.2 - Display indication - error messages

Display mnemonic	Reason for trip	Check points	Solution
cL	Loss of current signal speed reference.	Level of current setpoint 4 - 20 mA or 20 - 4 mA. (1)	Check that the input reference level is > 3.5 mA.
Err	Hardware trip when unit switched on.	Control board : • IN 50 (FMV 2305 1.5T to 11T FMV 2305 A 1.5T to 11T), • IN 40 (FMV 2305 16T to 100T FMV 2305 A 16T to 120T).	RESET is no longer active. Power the inverter off and then on again. If the fault persists, consult your supplier.
Et	External trip.	• Terminal 12. • Control via the serial link.	• Check that terminal 12 is connected to 0V. • Check the control commands via the serial link.
It	I x t overload fault.	• Motor load. • Adjustment of I x t threshold (parameters Pr4, Pr5).	• Check that the motor is not overloaded. • Check that the I x t protection is correctly set.
OA (2)	Ambient temperature outside the range.	•Ambient temperature. •Ventilation holes. •Cooling fan. (3)	• Make sure the ambient temperature is between -10 and +50°C. • Check that there is sufficient space around the inverter. • Check that the cooling holes are not blocked and that the fans are working.
Oh	Heatsink overheated. The in-rush contactor has not closed during power on. (4)	• Cooling fans (3). • Ambient temperature. • The in-rush contactor (internal).	• Check that : - the fans are turning, - the cooling holes are not obstructed. • The ambient temperature is lower than 50°C, • There is sufficient space around the inverter. • Power the inverter off and then on again.

5.2 - Continued

Display mnemonic	Reason for trip	Check points	Solution
OI	Instantaneous overcurrent.	Terminals : U, V, W, PE. • Short-circuit between phases or faulty earth. • Significant variation in the load. • Speed of deceleration. • Motor power greater than that of inverter. • Cable between the motor and the inverter too long. • Power module in short-circuit.	• Check the output wiring. • Eliminate the short-circuit. • Eliminate the variation. • Program a longer time period for Pr3. • Check the setting of b2 and b7. • Check the motor and inverter name plates. • Use motor chokes. • Return the inverter for repair.
OU	Overvoltage on the D.C. bus.	• Rapid deceleration (inertial load) : operation above Prc. • Terminals L1, L2, L3 : Overvoltage on mains supply.	• Program a greater deceleration time period at Pr3. • Check the stop mode set via b2 and b7. • Use a braking unit (optional). • Check the mains supply.
Ph (5)	Disappearance of one or two phases.	Terminals : L1; L2, L3 : Voltage of one or two input phases < 380V - 15 %.	Check the three mains supply phases.
PS	Internal supply fault.	Internal supply terminals.	Power the inverter off and then on again. If the fault persists, consult your supplier.
th	Triggering of motor probe (PTC).	• Motor temperature too high (PTC resistance > 3 kΩ). • Terminal 9 : short-circuit on PTC probe (resistance < 100 Ω).	• Check the motor load. • Reduce the authorised overload level. • Check the motor ventilation and the ambient temperature. • Check the probe wiring.
UU (5)	Undervoltage on the D.C. bus.	• Terminals : L1, L2, L3 : prolonged undervoltage on the mains supply. (6)	• Check the mains supply .
AcUU	Low mains supply warning. (7)	• Terminals : L1, L2, L3 : undervoltage on the mains supply < 380V - 15 %.	• Check the mains supply.

Note : All trips can be cleared using "RESET" except "PS" and "Err" (turn the power off and then back on). Thermal devices should not be triggered and reset several times in succession.

(1) "cL" protection is not active if b11 = 0.20 (0 to 20 mA).
(2) "OA" protection is only available on the following inverters : FMV 2305 16T to 100T and FMV 2305 A 16T to 120T.
(3) Inverters which have a cooling fan are : FMV 2305 3.5T to 100T and FMV 2305 A 3.5T to 120T.
(4) Only for inverters FMV 2305 16T to 100T and FMV 2305 A 16T to 120T.
(5) At power off, the "Ph" or "UU" trips which appear are not recorded in the fault log (PrA), if the inverter is already tripped.
(6) The "UU" trip may result from a failure of the internal components. Please consult your supplier.
(7) The display "AcUU" does not indicate a fault, but simply warns of a reduction in input voltage.
- If the mains supply re-establishes itself before the motor stops, the inverter tries to reaccelerate the motor to the setpoint level.
- If the motor reaches zero speed, the inverter will trip on "UU" or "Ph".

5.3 - Display indication - inverter status

Display	Description
"rdY"	Motor stopped, inverter output inactive.
Numeric value	Motor operating (see section 3.1.1 - "initial display". The numeric value is : - the output frequency (Hz), or - the output current (% I_N), or - the frequency setpoint (Hz) depending on the programming of b8 and b9.
"dc"	D.C. injection braking is active. (See b2, b7).
"Inh"	The motor will stop in freewheel mode, the inverter output is not active. (See b2, b7).
"SCAN"	The inverter looks for the motor frequency to perform a flying restart. (See b52).
Flashing decimal points	The inverter is in I x t overload. (See Pr4, Pr5).

Note : The signals above do not indicate a fault status, but the inverter operating status. However, flashing decimal points are a warning. If the inverter remains in a state of I x t overload for a period defined by Pr4 and Pr5, it will trip.

5.4 - Indication via logic outputs

5.4.1 - FMV 2305 1.5T to 11T
FMV 2305 A 1.5T to 11T

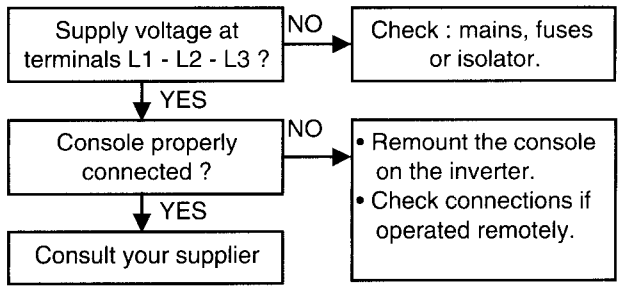
Terminal	Type of output	Information supplied	Associated parameter
1 2 3	Relay (assignable)	The inverter is not tripped or At speed.	b50
AO	Transistor with open collector (assignable)	Inverter running or At minimum speed.	b53 Pr0

5.4.2 - FMV 2305 16T to 100T
FMV 2305 A 16T to 120T

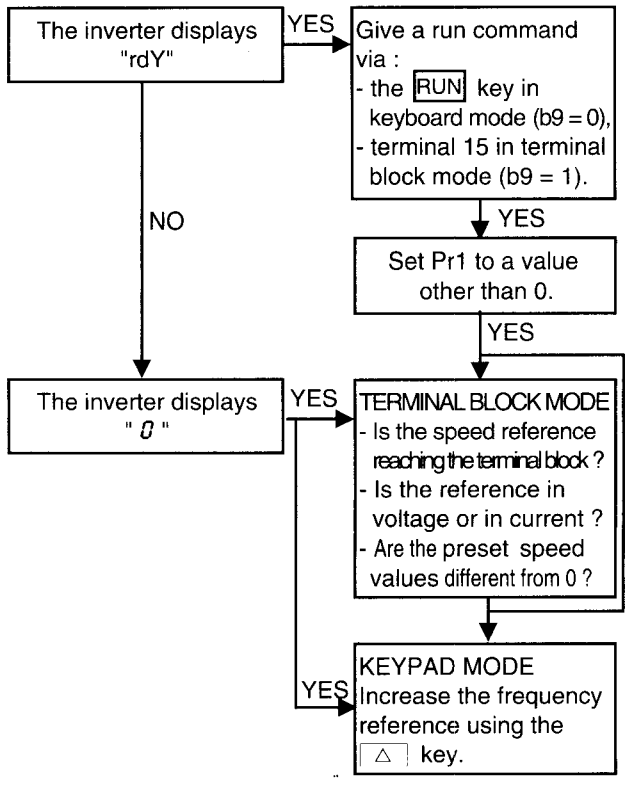
Terminal	Type of output	Information supplied	Associated parameter
Z1 Z2 Z3	Relay	At minimum speed.	Pr0
R1 R2 R3	Relay (assignable)	Inverter running or At speed.	b50
1 2 3	Relay	The inverter is not tripped.	-
A3	Transistor with open collector (assignable)	I x t overload or Inverter tripped.	Pr4, Pr5 b53

5.5 - Flow charts for localising malfunctions

• The inverter display does not come on

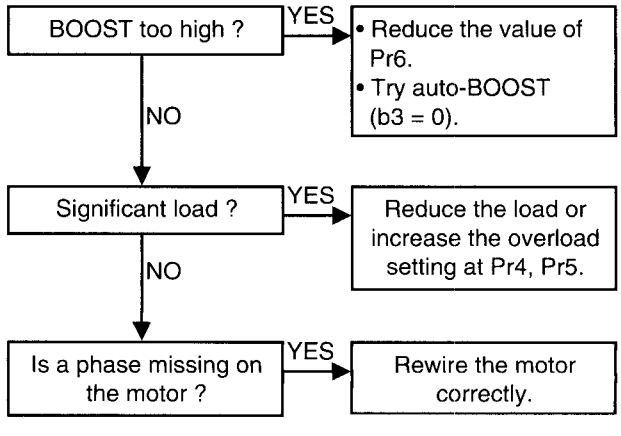


• The motor will not start

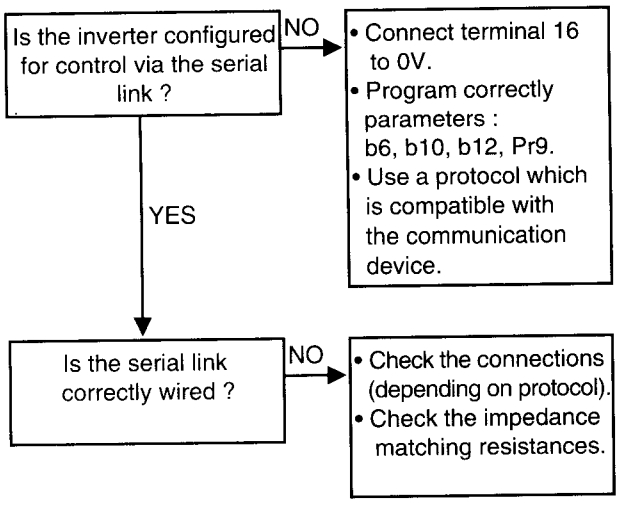


• Display of a trip code
See section 5.2.

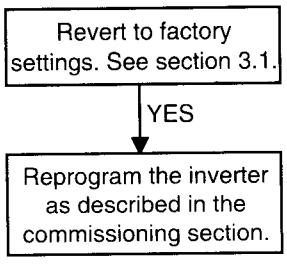
• The motor does not accelerate and is noisy



• The inverter does not react to programming instructions via the serial link



• Inverter parameters incorrectly set



Note :
- The inverter malfunction is often due to incorrect settings. A guide to settings is given in section 3.2.2.
- If, after performing all the above checks, the system still does not work, contact your supplier.

6 - MAINTENANCE

6.1 - Introduction and advice

Caution

The power board printed circuit (lower circuit) is connected directly to the mains.

Do not perform any operations on the inverter without first manually opening the supply circuit of the power stages (fused isolator or circuit-breaker) **or opening the KM input contactor and manually locking** (key) **the remote control of KM.**

Note also that the smoothing capacitor can be subjected to very high voltages. Do not touch the inverter terminals without first performing one of the following four operations.

a) - After switching the power off to the inverter, wait 5 minutes for the capacitors to discharge.

b) - Use a voltmeter to check that the voltage on the D.C. bus is less than 15 volts.

c) - Should it not be possible to perform the above operations due to lack of time, place a discharge resistor (30 W-500Ω) very carefully (High voltage !!!) on the D.C. bus terminals for at least 15 seconds.

FMV 2305 - FMV 2305 A inverters require a minimum of maintenance and repair operations on the part of the user. Detailed below are normal maintenance operations and simple methods for checking that the inverter is operating correctly and for making an initial diagnosis of correct operation on the power stages.

6.2 - Care

For the inverter, it is important to bear in mind that all electronic equipment may be subject to problems after being exposed to excessive heat, humidity, oil, dust, or if any external matter is allowed to penetrate.

Clean the motor ventilation holes from time to time and follow any lubricating instructions for the bearings as indicated on the name plate.

Printed circuits and their components do not normally require any maintenance. Contact your retailer or nearest approved service centre if any problems occur.

DO NOT REMOVE PRINTED CIRCUIT BOARDS DURING THE GUARANTEE PERIOD, AS THIS WILL IMMEDIATELY RENDER IT NULL AND VOID.

Do not touch integrated circuits or the microprocessor with your fingers or with any charged or live material. Earth yourself, as well as the bench or soldering iron before any intervention on the circuits.

Do not handle the socket-mounted integrated circuits located on the printed control circuit (risk of damage).

Leroy-Somer recommend replacing the smoothing capacitor and the cooling fan every five years (normal lifespan for these parts). Note that this lifespan is considerably reduced if significant loads are applied at high temperature. When you are replacing a capacitor which has been stored for more than three years, it must be "aged" before use by the following procedure :

1 - First apply 80% of the capacitor rated voltage at normal temperature for one hour.

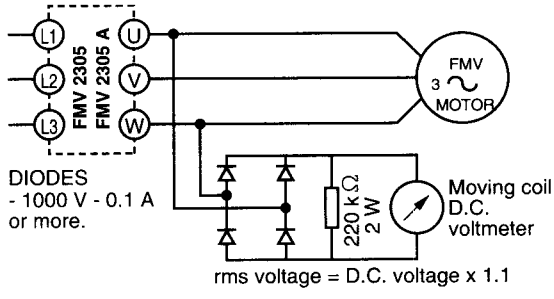
2 - Next apply 90% of the capacitor rated voltage at normal temperature for one hour.

3 - Finally apply the capacitor rated voltage at normal temperature for five hours.

6.3 - How to measure motor voltage and current

6.3.1 - Measuring the voltage at the inverter output, on load

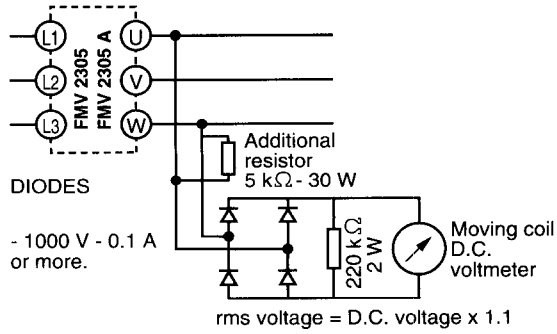
The harmonics from the inverter mean that it is not possible to measure the voltage at the motor input correctly with an ordinary voltmeter. However, you can obtain an approximate value of the rms voltage of the fundamental wave (which has a bearing on the torque) by using an ordinary moving coil D.C. voltmeter and the arrangement described in the diagram below.



rms voltage = D.C. voltage x 1.1

6.3.2 - Measuring the inverter output voltage, no load

The very weak value of the leakage current from the power semi-conductors (2 mA) would make the above arrangement too imprecise to measure the no-load inverter voltage. Use the arrangement in the diagram below.



rms voltage = D.C. voltage x 1.1

6.3.3 - Measuring the motor current

The current drawn by the motor and the inverter input current can be measured approximately using an ordinary moving coil ammeter.

6.3.4 - Measuring the inverter input and output power

The inverter input and output power can be measured using an electro-dynamic instrument.

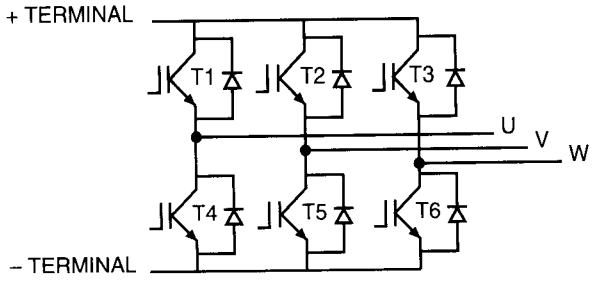
6.4 - Testing the inverter power stages

Preliminary remarks :

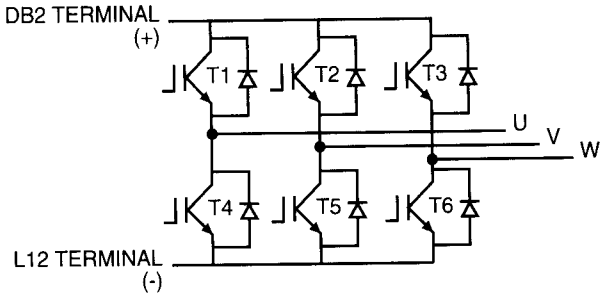
The tests described below are intended to **perform a qualitative test** of the state of the power stages. Use an ohmmeter set to the 1 Ω scale and take measurements after switching off the inverter and waiting for the smoothing capacitor to discharge completely. Each measurement must last for at least 10 seconds to avoid false readings from any charge which might still be present in the inverter circuits. If there is any doubt about the power stages, make a visual check of the state of the gate drive modules which may have been damaged subsequently.

The following diagrams represent the general schematic diagram of the transistor inverter stage in the speed controller.

- FMV 2305 1.5T to 11T
  FMV 2305 A 1.5T to 11T



- FMV 2305 16T to 100T
  FMV 2305 A 16T to 120T



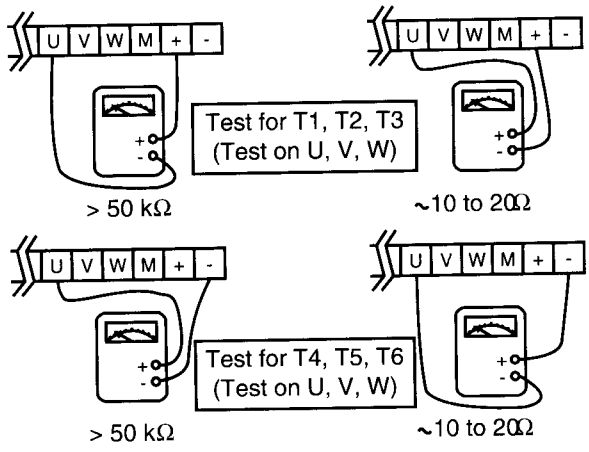
Two levels of test can be performed :

6.4.1 - Test using the terminal block

This test is fairly crude. A positive response does not necessarily mean that the power stages are accurate. However, a negative response generally indicates that they have been damaged.

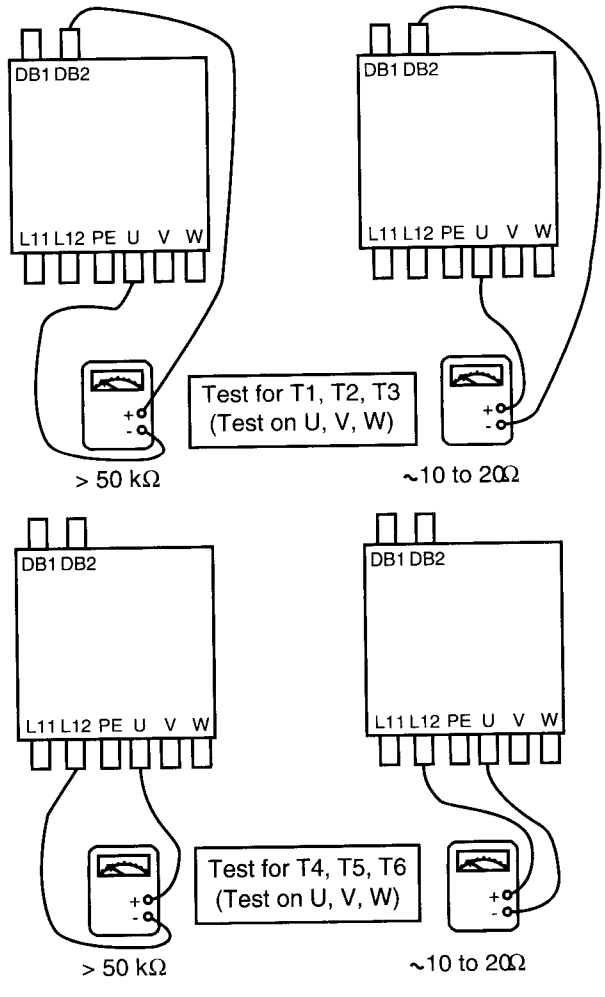
- FMV 2305 1.5T to 11T
  FMV 2305 A 1.5T to 11T

Use the U, V, W, +, - terminals on the power circuit.



- FMV 2305 16T to 100T
  FMV 2305 A 16T to 120T

Use the U, V, W, DB2, L12 terminals on the power circuit.



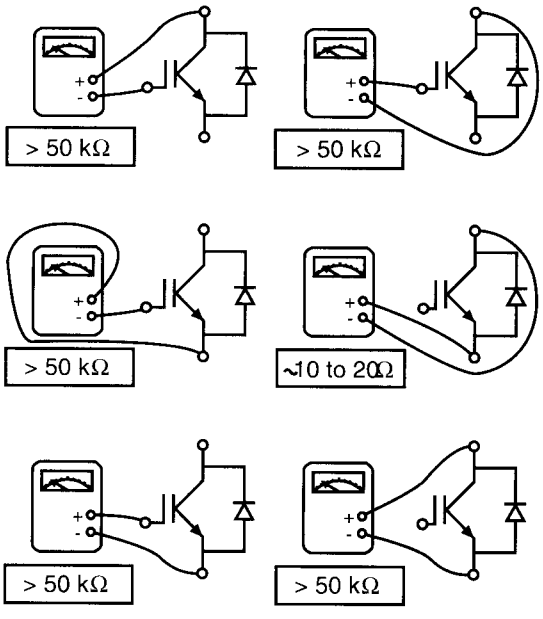
6.4.2 - Testing power modules individually

This test is much more comprehensive. As before, this is a test which is able to detect faults, but cannot guarantee that the equipment is accurate.

CAUTION :
For this test it is necessary to dismantle the inverter printed circuits. Do not follow this procedure during the guarantee period. The guarantee would be invalidated as a result.

To perform this test, check each of the six power modules according to the diagrammatic instructions below.

When replacing a power module, apply silicon grease for thermal conduction over the module cooling surface.



6.5 - Testing the inverter isolation and withstand voltage

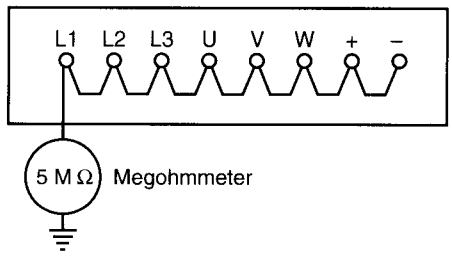
6.5.1 - Introduction

CAUTION :
The tests decribed below should be performed wth care. Should the power stages be destroyed as a result of a handling error or not following the instructions they would not be covered by the guarantee.

6.5.2 - Testing inverter isolation

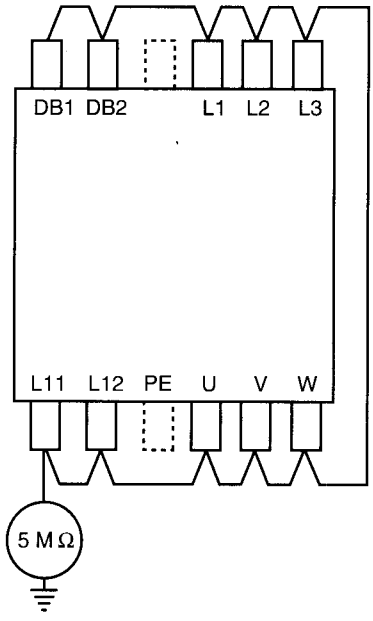
Short-circuit all the terminals on the power terminal block, except the PE terminal (earth), as shown below. Use a megohmmeter to measure the resistance between these terminals and the earth. This resistance should be at least 5 MΩ.

- FMV 2305 1.5T to 11T
  FMV 2305 A 1.5T to 11T



DO NOT CARRY OUT ISOLATION OR WITHSTAND VOLTAGE TESTS ON ANY TERMINALS OTHER THAN THOSE SHOWN ABOVE.

- FMV 2305 16T to 100T
  FMV 2305 A 16T to 120T



DO NOT CARRY OUT ISOLATION OR WITHSTAND VOLTAGE TESTS ON ANY TERMINALS OTHER THAN THOSE SHOWN ABOVE.

6.5.3 - Testing the inverter withstand voltage

Apply an A.C. voltage of 2000V between the earth and the short-circuited power terminal block for one minute as described in the diagrams above.
Check that nothing abnormal happens during the test.

CAUTION :
Never carry out a withstand voltage test on any terminals other than those indicated above. Such an operation would damage the inverter and invalidate the guarantee.

Annex

Complete the last column of the table with your own settings.

Parameter		Factory setting	Own setting	own setting
Pr0	Minimum output frequency	0		
Pr1	Maximum output frequency	50		
Pr2	Acceleration ramp	- FMV 2305 1.5T to 40T : 5.0 - FMV 2305 50T to 100T : 10.0 - FMV 2305 A 1.5T to 120T : 100		
Pr3	Deceleration ramp	- FMV 2305 1.5T to 40T : 10.0 - FMV 2305 50T to 100T : 20.0 - FMV 2305 A 1.5T to 120T : 100		
Pr4	Maximum overload current : - FMV 2305 - FMV 2305 A	 150 120		
Pr5	Maximum continuous current	100		
Pr6	Torque at low speed (BOOST)	5,1		
Pr7	Slip compensation	0		
Pr8	Level of braking by D.C. injection : - FMV 2305 - FMV 2305 A	 150 120		
Pr9	Inverter address - serial link	11		
PrA	Log of last 10 faults	-		
Prb	Security code - via keypad - via serial link	 0 0		
b0	Selection : " torque " or frequency reference	1 (frequency)		
b1	Selection : automatic or controlled starting	- FMV 2305 1.5T to 11T FMV 2305 A 1.5T to 11T : 1 (controlled) - FMV 2305 16T to 100T FMV 2305 A 16T to 120T : 0 (automatic)		
b2 - b7	Selection : mode of stopping b2 b7	 0 (stoping following ramp or 0 prolongation of the ramp).		
b3	Selection : automatic or manual BOOST.	0 (automatic)		
b4	Selection : reference polarity.	1 (0/10V)		
b5	Selection : speed feedback.	1 (without feedback)		
b6	Selection : master or slave mode.	0 (master)		
b7	See parameter b2.	0		
b8	Selection : display of output current or frequency.	0 (frequency)		
b9	Selection : control via the keypad or terminal block.	1 (terminal block)		
b10	Selection : parity (serial link).	0 (even)		
b11	Selection : remote speed reference.	4.20 (4/20 mA)		
b12	Selection : speed of data exchange via the serial link.	4.8		
b13	Selection of the original parameters (factory settings).	0 (not active)		
b14	Selection : Switching frequency and ULF (Upper Limit Frequency).	2.9/120		
Prc	Maximum voltage frequency : MVF	50		
Prd	Access to specific parameters	0		

Parameter		Factory setting	Own setting	own setting
Pr10	Skip frequency - 1	0		
Pr11	Skip frequency - 2			
Pr12	Skip frequency - 3			
Pr13	Skip width - 1	± 0.5		
Pr14	Skip width - 2			
Pr15	Skip width - 3			
Pr20	Preset speed - 1	0		
Pr21	Preset speed - 2			
Pr22	Preset speed - 3			
Pr23	Preset speed - 4			
Pr24	Preset speed - 5			
Pr25	Preset speed - 6			
Pr26	Preset speed - 7			
Pr27	Jog frequency	1.5		
b20	Selection : Jog + 3 preset speeds or 7 preset speeds.	0 (3 presets + JOG)		
b21	Selection : Standard acceleration/ deceleration ramps or specific preset speed ramps.	0 (standard)		
b22	Selection : Reversal of direction via terminal 17 or via the preset speed sign.	0 (terminal 17)		
Pr30	Acceleration preset speed - 1	FMV 2305 : 5.0 FMV 2305 A : 100		
Pr31	Acceleration preset speed - 2			
Pr32	Acceleration preset speed - 3			
Pr33	Acceleration preset speed - 4			
Pr34	Acceleration preset speed - 5			
Pr35	Acceleration preset speed - 6			
Pr36	Acceleration preset speed - 7			
Pr37	Acceleration - jogging	0.2		
Pr40	Deceleration preset speed - 1	FMV 2305 : 10.0 FMV 2305 A : 100		
Pr41	Deceleration preset speed - 2			
Pr42	Deceleration preset speed - 3			
Pr43	Deceleration preset speed - 4			
Pr44	Deceleration preset speed - 5			
Pr45	Deceleration preset speed - 6			
Pr46	Deceleration preset speed - 7			
Pr47	Deceleration - jogging	0.2		
Pr50	Number of automatic resets.	0		
Pr51	Delay of automatic resets.	1		
b50	Selection of the relay function, terminals 1 - 2 - 3 : inverter status or at speed. - FMV 2305 1.5T to 11T FMV 2305 A 1.5T to 11T Selection of the relay function, terminals R1 - R2 - R3 : inverter running or at speed. - FMV 2305 16T to 100T FMV 2305A 16T to 120T	0 (inverter status) 0 (running)		

Parameter		Factory setting	Own setting	own setting
b51	Enable "FWD/REV" key.	0 (disabled)		
b52	Enable flying restart.	FMV 2305 : 0 (disabled) FMV 2305 A : 1 (enabled)		
b53	Selection of logic output A0 : inverter running or minimum speed. - FMV 2305 1.5T to 11T FMV 2305A 1.5T to 11T Selection of logic output A3 : alarm overload or inverter status. - FMV 2305 16T to 100T FMV 2305 A 16T to 120T	0 (running) 0 (alarm I x t)		
b54	Selection : fixed or dynamic U/f characteristic.	FMV 2305 : 0 (U/f fixed) FMV 2305 A : 1 (U/f dynamic)		

Notes

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