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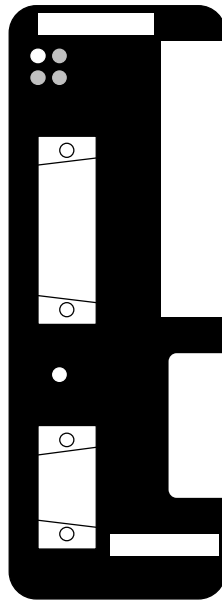
OPERATING MANUAL

SERIES SMT-100D

DIGITAL BRUSHTYPE AMPLIFIER

(Version 1.0)

European version 1.0



This is a general manual describing a series of digital servo amplifiers having the capability for driving DC Brushtype servo motors. This manual may be used in conjunction with appropriate and referenced drawings pertaining to the various specific models.

Maintenance procedures should be attempted only by highly skilled technicians (EN 60204.1 standard) using proper test equipment. Read your warranty provision carefully before attempting to adjust or service the unit.

RECEIVING AND HANDLING

Upon delivery of the equipment, inspect the shipping containers and contents for indications of damages incurred in transit. If any of the items specified in the bill of lading are damaged, or the quantity is incorrect, do not accept them until the freight or express agent makes an appropriate notation on your freight bill or express receipt.

Claims for loss or damage in shipment must not be deducted from your invoice, nor should payment be withheld pending adjustment of any such claims.

Store the equipment in a clean, dry area. It is advisable to leave the equipment in its shipping container until ready for use. Each amplifier is checked carefully before shipment. However, upon receipt, the user should make sure that the amplifier received corresponds to or is properly rated in terms of rated voltage and current for the type of motor which is to be driven. The descriptive label affixed to the amplifier specifies electrical ratings.

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**OPERATING MANUAL
INFRANOR
SERIES SMT-100D**

(September 1998)

1.0.0	GENERAL	4
1.1.0	INTRODUCTION.....	4
1.2.0	GENERAL DESCRIPTION.....	4
2.0.0	AMPLIFIER SPECIFICATIONS.....	5
2.1.0	TECHNICAL SPECIFICATIONS.....	5
2.2.0	BLOCK DIAGRAM	6
2.3.0	MODULE DIMENSIONS.....	6
2.4.0	MAIN PROTECTIONS.....	7
3.0.0	INPUTS / OUTPUTS	9
3.1.0	CONNECTOR LOCATIONS.....	9
3.2.0	X2 SERIAL LINK (SUB-D 15 POINTS MALE)	9
3.3.0	X3 ENCODER INPUT CONNECTOR (SUB-D 9 POINTS FEMALE).....	10
3.4.0	X10 INPUT - OUTPUT COMMAND REAR CONNECTOR	10
3.5.0	LOGIC INPUTS/OUTPUTS SPECIFICATION	11
3.6.0	SERIAL LINK CONNECTION.....	12
4.0.0	PARAMETERS SETTINGS.....	13
4.1.0	INSTRUCTIONS LIST.....	13
5.0.0	POWER SUPPLY SPECIFICATIONS.....	17
5.1.0	TECHNICAL SPECIFICATIONS (MP/DR100A)	17
5.2.0	BLOCK DIAGRAM	17
5.3.0	INPUTS / OUTPUTS	18
5.4.0	MECHANICAL DIMENIONS.....	18
6.0.0	RACK CHASSIS	19
6.1.0	CONNECTIONS.....	19
6.2.0	CONNECTORS LOCATION	20
6.3.0	RACK DIMENSIONS.....	21
6.3.0	CONNECTION DIGRAMS	22
6.4.0	WIRING RECOMMENDATIONS.....	22
7.0.0	COMMISIONING	24
7.1.0	PUTTING INTO OPERATION.....	24
7.2.0	AMPLIFIER COMMISIONING AND ADJUSTMENTS.....	24
8.0.0	FAULT FINDING	25
8.1.0	OPERATING PROBLEMS.....	25
8.2.0	AMPLIFIER'S FAULT	25
9.0.0	APPENDIX	26
9.1.0	ADRESSING FUNCTION	26
9.2.0	SPEED FEEDBACK MODES.....	28
9.3.0	COMPONENTS LOCATIONS	30
9.4.0	360 ⁰ SHIELD ON THE CONNECTORS.....	31
9.5.0	DEFAULT AMPLIFIER PARAMETERS.....	32

1.0.0 GENERAL

1.1.0 Introduction

Series SMT-100D servo modules are digital PWM servo amplifiers that provide velocity control for DC brush type motors with or without encoder feedback.

The pluggable SMT-100D system is available as multi-axis version that can receive up to six axes in a standard 19" rack.

The single axis, four axis or six axis rack includes:

- one MP/DR100A power supply unit,
- one or several SMT-100D amplifiers (up to 6 axis)
- one backplane receiving the several axis.

The various modules are mechanically mounted into the rack to increase the heat dissipation.

The complete system has been certified regarding its conformity to the EMC standards:

- EN 55011, group 1, class A, regarding radioelectric disturbances,
- CEI 1000-4-2, 1000-4-3, 1000-4-4, 1000-4-5 regarding immunity.

1.2.0 General description

The SMT100D amplifier module is a speed regulator for DC motors. This amplifier controls the speed of a DC motor with an input command voltage either analog or digital by means of a speed loop corresponding by BEMF feedback or by encoder feedback.

The SMT100D modules are digital amplifiers. All control parameters are programmable via a serial link and are saved in an EEPROM.

The power supply MP/DR100A has the following characteristics:

- Provide the amplifier(s) (single phase or three phases) with a rectified and filtered power bus voltage.
- Generate (single-phase input 220VAC) the logic voltages required for the amplifier(s).
- Control the power voltage during the motor braking cycles (shunt regulator system).

The power supply unit provides both power and logic supplies for up to 6 amplifiers.

2.0.0 AMPLIFIER SPECIFICATIONS

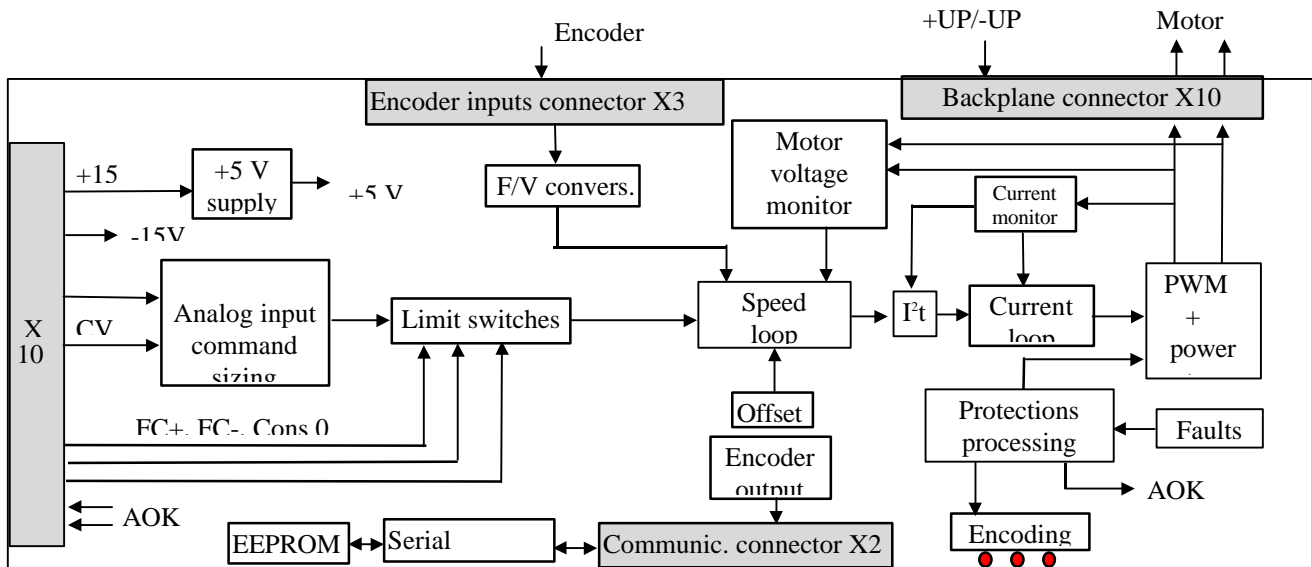
2.1.0 Technical specifications

The SMT100-I-D amplifier is available with the following ratings:

Amplifier	Rated current (A)	Max. current (A)	Rated power (W)
SMT-100 - 08 D	4	8	400
SMT-100 - 20 D	8	20	800

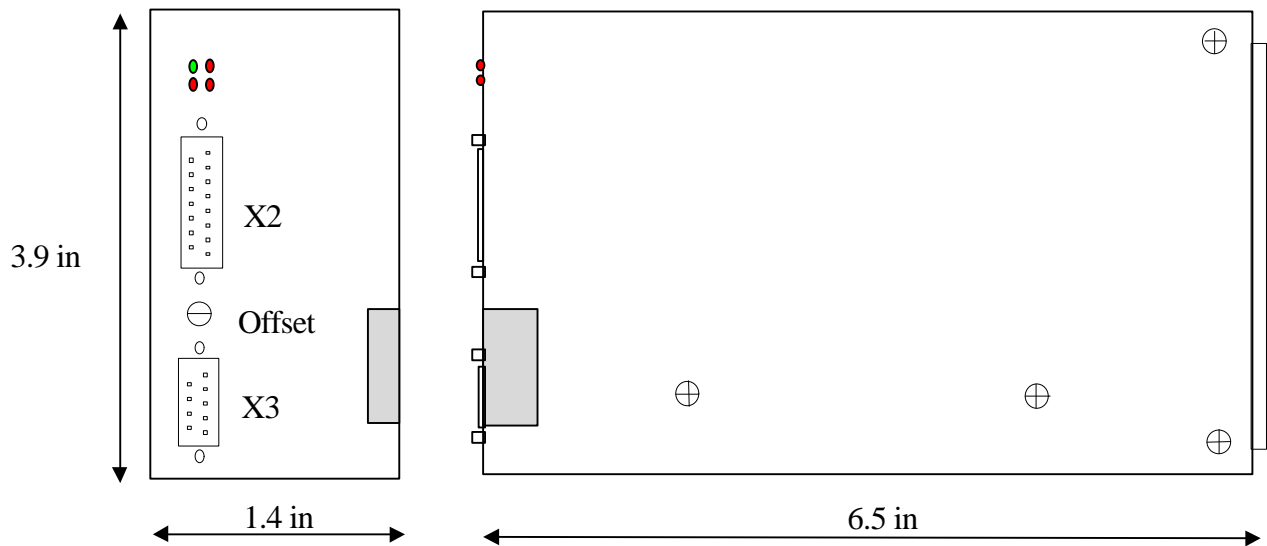
Power supply voltage	40 V < DC bus < 130 V
Speed input command	+/- 10 V analog input - Resolution: 10 bits.
Speed signal	BEMF feedback or encoder feedback (line driver).
Minimum load inductance	1 mH
Regulator	PI
Modulation ratio	> 85%
Logic inputs	Enable/disable: Enable (negative logic) Limit switches (negative logic) Zero input command (positive logic)
Logic output	Relay contact "Amplifier ready" (Umax = 100 V / Imax = 500 mA)
Amplifier protections	Overcurrent Power overvoltage No power voltage Power stage overtemperature Software Pt protection
Front panel displays	Fault LEDs LED for +5 V logic available
Parameter setting via serial link RS485	
Parameters saving in an EEPROM	
Front panel adjustment	Speed offset
Electromagnetic compatibility	IEC standards 801- 2 - 3 - 4, level 4
Conducted and radiated disturbances	EN 5011 Group 1, class A
Electrical standards for industrial machines	EN 60204.1: 1500 VAC - 1min insulation Current leakage >3mA (EMI filters)
Temperature	storage - 20° C to + 70° C operation 5° C to +50° C altitude: 1000 m (3300 feet) moisture: < 50 % at 40°C and < 90 % at 20°C (EN 60204.1 standard)

2.2.0 Block diagram



Power voltage reference "-UP" referenced to the rack.

2.3.0 Module dimensions



2.4.0 Main protections

Power stage overtemperature (fault is stored)

In case of a power stage overheating ($T > 90^{\circ}\text{C}$), the amplifier will disable the power stage.

Overcurrent detection circuit (fault is stored)

This circuitry will disable the amplifier as soon as the current exceeds the amplifier max. current (short-circuit at the motor phases).

Power voltage monitoring Up

DC Bus voltage should be between: $30\text{ V} < U_p < 170\text{ V}$:

- Overvoltage for $U_p > 170\text{ V} \pm 3\text{ V}$ (fault stored),
- Undervoltage for $U_p < 30\text{ V} \pm 3\text{ V}$ (fault stored).

Possibility to disable this monitoring protection by making a jumper to "AP" (amplifier solder side).

I²t protection

"Limiting" mode:

The calculation of the motor current with an integrator simulates the motor RMS current value.

When exceeding the rated current, this device limits the motor current at the rated current.

The authorized I_{max} duration (Δt) before limitation at I_{rated} depends on the value of the parameters "*Max. current*" (I_{Mxxxx}) and "*Rated current*" (I_{Nxxxx}) (see formula below).

"Fusing" mode:

The calculation of the motor current with an integrator simulates the motor RMS current value.

When exceeding the rated current, this device disables the amplifier and the fault is memorized.

The authorized I_{max} duration (Δt) before disabling depends on the value of the parameters "*Max. current*" (I_{Mxxxx}) and "*Rated current*" (I_{Nxxxx}).

$$\Delta t(s) = 8.7 \times \ln\left(\frac{K \times K}{K \times K - 1}\right), \text{ with } K = \left(\frac{I_{\text{max.}}}{I_{\text{rated}}}\right)$$

Example: SMT-100/08D - For an 8A max. current and a 4A rated current, $\Delta t = 2.5$ seconds.







Software protection (fault is stored)

The operator is warned about an EEPROM reading or writing error (watchdog fault) and the I²t protection in "fusing" mode is enabled.

Protection by fuse

Power stage protection (5x20mm): SMT-100/08 D = 5 AT
SMT-100/20 D = 10AT

Fault codes

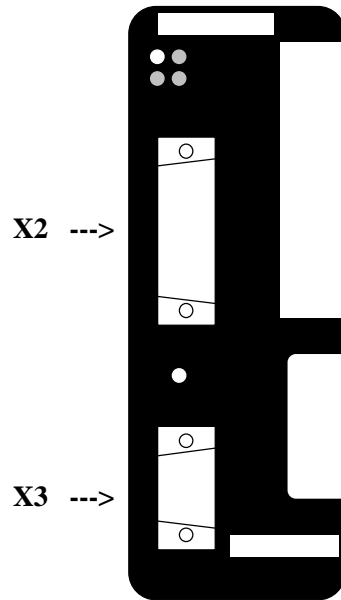
PROTECTION	CODE
Power stage overtemperature	
No power voltage	
Limitation at rated current	
Overcurrent	
Overvoltage	
Software protection	

Note:

- To reset a stored fault, switch power off .
- The ASCII instruction "RZ" allows to reset the faults.

3.0.0 INPUTS / OUTPUTS

3.1.0 Connector locations



3.2.0 X2 Serial link (Sub-D 15 points male)

This connector allows:

- Communication via serial link RS485 between amplifier(s) and an ASCII terminal,
- Connect the encoder signals with the NC in mode "Speed feedback by encoder signals".

PIN	FUNCTION	REMARKS
1	0 Volt	GND (shield connection if no "360°" connection on the connector)
2	RXH	Receive data RS485
3	TXL	Transmit data RS485
4	NC	NC
5	NC	NC
6	Channel B/	Differential output of the encoder channel B/ from X3-3 (5 V, 20 mA max.)
7	Channel B	Differential output of the encoder channel B from X3-7
8	Marker Z	Differential output of the encoder marker pulse
9	5 V	Input 5V for encoder
10	RXL	Receive data RS 485
11	TXH	Transmit data RS485
12	NC	NC
13	Channel A/	Differential output of the encoder channel A/ from X3-6 (5 V, 20 mA max.)
14	Channel A	Differential output of the encoder channel A from X3-2
15	Marker Z/	Differential output of the encoder marker pulse from X3-8 (5 V, 20 mA max.)

3.3.0 X3 encoder input connector (Sub-D 9 points female)

This connector is only used in mode "Speed feedback by encoder signals".

PIN	FUNCTION	I/O	REMARKS
1	5 V	O	Output 5V for encoder from X2-9
2	Channel A	I	Differential input of the encoder channel A
3	Channel B	I	Differential input of the encoder channel B
4	Marker Z	I	Differential input of the encoder marker pulse
5	0 V		
6	Channel A/	I	Differential input of the encoder channel A/
7	Channel B/	I	Differential input of the encoder channel B/
8	Marker Z/	I	Differential input of the encoder marker pulse
9	0 V		

3.4.0 X10 input - output command rear connector

PIN	FUNCTION	I/O	REMARKS
a2	Amplifier ready	O	Relay contact: closed if amplifier OK, open if fault.
c2	Amplifier ready	O	Pmax = 10 W with Umax = 50 V or Imax = 100 mA
a4	Current monitor output	O	± 10 V; resolution: 8 bits; load: 10 mA
c4	Motor voltage monitor output	O	Negative logic input
a6	ENABLE	I	Negative logic input
c6	0 V ENABLE	I	
c8	0 V logic input	I	
c10	Input command CV +	I	± 10 V speed input command for max. speed
c12	Input command CV -	I	or current ± 10 V input command for Imax
a12	0 Volt speed input command CV	I	
c14	Limit switch -	I	Negative logic input
c16	Limit switch +	I	Negative logic input
a16	CV0 Zero speed input command	I	Positive logic input
a20-c20	+15V	I	Input logic voltage +15V
a22-c22	0 V logic input	I	
a24-c24	-15V	I	Input logic voltage -15V
a26-c26	Motor output M2	O	Output motor terminal M2
a28-c28	Motor output M1	O	Output motor terminal M1
a30-c30	Positive DC Bus power (+Up)	I	DC Bus power input < 30VDC DC Bus <130VDC
a32-c32	Negative DC Bus power (-Up)	I	DC Bus power input negative/ground

3.5.0 Logic inputs/outputs specification

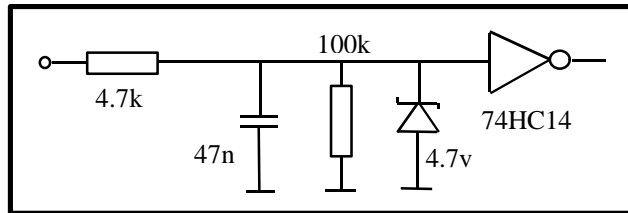
The SM-100/I amplifier has four logic inputs as well as an “*amplifier ready*” output signal.

3.5.1 Zero input command

When the “*zero input command*” is activated, the amplifier receives a zero input command and immediately stop the motor (except for the offset variation) whatever the speed input command value is.

Positive logic input: $15\text{ V} < U < 24\text{ V}$.

The response time is about 500 μs .



3.5.2 Limit switch inputs

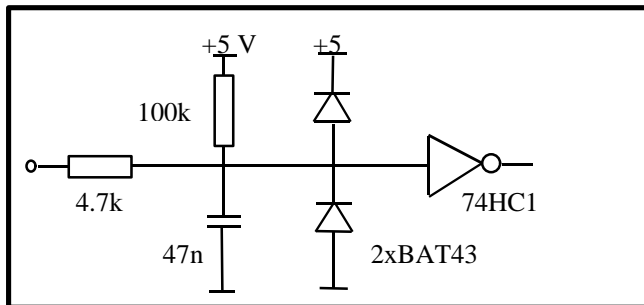
If one of the limit switch contacts is activated during operation, the motor speed will be disabled in the direction corresponding to that limit switch (except for the offset variation).

Negative logic inputs

FC+ activated: The motor stops in CW direction (from motor shaft side).

FC- activated: The motor stops in CCW direction (from motor shaft side).

The response time is about 500 μs .

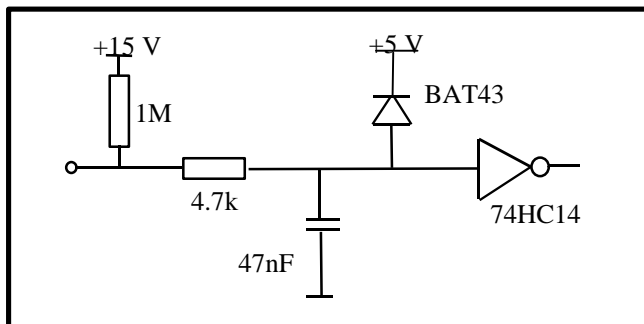


3.5.3 Enable input

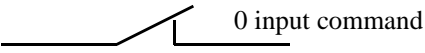
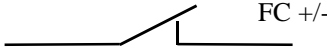
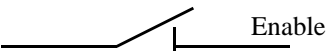
The SMT-100 amplifier is disabled when the ENABLE contact is open (free motor rotation).

Negative logic input

The response time is about 150 μs .



3.5.4 Logic inputs connection

LOGIC INPUTS	CONNECTION	
Zero command input	15 V < U < 24 V	 0 input command
Limit switch inputs	0 V	 FC +/-
Enable input	0 V	 Enable

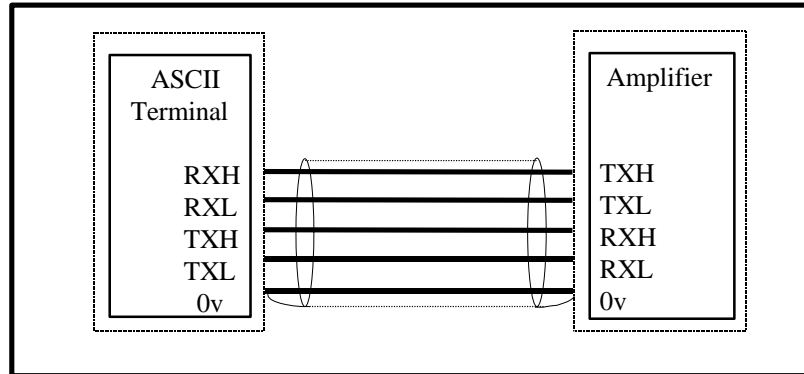
3.5.5 Amplifier ready output

Relay contact AOK opens if any amplifier fault occurs.

Note: On the 4 and 6 axes rack, two outputs corresponding to the serial connection of the amplifiers AOK relay contacts allow to process the information "rack failure".

This function is described in the wiring diagram of chapter 6.1.4.

3.6.0 Serial link connection



Note: It is possible to use the “Addressing function” to communicate as a multi-axis system (see appendix chapter 9.1.0)

ASCII Terminal Configuration

- Communications speed: 4800 bauds (default value)
- Data: 8 bits
- Parity bit: none
- Stop bit: 1

4.0.0 PARAMETERS SETTINGS

The SMT-100D amplifier is a digital amplifier. All command parameters are programmable via a serial link and can be saved in an EEPROM.

The parameters are sent to the amplifier by an ASCII terminal. Each instruction is coded as 2 ASCII characters with or without parameter(s). These instructions allow to modify or read the value of a variable.

When followed by a parameter, the variable corresponding to the instruction will take this value; otherwise, the amplifier will send back the current variable value via the serial link.

Each instruction (possibly followed by a parameter) sent to the amplifier must be confirmed by the character "carriage return" (ASCII code 13).

- Any character taken into account by the amplifier is sent back by echo.
- Any instruction refused by the amplifier is sent back by "?".
- Any parameter is sent as a hexadecimal value in a specific amplifier format.

4.1.0 Instructions list

Current limitation parameters

Maximum current limitation

Instruction	IM
Parameter	Can have any hexadecimal value between 20 and 7F.
Condition	Instruction taken into account when the software is disabled.
Remark	This instruction allows to limit the amplifier max. current. Limitation of $I_{max} (A) = IM(10) \times \text{Amplifier current sizing} (A)/127$. With: IM(10): IM parameter value in base 10. Ex.: IM7F corresponds to $I_{max} = I_{max}$ amplifier.

Rated current limitation

Instruction	IN
Parameter	Can have any hexadecimal value between 1A and 40.
Condition	Instruction taken into account when the software is disabled.
Remark	This instruction allows to limit the amplifier rated current. Limitation of $I_{rated} (A) = IN(10) \times \text{Amplifier current sizing} (A)/127$. With: IN(10) : IN parameter value in base 10. Ex.: IN40 corresponds to $I_{rated} = I_{max}$ amplifier /2.

Speed feedback mode parameters

Speed feedback by motor voltage monitor -- Speed feedback by encoder signals processing

Instruction	VC
Parameter	0 or 1.
Condition	Instruction taken into account when the software is disabled
Remark	VC0: Speed feedback by motor voltage monitor. VC1: Speed feedback by encoder signals processing.

Filter activated / not activated on speed feedback

Instruction	FK
Parameter	0 or 1
Condition	Instruction taken into account when the software is disabled.
Remark	FK0 : Filter not activated. FK1 : Filter activated.

Scale factor in mode "Speed feedback by encoder resolution"

Instruction	SC
Parameter	Can have any hexadecimal value between 0 and FFFF.
Condition	Instruction taken into account when the software is disabled.
Remark	The value of this parameter is depending on the motor encoder resolution and the maximum application speed (see appendix "Speed signal mode by encoder resolution").

Gain parameters

Proportional speed loop gain

Instruction	KP
Parameter	Can have any hexadecimal value between 0 and 7FFF.
Condition	none

Integral speed loop gain

Instruction	KI
Parameter	Can have any hexadecimal value between 0 and 7FFF.
Condition	none

Speed regulator output filter

Instruction	FC
Parameter	Can have any hexadecimal value between 0590 and 7800.
Condition	Instruction taken into account when the software is disabled.
Remark	The cut-off frequency is ruled by: $F_c(\text{hertz}) = \frac{1000}{\pi} \times \ln \frac{32767}{FC(10)}$ with FC(10): FC parameter value in base 10.

Command input parameters

Analog input command mode / Digital input command mode

Instruction	AN
Parameter	0 or 1.
Condition	Instruction taken into account when the software is disabled.
Remark	In "analog input command" mode (AN1), the analog input command sent is received as an input command by the amplifier. In "digital input command" mode (AN0), the digital input command CVxxxx is received as an input command by the amplifier independently from the analog input command entered. The "AN0" mode can be used during the machine commissioning. When the motor is coupled with the load, be careful if the useful motion trajectory is limited.

Digital input command

Instruction	CV
Parameter	Can have any hexadecimal value between 0000 and FFFF.
Condition	none
Note	Instruction used in "digital input command mode"(AN0). Motor speed (rpm) = CV(10) x Nmax amplifier (rpm) / 32767 for 0 < CVxxxx < 7FFF With: CV(10) : Parameter value CVxxxx in base 10 The opposite rotation direction is obtained by taking the two's complement of CV(xxxx)

Maximum speed limitation

Instruction	VL
Parameter	Can have any hexadecimal value between 0 and 1FF.
Condition	Instruction taken into account when the software is disabled.
Remark	Speed limitation (rpm) = VL(10) x Nmax (RPM) / 2047. With VL(10): VL parameter value in base 10.

Rotation direction reversal

Instruction	IV
Parameter	0 or 1.
Condition	Instruction taken into account when the software is disabled.
Remark	The IV0 or IV1 instructions allows to reverse the rotation direction for a given input command polarity.

Command parameters

Software enabling / disabling

Instruction	MA
Parameter	0 or 1.
Condition	none
Remark	MA0: Software disabling. This instruction allows to disable the amplifier independently from the ENABLE input. MA1: Software enabling. This instruction allows to enable again the amplifier after the MA0 instruction.

Various parameters

Speed / torque mode

Instruction	MV
Parameter	0 or 1.
Condition	Instruction taken into account when the software is disabled.
Remark	In "speed mode" (MV1), the input command sent is taken into account as a speed input command by the amplifier (motor speed control). A 10 V analog input command corresponds to amplifier Nmax. In " torque mode " (MV0), the input command sent is taken into account by the amplifier as a current input command (motor torque control). A 10V analog input command corresponds to amplifier Imax.

Reset of the memory stored faults

Instruction	RZ
Parameter	No parameter.
Condition	none
Remark	This instruction allows the reset of a fault memory storage.

Parameters saving in an EEPROM

Instruction	SV
Parameter	No parameter.
Condition	Instruction taken into account when the software is disabled.
Remark	This instruction allows to save any parameter in an EEPROM after the amplifier adjustment.

Communication speed

Instruction	BD
Parameter	2580 (9600 Bauds), 12C0 (4800Bds), 960 (1200 Bds), 258 (600 Bds), 12C (300 Bds).
Condition	none
Remark	This instruction allows to set the communication speed. In standard, the communication speed is set at 4800 bauds (BD12C0).

Reading of the amplifier software version

Instruction	VE
Parameter	No parameter.
Condition	none
Remark	This instruction allows to read the EPROM software version. Ex.: Version 1.0 = 0100.

Taking into account or ignoring the statement of the "0 input command " input

Instruction CO
Parameter 0 or 1
Condition Instruction taken into account when the software is disabled.
Remark CO0: Ignoring the logic statement of the "0 input command " input.
CO1: Taking into account of the logic statement of the "0 input command " input.

Operation mode of the I²t protection

Instruction IP
Parameter 0 or 1
Condition Instruction taken into account when the software is disabled.
Remark IP0 : "Limiting" mode
IP1 : "Fusing" mode.

Reading of the amplifier status

Instruction LS
Parameter no parameter.
Condition none
Remark Allows the reading of the amplifier status.

Bit 15	Bit 14	Bit 13	Bit12	Bit 2	Bit 1	Bit 0
--------	--------	--------	-------	-------	-------	-------	-------

Bits signification:

- Bit 0 : Hardware disabling (1) / Hardware enabling (0).
- Bit 1 : Active positive limit switch (1) / Inactive positive limit switch (0).
- Bit 2 : Active negative limit switch (1) / Inactive negative limit switch (0).
- Bit 3 : 0 input command active (1) / inactive (0).
- Bit 4 : Speed mode (0) / Torque mode (1).
- Bit 5 : Analog input command mode (0) / Digital input command mode (1).
- Bit 6 : Limitation at I rated (1) / No limitation (0).
- Bit 7 : Amplifier fault (1) / No amplifier fault (0).
- Bit 8 : Speed by encoder resolution processing (1) / Speed by motor voltage monitor (0).

Communication in addressing mode

Instruction AD
Parameter Can have any hexadecimal value between 1 and F.
Condition none/
Remark Allows the communication with the amplifier having the address x in parallel wiring of the serial link (see chapter 9.1.0).

5.0.0 POWER SUPPLY SPECIFICATIONS

The function of the **MP/DR100A** a power supply unit is:

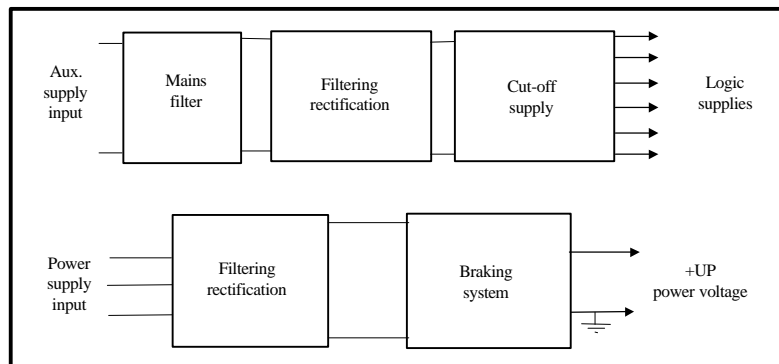
- Provide the amplifier(s), from an alternative single-phase or three-phase source, with a rectified and filtered power bus voltage,
- Generate, from an auxiliary 230 Vrms alternative single-phase input, the logic voltages required for the amplifier(s) supply,
- Control the power voltage level during the motor braking phases (braking regulator).

The power supply unit provides both power and logic supplies for up to 6 amplifiers.

5.1.0 Technical specifications (MP/DR100A)

Power supply input	90 Vrms max. single-phase or three-phase
Aux supply input	230 Vrms +/- 10% 50-60 Hz single-phase
Logic voltage generated	+15V regulated +/- 5% max current 800 mA -15 V regulated +/- 5% max current 350 mA +15V +/-1 V with floating reference, max current 600 mA
Filtering capacity	1000 μ F
Max. output current	35 A continuous
Braking regulator	Triggering voltage: 155 Vdc Hysteresis: 20 Vdc Instant power: 1,6 KW Rated power: 100 W Ohmic value: 15 ohms.
Protections	Protection by fuse of the auxiliary supply Protection by fuse of the braking regulator Short-circuit protection of the logic supplies
Front panel display	Power voltage LED +15 V / -15 V LED
Temperature	Storage: -20°C / +70°C Operation: +5°C / +50°C

5.2.0 Block diagram



5.3.0 Inputs / Outputs

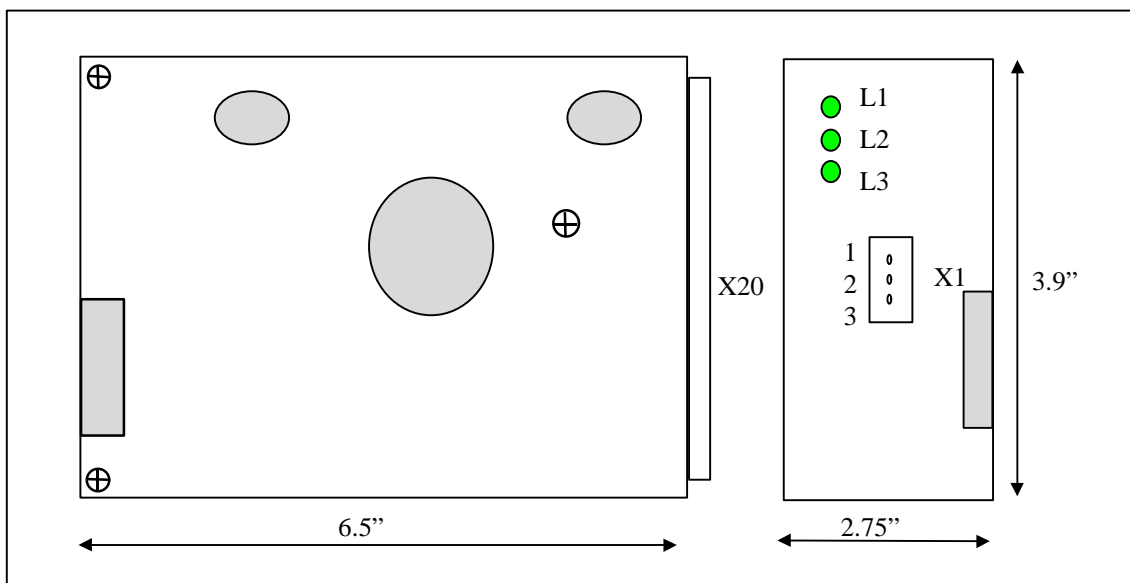
5.3.1 X1 Auxiliary input voltage (3 points orange connector)

PIN	FUNCTION	REMARKS
1	Earth (ground)	GND
2	230 Volt	Single phase input +/- 10%
3	230 Volt	Single phase input +/- 10%

5.3.2 X20 Backplane connector (15 points Shroff connector)

PIN	FUNCTION	REMARKS
d6-z4	Power phase 1	Sinusoidal input power - phase 1
d10-z8	Power phase 2	Sinusoidal input power - phase 2
d14-z12	Power phase 2	Sinusoidal input power - phase 3
d30-z32	-Up	Negative DC Bus output voltage
d26-z28	+Up	Positive DC Bus output voltage
z24	+15V	Output +15V logic (800mA max)
d22	0 Volt	0 Volt logic output
z20	-15V	Output -15V logic (350mA max)
z16	+15V floating	Floating +15V output (600mA max)
d18	-15V floating	Floating -15v output

5.4.0 Mechanical dimensions

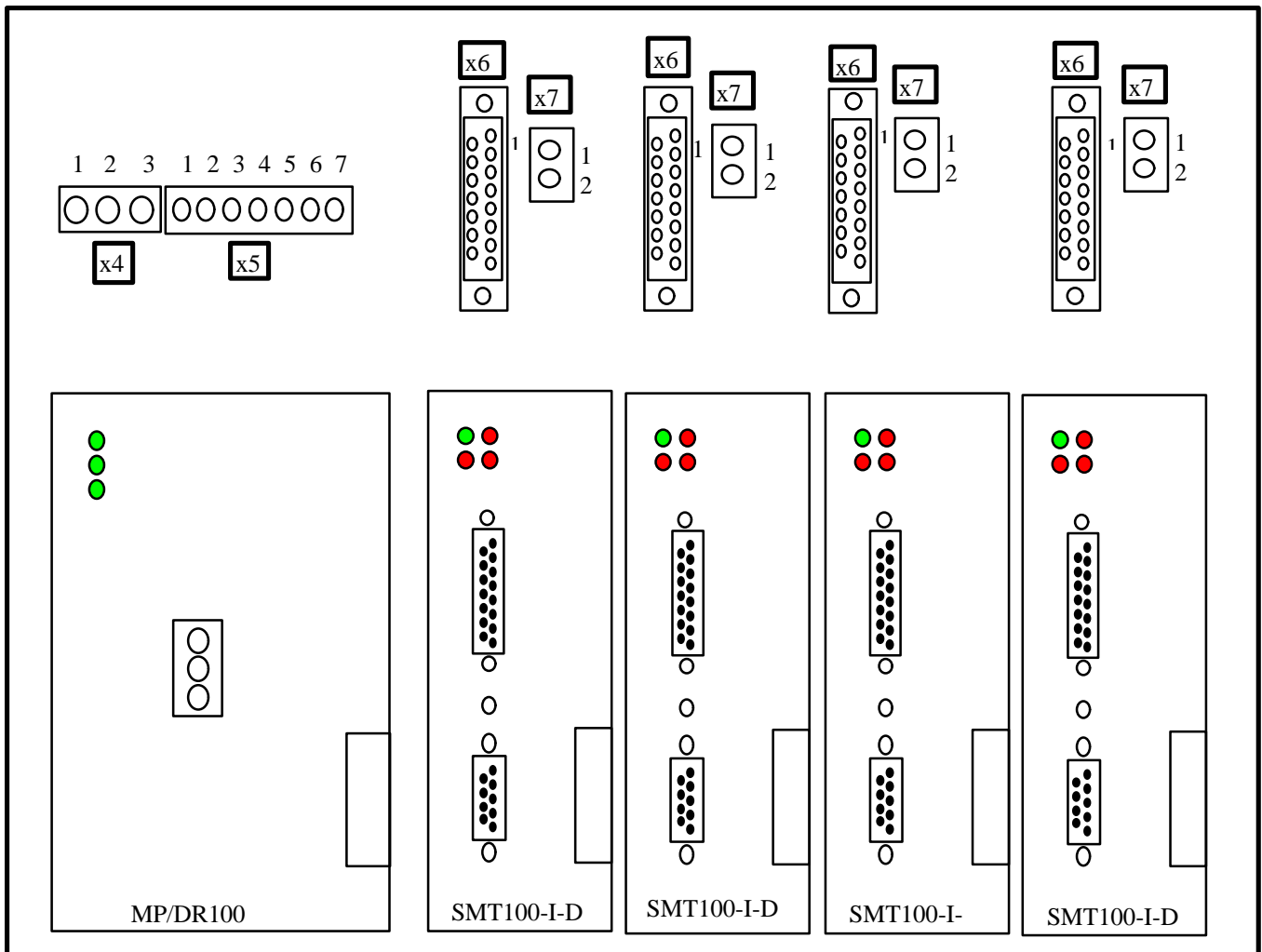


L1 : -15 V voltage ok.
 L2 : +15 V voltage ok.
 L3 : Power voltage ok.

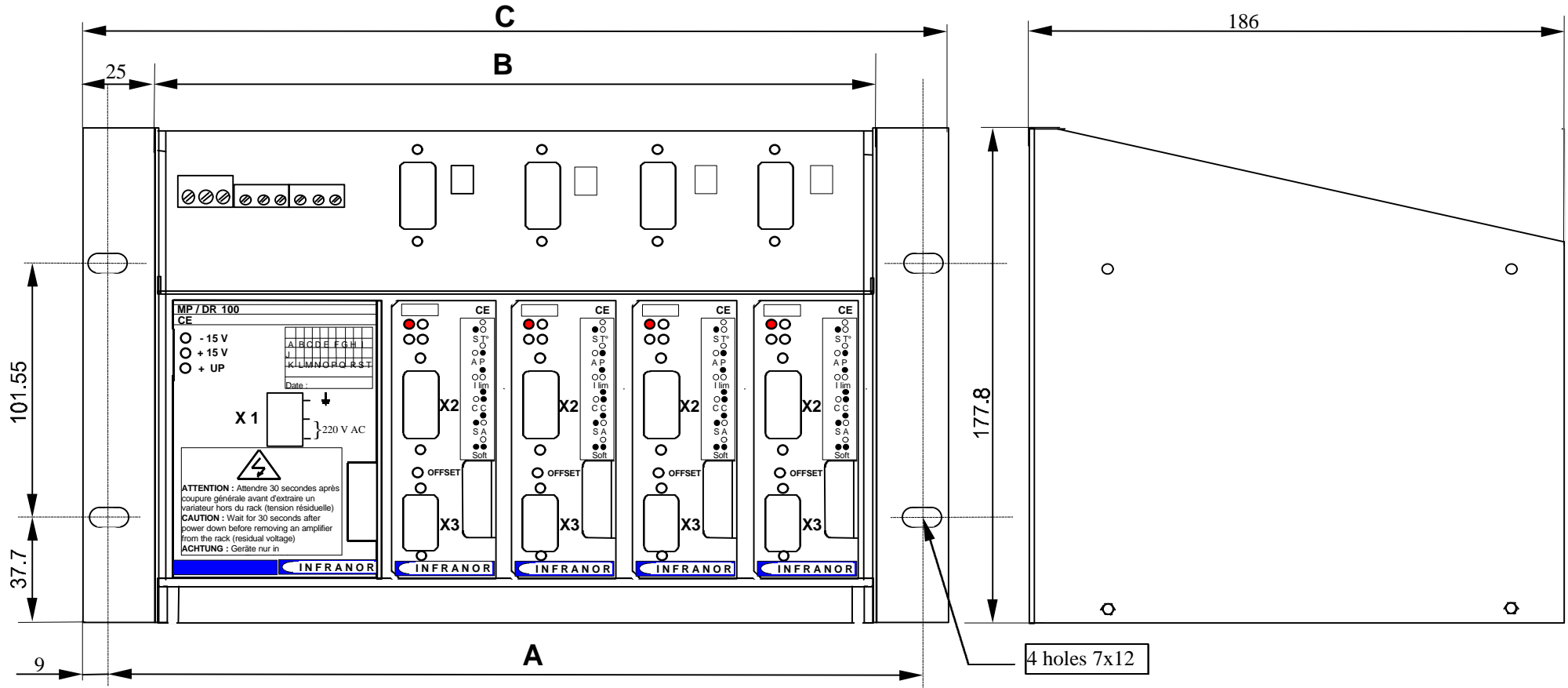
(*): In order to have a common "Enable" signal for all axes, make the jumpers marked as "G" on the backplane: The enabling command will then be located between pins 1 and 2 of the X5 connector.
 In order to have each axis independently controlled via the X6 connectors, the "G" jumpers must be "open".
 Location of the "G" jumpers: see backplane printed circuit (solder side).

(**): In order to get the "rack failure" signal (serial connection of the AOK contact relays), check for the presence of the E and F solder bridges on each axis as well as for the "C-D" jumper on the last axis.
 The serial connection of the AOK relay contacts is located between pins 3 and 4 of the X5 connector.
 In order to get the independent "AOK" signals accessible on the X6 connectors, open the "E-F" jumpers and make the "C-D" jumpers on each axis.
 Location of the "C-D" and "E-F" jumpers: see backplane printed circuit (solder side).

6.2.0 Connectors location

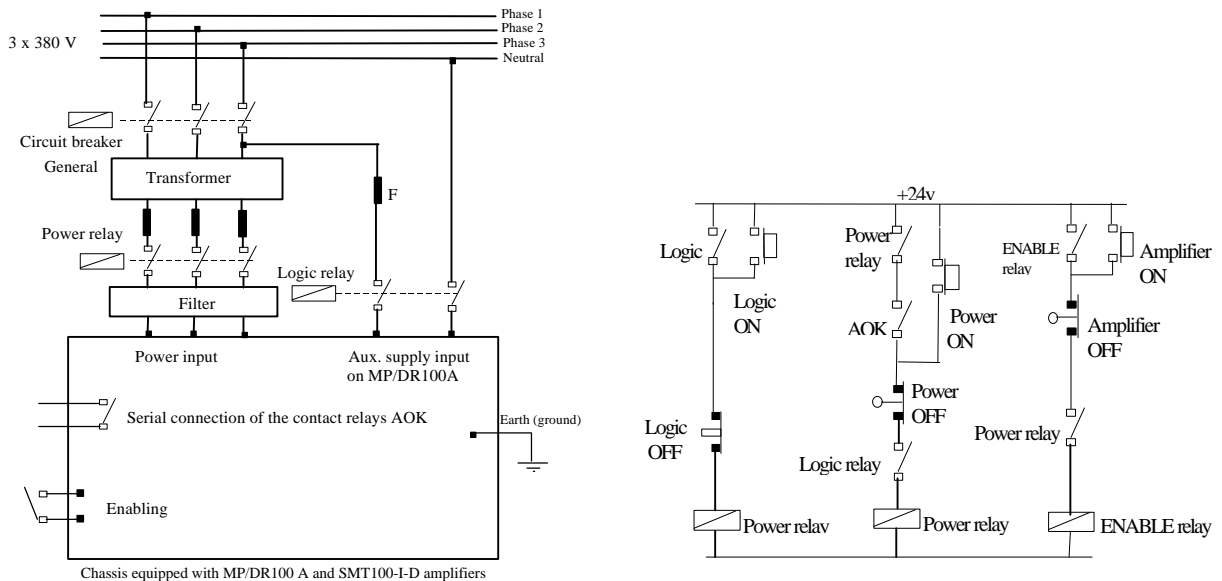


6.3.0 Rack dimensions



	Dimension A	Dimension B	Dimension C
1 axis chassis	159	136	177
4 axis chassis	281	258	299
6 axis chassis	362	339	380

6.3.0 Connection digrams



- "AOK" : serial connection of the AOK relay contacts.
- "Power relay" : power voltage switch on relay.
- "Logic relay" : logic voltage switch on relay.
- "ENABLE relay" : enabling relay.

Note: **All power lines must ABSOLUTELY be cut off at ALL POLES.**

6.4.0 Wiring recommendations

Grounding and ground wiring must be very carefully made.

The reference potential is the **earth (ground)**.

Cables with low potential should **NEVER** run in the proximity of power lines.

Host system (controller), rack, motor and machine housing must be grounded via connections as short as possible. It is advisable to use braidings.

The equipotentiality **MUST** be kept between NC / rack / machine housing and motor.

The conformity with the CEI 801 standard requires metallic or metal plated connectors in order to allow the 360° shield connections.

6.4.1 Motor cable

The motor cables must be shielded.

6.4.2 Input command cable

The input command cable must be a twisted pair and shielded. The shield connection over 360° must be made at the SUB-D connector.

6.4.3 Encoder signal cables

The encoder cables must be a twisted pair and shielded. The shield connection over 360° must be made at the SUB-D connector.

6.4.4 Modules fastening in the rack

The various modules (power supply and amplifiers) must be fastened by means of 2 knurled screws with fan-shaped washer (M4).

For shield connections, see appendix chapter 9.4.0.

7.0.0 COMMISSIONING

CAUTION

- **NEVER** plug in or remove a module under voltage.
- After the power supply is off, wait at least 30 seconds before removing any module out of the rack.

7.1.0 Putting into operation

Switch on the 230 Vrms aux. supply: check that both LEDs "*+15 V and -15 V voltages*" are lit on the MP/ DR100A power supply unit. On the amplifier(s) the "*No power voltage*" signal must be displayed (if not disabled).

Switch on the power supply: check that the LED "*Power voltage*" is lit on the MP/DR100A power supply unit. The maximum output voltage value of the transformer must be less than 90 Vrms between phases.

On the SMT100 amplifiers, only the green LED "*+5 V voltage*" must be lit.

7.2.0 Amplifier commissioning and adjustments

7.2.1 Communication via serial link

Connect the serial link RS485 between amplifier and terminal according to the wiring diagram of section 3.6.0 (**amplifier must be off**).

For the multiaxes addressing mode, see chapter 9.1.0.

Switch on the system according to the above section "Putting into operation", with the **amplifier disabled (ENABLE contact open)**

7.2.2 Maximum current and rated current adjustment

Check that the value of the maximum current (IM) and rated current (IN) parameters **are compatible with the motor** used, otherwise, change them to the motor specifications.

7.2.3 Speed feedback mode selection

Select the desired speed feedback mode by means of the "VU" instruction (Speed feedback by BEMF) or the "VC" instruction (Speed feedback by encoder feedback) - see chapter 9.2.0.

If necessary, adjust the maximum speed by means of the "VL" instruction.

7.2.4 Speed loop adjustment

- Enter a zero input command in the amplifier.
- Enable the amplifier.
- Set preliminarily the integral gain at zero (KI).
- Increase the proportional gain value KP until the loop begins oscillating, then reduce slightly the KP value in order to get a stable loop.
- Increase progressively the integral gain value KI until the loop begins oscillating, then reduce slightly the KI value until the loop remains stable.
- Sent input command steps to the amplifier and check for the loop stability over the whole speed range.

8.0.0 FAULT FINDING

8.1.0 Operating problems

8.1.1 Motor does not move

- Check that the rack is under power.
- Check for no fault on the amplifier.
- Check for the motor - amplifier connections.
- Check for the wiring of the "Inhibit", "Zero input command" and "Speed input command" inputs.
- Check for the correct amplifier status with terminal control (see section 4.1.0).

8.1.2 Loud crackling noise in the motor at standstill

- Check that the ground connections motor - amplifier - NC are made accordingly to section 6.4.0.
- Check for the speed loop adjustment (see section 7.2.4).

8.2.0 Amplifier's fault

8.2.1 "No power voltage"

- Check that the secondary voltage of the power transformer is available,
- Check that the amplifier power fuse is not damaged.

8.2.2 "Overvoltage"

- Check for no short-circuit in the motor wiring and at the motor terminals.

8.2.3 "Power overvoltage"

- Check that the secondary voltage of the power transformer is in conformity with the specifications,
- Check for the correct operation of the braking regulator during the motor braking phases.

8.2.4 "I_t protection "

- Check for the value of the amplifier rated current (I_N) with regard to the current required for the duty cycle.

9.0.0 APPENDIX

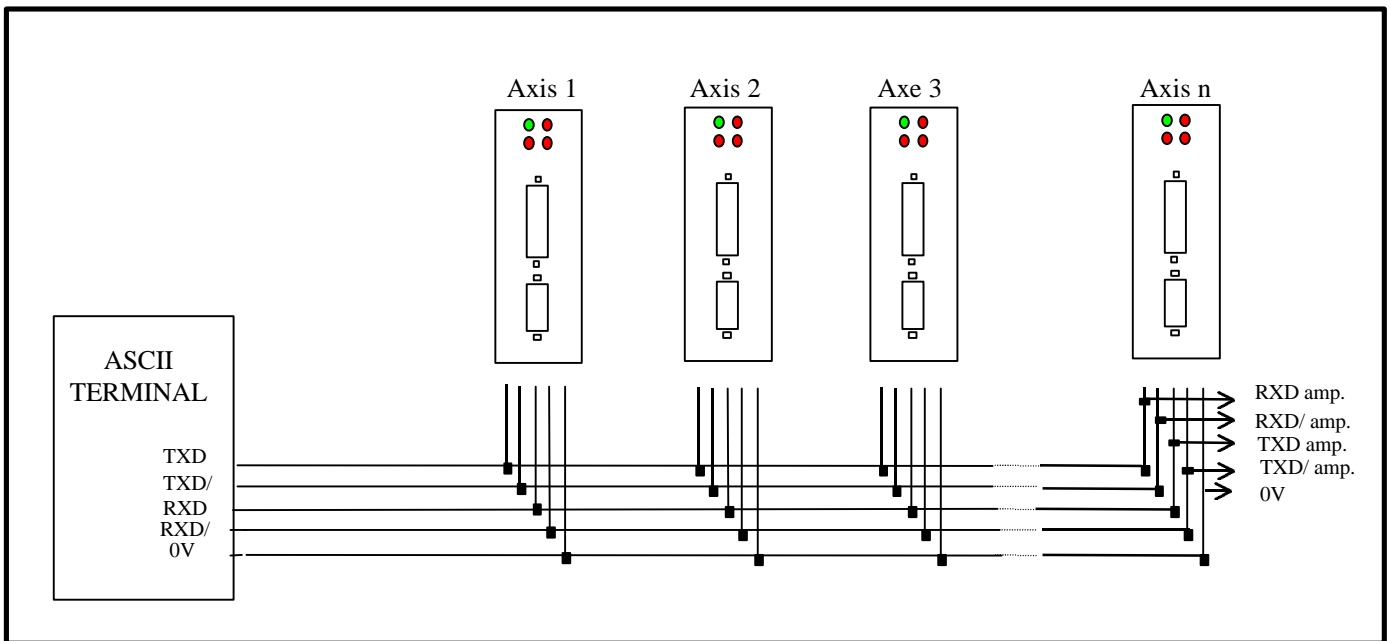
9.1.0 Addressing function

In a multi-axes system, this function allows to individually communicate with the amplifier through the serial RS485 link.

Four micro-switches available on the amplifier allow to configurate the amplifier hardware address.

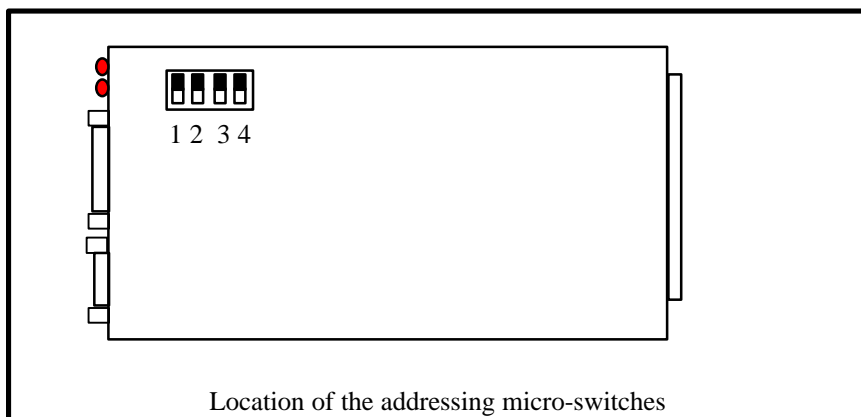
Under terminal control, the communication with the amplifier with address xxxx is obtained by executing the "ADn" command (n corresponding to the hexadecimal value of the xxxx address).

PARALLEL WIRING OF THE SERIAL LINK






AMPLIFIER ADDRESS CONFIGURATION

- Four micro-switches allow to configurate the amplifier xxxx address.
- Each amplifier must be configured with a different addressing.
- The addressing configuration must be made before turning power to the system



CONFIGURATION EXAMPLES

Amplifier addressing configuration	Communication instruction
 1 2 3 4	AD1
 1 2 3 4	AD2
 1 2 3 4	AD3

NOTE:

The 0000 addressing **CAN NOT** be used in parallel wiring.

The 0000 addressing is only to be used when the terminal is connected to only **one** amplifier. The communication with the amplifier will be directly obtained at power on without needing the "ADn" instruction.

COMMUNICATION

- Wire the serial link according to the table above.
- When the rack is off, configurate each amplifier addressing by means of the four micro-switches.
- To communicate with the amplifier with address "n+1", send the "ADn+1" instruction, ... etc.

9.2.0 Speed feedback modes

9.2.1 Speed control by BEMF feedback

Principle:

On a DC motor, the EMF is proportional to the speed:

$$\text{FEM (V)} = K_e (\text{V/rpm}) \times N (\text{rpm}).$$

The speed is different from the voltage available at the motor terminals because of the voltage drop at the terminals of the motor resistance: $\text{EMF} = U_{\text{mot}} - R_{\text{int}} \times I$ consumed.

Via a limiting differential stage, the motor voltage is digitalized before being processed by the speed loop.

The motor voltage is sized by both RU1 and RU2 resistors that must meet the following formula:

$$RU1 = RU2 = \frac{1000}{K_e \times N_{\text{max}} + R_{\text{int}} \times I_{\text{consumed}}} \quad (\text{Formula 1}).$$

With:

K_e = motor constant in V/rpm.

R_{int} = internal motor resistance in Ohms.

N_{max} = Max. application speed (rpm) corresponding to a 10 V speed input command.

I_{consumed} = current in Amps.

RU1 and RU2 are in kOhms.

$$\text{Formula (1) gives } N_{\text{max}} = \frac{1000}{RU1 \times K_e} - \frac{R_{\text{int}} \times I_{\text{consommé}}}{K_e} \quad (\text{Formula 2}).$$

Example:

Mavilor MS04: $K_e = 18 \text{ V}/1000 \text{ rpm}$, $R_{\text{int}} = 1.25 \text{ Ohms}$, $I_{\text{rated}} = 7.8 \text{ A}$, $N_{\text{rated}} = 3000 \text{ rpm}$.

$$RU1 = RU2 = \frac{1000}{0.018 \times 3000 + 1.25 \times 7.8} = 15.7 \text{ kOhms}.$$

In standard, the ohmic value of the RU1 and RU2 resistors is 12.7 kOhms / 1%.

RU1/RU2 location, see section 9.3.0.

Note: In practice, use a RU1/RU2 value that is slightly higher than the value calculated. It will still be possible to limit the maximum speed by means of the software parameter "VL".

9.2.2 Speed control by encoder feedback

Principle:

After processing, the four encoder signals A, /A, B, /B are converted into 2 signals:

- One logic direction signal which status is depending on the motor shaft rotation direction.
- One clock pulse for the edges counting (x4).

After counting and derivation, the numerical value obtained will be the motor speed monitor.

In "Speed control by encoder feedback" mode, it is necessary to define the scale factor ("SC" parameter).

The value of this parameter is depending on the maximum speed as well as on the encoder pulses per revolution:

$$SC(10) = \left(\frac{32704 \times 60 \times 250 \times 2}{4 \times N_{\text{max}} \times N_{\text{ptc}}} \right).$$

With:

SC(10): Scale factor in base 10.

N_{max} : Maximum application speed corresponding to a 10 volts input command (rpm).

N_{ptc} : Encoder pulses per revolution.

Example: If using a 1000 ppr encoder - Maximum application speed: 3000 rpm.

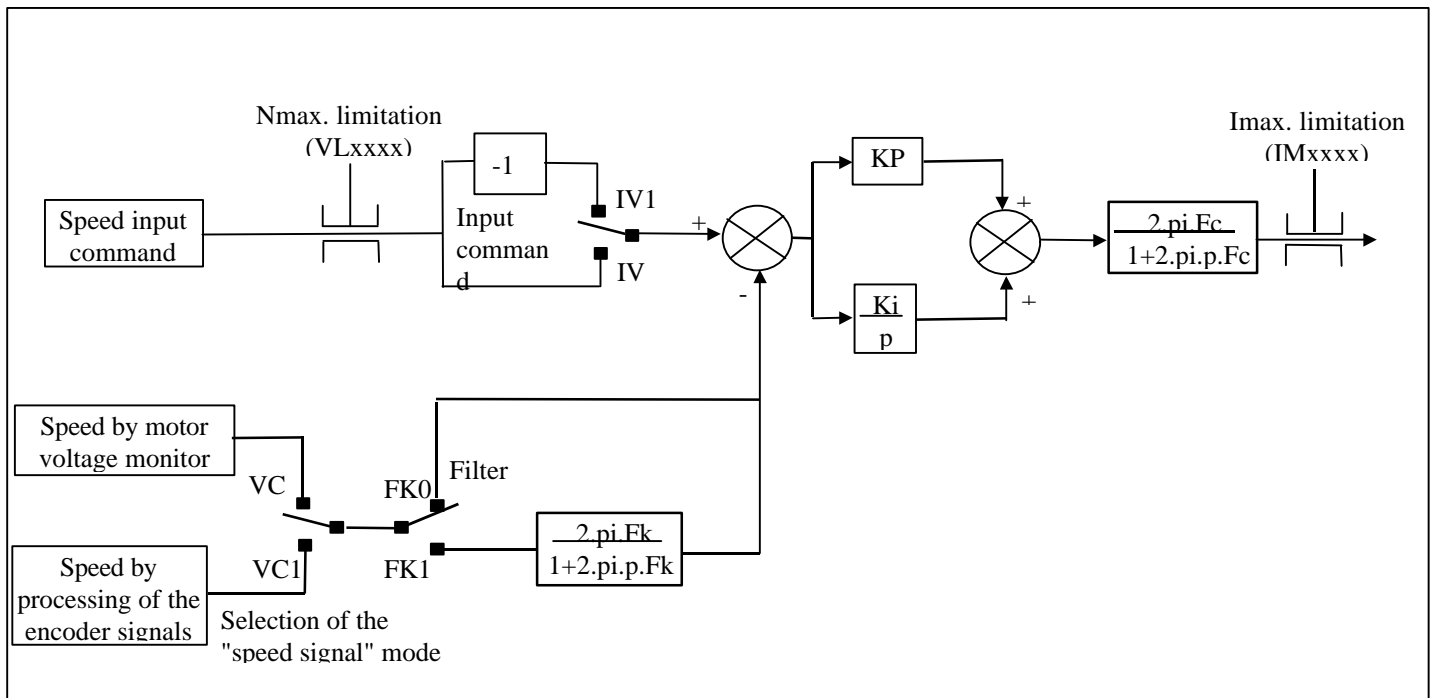
$$\text{Calculation of the SC(10) parameter} = \left(\frac{32704 \times 60 \times 250 \times 2}{4 \times 3000 \times 1000} \right) = 82.$$

In **hexadecimal**, the "SC" parameter value will be: **52**.

NOTES

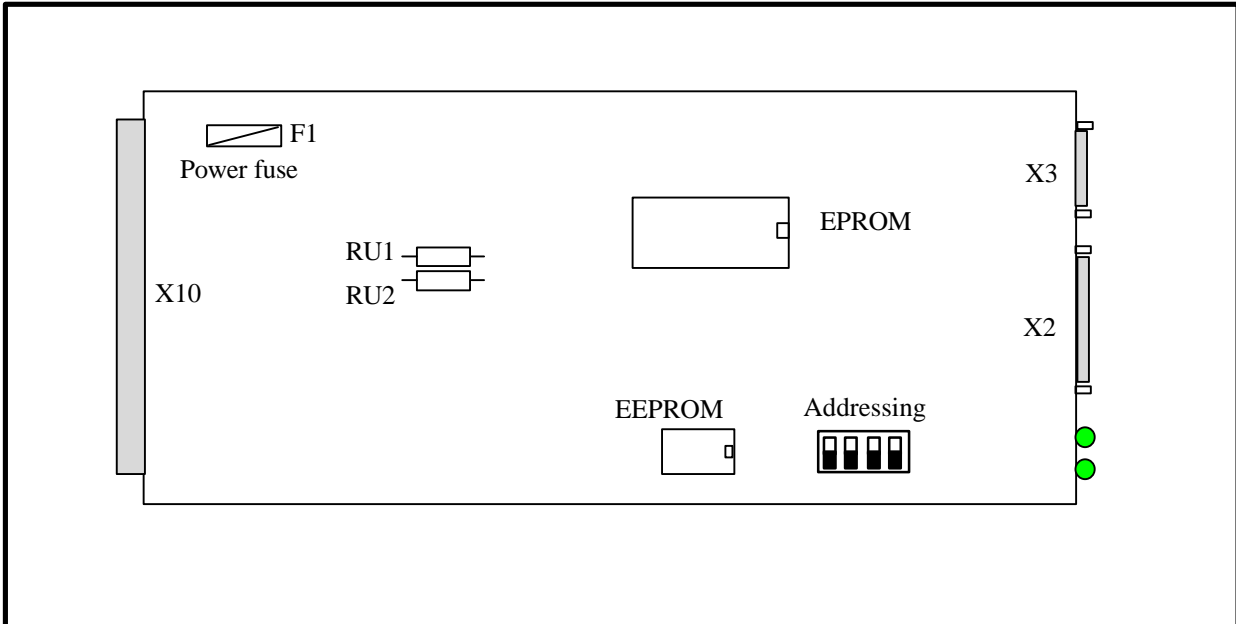
- We recommend to use a minimum encoder resolution of 1000 ppr.
- The encoder signals must be wired according to the section 3.3.0.
- On the amplifier, the encoder signals interface is made by means of a driver type 26LS32 (Thomson).
- In standard, the maximum speed is set at 3000 rpm for a 1000 ppr encoder (with possibility to reduce Nmax by means of the "VL" software instruction).

SPEED LOOP REGULATOR



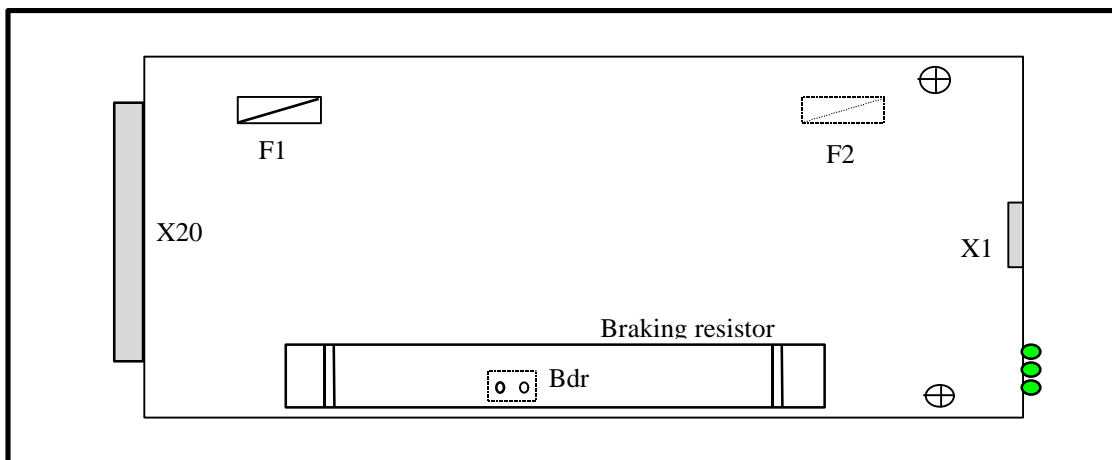
9.3.0 Components locations

9.3.1 Amplifier SMT-100/I



- X3:** Encoder connector.
- X2:** RS-485 connector.
- X10:** Backplane connector.
- F1:** 5x20 5AT fuse (SMT100-08D) - 5x20 10AT fuse (SMT100-20D).
- RU1-RU2:** Speed BEMF motor feedback.
- EEPROM:** Parameters memory.

9.3.2 Power supply MP/DR 100-A



- F1:** Braking resistor protection fuse (upper board): 5x20 2AT.
- F2:** Protection fuse for the logic supply (lower board): 5x20 1AR.
- X1:** Auxiliary supply input connector.
- X20:** Backplane connector.
- Bdr.:** Space for the location of a 2 pins connector for the connection of an external braking resistor.

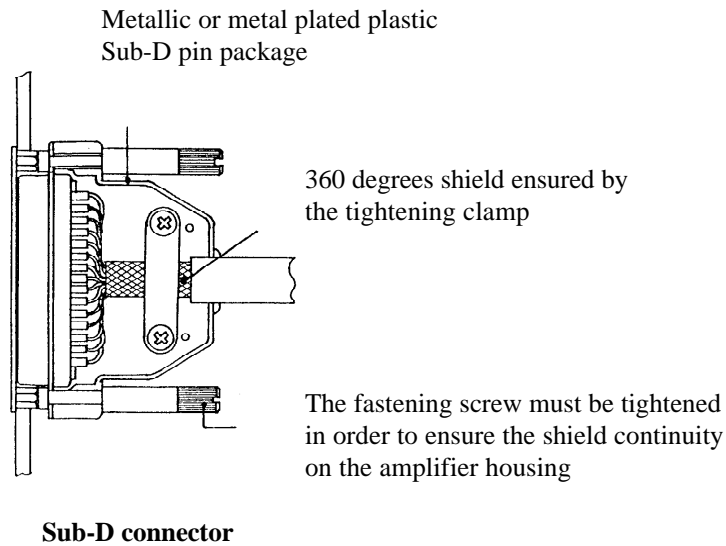
9.4.0 360° shield on the connectors

RULE

There must be **NO** shield interruption over the whole cable length.

NOTE

When the 360 degrees shield is made by means of a clamp, it is not necessary to connect a wire to the appropriate pin on the Sub-D connector



9.5.0 Default amplifier parameters

Current limitation parameters:

- Maximum current limitation **IM 007F**.

- Rated current limitation **IN 0040**.

"Regulation mode" parameters:

- Speed mode **MV1** - Torque mode **MV0**

"Speed monitor" parameters

- Speed mode by motor voltage **VC0** - Speed mode by encoder feedback **VC1**

- Encoder resolution scale factor **SC 00A3**.

- Motor voltage monitor : Filter "ON" **FK1** - Filter "OFF" **FK0**

Speed gain parameters:

- Proportional gain **KP 0300**.

- Integral gain **KI 0200**.

- Current input command filter **FC 0590**.

Command input parameters:

- Analog input command mode **AN1** - Digital input command mode **AN0**

- Rotation direction + **IV0** - Rotation direction - **IV1**

- Speed limitation **VL 01FF**.

Various parameters:

- I²t mode "fusing" **IP1** - I²t mode "limiting" **IP0**

- Communication speed **BD 12C0**.

- "Zero command" input: - **CO wired 1** - **CO not wired 0**