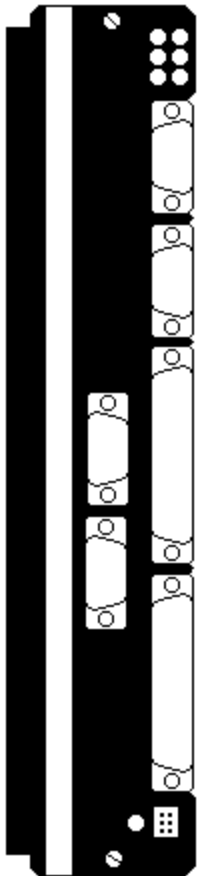


SMT-BD1/k

gb



**Digital drive with
CANopen
interface**

Installation Guide



WARNING



This is a general manual describing a series of servo amplifiers having output capability suitable for driving AC brushless sinusoidal servo motors.

Instructions for storage, use after storage, commissioning as well as all technical details require the MANDATORY reading of the manual before getting the amplifiers operational.

Maintenance procedures should be attempted only by highly skilled technicians having good knowledge of electronics and servo systems with variable speed (EN 60204-1 standard) and using proper test equipment.

The conformity with the standards and the "CE" approval is only valid if the items are installed according to the recommendations of the amplifier manuals. Connections are the user's responsibility if recommendations and drawings requirements are not met.



Any contact with electrical parts, even after power down, may involve physical damage. Wait for at least 5 minutes after power down before handling the amplifiers (a residual voltage of several hundreds of volts may remain during a few minutes).



ESD INFORMATION (ElectroStatic Discharge)

INFRANOR amplifiers are conceived to be best protected against electrostatic discharges. However, some components are particularly sensitive and may be damaged if the amplifiers are not properly stored and handled.

STORAGE

- The amplifiers must be stored in their original package.
- When taken out of their package, they must be stored positioned on one of their flat metal surfaces and on a dissipating or electrostatically neutral support.
- Avoid any contact between the amplifier connectors and material with electrostatic potential (plastic film, polyester, carpet...).

HANDLING

- If no protection equipment is available (dissipating shoes or bracelets), the amplifiers must be handled via their metal housing.
- Never get in contact with the connectors



ELIMINATION

In order to comply with the 2002/96/EC directive of the European Parliament and of the Council of 27 January 2003 on waste electrical and electronic equipment (WEEE), all INFRANOR devices have got a sticker symbolizing a crossed-out wheel dustbin as shown in Appendix IV of the 2002/96/EC Directive.

This symbol indicates that INFRANOR devices must be eliminated by selective disposal and not with standard waste.

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 Issue: **2.2**

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Chapter 1 – General description

1 - INTRODUCTION

Series **SMT-BD1** digital servo modules are PWM servo amplifiers that provide speed control for AC sinusoidal motors (brushless) with transmitter resolver.

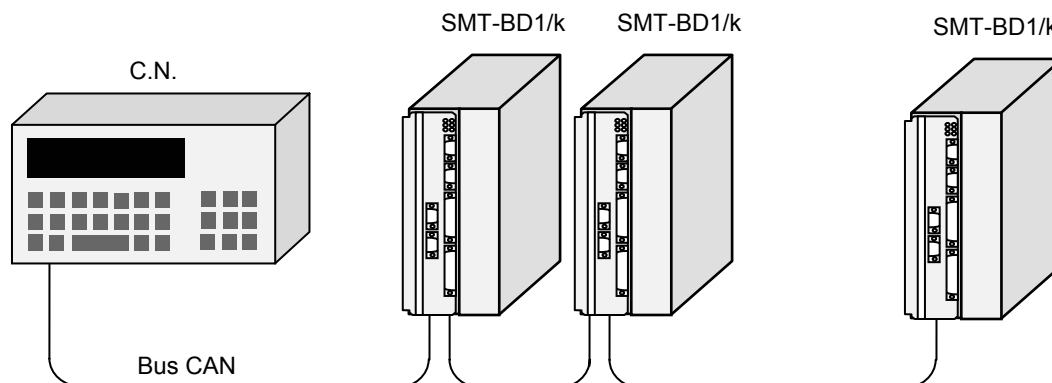
The **SMT-BD1/k** servo drive is 220 VAC or 400 VAC mains operated. The **SMT-BD1** plug-in system with 220 VAC power supply is available as a single-axis block version or as a multi-axis version that can receive up to six axes in a standard 19" rack including the power supply. The **SMT-BD1/k** plug-in system with 400 VAC power supply is available as a multi-axis version that can receive up to three axes in a standard 19" rack including the power supply.

NOTE: For the operation with 400 V supply, please see [manual BD1/a-400 V](#).

The **SMT-BD1/k** amplifier is a version of the standard SMT-BD1 amplifier, with a CANopen interface allowing the receipt of the motion commands by the CAN bus instead of the analog +/- 10 V input.

The operation of this drive is entirely controlled by messages exchanges on the CANopen bus.

This amplifier is to be run by controllers having a CANopen interface and controlling amplifiers according to a protocol described in the [CANopen Communication Protocol manual](#).



2 - CONFORMITY WITH EUROPEAN STANDARDS: "CE" APPROVAL

2.1 - GENERAL DESCRIPTION

The **SMT-BD1** amplifiers have their own DC/DC converter to provide appropriate logic voltage to the modules. This power supply can use, as a source, either the bus power voltage of 310 V DC or an auxiliary power supply which is necessary particularly when the position output information needs to be saved.

Each module is packaged as a 6 U "double Eurocard":

- one power board with IGBT transistors
- one logic board with DSP (Digital Signal Processing).

The **SMT-BD1** amplifier directly controls the motor torque and speed by means of the information provided by a transmitter resolver sensor.

All control parameters are programmable via the serial link RS232 or CANopen bus and saved in one single EEPROM. The auto-tuning and auto-phasing functions allow a quick and easy commissioning of the amplifier.

2.2 - REFERENCE TO THE STANDARDS

The 220 VAC version of the **SMT-BD1** amplifiers operating in the BF rack, which is equipped with the mains filter BF-35 or 70, has been approved for its conformity with the Electromagnetic Compatibility standards:

- EN 55011, Group 1, Class A regarding the conducted and radiated radioelectric disturbances,
- CEI 801 - 2 - 3 - 4 regarding the immunity.

The 400 VAC version of the **SMT-BD1** amplifiers operating in the BF-400 rack, which is equipped with the mains filter F400-35 or 70, has been approved for its conformity with the Electromagnetic Compatibility standards:

- EN 55011, Group 1, Class A regarding the conducted and radiated radioelectric disturbances,
- CEI 801 - 2 - 3 - 4 regarding the immunity.

The results and test conditions of the LCIE (Laboratoires Central des Industries Electriques), which is approved by the European Community, are referenced with the n° 416040 - 416041 - 416042 - 416043.

The results of the tests made according to the Low Voltage directive are referenced in the LCIE report n° 413777.

Standard to be applied to the electrical equipments of industrial machines: EN 60204.1.

2.3 - "CE" MARK

The amplifiers have been "CE" labelled since 1995.

Chapter 2 - Specifications

1 - MAIN TECHNICAL DATA

Operating voltage	310 VDC (270 V < DC bus < 340 VDC)
Auxiliary supply voltage	310 VDC (200 V < Uaux < 340 VDC max.)
Motor terminal to terminal output voltage	200 Vrms for DC bus 310 VDC

Output currents for the **Fusing mode of the I²t protection** (see Chapter 8, part 3.3)

AMPLIFIER TYPE	U rated (Vrms)	I _{max} (Arms) 1 s	Max. authorized rated current (Arms) of the amplifier		
			Without fan*	Fan type 1*	Fan type 2*
SMT-BD1/k-220/04	240	4,4	2		
SMT-BD1/k -220/08	240	8,8	4		
SMT-BD1/k-220/12	240	13,8	6		
SMT-BD1/k-220/17	240	17,7	8,5		
SMT-BD1/k-220/30	240	30,8	10	12	15
SMT-BD1/k-220/30r	240	30,8	10	15	
SMT-BD1/k-220/45	240	48,6	10	15	20
SMT-BD1/k-220/45r	240	48,6	10	20	23
SMT-BD1/k-220/60	240	61	10	19	25
SMT-BD1/k-220/60r	240	61	12	26	30
SMT-BD1/k-220/70	240	70	25	30	35
SMT-BD1/k-220/100	240	100	25	30	35

Output currents for the **Limiting mode of the I²t protection** (see Chapter 8, part 3.3)

AMPLIFIER TYPE	U rated (Vrms)	I _{max} (Arms) 1 s	Max. authorized continuous current (Arms) of the amplifier		
			Without fan*	Fan type 1*	Fan type 2*
SMT-BD1/k-220/04	240	4,4	2		
SMT-BD1/k -220/08	240	8,8	4		
SMT-BD1/k-220/12	240	13,8	6		
SMT-BD1/k-220/17	240	17,7	8,5	8,5	
SMT-BD1/k-220/30	240	30,8	8,5	12	15
SMT-BD1/k-220/30r	240	30,8	10	15	
SMT-BD1/k-220/45	240	48,6	8,5	15	18
SMT-BD1/k-220/45r	240	48,6	10	20	23
SMT-BD1/k-220/60	240	61	8,5	17	20
SMT-BD1/k-220/60r	240	61	12	26	30
SMT-BD1/k-220/70	240	70	17	30	35
SMT-BD1/k-220/100	240	100	25	30	35

* Maximum room temperature = + 40° C, fan 1 = 56 l/s, fan 2 = 90 l/s

Note: The **SMT-BD1-k-X/Xr** amplifier types are equipped with an additional heatsink in order to improve the heat dissipation and increase their rated current. The width of these amplifier types is then 18 TE instead of 12 TE.

PWM switching frequency	10 KHz
Minimum inductance between phases	1 mH
Current regulator (PI)	Adjusted to the motor
Current loop bandwidth	Cut-off frequency for 45° phase shift: 45° > 1 kHz
Internal current limitation	I _{max} : 20 % to 100 % and I rated: 20 % to 50 % I _{max} duration = 1 second
PI ² speed regulator	Sampling period = 0,5 ms
Position regulator	Anti-wind-up system of the integrator Antiresonance filter

Speed loop bandwidth	Adjustable digital gains Cut-off frequency for 45° phase shift: Selectable : 50 Hz, 75 Hz or 100 Hz
Max. motor speed	Adjustable from 100 rpm to 14000 rpm
Encoder position output	Two A and B channels in quadrature with n marker pulse(s) per revolution. RS422 line driver. Programmable resolution: max. 8192 ppr up to 900 rpm max. 4096 ppr up to 3600 rpm max. 1024 ppr up to 14000 rpm Accuracy: 8 arc minutes + 1/4 point (2 arc minutes + 1/4 point on request) Note: The total position accuracy must take into account the accuracy of the resolver used.
Analog outputs (test connector)	Speed input command (CV): ± 10 V pour \pm vitesse max Speed monitor (GT): ± 8 V for ± 14000 rpm, linearity: 10 %. Current input command (I DC): ± 10 V for amplifier current rating, 8 bit resolution Current monitor (Imes): ± 10 V for \pm amplifier current rating, 8 bit resolution
Logic inputs	Enable / Disable: ENABLE Limit switch +: FC+ Limit switch -: FC- Index input: INDEX Fault reset: RAZ
Logic outputs	Relais contact $U_{max} = 50$ V $I_{max} = 100$ mA, $P_{max} = 10$ W "Amp ready": closed if amplifier OK, open if fault "Power ready": closed if power OK, open if fault Brake control
Command inputs	CAN bus Speed: 1 Mbit ISO/DIS 11898 standard
Encoder inputs (option)	A and B quadrature + Z Line receiver RS-422 Maximum frequency: 500 kHz
Error display	LEDs on front panel + diagnostic via serial link RS232 + diagnostic via CANopen bus
Motor and application parameter setting	Serial link RS232 and CANopen bus
Automatic functions	Amplifier adjustment to the motor (AUTOPHASING) Automatic regulator tuning (AUTOTUNING)
Conformity with the standards: CE approval with multi-axis power supply configuration BF rack and mains filter BF 35 or 70, or SMT-BM20A single-axis rack and filters FN 612-20/06, FN 356-16/06 or BF 35 "360°" shields; equipotential according to the wiring rules	Standards regarding Electromagnetic Compatibility: - Immunity: CEI standards 801- 2 - 3 - 4 - Conducted and radiated disturbances: EN 55011, Group 1, class A Electrical standards for industrial machines: - EN 60204-1 : Insulator: 1500 Vac / 1 min Leakage current > 3 mA (EMI filters)
Temperature - storage: -20° C to +70° C - operation: +5° C to +40° C	From 40°C on, the rated currents must be reduced of 3 %/°C Max. temperature: 50°C
Altitude	1000 m

Moisture
Cooling

< 50 % at 40°C and < 90 % at 20°: EN60204-1 standard
Natural convection or forced air, according to the rated current (see current table, chap. 2, section 1)

2 - MAIN PROTECTIONS

2.1 - STORED PROTECTIONS

PROTECTION	ERROR DISPLAY	LED
Amplifier rated current overload *: - blinking display = Idyn signal (I ² t threshold reached) - continuous display = amplifier inhibited (I ² t fault)	I ² t	● ○ ○ ○
Position following error	Position	○ ○ ○ ●
CAN input command error	Synchro CAN	● ○ ○ ●
Resolver cable interruption	Resolver	○ ● ○ ○
Power stage failure: - power supply overvoltage - internal switch protection - short-circuit between phases	Power stage	● ● ○ ○
Resolver converter failure	R. D. C.	○ ○ ● ○
Amplifier overtemperature	°C Amp	● ○ ● ○
Power supply undervoltage	Undervolt.	○ ● ● ○
Motor overtemperature	°C Motor	● ● ● ○
Fault of the amplifier parameter memory	EEPROM	● ○ ● ●
Amplifier automatic procedure: - blinking display = procedure is running - continuous display = execution error	Busy	● ● ● ●

○ : LED is unlit

● : LED is lit.

* The I²t protection mode is described in [Chapter 8, section 3.3](#).

All these faults are memory stored in the amplifier except for the fault "Undervolt."

The reset of a memory stored fault can be made:

- via the CAN bus,
- via the fault RESET input (pin 13 of the X4 connector),
- by switching off the amplifier power supply.

2.2 - FUSE PROTECTION

F1 : Control of the average DC current of the power board supply (see chapter 8).

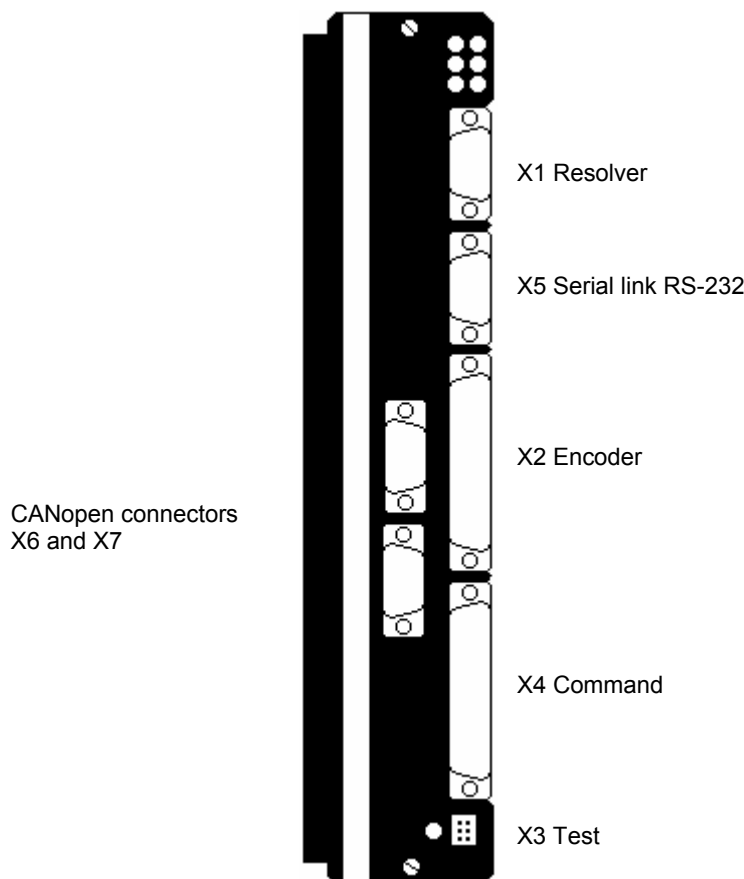
F2 : Control of the average DC current of the logic board supply (see chapter 8).

AMPLIFIER TYPE	F1 Power	F2 Logic
SMT-BD1/k-220/04 to 12	10 AT	1 A
SMT-BD1/k-220/17 and 30	15 AT	1 A
SMT-BD1/k-220/45	20 AT	1 A
SMT-BD1/k-220/60	20 AT	1 A
SMT-BD1/k-220/70	-	1 A
SMT-BD1/k-220/100	-	1 A

Chapter 3 – Inputs - Outputs

1 – CONNECTORS LOCATION

Front panel connectors:



2 - X1: RESOLVER CONNECTOR

Sub D 9 pins female.

PIN	FUNCTION	DESCRIPTION
1	TC (pin H sensor connector)	If thermal switch connected to X1
6	Shield connection	If no "360°" connection on the connector
2	TC (pin I sensor connector)	If thermal switch connected to X1
7	S1 (pin C sensor connector)	MAVILOR motor
3	S3 (pin D sensor connector)	MAVILOR motor
8	S4 (pin B sensor connector)	MAVILOR motor
4	S2 (pin A sensor connector)	MAVILOR motor
9	R2 (pin F sensor connector)	MAVILOR motor
5	R1 (pin E sensor connector)	MAVILOR motor

For resolver connections other than those of MAVILOR motors in standard version, please see resolver wiring table in [Chapter 8 \(Appendix\), part 2](#).

3 - X2: ENCODER CONNECTOR

Sub D 25 pins female

PIN	FUNCTION	I/O	DESCRIPTION
1	/CZ	O	Differential output of the encoder marker pulse (5 V, 20 mA max.)
2	CZ	O	Differential output of the encoder marker pulse
3	/CA	O	Differential output of the encoder channel A/ (5 V, 20 mA max.)
4	CA	O	Differential output of the encoder channel A
5	/CB	O	Differential output of the encoder channel B/ (5 V, 20 mA max.)
6	CB	O	Differential output of the encoder channel B
7, 10, 11	0 V		
12	/A	I	Differential input of the encoder channel A/
13	A	I	Differential input of the encoder channel A
14	/B or LIN0	I	Differential input of the encoder channel /B or logic input LIN0 (optocoupled)
15	B or LIN1	I	Differential input of the encoder channel B or logic input LIN1 (optocoupled)
16	/Z or LIN2	I	Differential input of the encoder channel /Z or logic input LIN2 (optocoupled)
17	Z or LIN3	I	Differential input of the encoder channel Z or logic input LIN3 (optocoupled)
24	5 V		±5%, 300 mA available with "5 V" jumper closed for encoder supply
8	LIN4	I	Logic input LIN4 (optocoupled)
18	LIN5	I	Logic input LIN5 (optocoupled)
9	LOUT0	O	Logic output LOUT0 (optocoupled)
20	LOUT1	O	Logic output LOUT1 (optocoupled)
21	LOUT2	O	Logic output LOUT2 (optocoupled)
22	LOUT3	O	Logic output LOUT3 (optocoupled)
23	GND 24 V		0 V for optocoupled inputs/outputs
25	GND		

The encoder input is optional.

When the encoder input is available, the logic inputs LIN0, LIN1, LIN2 and LIN3 are not available.

4 - X3: TEST CONNECTOR

PIN	FUNCTION	DESCRIPTION
1 - 6	0 Volt	
2	Current input command I DC	± 10 V; resolution: 8 bits, linearity: 2 % (DAC out 1)*
3	Speed input command CV	± 10 V for ± max. speed
4	Speed monitor GT	± 8 V for ± 14000 rpm
5	Current monitor I mes	± 10 V; resolution: 8 bits, linearity: 2 % (DAC out 2)*

* 10 V for amplifier current rating

5 - X4: COMMAND CONNECTOR

Sub D 25 pins male.

PIN	FONCTION	I/O	DESCRIPTION
1	Limit switch +	I	Positive limit switch
14	Limit switch -	I	Negative limit switch
24	0 Volt of limit switch	I	
20	ENABLE	I	"Hardware" enabling condition
23	0 Volt ENABLE	I	
4	Reserved	I	
7	INDEX	I	Homing input
25	0 Volt logic input		
13	Reset	I	Reset via 0 Volt (contact between pins 13 and 12)
12	0 Volt Reset	I	
15	Reserved		
16	Reserved		
17	Reserved		
3	Reserved		
10	Speed monitor output	O	
2	Current monitor output	O	
11	0 Volt analog output	O	
18, 19	Amp OK (amplifier ready)	O	Relay contact: closed if amplifier OK Pmax = 10 W avec Umax = 50 V ou Imax = 100 mA
8, 9	Brake control output	O	Relay contact: Pmax = 10 W avec Umax = 50 V ou Imax = 100 mA
21	+15 Volt	O	50 mA max
22	-15 Volt	O	50 mA max
5, 6	Non connected		

The **ENABLE**, **INDEX**, and **Limit Switch** inputs can be configured in positive logic or negative logic.

6 - X5: RS-232 CONNECTOR

PIN	FUNCTION	DESCRIPTION
5	0 V	GND (connection of the shield if no "360°" connection on the connector)
3	TXD	Transmit data RS 232
2	RXD	Receive data RS 232
6	TXH	Transmit data RS 422
7	TXL	Transmit data RS 422
8	RXL	Receive data RS 422
9	RXH	Receive data RS 422

7 - CAN CONNECTORS

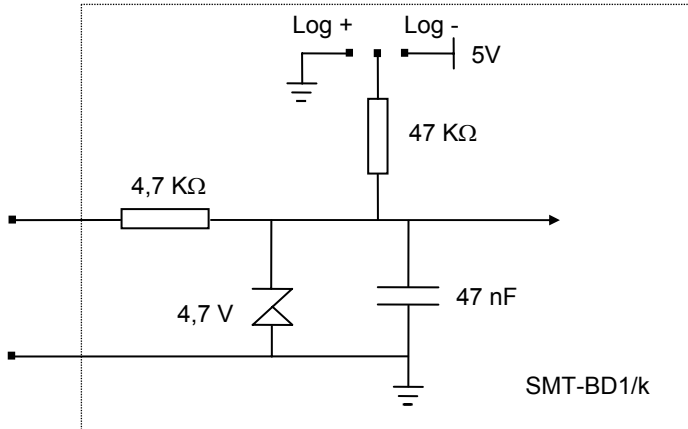
- Link without insulation.
- Compliant with the ISO/DIS 11898 standard.
- Compliant with the CiA recommendation DS-102 version 2.0.
- 1 Sub-D 9 pin male connector and 1 connecteur Sub-D 9 pin female on each amplifier.

PIN	FUNCTION	DESCRIPTION
2	CAN_L	CAN_L line (dominant low)
3	CAN_GND	CAN ground
7	CAN_H	CAN_H line (dominant high)

8 - SPECIFICATIONS OF THE INPUTS-OUTPUTS

8.1 - DEDICATED LOGIC INPUTS

Dedicated logic inputs: FC+, FC-, INDEX, ENABLE.

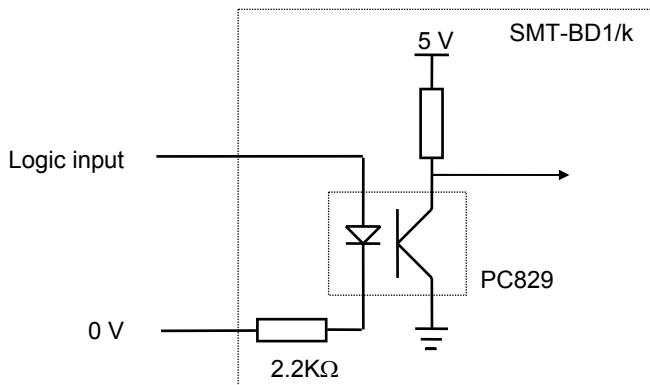


Input impedance: 4,7 KΩ.

Response time:
FC+, FC-, INDEX, ENABLE : 500 μs.

8.2 - LOGIC INPUTS

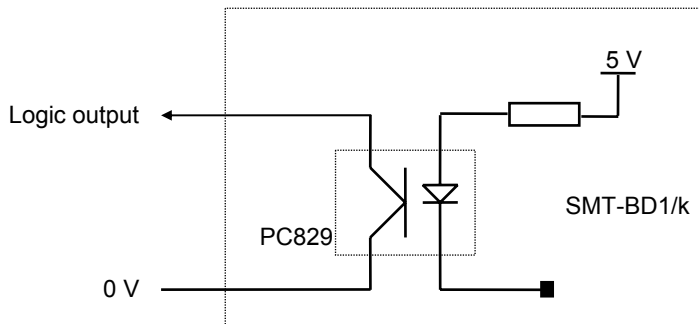
Logic inputs: LIN0 to LIN5



The input voltage corresponding to level 1 is between 5 V and 24 V.

8.3 - LOGIC OUTPUTS

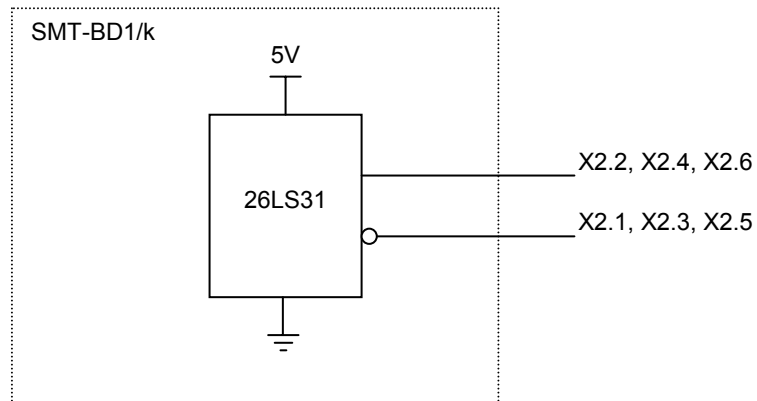
Logic outputs LOUT0 to LOUT3



The logic outputs are open collector outputs

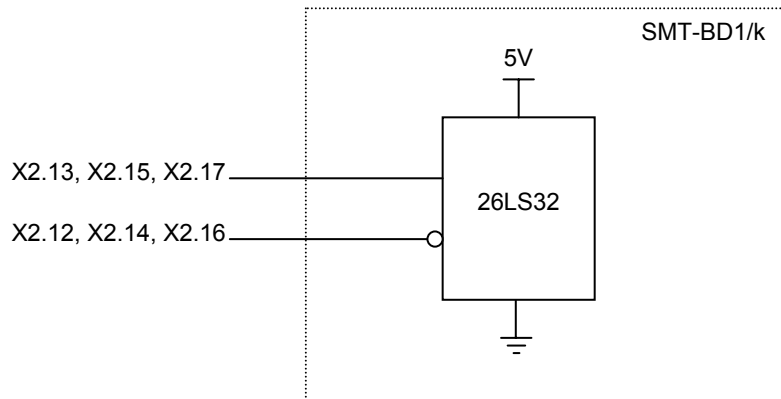
The output current is 5 mA.

8.4 - INCREMENTAL ENCODER OUTPUT



Recommended line receiver: 26LS32.

8.5 - INCREMENTAL ENCODER INPUT



Recommended line driver: 26LS31.

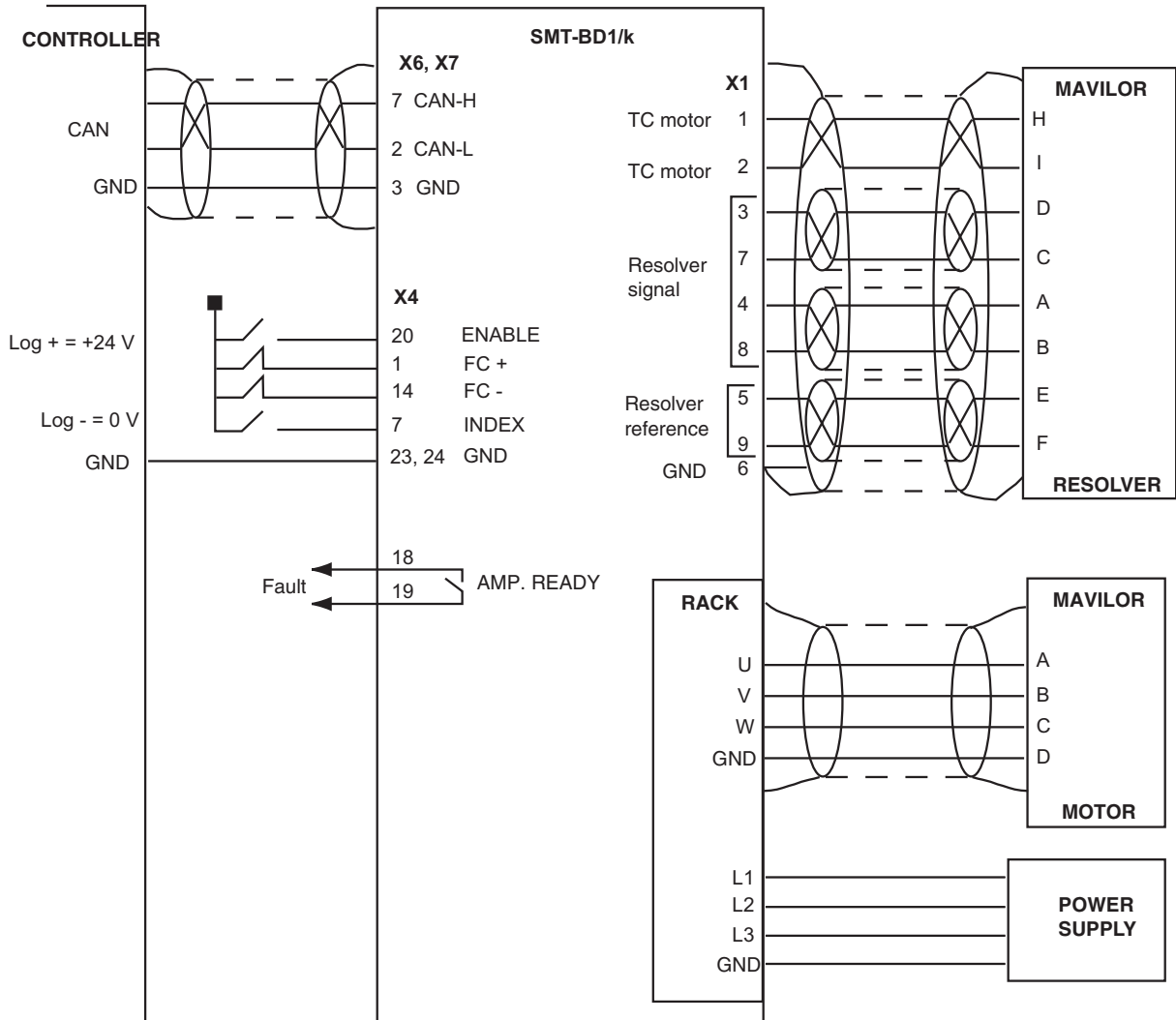
Chapter 4 - Connections

1 - CONNECTION DIAGRAMS

1.1 - CONNECTION OF THE RACK POWER SUPPLIES AND THE MOTORS

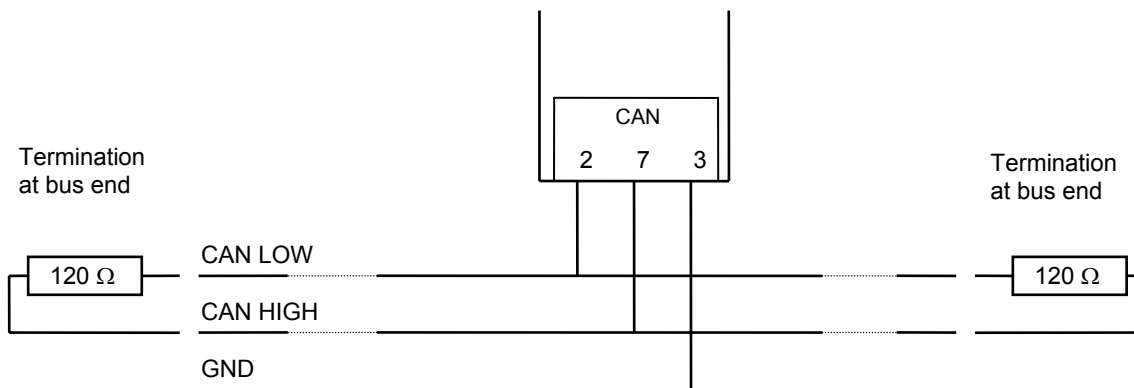
See manuals **SMT-BM 20 A - BMM 05 F - BMM 05 AF** for single-axis racks and **BF Rack** for multiaxis racks.

1.2 - CONNECTION BETWEEN CONTROLLER AND DRIVE



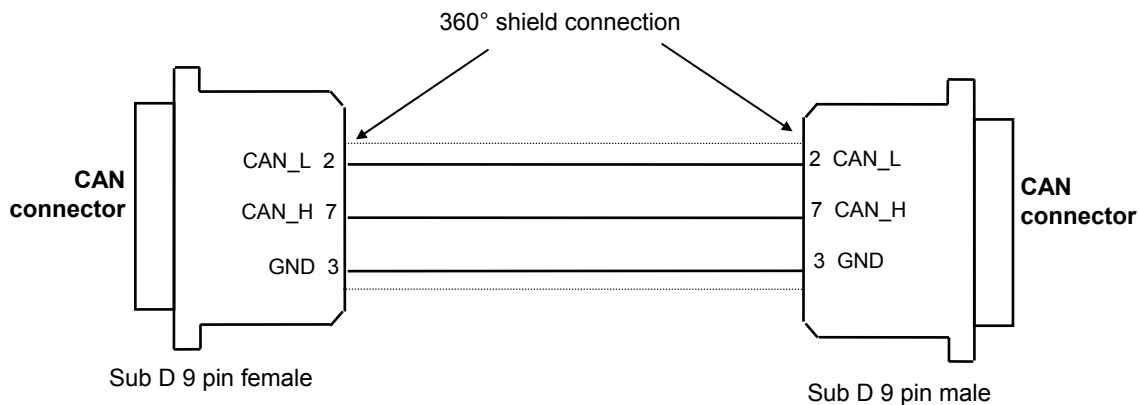
1.3 - CONNECTION OF THE CAN INTERFACE

For each amplifier connected to the network:

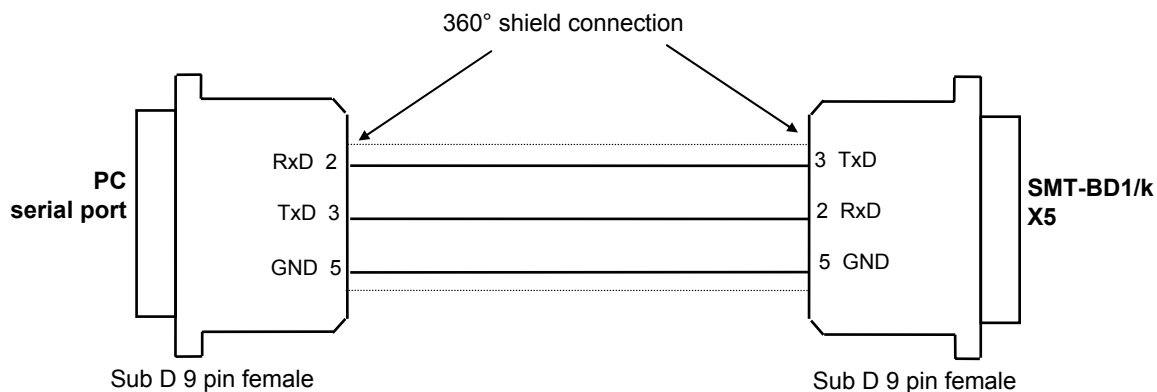


The specific cable impedance is about 120 Ω.
 The total bus length must not exceed 40 m at 1 Mbit.
 Both bus ends must be connected to a 120 Ω load resistor.

Cable required for the connection between two nodes:



1.4 - CONNECTION OF THE SERIAL LINK RS 232



2 – WIRING

(according to CEI 801 and EN 55011 standards - See enclosed drawings (see [Chapter 8: "Shield connection on the connectors"](#))).

2.1 - GND WIRING AND GROUNDING

The reference potential is the **earth (ground)**. Motors and resolvers are grounded via their housing. If a reference of potential is existing, like a main chassis or a cabinet, with a low impedance between the different elements, it should be used with short connections and this reference potential should also be grounded.

Reference potential connections (especially to the ground) are recommended **ONLY** if these connections have a very low impedance ($< 0,1 \Omega$).

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

Each conductor cable (carrying a potential) must be **shielded**. Several wires in the **same sleeve** must be **twisted** and **shielded**.

According to the **CEI 801 standard**, the connectors must be metallic or metal plated and must have a **360° shield connection** (see [Chapter 8, part 5](#)).

2.2 - MOTOR AND RESOLVER CABLES

Cable ends should have a metallic collar allowing a 360° shield connection.

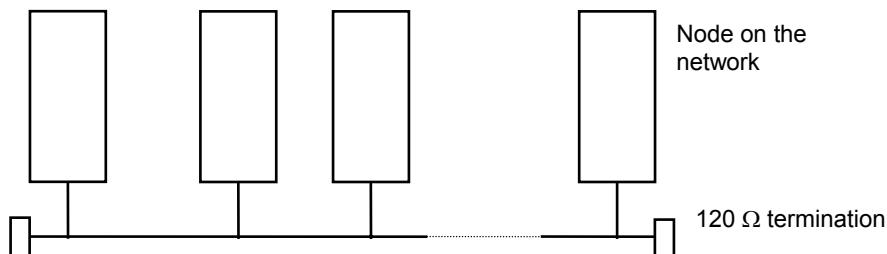
Motor and resolver cables must be shielded.

The recommended resolver cable is a **three pair twisted with an individual shield on each pair** (sin, cos, ref.).

2.3 - CAN AND SERIAL LINK CABLES

The CAN bus signal requires a pair twisted and shielded cable. The specific cable impedance must be about 120Ω and both bus ends must be connected to a load resistor of 120Ω .

The 360° shield connection must be made by means of the metal connectors at both cable ends.



The serial link also requires a shielded cable according to the shield connection recommendations mentioned above.

CAUTION !

The command cables (CAN, serial link, position, resolver) as well as the power cables **MUST** be connected and disconnected with the amplifier **TURNED OFF**.

Chapter 5 – Adjustable functions

1 - PARAMETER SETTING

The SMT-BD1/k drive is only operated with the CANopen interface.

All parameters can be modified by SDO (see [CANopen Communication Protocol](#)).

The parameters can also be modified via the serial link. The VDSetup software version 1.11 and higher allows to adjust the amplifier parameters from a PC. The use of the VDSetup software is described in the pertaining User manual.

2 - BAUDRATE

The CAN bus communication speed is set by means of the SW2.3 and SW2.4 micro-switches (see [Chapter 8, "Hardware adjustments"](#) for the location of these micro-switches):

SW2		Baudrate
4	3	
Off	Off	1000
Off	ON	500
ON	Off	250
ON	ON	125

The micro-switch position modification becomes effective at the next power up of the amplifier.

3 - ADDRESSING

Each amplifier of the CANopen network must have a single address which is not zero.

When the address is set at 0, the amplifier runs in local mode (via RS-232 link) and the CAN connection is disabled.

The micro-switches SW1 and SW2 allow to define the amplifier address which value is defined on 6 bits (see [Chapter 8, "Hardware adjustments"](#) for the location of these micro-switches).

SW2		SW1				Address
2	1	4	3	2	1	
Off	Off	Off	Off	Off	Off	0
Off	Off	Off	Off	Off	ON	1
Off	Off	Off	Off	ON	Off	2
...
Off	ON	Off	Off	Off	Off	16
...
ON	Off	Off	Off	Off	Off	32
...
ON	ON	ON	ON	ON	Off	62
ON	ON	ON	ON	ON	ON	63

The micro-switch position modification becomes effective at the next power up of the amplifier.

Chapter 6 - Commissioning

1 - CHECKING THE AMPLIFIER CONFIGURATION

The standard amplifier configuration for MAVILOR motors is the following:

- Customization board **P RES** resolver: 4 x 12,7 K Ω 1 %.
- Adjustment of the current loops according to the table in [chapter 8, section 1](#).
- Motor thermal switch PTC : jumper **MN**.
- Positive control logic: jumpers **E - F - G** closed.
- No auxiliary supply: jumper **JK** closed and jumper **KL** open.

See [Chapter 8, parts 2, 3 and 4](#) for the amplifier adjustment to other motor or resolver types or to another control logic.

2 - POWERING OF THE AMPLIFIER

Test the power supply voltage: rated value: 230 Vrms between phases.
Maximum value without load (must never be exceeded): 260 Vrms, all mains variation tolerances included.

Test the continuous voltage on the rack rear bus: UDC \approx 310 V, UDC max < 370 V, UDC min > 200 V.

The braking resistor must remain cold (CAUTION ! This resistor is under very high voltage).

Switch off the power supply and wait for the voltage to drop below 10 V before plugging the first amplifier in the rack.

"ENABLE" input must be disabled.

Plug the amplifier and switch on the power supply.

1st CASE

Use without auxiliary supply.

At power up, the green **ON** LED must be lit and the red **ERROR** LEDS must be unlit after the amplifier autotest procedure.

2nd CASE

Use without auxiliary supply (see [Chapter 8, section 4.2](#)).

At power up, the **Undervolt.** error may be displayed.

In that case, switch on the power supply to cancel this display.

CAUTION !

It is mandatory to wait for at least 30 seconds between switching off and on again the drive.

Activate the Enable input.

3 - STARTING AND ADJUSTING THE AMPLIFIER

The amplifier operation is depending on the CANopen messages, even during the adjustment. Especially the **SYNC** synchro message and the **RPDO3** input command message must be continuously available (see manual "CANopen Communication Protocol").

3.1 - ADJUSTMENT TO A NEW MOTOR

Select the amplifier type as well as the fan type used, according to the table in [Chapter 2, section 1](#).

Select the amplifier current limitation mode (I^2t mode). The **Fusing** mode is recommended for the commissioning phases.

Check that the values of the **Maximum current** and **Rated current** parameters are compliant with motor and amplifier. Otherwise, modify them according to the appropriate motor and amplifier specifications.

Check that the value of the **Maximum speed** parameter is compliant with motor and application. Otherwise, modify them according to the appropriate motor and application specifications.

Uncouple the motor from the mechanical load and check that the motor shaft is free and that its rotation over one revolution is not dangerous for the operator.

Execute the "auto-phasing" procedure (the ENABLE signal must be active) in order to define the following parameters: **Number of pole pair**, **Motor phase**, **Resolver adjustment**.

Note:

During the "auto-phasing" procedure, the motor is automatically enabled and then disabled at the end of the auto-phasing.

Define the **Phase lead** parameter according to the specific motor parameters (this function is especially useful for motors with a low inductance and running at high speeds):

Phase shift:

$$\tan \varphi = \frac{0,6 \cdot 10^{-7} \cdot K_t \cdot N_p \cdot (\text{MaxMotSpeed})^2}{L \cdot I_{\text{nom}}}$$

K_t : Motor torque constant (Nm/ A_{rms})

N_p : Number of motor pole pairs

MaxMotSpeed: Maximum motor speed (rpm)

I_{rated} : Motor current (A_{rms})

with: $0 \leq \varphi \leq 45^\circ$

Phase lead coefficient (electrical degree/1000 rpm):

$$\text{Coef} = \varphi \frac{1000}{\text{MaxMotSpeed}}$$

3.2 - ENABLING

- In local mode, the amplifier can be enabled by means of the VDSetup software. In CAN mode, the SMT-BD1/k amplifier can only be enabled by means of the CAN bus.
- By default, the amplifier is disabled at power up.
- When a fault occurs, the amplifier is disabled and will remain disabled even after cancelling of the fault.
- The enabling requires the ENABLE signal. If this signal is disabled, the amplifier will be disabled.

3.3 - ADJUSTMENT OF THE AMPLIFIER

Select the speed (P, PI ou PI²) or position regulator type used. In the case of an axis with a vertical load, see [part 3.6 of this chapter](#).

Check that the motor shaft is free and its rotation over one revolution not dangerous for operator and machine, before starting the auto-tuning procedure.

After the auto-tuning procedure, check that the motor correctly runs in both directions. Check the response at a low speed level without IDC saturation.

In case of loud noise in the motor at standstill and when running, check the rigidity of the transmission between motor and load (backlashes and elasticities in gears and couplings).
If necessary, renew the auto-tuning procedure by selecting a lower bandwidth.

If the problem remains, renew the auto-tuning procedure by activating the anti-resonance filter

If required, adjust more accurately the loop response stability by adjusting the value of the gains calculated by the auto-tuning procedure.

Note

When the auto-tuning is executed in speed mode (P, PI or PI²), the position loop gains are not calculated. If the position mode via CANopen is required, the auto-tuning must be executed with the position mode selected.

3.4 - PARAMETER SAVING

When all adjustments are made tous les réglages sont effectués, the parameters must be saved in the EEPROM (the amplifier must be disabled).

3.5 – BRAKE CONTROL

- The SMT-BD1/k amplifier has got a brake control signal.
- This signal is a low powered one and cannot directly control the brake. The BMM05F single-axis rack is therefore equipped with a power relay allowing the brake control.
- The brake control is activated (relay open) or deactivated (relay closed) according to the amplifier status (disabled or enabled).

3.6 - SPEED LOOP ADJUSTMENT WITH A VERTICAL LOAD

In the case of an axis with vertical load, proceed as follows:

Select the "Limiting" current limitation mode.

Select the speed regulator type used (PI ou PI²).

Initialize the speed loop gains corresponding to the motor without load (therefore, start the auto-tuning procedure with the motor uncoupled from the mechanical load).

Couple the motor to the load. If possible, perform a control in speed loop by means of the controller. Otherwise, close the position loop with a **stable gain**.

Move the axis via the controller until a stall position where one motor revolution is not dangerous for operator and machine (far enough from the mechanical stops).

Then execute the auto-tuning procedure with the motor at standstill, as described in [section 3.3](#). If the shaft is moving, then the auto-tuning procedure has not been performed by the amplifier

Chapter 7 - Troubleshooting

1 - SYSTEM FAULT

If the red **SYS** led is lit at power up, the logic board is defective.

- Check that the EPROM firmware memory is correctly plugged on the amplifier.
- Check for the EPROM version to be x.x3.
- Check for the possible presence of any conducting dust that may involve short-circuits on the amplifier logic board.

2 - MEMORY STORED FAULTS

If a fault occurs on the amplifier, it can generate the detection of several other faults which are only a consequence of the original one. In order to make diagnostic and maintenance easier, the faults are displayed and processed with the priority described below. For safety reasons, the power must be TURNED OFF for the cancelling of some faults that requires the handling of the amplifier. In this case, the RESET is automatic when power is turned on again. When handling the drive with power on, do not forget to make a RESET immediately after the fault has been cancelled.

2.1 - "BUSY"

- If the BUSY fault is continuously displayed after the amplifier is turned on, the **AUTOTEST** procedure has failed and the amplifier is not ready for operation.
- If the BUSY fault is continuously displayed after the execution of the **AUTO-PHASING** function, the procedure has failed because of an external cause and the calculated parameters are wrong. Check that the ENABLE input is actually open. Then check that the motor is unloaded and the shaft movement free during the procedure.
- If the BUSY fault is continuously displayed after the execution of the **AUTO-TUNING** function, the procedure has failed because of an external cause and the calculated parameters are wrong. Check that the ENABLE input is activated. Then check that the motor shaft is free during the procedure.

2.2 - "EEPROM"

- Check the presence of the EEPROM and check its correct orientation.
- If the fault remains, the EEPROM is not correctly initialized (**CHECKSUM**) or is not compliant with the amplifier software.

2.3 - "°C MOTOR"

- If the fault occurs when starting the amplifier:
 - * Check the configuration of the **MN** and **OP** jumpers with regard to the type of thermal switch used in the motor.
 - * Check the connection between the thermal switch and the amplifier on the front panel X1 connector or the X6 connector at the rear of the rack, according to the wiring used.
- If the fault occurs during the operation:
 - * Check the motor temperature and look for the reason of this overheating (mechanical shaft overload, duty cycle too high, ...).

2.4 - "UNDERVOLT."

- If the fault occurs when starting the amplifier:
 - * Check that the power supply is on.

2.5 - "°C AMPLI"

Check for the correct fan type with regard to the rated current required (see current table, [Chapter 2, section 1](#)).

2.6 - "POWER STAGE"

- If the fault occurs when starting the amplifier:
 - * Check the DC bus voltage and the terminal voltage of the power transformer secondary (DC bus < 370 VDC and V secondary < 260 VAC).
- If the fault occurs during the operation:
 - * Check the braking system operation during the motor decelerations,
 - * Check the sizing of the braking resistor with regard to the motor deceleration phases.
 - * Check that the required amplifier current cycle is corresponding to the current table (see [chapter 2, section 1](#)).
 - * Check for no short-circuit in the motor wiring and at the motor terminals

2.7 - "RESOLVER"

- Check the resolver connection on the amplifier connector X1.
- Check for the presence of the P-RES components on the amplifier.
- Check that the resolver type is correct with regard to the P-RES components (see [chapter 8, section 2](#)).
- Check the connections between the resolver and the amplifier and at the resolver terminals.

2.8 - "R.D.C"

- If the fault occurs when starting the amplifier:
 - * Check that the values of the P-RES components are corresponding to the resolver transformation ratio.
- If the fault occurs during the operation:
 - * Check that the motor speed does not exceed the speed limit defined below.
 - If **Maximum speed** ≤ 900 rpm, then the speed limit = 900 rpm.
 - If 900 rpm < **Maximum speed** ≤ 3600 rpm, then the speed limit = 3600 rpm.
 - If 3600 rpm < **Maximum speed** ≤ 14000 rpm, then the speed limit = 14000 rpm.
 - Be careful about the torque mode operation where the motor speed is defined by the load.

2.9 - "I²T"

- Check the required amplifier rated current value with regard to the table of currents in pulse mode cycle ([chapter 2, section 1](#)).
- Check the amplifier rated current value defined in the **Rated current** parameter with regard of the current required for the operation cycle.

2.10 - CAN SYNCHRO

- Check the communication speed between the controller and the amplifiers.
- Check the presence of the SYNC synchro message and of the command message RPDO3 as well as the communication cycle (object 1006h).
- Check for the correct amplifier addresses.
- Check for no problem on the bus (no 120 Ω termination, cable too long, too many messages with regard to the cycle time,...).

3 - OPERATION PROBLEMS

3.1 - MOTOR DOES NOT MOVE

- Check that the amplifier is on.
- Check that the power supply is on.
- Check the amplifier fuses (F1 and F2) and the motor connection.
- Check the logic wiring of the signals FC+, FC- and ENABLE (see [chapter 8, section 4](#)).
- Check that the amplifier is enabled:
 - At power on, the amplifier is disabled by default.
 - The amplifier can only be enabled by a CAN message (command 91).
 - When the amplifier is disabled by an error, it will remain disabled even after the error has been cancelled.

3.2 - MOTOR SUPPLIED, BUT NOT TORQUE

Check that the **Maximum current** and **Rated current** parameters have no zero value.

3.3 - SHAFT LOCKED, ERATIC OSCILLATIONS OR ROTATION AT MAXIMUM SPEED

- Check the resolver wiring on the X1 connector and the mechanical mounting of the resolver on the motor.
- Check the values of the motor parameters (number of pole pairs, resolver adjustment, motor phase).

3.4 - DISCONTINUOUS MOTOR ROTATION WITH ZERO TORQUE POSITIONS

Check the connection of the three phase cables between motor and amplifier.

3.5 - LOUD CRACKLING NOISE IN THE MOTOR AT STANDSTILL

Check that the motor-amplifier-controller ground connections are compliant with the recommendations of [chapter 4](#).

3.6 - LOUD NOISE IN THE MOTOR AT STANDSTILL AND WHEN RUNNING

- Check the rigidity of the mechanical transmission chain between motor and load (backlash and elasticity in the gearboxes and couplings).
- Execute the **AUTO-TUNING** command again by selecting a lower bandwidth (**Medium** or **Low**).

4 - SERVICE AND MAINTENANCE

When exchanging an amplifier on a machine, proceed as follows:

- Check that the new amplifier has the same hardware configuration as the old one (the address as well),
- Plug the **parameter EEPROM** (or a copy of it) of the old amplifier on the new one.

The new amplifier is configured like the old one.

Chapter 8 - Appendix

1 - HARDWARE ADJUSTMENTS

All hardware adjustments of the SMT- BD1-k amplifier module are located on the hardware location diagram.

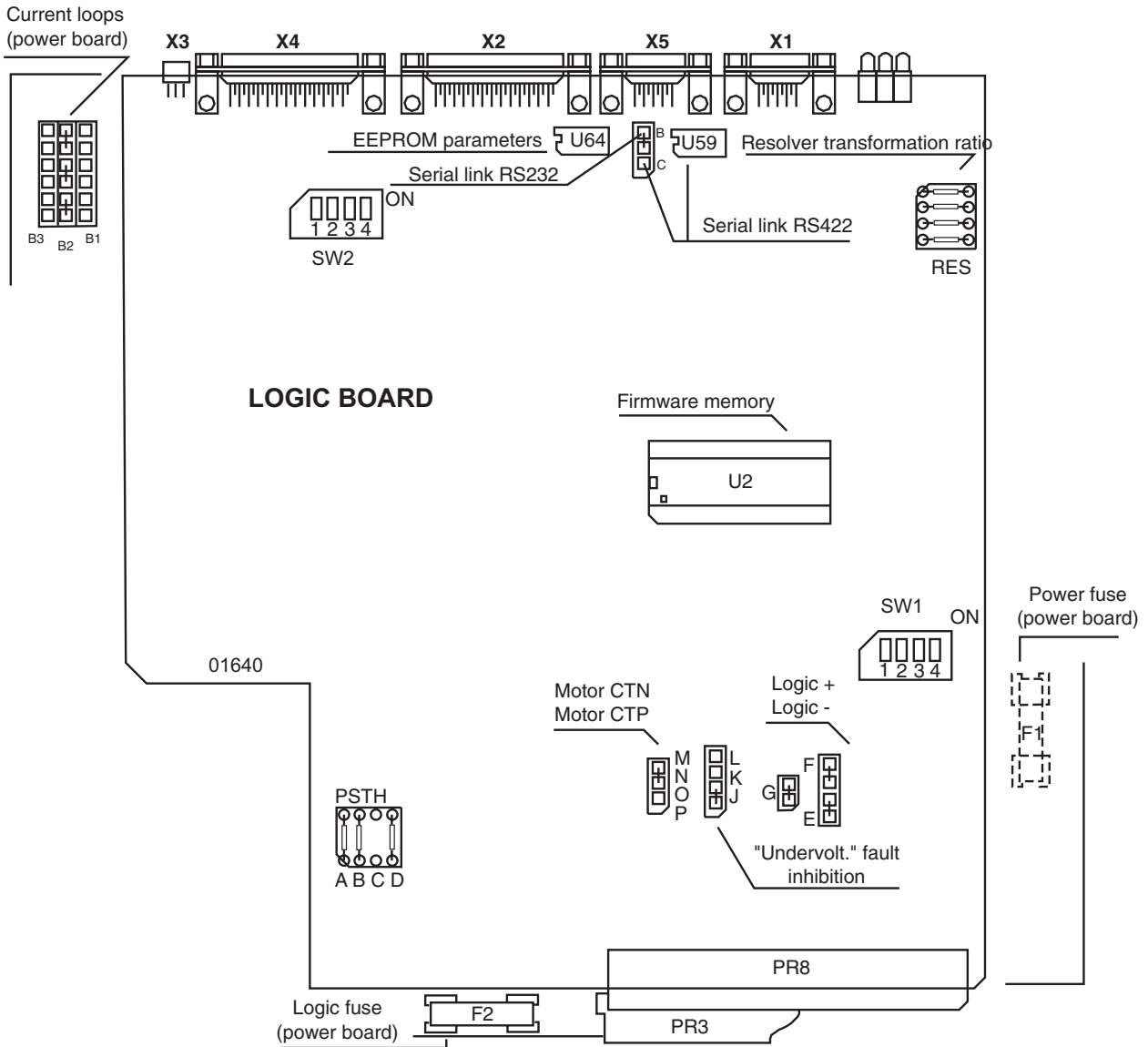
For the **BL** and **MA MAVILOR** motor series, the current loop adjustments are made by means of the **B1**, **B2**, **B3** jumpers.

Amplifier Motor	4 A	8 A	12 A	17 A	30 A	45 A	60 A	70 A	100 A
MA 3		B1							
MA 6		B1	B1						
MA 10		B2	B1	B1	B1				
MA 20		B2	B1	B1	B1	B1	B1		
MA 30				B2	B2	B2	B1	B1	
MA 45					B2	B2	B1	B1	B1
MA 55						B2	B2	B2	B1
BL 55-3	B1								
BL 55-5	B1								
BL 71		B2							
BL 72		B2	B1	B1					
BL 73		B2	B1	B1					
BL 74		B2	B1	B1					
BL 111		B1	B1						
BL 112		B2	B2	B1	B2				
BL 113		B3	B3	B2	B2	B2			
BL 114				B3	B3	B2	B2		
BL 115				B3	B3	B2	B2	B2	
BL 141				B2	B2	B2	B1	B1	
BL 142				B3	B3	B2	B2	B1	
BL 143				B3	B2	B2	B1	B1	B1
BL 144				B2	B2	B2	B1	B1	B1

In standard, the serial link is the RS232 link, with jumper B closed. In option, the amplifier can be delivered with a RS422 serial link, with jumper C closed.

The **Firmware memory** of the amplifier "k" version (CANopen) is **x.x3**.

HARDWARE LOCATION



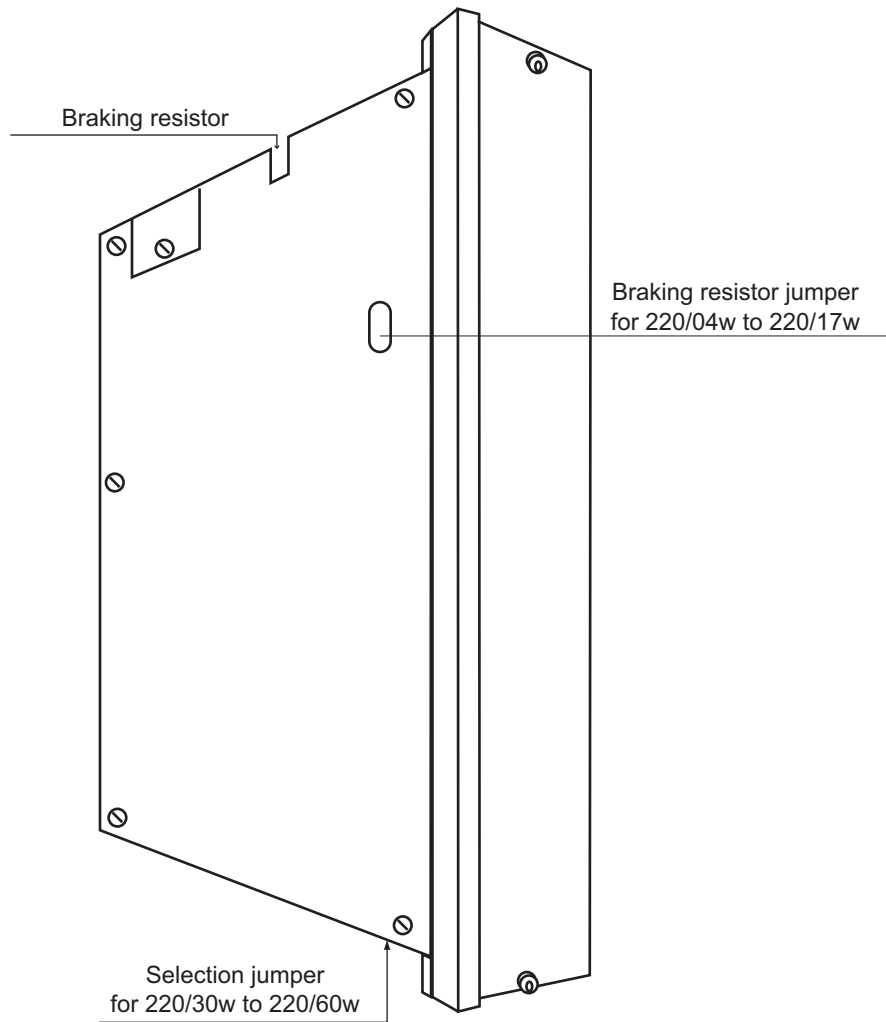
NOTE: PSTH = Threshold adjustment of the thermal sensor on logic board 01640 only

For current ratings 4 A to 100 A

CAUTION !



For amplifier versions with 70 A and 100 A current ratings in 220 V and serial numbers lower than 260600, please contact INFRANOR.

BRAKING SYSTEM SELECTION ON SMT-BD1-k-220/04w to 220/60w AMPLIFIERS


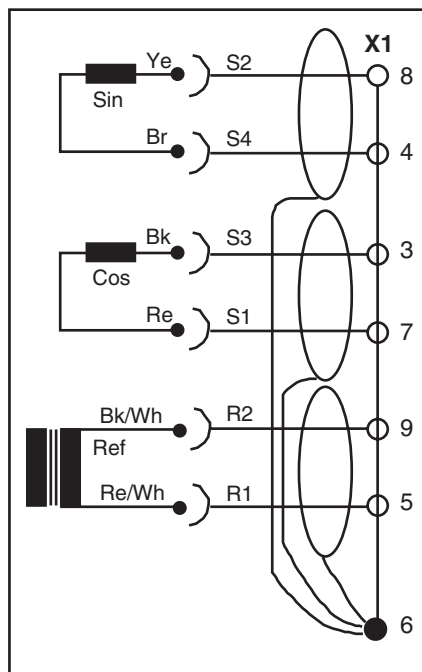
SMT-BM20 A single-axis rack: selection jumper closed.
 BF Rack: selection jumper open.

NOTE

This braking resistor system selection is only available on "w" referenced amplifiers.

2 - RESOLVER CONNECTIONS

For the use of other **resolvers** than those mounted on MAVILOR motors, see following wiring diagram of the **X1** connector as well as the manufacturer's diagram:



For the use of **resolvers** with **transformation ratios** others than 0,5, the Cos and Sin signal amplitude must be adjusted by means of the "**P-RES**" components according to the table below:

TRANSFORMATION RATIO	P-RES			
	0,3	0,45	0,5	1
A - B - C - D (tolerance < 1 %)	21 K	14,3 K	12,7 K	6,34 K

It may be sometimes necessary, for some resolvers, to adjust the phase shift between the Reference and the Cos and Sin signals by means of the "C60" capacitor. This adjustment is factory set by INFRANOR.

Note

When using resolvers with a number of pole pairs $N > 1$, all speed values displayed in the amplifier are equal to N times the motor rotation speed.

3 - ADJUSTMENT TO VARIOUS

3.1 - MOTOR THERMAL SENSOR

The thermal sensor is connected to the resolver connector **X1** (pins 1 and 2).

3.1.1 - PTC THERMAL SENSOR

On motors with a PTC thermal sensor (relay opening at triggering), the amplifier configuration is the following: **MN** jumper closed and **OP** jumper open.

The triggering threshold adjustment for PTC thermal sensors is made by means of the PSTH components, as described below:

PSTH-D = 14,3 k Ω / PSTH-B = 28 k Ω

PSTH-A = 3 x RPTC (120°C) in k Ω .

RPTC (120°C): ohmic value of the PTC thermal sensor resistor at 120°C.

In standard, PSTH-A = 10 K Ω , that is RPTC (120°C) # 3 K Ω .

3.1.2 - NTC THERMAL SENSOR

On motors with an NTC thermal sensor (relay closing at triggering), the amplifier configuration is the following: **OP** jumper closed and **MN** jumper open.

The triggering threshold adjustment for the NTC thermal probes is made by means of the PSTH components, as described below:

PSTH-D = 14,3 k Ω / PSTH-B = 28 k Ω

PSTH-A = 3 x RNTC (120°C) in k Ω .

RNTC (120°C): ohmic value of the NTC thermal probe resistor at 120°C.

In standard, PSTH-A = 10 K Ω , that is RNTC (120°C) # 3 K Ω .

3.2 - CURRENT LOOPS

The adjustment of the current loop **P.I. regulators** according to the **amplifier current** and to **the inductance between the motor terminals** is made as follows:

4 A, 8 A, 12 A AND 17 A AMPLIFIERS

- Calculation of **G = 1,4. Amplifier current (A) . Inductance between phases (mH)**,
- If **G < 60**, current loop jumpers (x3) on **B3** position
- If **60 < G < 100**, current loop jumpers (x3) on **B2** position,
- If **G > 100**, current loop jumpers (x3) on **B1** position.

30 A, 45 A AND 60 A, 70 A AND 100 A AMPLIFIERS

- Calculation of **G = 1,4. Amplifier current (A) . Inductance between phases (mH)**,
- If **G < 100**, current loop jumpers (x3) on **B3** position,
- If **100 < G < 250**, current loop jumpers (x3) on **B2** position,
- If **G > 250**, current loop jumpers (x3) on **B1** position.

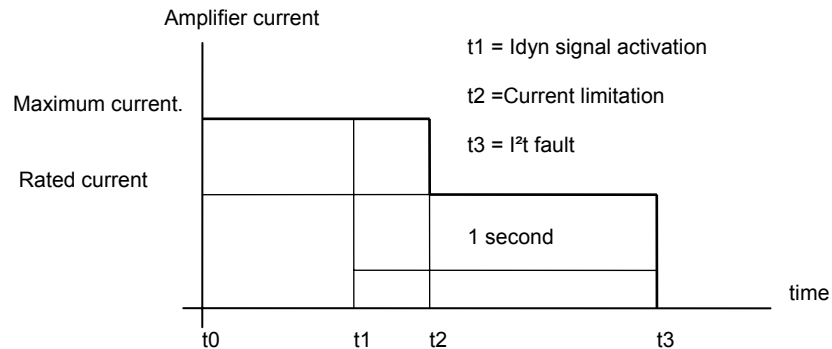
3.3 - I²T PROTECTION

Current limitation in Fusing mode

When the amplifier RMS current (I²t) reaches 85 % of the **Rated current**, the Idyn signal output is activated and the I²t error display is blinking on the amplifier front panel. If the RMS current (I²t) has not dropped below 85 % of the **Rated current** within 1 second, the I²t fault is released and the amplifier is disabled (otherwise, the Idyn signal and the blinking I²t error display are both cancelled).

When the amplifier RMS current (I²t) reaches the **Rated current** value, the I²t protection limits the amplifier current at this value.

The amplifier current limitation diagram in an extreme case (motor overload or locked shaft) is shown below.



The maximum current duration before the release of the Idyn signal depends on the value of the **Rated current** and **Maximum current** parameters. This value is calculated as follows:

$$T_{\text{dyn}} (\text{second}) = t_1 - t_0 = 3.3 \times \left[\frac{\text{Rated current } (\%)}{\text{Maximum current } (\%)} \right]^2$$

The maximum current duration before the limitation at the rated current also depends on the value of the **Rated current** and **Maximum current** parameters. This value is calculated as follows:

$$T_{\text{max}} (\text{second}) = t_2 - t_0 = 4 \times \left[\frac{\text{Rated current } (\%)}{\text{Maximum current } (\%)} \right]^2$$

NOTE 1

The above formulas are valid as long as the **Maximum current / Rated current** ratio is higher than 3/2. When the **Maximum current / Rated current** ratio is close to 1, the calculated values of T_{dyn} and T_{max} are quite below the real values. For example when **Maximum current / Rated current** = 1.2, the measured T_{dyn} = 3.4 seconds and the measured T_{max} = 4.4 seconds. When the **Maximum current / Rated current** ratio is equal to 1, the I²t protection is no more disabling the amplifier but the current is limited at the **Rated current** value.

NOTE 2

The amplifier I²t signal can be displayed on the digitizing oscilloscope by selecting the "I²t" signal in the "Channel" menu. The I²t signal threshold values according to the I²t protection mode described above are calculated in the following way:

$$\text{Idyn signal activation threshold } (\%) = \frac{[\text{Rated current } (\%)]^2}{70}$$

$$\text{Current limitation threshold } (\%) = \frac{[\text{Rated current } (\%)]^2}{50}$$

The corresponding amplifier RMS current value can be calculated according to following formula :

$$\text{Amplifier RMS current } (\%) = [\text{I}^2\text{t signal value } (\%) \times 50]^{1/2}$$



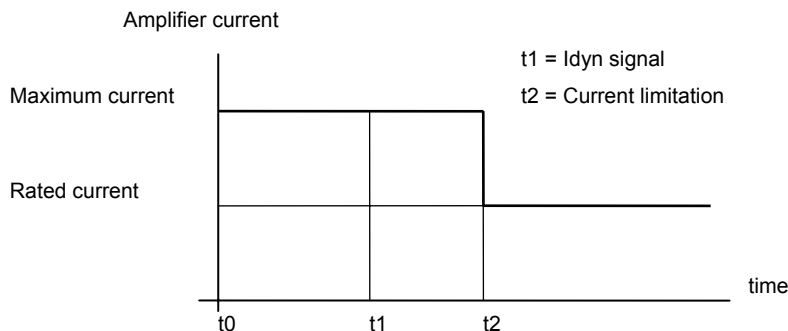
In Fusing mode, the amplifier **Rated current** value must be adjusted lower or equal to the **Maximum authorized rated current** of the amplifier (see Chapter 2, section 1).

Current limitation in Limiting mode

When the amplifier RMS current (I^2t) reaches 85 % of the **Rated current**, the Idyn signal output is activated and the I^2t error display is blinking on the amplifier front panel. When the RMS current (I^2t) drops below 85 % of the **Rated current**, the Idyn signal and the blinking I^2t error display are both cancelled.

When the amplifier RMS current (I^2t) reaches the **Rated current** value, the I^2t protection limits the amplifier current at this value.

The amplifier current limitation diagram in an extreme case (motor overload or locked shaft) is shown below.



The maximum current duration before the release of the Idyn signal output ($t_1 - t_0$) and before limitation at the rated current ($t_2 - t_0$) is calculated the same way as for the **Fusing mode**.

The I^2t signal threshold values and the amplifier RMS current value on the digitizing oscilloscope, are also calculated the same way as for the **Fusing mode**.



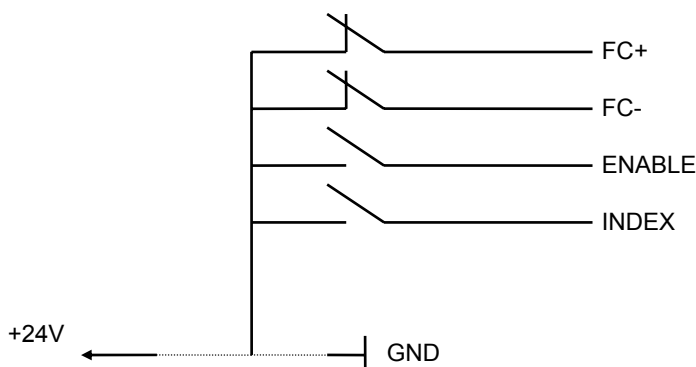
In **Limiting mode**, the amplifier **Rated current** value must be adjusted lower or equal to the **Maximum authorized continuous current** of the amplifier (see [Chapter 2, section 1](#)).

4 - ADJUSTMENT TO THE COMMAND LOGIC

4.1 - POSITIVE OR EN LOGIQUE POSITIVE OU NEGATIVE

The logic inputs **FC+**, **FC-**, **ENABLE** and **INDEX** of the command connector **X4** can be configured in positive logic (control by +24 V) or in negative logic (control by 0 V) as described below:

The logic inputs FC+, FC-, ENABLE, INDEX of the X4 command connector can be configured in positive logic (control by +24 V) or in negative logic (control by 0 V), as shown below:



POSITIVE LOGIC: E-F-G jumpers closed.
Input impedance: 10 KΩ.

Range: active at level 5 < V < 30 V.
Response time: 500 μs

NEGATIVE LOGIC: E-F-G jumpers open.
Input impedance: 10 KΩ.

Range: inactive or open at level 5 < V < 30 V
Response time: 500 μs

NOTE

The concerned inputs (FC +, FC -, ENABLE, INDEX) of the X4 connector are all in positive logic or all in negative logic.

4.2 - USE OF THE "AMP. READY" AND "POWER READY" OUTPUTS

If the position initialization references must be saved when a stored fault is released on the amplifier or when the power supply is switched off, it must be possible:

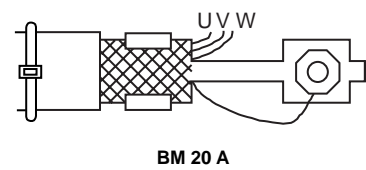
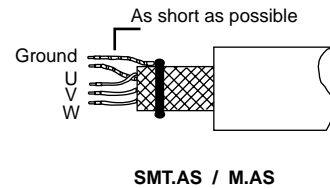
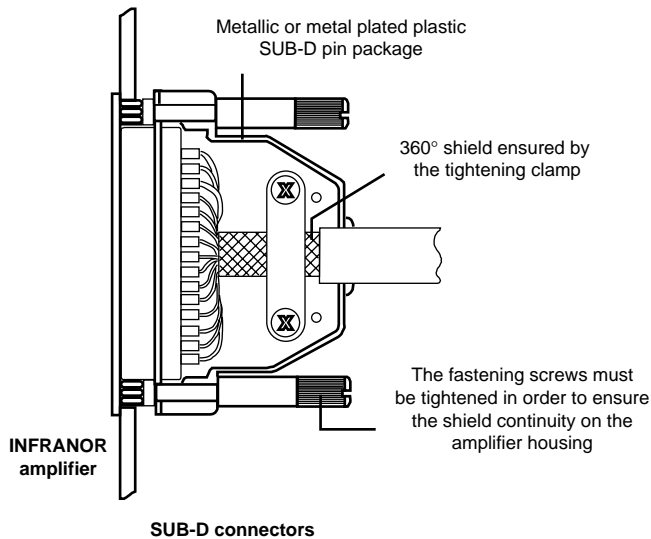
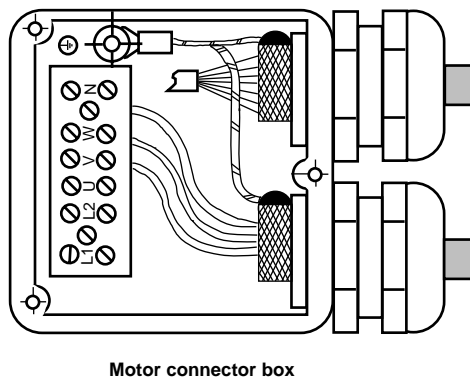
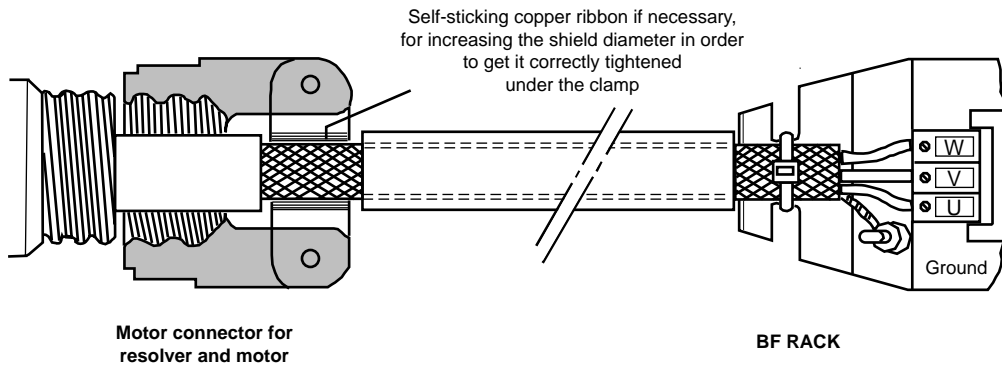
- * to reset the faults via pin 13 of X4 without interrupting the logic supply,
- * to have a logic supply voltage input (auxiliary supply) which is independent from the power supply in order to be switch off the power supply without switching off the logic supply.
- If the amplifier has an auxiliary supply on the PR8 connector, which is independent from the power supply, the **IJK** jumper of the power board allows to inhibit or to release the "**Undervolt.**" fault when switching on the auxiliary supply before switching on the power supply..
- * **JK jumper closed and KL jumper open.** With the auxiliary supply switched on before the main power supply, the "**Undervolt.**" fault is displayed and may hide a fault of lower priority. The "AMP READY" and "POWER READY" outputs are both inactive (contact is open) until the power supply is on.
- * **JK jumper open and KL jumper closed.** The "**Undervolt.**" fault is inhibited when turning on the auxiliary supply before switching on the main power supply. The "AMP READY" output is then active and "POWER READY" remains inactive (contact open) until the main power supply is on.

For the wiring of the "AMP. READY" and "POWER READY" outputs, [see manuals "SMT-BM 20 A – BMM 05 F – BMM 05 AF single-axis racks" and "BF rack"](#).

5 - 360° SHIELD ON THE CONNECTORS

RULE

The shield must never be interrupted or corrupted over the whole cable length.



NOTE

When the 360° shield is made by means of a clamp, it is not necessary to additionally connect a cable on the appropriate connection pin of the SUB-D connector.

6 - ORDER CODE