INFRANOR
SERVO DRIVES & MOTION CONTROL

SMT-BD2/m

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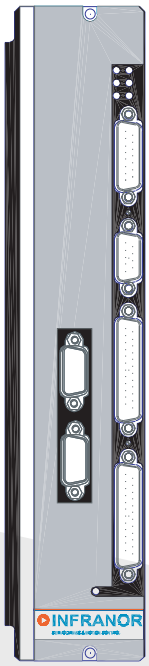

POSITIONER FOR SINUSOIDAL BRUSHLESS LINEAR AND ROTATING AC MOTORS

INFRANOR
SERVO DRIVES & MOTION CONTROL

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.

INFRANOR does not assume any responsibility for any physical or material damage due to improper handling or wrong descriptions of the ordered items.
Any intervention on the items, which is not specified in the manual, will immediately cancel the warranty.

Infranor reserves the right to change any information contained in this manual without notice.

Issue: **2.2**

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CHAPTER 1 - GENERAL DESCRIPTION

1 - INTRODUCTION

Series **SMT-BD2/m** digital servo modules are sinusoidal PWM power amplifiers that provide position, speed and torque/force control for AC brushless motors (rotating or linear) equipped with encoder only or encoder with Hall Effect Sensors (HES) for the position feedback.

The **SMT-BD2/m** digital servo drive is 220 VAC or 400 VAC main operated. The **SMT-BD2/m** plug-in system with 400 VAC power supply is available as a multiaxis version that can receive up to three axes in a standard 19" rack including the power supply. The **SMT-BD2/m** plug-in system with 220 VAC power supply is available as a single-axis block version or as a multiaxis version that can receive up to six axes in a standard 19" rack including the power supply.

2 - GENERAL DESCRIPTION

Series **SMT-BD2/m** amplifiers have their own DC/DC converter to provide the appropriate supply voltage (+5 V, +15 V, -15V). The source supply voltage for the logic board is the auxiliary 310 VDC supply voltage. The auxiliary supply voltage allows to have the axis position value still available when the power supply voltage is turned off.

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-BD2/m** amplifier directly controls the motor torque/force, speed and position by means of the information provided by an encoder feedback device. The sinusoidal current commutation based on encoder feedback provides smooth motor torque/force control.

The **SMT-BD2/m** amplifier can be configurated for various encoder feedback types. The appropriate encoder input configuration is selectable by jumpers.

- With an incremental encoder only, a motor phasing procedure must be executed at each amplifier power up before the motor enabling.
- With an incremental encoder + HES feedback from the motor, the motor phasing procedure is no more necessary and the servo motor can immediately be enabled after the amplifier power up.
- With an absolute single turn SinCos encoder feedback from the motor (Heidenhain ERN 1085 or compatible), the servo motor can also immediately be enabled after the amplifier power up.

The **SMT-BD2/m** amplifiers are suited for axis positioning applications. Up to 128 control sequences including axis homing, absolute or relative displacement, speed profile running and torque regulation can be programmed and combined in order to solve various applications. The sequence chaining capability allows to define macro-sequences for complex applications: several control sequences can be linked together in order to be automatically executed one after the other. The control sequences are pre-programmed. So, the application programmation simply consists in initializing the sequences parameters with the desired values. A control sequence can then be selected by using the programmable logic inputs activation and its execution is started by using the START logic input. The **SMT-BD2/m** amplifiers can operate in stand alone or in connection with a host controller (PC or PLC). The motor position output is available as two A and B encoder type channels in quadrature, and one Z marker pulse per revolution via RS422 line drivers. The ratio between the number of pulses on the motor encoder and the number of pulses on the **SMT-BD2/m** amplifier encoder output is programmable.

The amplifier faults are displayed on the front panel and can also be read via the serial link.

All control parameters are programmable by means of the serial link and saved in an EEPROM. The auto-configuration and auto-tuning functions allow an easy and quick commissioning of the amplifier.

The **Visual Drive Setup** software, which is IBM-PC compatible with the WINDOWS® operating system, makes the amplifier commissioning and the application programmation easier. The **Visual Drive Setup** software also includes a digitizing oscilloscope function that is particularly useful for the drive commissioning and maintenance.

3 - REFERENCE TO THE STANDARDS

The 220 VAC version of the **SMT-BD2/m** 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-BD2/m** 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.

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

The **SMT-BD2/m** amplifiers have been "CE" marked since year 2002.

4 - REFERENCE TO OTHER DOCUMENTS

- BF-400 rack – for the use of the 400 VAC amplifier version in a multiaxis rack.
- BF rack – for the use of the 220VAC amplifier version in a multiaxis rack.
- BM20A/BMM05F/05AF single-axis rack – for the use of the 220 VAC amplifier version in a single-axis rack.

CHAPTER 2 - SPECIFICATIONS

1 - TECHNICAL SPECIFICATIONS

1.1 - CURRENT RATINGS FOR THE 220 VAC AMPLIFIER VERSION

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

Authorized output currents for **current pulse mode** operation (I^2t protection in fusing mode)

AMPLIFIER	U rated (Vrms)	Imax (A rms) 1 s	Max. authorized rated current (Arms) of the amplifier		
			WITHOUT FAN*	FAN TYPE 1*	FAN TYPE 2*
SMT-BD2/m - 220/04	240	4,4	2		
SMT-BD2/m - 220/08	240	8,8	4		
SMT-BD2/m - 220/12	240	13,8	6		
SMT-BD2/m - 220/17	240	17,7	8,5		
SMT-BD2/m - 220/30	240	30,8	10	12	15
SMT-BD2/m - 220/30r	240	30,8	10	15	
SMT-BD2/m - 220/45	240	48,6	10	15	20
SMT-BD2/m - 220/45r	240	48,6	10	20	23
SMT-BD2/m - 220/60	240	61	10	19	25
SMT-BD2/m - 220/60r	240	61	12	26	30
SMT-BD2/m - 220/70	240	70	25	30	35
SMT-BD2/m - 220/100	240	100	25	30	35

Authorized output currents for **continuous current mode** operation (I^2t protection in limiting mode)

AMPLIFIER TYPE	U rated (Vrms)	Imax (A rms) 1 s	Max. authorized continuous current (Arms) of the amplifier		
			WITHOUT FAN*	FAN TYPE 1*	FAN TYPE 2*
SMT-BD2/m - 220/04	240	4,4	2		
SMT-BD2/m - 220/08	240	8,8	4		
SMT-BD2/m - 220/12	240	13,8	6		
SMT-BD2/m - 220/17	240	17,7	8,5	8,5	
SMT-BD2/m - 220/30	240	30,8	8,5	12	15
SMT-BD2/m - 220/30r	240	30,8	10	15	
SMT-BD2/m - 220/45	240	48,6	8,5	15	18
SMT-BD2/m - 220/45r	240	48,6	10	20	23
SMT-BD2/m - 220/60	240	61	8,5	17	20
SMT-BD2/m - 220/60r	240	61	12	26	30
SMT-BD2/m - 220/70	240	70	17	30	35
SMT-BD2/m - 220/100	240	100	25	30	35

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

Note: The **SMT-BD2/m**-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.

Minimum inductance between phases 1 mH

Conformity with the standards: **CE** approval with multiaxis power supply configuration BF rack and mains filter BF-35 or 70, or SMTB.M 20 A single-axis rack and BF 35 filter. "360°" shields; equipotential according to the wiring rules.	- EMC standards 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 range	* 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

1.2 - CURRENT RATINGS FOR THE 400 VAC AMPLIFIER VERSION

Operating voltage	DC bus 565 VDC (480 VDC < DC bus < 685 VDC max.)
Auxiliary supply voltage	310 VDC (200 VDC < Uaux < 340 VDC max.)
Motor terminal to terminal output voltage	380Vrms for 565 VDC bus

Authorized output currents for **current pulse mode** operation (I^2t protection in fusing mode)

AMPLIFIER	U rated (Vrms)	Imax (A rms) 1 s	Max. authorized rated current (Arms) of the amplifier	
			WITHOUT FAN*	FAN TYPE 2*
SMT-BD2/m - 400/15	400	15.5	5	7.5
SMT-BD2/m - 400/30	400	30	8	15
SMT-BD2/m - 400/45	400	48	10	19
SMT-BD2/m - 400/60	400	60	not used	28
SMT-BD2/m - 400/100	400	100	not used	35

Authorized output currents for **continuous current mode** operation (I^2t protection in limiting mode)

AMPLIFIER TYPE	U rated (Vrms)	Imax (A rms) 1 s	Max. authorized continuous current (Arms) of the amplifier	
			WITHOUT FAN*	FAN TYPE 2*
SMT-BD2/m - 400/15	400	15.5	not used	5
SMT-BD2/m - 400/30	400	30	not used	10
SMT-BD2/m - 400/45	400	48	not used	15
SMT-BD2/m - 400/60	400	60	not used	23
SMT-BD2/m - 400/100	400	100	not used	28

* Maximum ambient temperature = + 40° C, fan 2 = 90 l/s.

Minimum inductance between phases	2 mH
Conformity with the standards: **CE** approval with multiaxis power supply configuration BF-400 rack and mains filter F400-35 or 70. "360°" shields; equipotential according to the wiring rules.	- EMC standards 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: 2500 VDC/1 min. - Leakage current > 3 mA (EMI filters without capacitors)
Temperature range	* 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

1.3 - OTHER SPECIFICATIONS

PWM switching frequency	10 kHz
Current regulator (PI)	Adjusted to motor
Current loop bandwidth	Cut-off frequency for 45° phase shift > 1 kHz
Internal current limitation	Maximum current range : 20 % to 100 % of Imax Rated current range : 20 % to 50 % of Imax Imax = amplifier current rating
Analog torque limitation input	0 V to 10 V, resolution = 12 bits 100 % to 0 % of the torque set point value No limitation for 0 Volt
Analog speed limitation input	±10 V, standard resolution = 12 bits 100 % to 0.1 % of the maximum speed value
Speed and position regulator	Sampling period = 0,5 ms Anti-wind-up system of the integrator Adjustable digital gains Antiresonance filter
Servo loop bandwidth	Cut-off frequency for 45° phase shift Selectable : 50 Hz, 75 Hz or 100 Hz (see Note 1)
Max. motor speed	Adjustable from 100 rpm to 25000 rpm (see Note 2)
Encoder input	Selectable by jumpers : Quadrature and TTL A & B signals with Z marker pulse RS 422 line receiver maximum pulses frequency: 500 kHz Resolution: 10^3 to 10^6 ppr Incremental Sin/Cos encoder Heidenhain 1Vcc Sin/Cos type or compatible maximum signal frequency: 500 kHz Resolution: 500 to 10^6 ppr Interpolation factor : 1024 Absolute single turn Sin/Cos encoder Heidenhain ERN 1085 or compatible maximum signal frequency: 200 kHz resolution: 2048 ppr or 512 ppr Interpolation factor : 1024

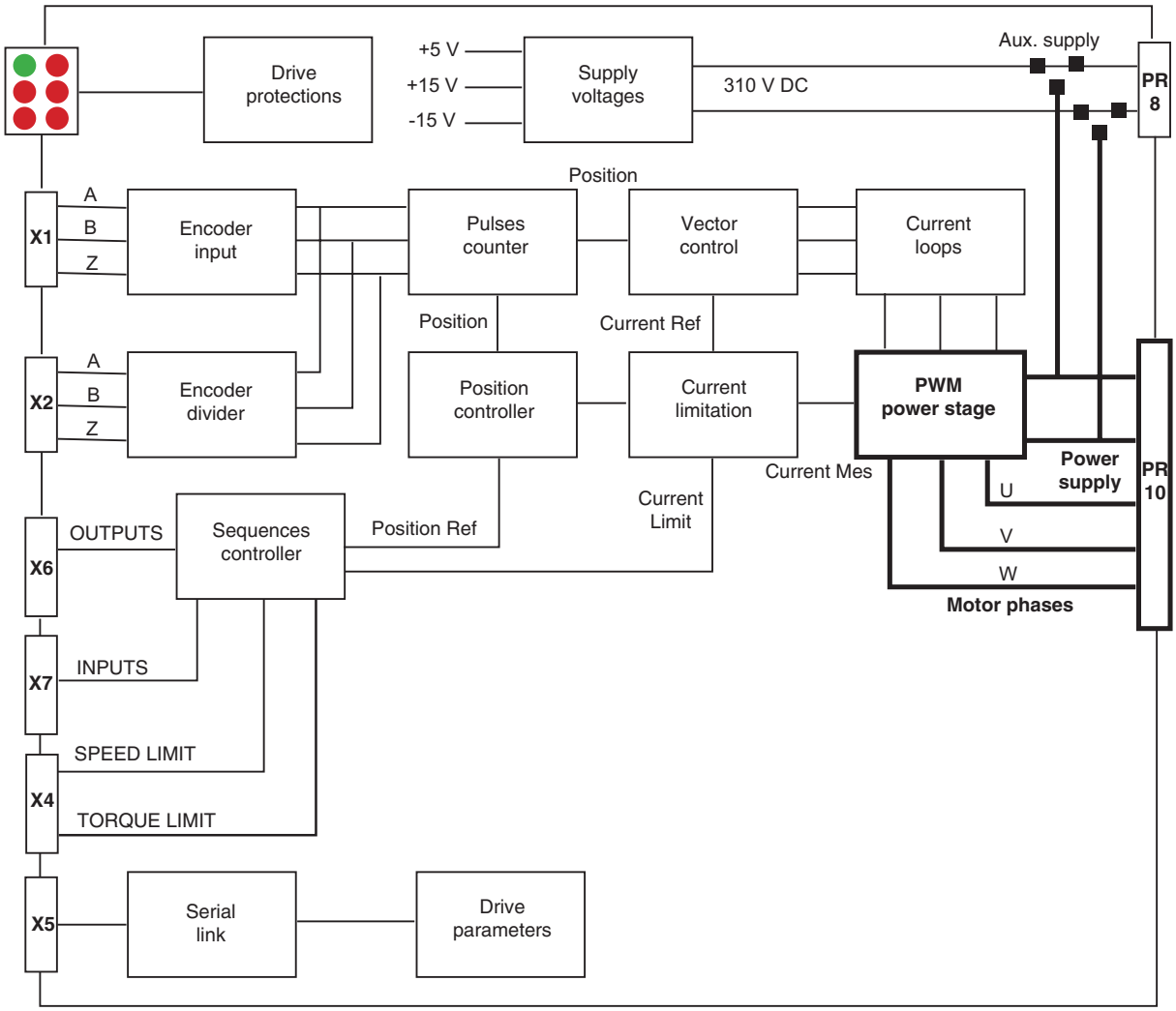
Note 1:
The maximum servo loop bandwidth value not only depends on the amplifier specification but also on the encoder resolution and the mechanical motor load. The lower the encoder resolution, the lower the servo loop gains and the servo loop bandwidth, to avoid any motor noise due to signal quantization effect. However when the “pulse interpolation” mode is activated with a Sin/Cos encoder type, the servo loop bandwidth can be dramatically increased because the internal position resolution is equal to the encoder resolution value multiplied by the interpolation factor (1024). The mechanical load backlashes and elasticity can also limit the servo loop gains and bandwidth to avoid mechanical resonances. The optimal servo loop gain value for a given application can be automatically calculated by using the amplifier Auto-tuning procedure.

Note 2:
The Max. motor speed value not only depends on the motor specification but also on the encoder specification. Both following conditions must be answered for taking into account the maximum encoder pulse frequency value :
Max. motor speed (rpm) < 60 x 10^6 / Number of encoder pulses per revolution
Max. motor speed (rpm) < 60 x Encoder pulse frequency limit (Hz) / Number of encoder pulses per revolution
For example with the ROD426 (Heidenhain) series encoder, the pulse frequency limit value is 300 kHz. So, a motor equipped with a ROD426 encoder having a resolution of 5000 ppr cannot exceed 3600 rpm.

Hall sensors input	Selectable by jumpers : 120° or 60° HES type 5 V or 15 V supply voltage HES sequence error detection
Encoder output	Quadrature and TTL A & B signals with Z marker pulse RS 422 line driver Programmable encoder division ratio output resolution / input resolution : 1, 1/2, 1/4, 1/8
Dedicated logic inputs	Optoisolated, positive logic, response time = 0.5 ms : •Enable/Disable: ENABLE •Servo On/Off: RUN •Homing switch: INDEX •Limit switch +: FC+ •Limit switch - : FC- •Sequence start: START •Sequence stop: STOP •Sequence wait: WAIT •Sequence teach: TEACH •Jog positive direction: JOG+ •Jog negative direction: JOG- Amplifier fault reset: RESET
Programmable logic inputs	Optoisolated, positive logic : IN1 to IN8
Dedicated logic outputs	Relay contact Umax = 60 V, Imax = 200 mA, Pmax = 10 W : • "Power ready": closed if power OK • "Amp ready": closed if amplifier OK • "Phasing OK": closed if motor phasing OK • "Brake": closed to desactivate the motor brake Optoisolated : •Sequence execution: SEQ •Position reached: POS •Speed reached: SPEED •Motor enabled: OK
Programmable logic outputs	Optoisolated : OUT1 to OUT8
Monitor outputs	2 channels ANout1 & ANout2 +/-10 V full scale, 12 bit resolution
digitizing	Programmable output signals on the oscilloscope Channel 1 and Channel 2 : current ref (IDC), current mes (ID,IQ,IMES,I2t), speed ref (CV), speed mes (GT)
Error display	LEDs on front panel and diagnostic via serial link
Parameter setting	Serial link RS232 in standard or RS422 optional
Automatic functions	Motor parameters adjustment (Auto-phasing) Regulator gains adjustment (Auto-tuning)
Altitude	1000 m
Moisture	< 50 % at 40°C and < 90 % at 20°C no condensation (EN 60204.1 standard)
Cooling	Natural convection or forced air, according to the rated current (see current tables).

2 - BLOCK DIAGRAM

The SMT-BD2/m servo module block diagram is presented below.



The PR8 and PR10 connectors are not accessible for direct wiring; they are plugged on the BM20A single-axis rack or on the multiaxis BF rack according to the SMT-BD2/m amplifier housing (see chapter 3).

3 - MAIN PROTECTIONS

3.1 - DISPLAYED PROTECTIONS

PROTECTION	ERROR DISPLAY	LED*
Amplifier rated current overload . blinking display = I^2t warning threshold is reached (Idyn output) . continuous display = I^2t fault (amplifier inhibited in fusing mode)	I^2 t	☼ ● ● ●
Encoder cable interruption	Encoder	● ☼ ● ●
Encoder pulses counting error	Counting	☼ ☼ ● ☼
Power stage failure: . power supply overvoltage . internal overcurrent protection . short-circuit between phases . amplifier overtemperature (220/04 to 220/60 current ratings and 400 VAC amplifier range)	Power stage	☼ ☼ ● ●
Amplifier overtemperature (only 220/70 and 220/100 current rating amplifiers)	°C Amp	☼ ● ☼ ●
Power supply undervoltage	Undervolt.	● ☼ ☼ ●
Motor overtemperature	°C Motor	☼ ☼ ☼ ●
Hall Effect Sensors or Sin/Cos commutation channels error	HES	● ● ☼ ●
Analog to Digital Conversion error	ADC	☼ ● ● ☼
Position following error	Position	● ● ● ☼
Fault of the amplifier parameter or sequences storage	EEPROM	☼ ● ☼ ☼
Amplifier automatic procedure: . blinking display = procedure operating . continuous display = operating error	Busy	☼ ☼ ☼ ☼

* ● = LED is unlit ☼ = LED is lit.

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

The reset of a stored fault can be made:

- by means of the RESET function in the **Visual Drive Setup** software
- via the fault RESET input (pin 13 of the X4 connector)
- by switching off the amplifier power supply.

3.2 - FUSE PROTECTION

3.2.1 - Fuse protection for the 220 VAC amplifier version

F1 : Control of the average DC current of the power board supply (see Hardware adjustments in chapter 5).
F2 : Control of the average DC current of the logic board supply (see Hardware adjustments in chapter 5).

AMPLIFIER TYPE	F1 Power	F2 Logic
SMTBD2/m-220/04 to 12	10 AT	1 A
SMTBD2/m-220/17 and 30	15 AT	1 A
SMTBD2/m-220/45	20 AT	1 A
SMTBD2/m-220/60	20 AT	1 A
SMTBD2/m-220/70	-	1 A
SMTBD2/m-220/100	-	1 A

3.2.2 - Fuse protection for the 400 VAC amplifier version

F2 : Control of the average DC current of the logic board supply (see Hardware adjustments in chapter 5).

AMPLIFIER TYPE	F2 Logic
SMT-BD2/m - 400/15	1 A
SMT-BD2/m - 400/30	1 A
SMT-BD2/m - 400/45	1 A
SMT-BD2/m - 400/60	1 A
SMT-BD2/m - 400/100	1 A

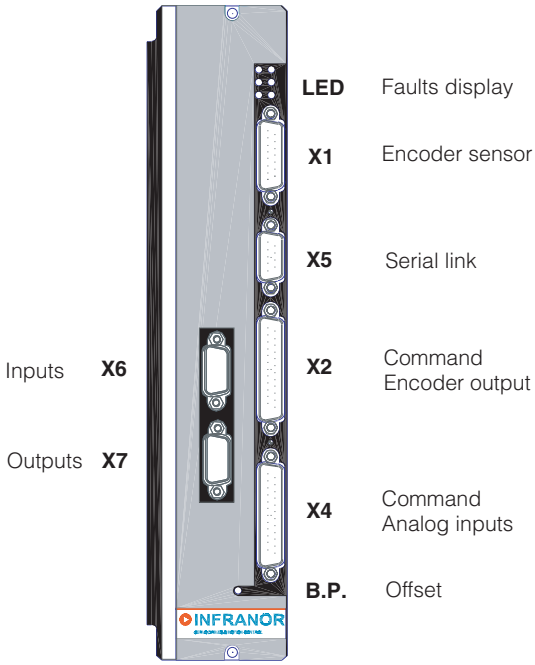
CHAPTER 3 - INPUTS - OUTPUTS

1 - CONNECTORS LOCATION

1.1 - RACK CONNECTORS

For the 400 VAC amplifier version, see **BF-400 RACK** manual.
For the 220 VAC amplifier version, see **SMTB.M 20 A SINGLE-AXIS RACK** manual or **BF RACK** manual.

1.2 - AMPLIFIER CONNECTORS



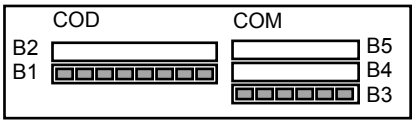
2 - X5 SERIAL LINK CONNECTOR (Sub D 9 pins male)

PIN	FUNCTION	REMARKS
5	0 Volt	GND (shield connection if no "360°" connection possible 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

3 - X1 ENCODER FEEDBACK CONNECTOR (Sub D 15 points female)

3.1 – X1 CONNECTOR FOR TTL INCREMENTAL ENCODER CONFIGURATION

The "TTL incremental encoder" configuration is selected according to the following COM and COD jumpers setting (see chapter 5, section 1: Hardware adjustments).

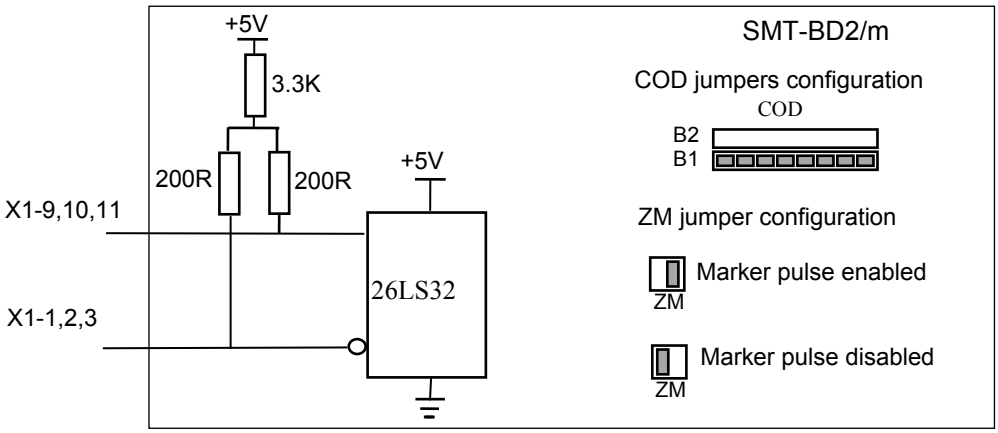


A wrong jumper configuration may damage the encoder and amplifier electronics.

The corresponding X1 connector pin function is described below.

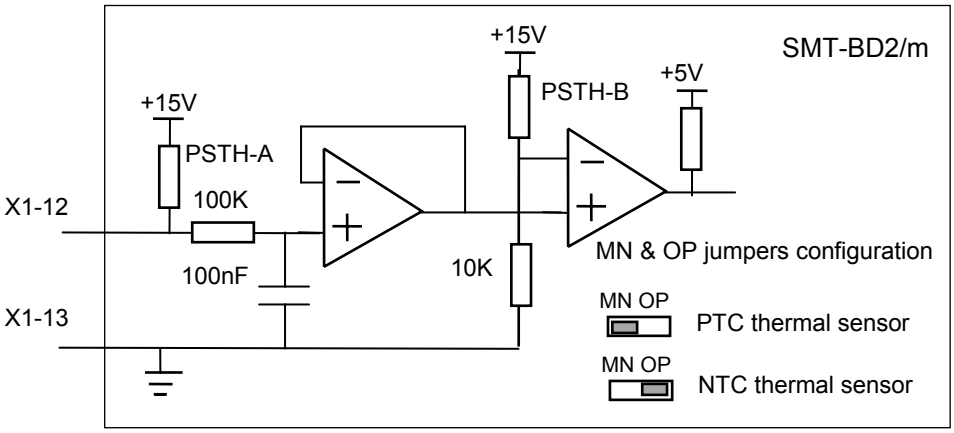
PIN	FUNCTION	REMARKS
1	Marker Z/	Differential input of the encoder marker pulse Z/
9	Marker Z	Differential input of the encoder marker pulse Z
2	Channel A/	Differential input of the encoder channel A/
10	Channel A	Differential input of the encoder channel A
3	Channel B/	Differential input of the encoder channel B/
11	Channel B	Differential input of the encoder channel B
5	+5V	Encoder supply voltage (400 mA max. current)
4	GND	Encoder supply GND
12	TC	Motor thermal sensor input (10 mA max. load current)
13	GND	Motor thermal sensor GND
6,7,8	reserved	
14,15	reserved	

Encoder input specification



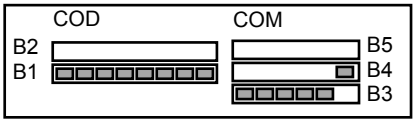
Recommended driver: 26LS31

Thermal sensor input specification

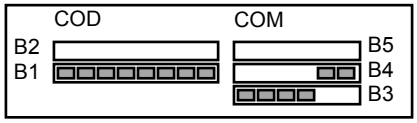


3.2 – X1 CONNECTOR FOR TTL INCREMENTAL ENCODER & HES CONFIGURATION

The " TTL incremental encoder & HES" configuration is selected according to the following COM and COD jumpers setting (see chapter 5, section 1: Hardware adjustments).



60° type HES



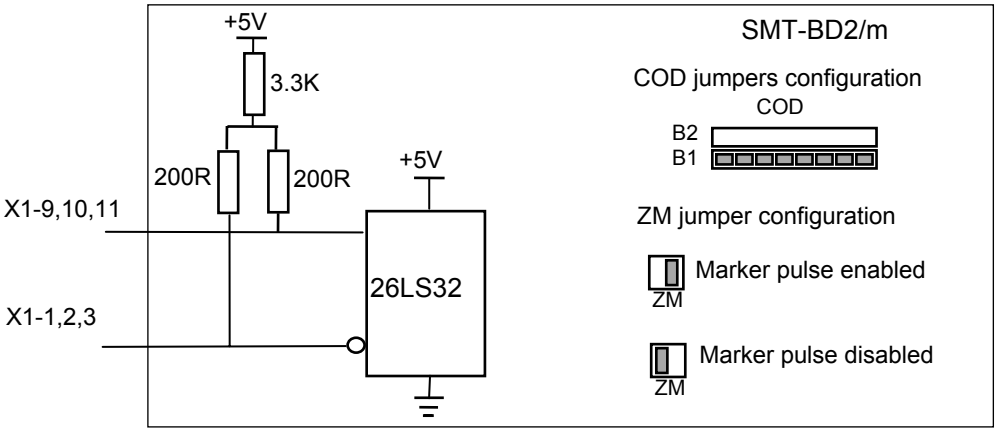
120° type HES

A wrong jumper configuration may damage the encoder and amplifier electronics.

The corresponding X1 connector pin function is described below.

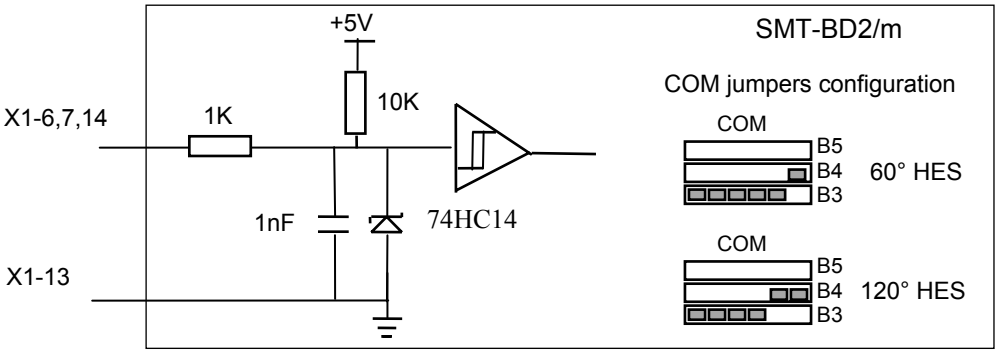
PIN	FUNCTION	REMARKS
1	Marker Z/	Differential input of the encoder marker pulse Z/
9	Marker Z	Differential input of the encoder marker pulse Z
2	Channel A/	Differential input of the encoder channel A/
10	Channel A	Differential input of the encoder channel A
3	Channel B/	Differential input of the encoder channel B/
11	Channel B	Differential input of the encoder channel B
5	+5V	Encoder supply voltage (400 mA max. current)
4	GND	Encoder supply GND
14	HALL U	Hall sensor input signal phase U
6	HALL V	Hall sensor input signal phase V
7	HALL W	Hall sensor input signal phase W
15	+15V	Hall sensors supply voltage (50 mA max. current)
12	TC	Motor thermal sensor input (10 mA max. load current)
13	GND	Hall sensors/Thermal sensor GND
8	reserved	

Encoder input specification



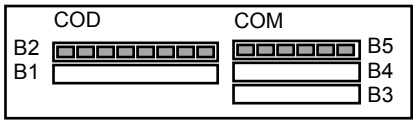
Recommended driver: 26LS31

Specification of the Hall sensors input



3.3 – X1 CONNECTOR FOR ABSOLUTE SINGLE TURN SIN/COS ENCODER CONFIGURATION

The " Absolute single turn Sin/Cos encoder " configuration (Heidenhain ERN 1085 or compatible) is selected according to the following COM and COD jumpers setting (see chapter 5, section 1: Hardware adjustments).

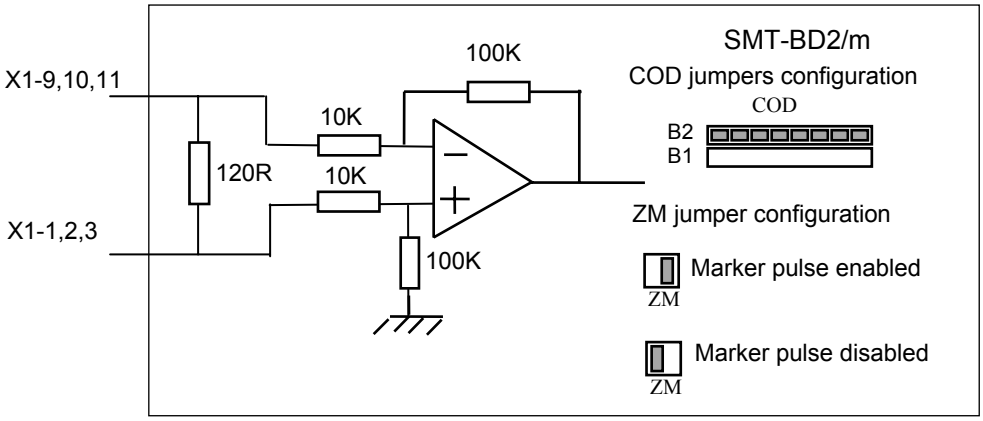


A wrong jumper configuration may damage the encoder and amplifier electronics.

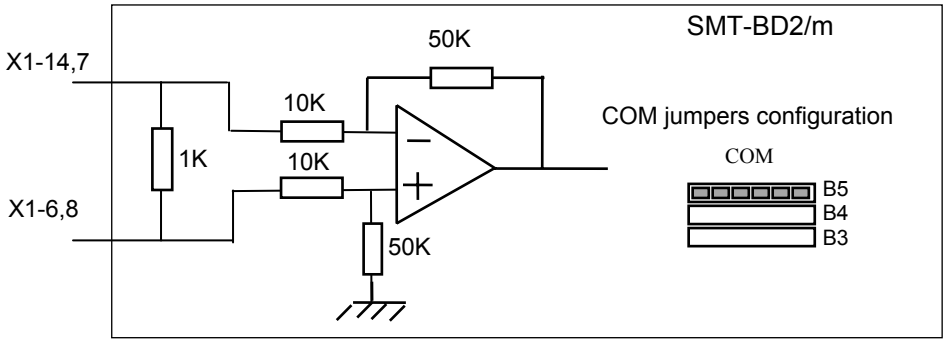
The corresponding X1 connector pin function description is given below.

PIN	FUNCTION	REMARKS
1	Reference R/	Differential input of the Sin/Cos encoder reference pulse R/
9	Reference R	Differential input of the Sin/Cos encoder reference pulse R
2	Channel A/	Differential input of the Sin/Cos encoder channel A/
10	Channel A	Differential input of the Sin/Cos encoder channel A
3	Channel B/	Differential input of the Sin/Cos encoder channel B/
11	Channel B	Differential input of the Sin/Cos encoder channel B
6	Channel C/	Differential input of the Sin/Cos encoder channel C/
14	Channel C	Differential input of the Sin/Cos encoder channel C
8	Channel D/	Differential input of the Sin/Cos encoder channel D/
7	Channel D	Differential input of the Sin/Cos encoder channel D
5	+5V	Sin/Cos encoder supply voltage (400 mA max. current)
4	GND	Sin/Cos encoder supply GND
12	TC	Motor thermal sensor input (10 mA max. load current)
13	GND	Motor thermal sensor GND
15	reserved	

Specification of the Sin/Cos encoder channels



Specification of the Sin/Cos commutation channels

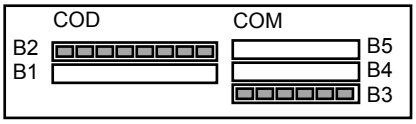


Remark: The Sin/cos encoder interpolation mode is activated by selecting the "pulse interpolation" configuration during the amplifier parameter setting.

3.4 – X1 CONNECTOR FOR OTHER SIN/COS ENCODER CONFIGURATIONS

3.4.1) X1 connector for incremental Sin/Cos encoder configuration

The " Incremental Sin/Cos encoder " configuration (Heidenhain 1Vcc Sin/Cos encoder or compatible) is selected according to the following COM and COD jumpers setting (see chapter 5, section 1: Hardware adjustments).



A wrong jumper configuration may damage the encoder and amplifier electronics.

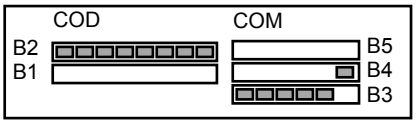
The corresponding X1 connector pin function description is given below.

PIN	FUNCTION	REMARKS
1	Reference R/	Differential input of the Sin/Cos encoder reference pulse R/
9	Reference R	Differential input of the Sin/Cos encoder reference pulse R
2	Channel A/	Differential input of the Sin/Cos encoder channel A/
10	Channel A	Differential input of the Sin/Cos encoder channel A
3	Channel B/	Differential input of the Sin/Cos encoder channel B/
11	Channel B	Differential input of the Sin/Cos encoder channel B
5	+5V	Sin/Cos encoder supply voltage (400 mA max. current)
4	GND	Sin/Cos encoder supply GND
12	TC	Motor thermal sensor input (10 mA max. load current)
13	GND	Motor thermal sensor GND
6,7,8	reserved	
14,15	reserved	

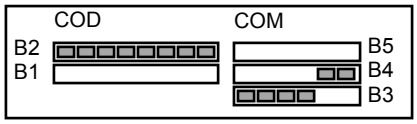
The Sin/Cos channels specifications are given in section 3.3 of this chapter. The Sin/cos encoder interpolation mode is activated by selecting the "pulse interpolation" configuration during the amplifier parameter setting.

3.4.2) X1 connector for incremental Sin/Cos encoder & HES configuration

The " Incremental Sin/Cos encoder & HES" configuration (Heidenhain 1Vcc Sin/Cos encoder or compatible) is selected according to the following COM and COD jumpers setting (see chapter 5, section 1: Hardware adjustments).



60° HES type



120° HES type

A wrong jumper configuration may damage the encoder and amplifier electronics.

The corresponding X1 connector pin function is described below.

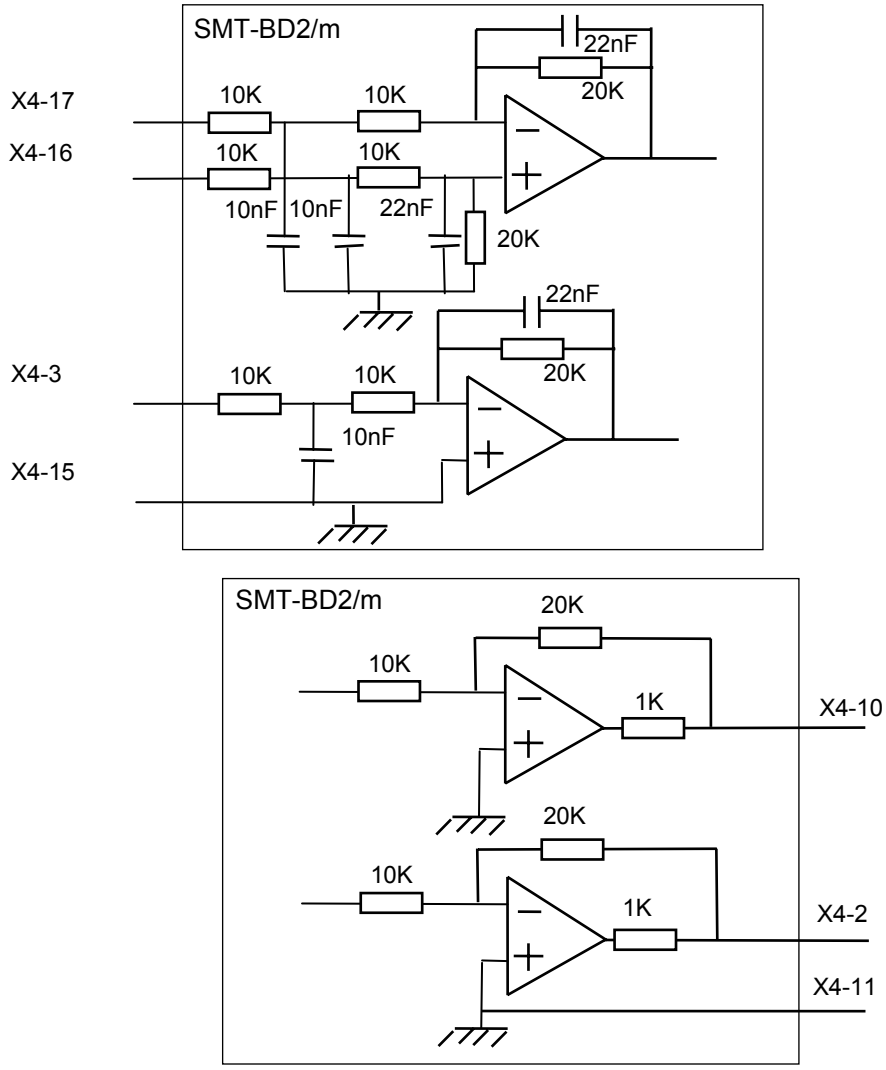
PIN	FUNCTION	REMARKS
1	Reference R/	Differential input of the Sin/Cos encoder reference pulse R/
9	Reference R	Differential input of the Sin/Cos encoder reference pulse R
2	Channel A/	Differential input of the Sin/Cos encoder channel A/
10	Channel A	Differential input of the Sin/Cos encoder channel A
3	Channel B/	Differential input of the Sin/Cos encoder channel B/
11	Channel B	Differential input of the Sin/Cos encoder channel B
5	+5V	Sin/Cos encoder supply voltage (400 mA max. current)
4	GND	Sin/Cos encoder supply GND
14	HALL U	Hall sensor input signal phase U
6	HALL V	Hall sensor input signal phase V
7	HALL W	Hall sensor input signal phase W
15	+15V	Hall sensors supply voltage (50 mA max. current)
12	TC	Motor thermal sensor input (10 mA max. load current)
13	GND	Motor thermal sensor GND
8	reserved	

The Sin/Cos channels and Hall sensor inputs specifications are given in section 3.3 of this chapter. The Sin/cos encoder interpolation mode is activated by selecting the "pulse interpolation" configuration during the amplifier parameter setting.

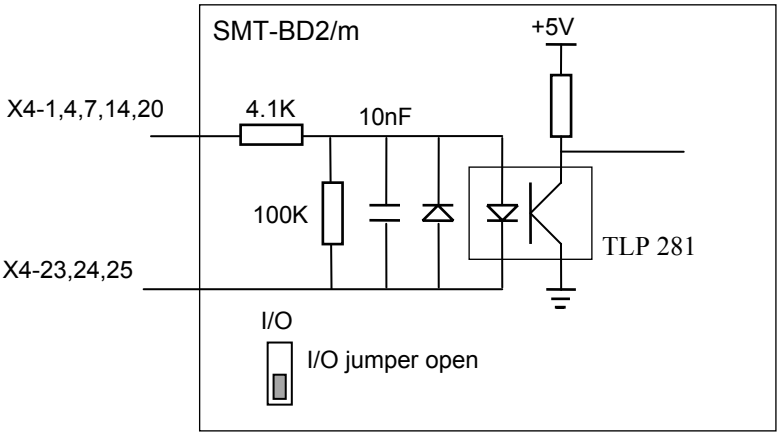
4 - X4 ANALOG INPUT & COMMAND CONNECTOR (Sub D 25 pins male)

Pin	FUNCTION	I / O	REMARKS
1	Positive limit switch (FC+)	I	Optoisolated input (I/O jumper open), positive logic (5V to 24V)
14	Negative limit switch (FC-)	I	Optoisolated input (I/O jumper open), positive logic (5V to 24V)
4	Run & phasing	I	Optoisolated input (I/O jumper open), positive logic (5V to 24V)
7	Index & Clear	I	Optoisolated input (I/O jumper open), positive logic (5V to 24V)
20	Enable/Disable	I	Optoisolated input (I/O jumper open), positive logic (5V to 24V)
23,24,25	0 Volt of optoisolated input	I	Optoisolated reference (I/O jumper open)
13	Reset	I	Amplifier reset via 0 V (contact between 13 and 12)
12	0 Volt of Reset input	I	
3	Torque limitation input	I I	Limitation from 100 % to 0 % of the torque set point value for 0 V to 10 V (no limitation for 0 Volt)
17	Speed limitation input	I I	Limitation from 100 % to 0.1 % of the maximum speed for 0 V to 10 V or 10 V to 0 V (the polarity is programmable)
15,16	0 Volt analog inputs		to be connected together
10	ANout1 monitor	O	± 10 V; resolution: 12 bits; load: 10 mA
2	ANout2 monitor	O	± 10 V; resolution: 12 bits; load: 10 mA
11	0 Volt analog outputs		Programmable output signals on the digitizing oscilloscope Channel 1 and Channel 2: current ref (IDC), current mes (ID, IQ, IMES, I^2t), speed ref (CV), speed mes (GT)
18,19	Amplifier ready	O	Relay contact: closed if amplifier OK Pmax = 10 W with Umax = 50 V or Imax = 100 mA Overvoltage pulse protection by bidirectional TRANSIL
5,6	Phasing OK	O	Relay contact: closed if motor phasing OK (in motor phasing configuration without HES) Pmax = 10 W with Umax = 50 V or Imax = 100 mA Overvoltage pulses protection by bidirectional TRANSIL
8,9	Brake control	O	Relay contact: closed to desactivate the motor brake Pmax = 10 W with Umax = 50 V or Imax = 100 mA Overvoltage pulses protection by bidirectional TRANSIL
21	+ 15 V	O	47 Ohms output impedance, 50 mA max. output current
22	- 15 V	O	47 Ohms output impedance, 50 mA max. output current

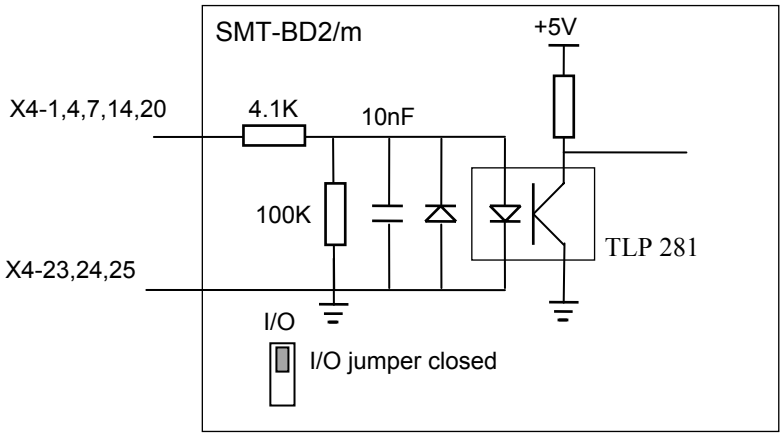
4.1 - SPECIFICATION OF THE ANALOG INPUTS / OUTPUTS



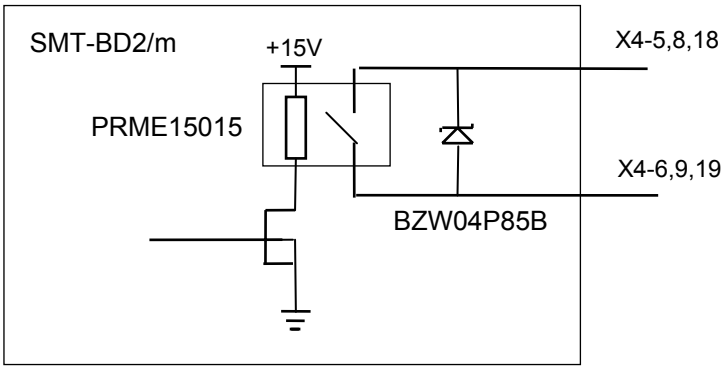
4.2 - SPECIFICATION OF THE LOGIC INPUTS / OUTPUTS



When the I/O jumper is open, the 0 V of the optoisolated inputs (X4 pins 23,24,25) is not connected to the 0 V of the SMT-BD2/m amplifier module (X4, pin 12).



When the I/O jumper is closed, the 0 V of the optoisolated inputs (X4, pins 23, 24, 25) is connected to the 0 V of the SMT-BD2/m amplifier module (X4, pin 12).

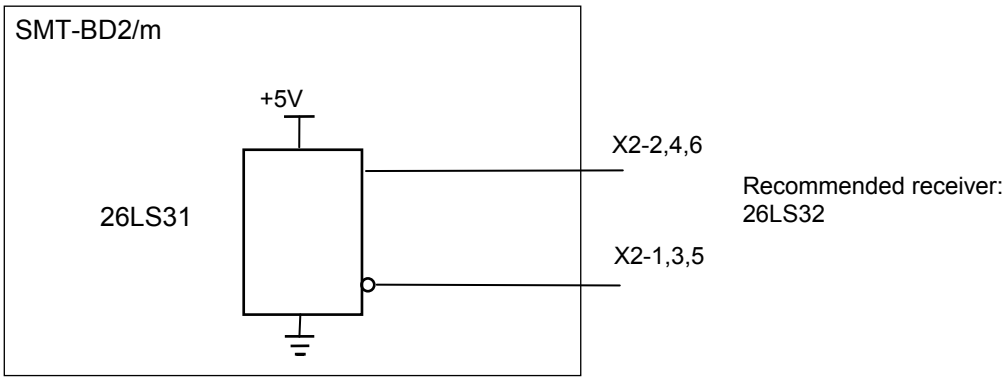


5 - X2 ENCODER OUTPUT & COMMAND CONNECTOR (Sub D 25 pins female)

PIN	FUNCTION	I / O	REMARKS
1	Marker Z/	O	Differential output of the encoder marker pulse (5 V, 20 mA max.)
2	Marker Z	O	Differential output of the encoder marker pulse
3	Channel A/	O	Differential output of the encoder channel A/ (5 V, 20 mA max.)
4	Channel A	O	Differential output of the encoder channel A
5	Channel B/	O	Differential output of the encoder channel B/ (5 V, 20 mA max.)
6	Channel B	O	Differential output of the encoder channel B
7, 10, 11	0 V		
14	START	I	Optocoupled logic input
15	STOP	I	Optocoupled logic input
16	WAIT	I	Optocoupled logic input
17	TEACH	I	Optocoupled logic input
8	JOG+	I	Optocoupled logic input
18	JOG-	I	Optocoupled logic input
9	SEQ	O	Optocoupled logic output
20	POS	O	Optocoupled logic output
21	SPEED	O	Optocoupled logic output
22	OK	O	Optocoupled logic output
12	24 V	I	24 V input. This input must only be used if one of the outputs SEQ, SPEED, POS and OK is used and if the OUT1 to OUT8 outputs are not wired.
23	GND 24 V		Mass of external 24 V
24	5 V	O	5 V output if the 5V jumper is closed
25	GND 5 V		Mass of internal 5 V

The programmable encoder ouput **Division ratio** (Output resolution / Input resolution) is only valid for the A and B channels. The Marker Z channel is not modified by this parameter value.

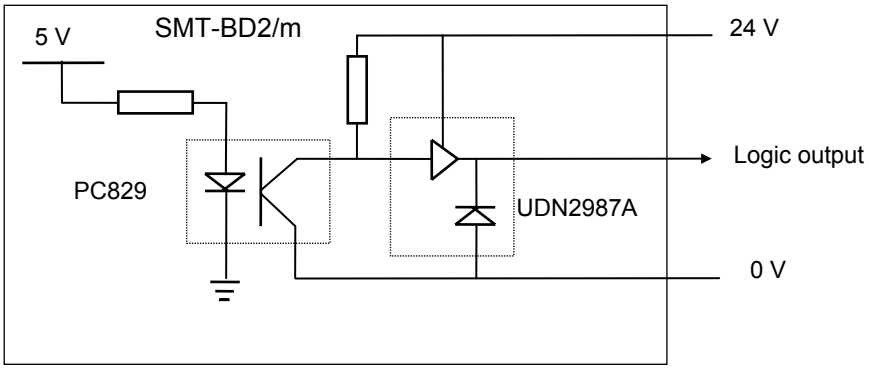
The specifications of the TTL encoder outputs are given below.



The specifications of the logic I/Os are given in sections 6 and 7.

6 - X6 LOGIC OUTPUTS CONNECTOR (Sub D 9 pins female)

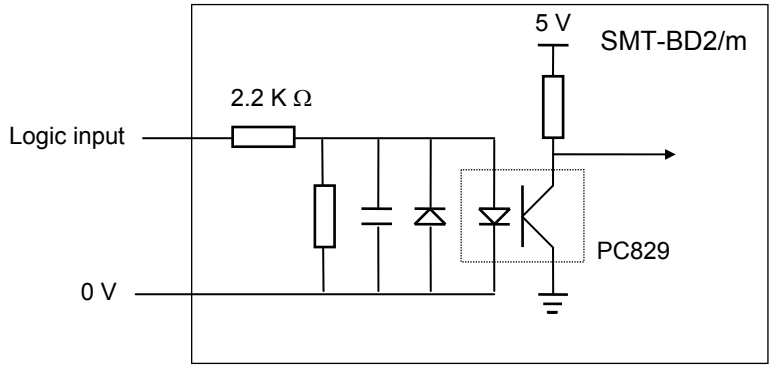
PIN	FUNCTION	REMARKS
1	OUT1	Programmable output n° 1
2	OUT2	Programmable output n° 2
3	OUT3	Programmable output n° 3
4	OUT4	Programmable output n° 4
5	OUT5	Programmable output n° 5
6	OUT6	Programmable output n° 6
7	OUT7	Programmable output n° 7
8	OUT8	Programmable output n° 8
9	24 V	24 V input. This input must be used if one of the OUT1 to OUT8 outputs is wired



The polarity of these outputs can be reversed by a software parameter. The parallel connection of these outputs must be made by means of diodes. The total output current is 350 mA for the 8 outputs OUT1 to OUT8.

7 - X7 LOGIC INPUTS CONNECTOR (Sub D 9 pins male)

PIN	FUNCTION	REMARKS
1	IN1	Logic input n° 1
2	IN2	Logic input n° 2
3	IN3	Logic input n° 3
4	IN4	Logic input n° 4
5	IN5	Logic input n° 5
6	IN6	Logic input n° 6
7	IN7	Logic input n° 7
8	IN8	Logic input n° 8
9	GND 24 V	Mass of external 24 V



The polarity of these inputs can be reversed by a software parameter. The input voltage corresponding to level 1 is between 5 V and 24 V.

CHAPTER 4 - CONNECTIONS

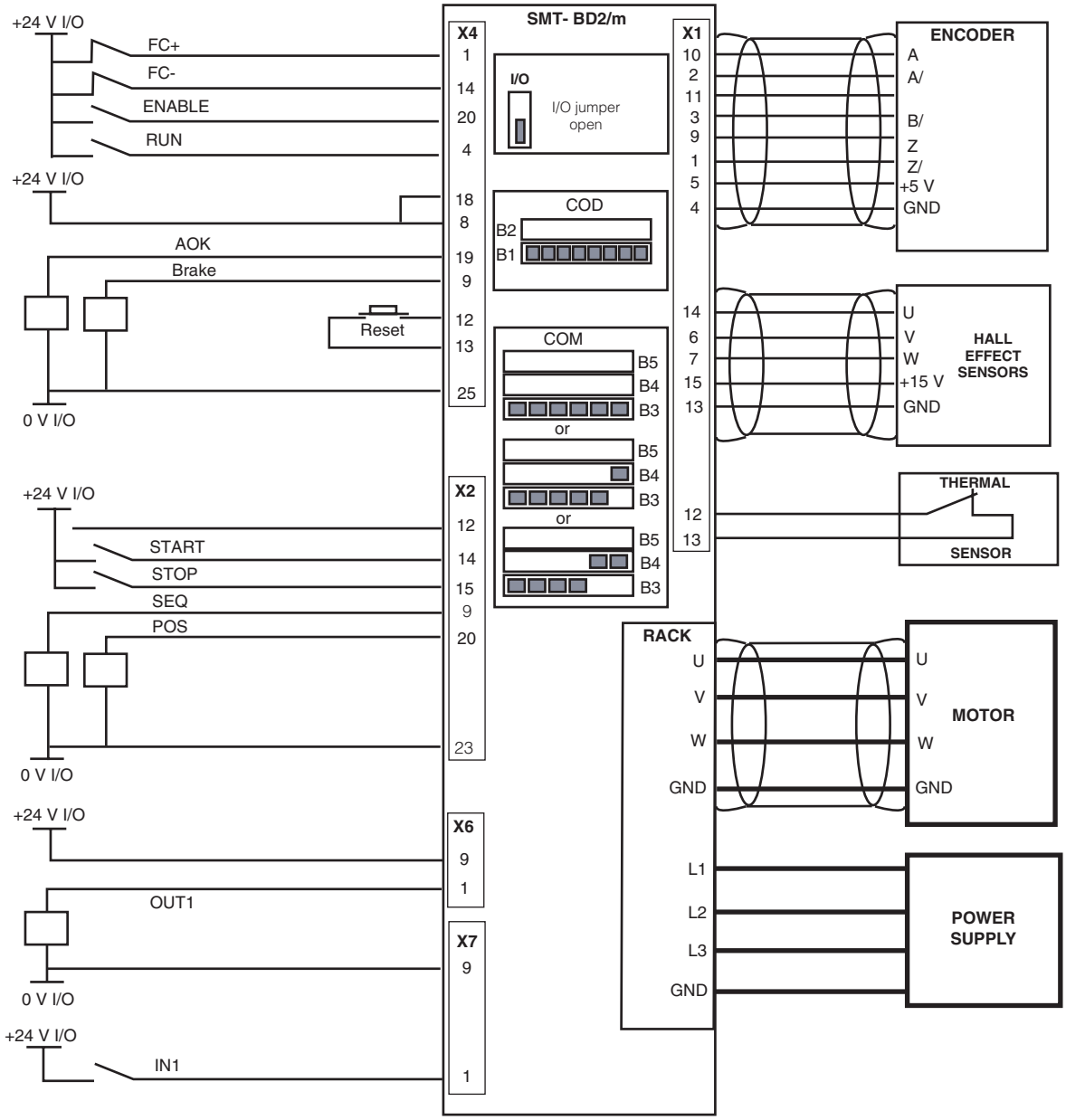
1 - CONNECTION DIAGRAMS

1.1 - RACK POWER SUPPLY AND MOTOR CONNECTION

For the 400 VAC amplifier version, see **BF-400 RACK** manual.
For the 220 VAC amplifier version, see **BM20A SINGLE-AXIS RACK** manual or **BF RACK** manual.

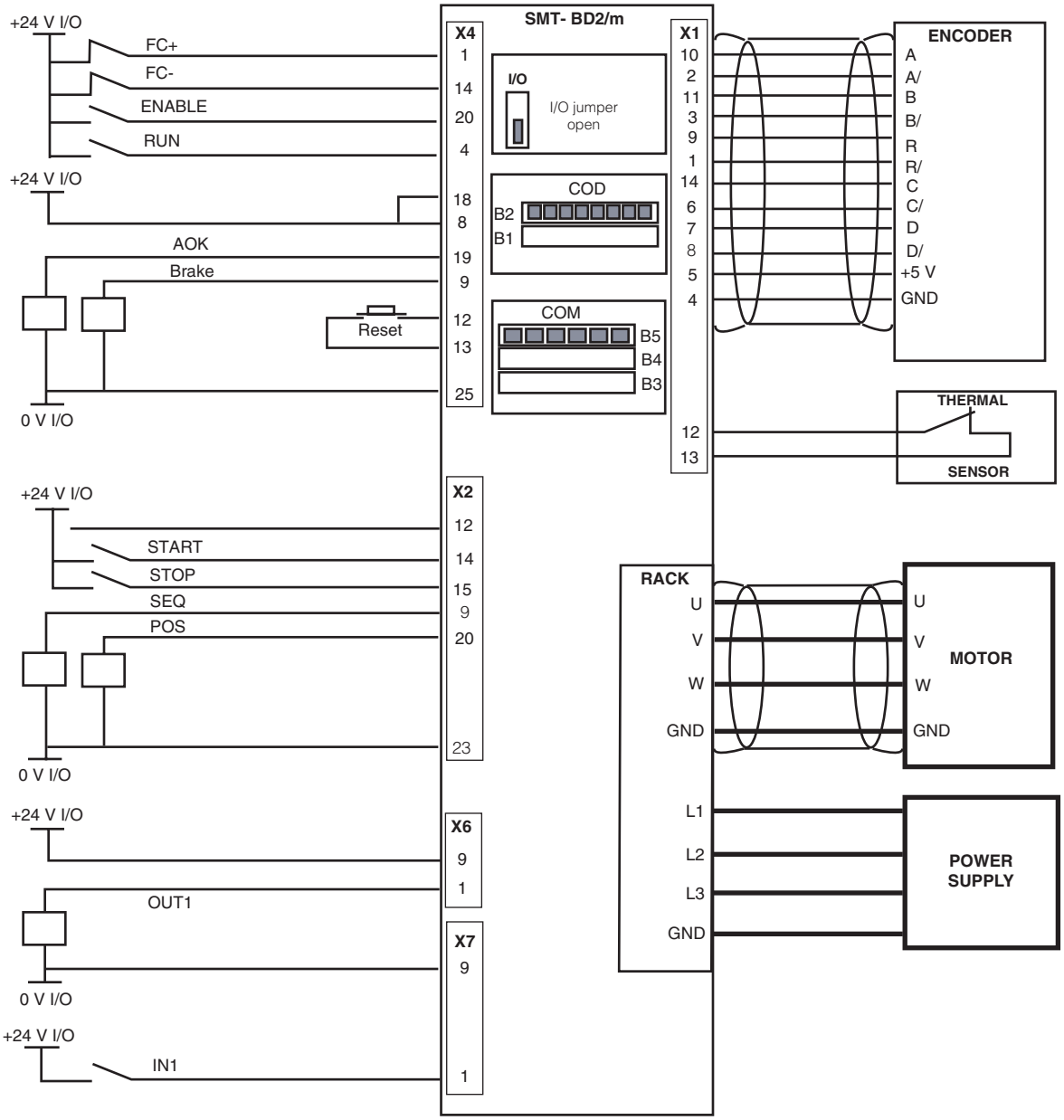
1.2 - AMPLIFIER I/O CONNECTIONS

1.2.1 - Amplifier connections with TTL encoder & HES motor feedback



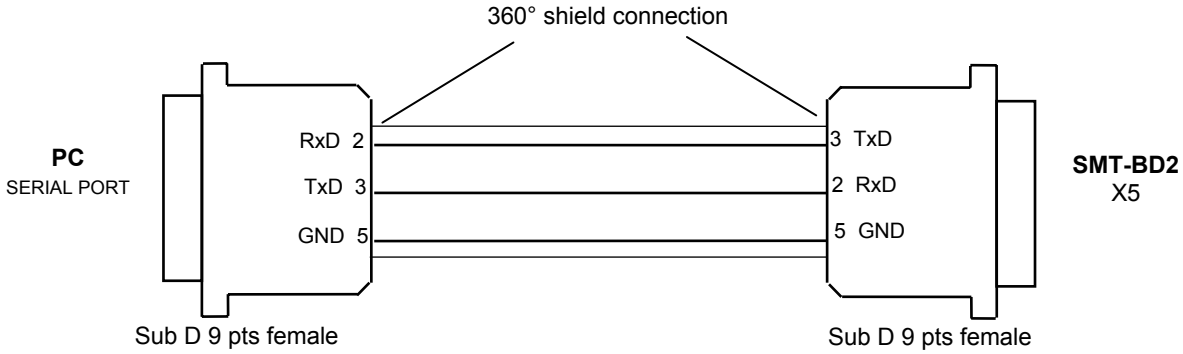
The I/O jumper must be open for getting the X4 connector I/Os optoisolation : the I/O 0 V (X4, pins 23, 24, 25) is disconnected from the 0 V of the SMT-BD2/m amplifier module.

1.2.2 - Amplifier connections with Absolute single turn Sin/Cos encoder feedback



The I/O jumper must be open for getting the X4 connector I/Os optoisolation : the I/O 0 V (X4, pins 23, 24, 25) is disconnected from the 0 V of the SMT-BD2/m amplifier module.

1.3 - RS-232 SERIAL LINK CONNECTION



2 - WIRING (according to CEI 801 and EN 55011 standards)

2.1 - GND WIRING AND GROUNDING

The reference potential is the **earth (ground)**. Motors and sensors (encoder + HES) are grounded via their housing. If a potential reference is existing, like a main chassis or a cabinet, with a low impedance between its various elements, it should be used to connect ALL references to it and also connect this reference to the earth (ground).

Long reference potential connections are suitable **ONLY** if these connections have an impedance < 0,1 Ω. 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**.

2.2 - MOTOR AND SENSORS CABLES

Cable ends should have a metallic collar allowing a 360° shield connection.
Motor cables must be shielded to avoid common mode effects.
Encoder and HES cable must also be shielded.

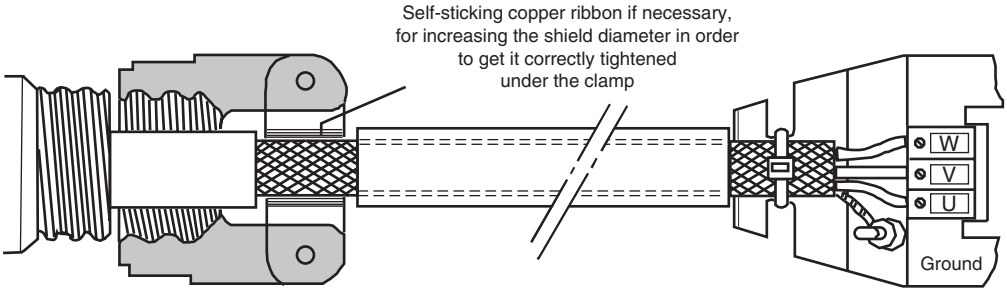
2.3 - ANALOG INPUTS AND SERIAL LINK CABLES

The analog input signals requires a pair twisted and shielded cable. The shield must have a "360°" connection via metallic collars at both ends. If the shield is connected by means of a wire thread, it must be connected at one end to a 0 Volt pin of X4 on the amplifier side with a connection as short as possible. For the 0 Volt, X4-15 and X4-16 pins must be connected together on the X4 connector.

The serial link cable must also be shielded according to the above mentioned shielding recommendations.

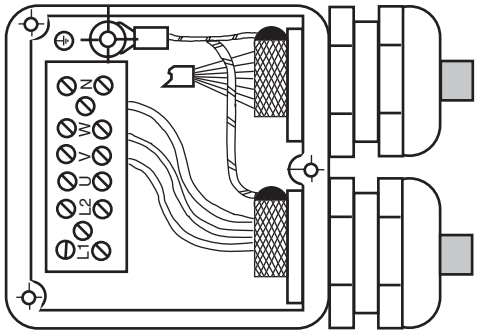
3 - 360° SHIELD ON THE CONNECTORS

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



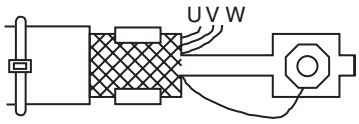
Motor connector for encoder and motor cables

BF Rack

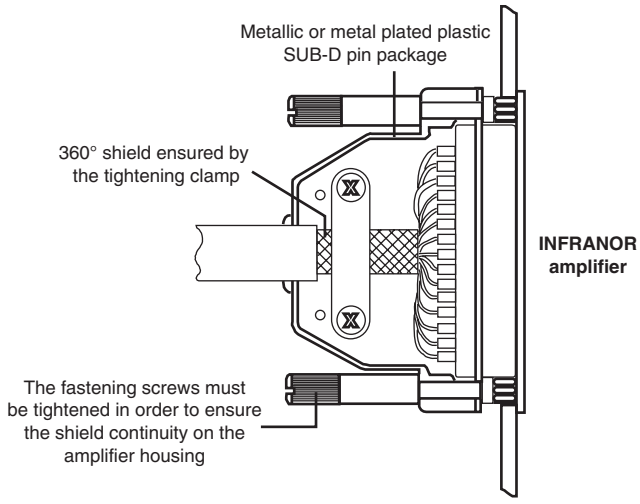


Motor connector box

The cable can be soldered on the shield because the connector box is metallic. This solution does not exactly meet the EMC requirements but it is acceptable.



SMT-BM 20 A rack



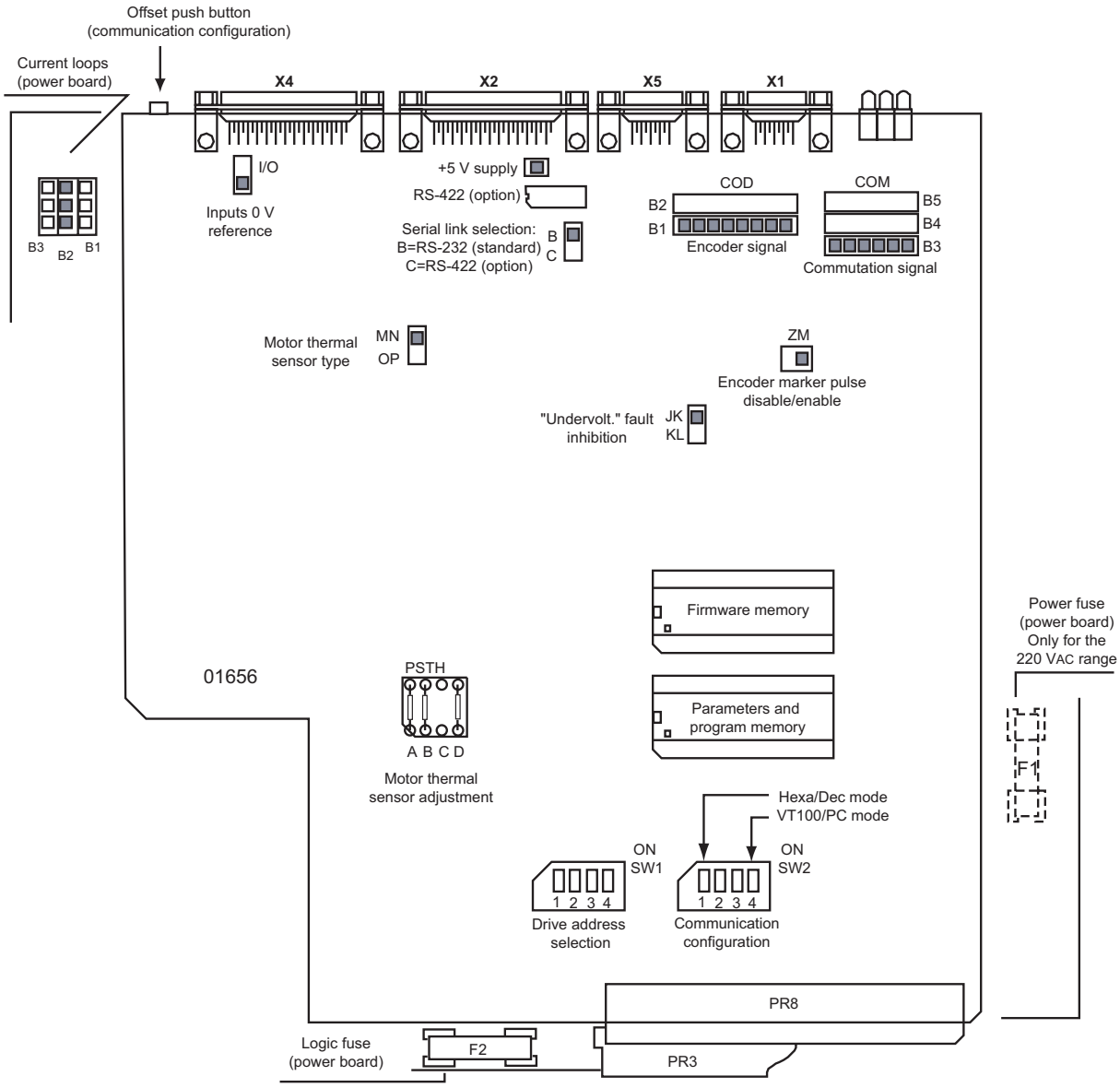
SUB-D connector

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

CHAPTER 5 - ADJUSTABLE FUNCTIONS

1 - HARDWARE ADJUSTMENTS

All the hardware adjustments of the SMT-BD2/m amplifier module are presented on the following diagrams.



For amplifier types 220/04 to 220/100 and 400/15 to 400/100 VAC range

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

2 - ADJUSTABLE PARAMETERS

The SMT-BD2/m serial link connector (X5) must be connected to the serial interface of a PC for the parameter setting operation. The **Visual Drive Setup** software, which is IBM-PC compatible with the WINDOWS® operating system, allows the clear display and easy modification of all the amplifier parameters. For the SMT-BD2/m parameter setting, the software version 1.10 or higher is required.

Please see Web site www.infranor.fr for downloading the **Visual Drive Setup** software.

Minimum requirements for the PC

Processor	:	Pentium
Operating system	:	WINDOWS 95/98, WINDOWS NT
Graphics adapter	:	Windows compatible, colour SVGA with resolution 800x600 or 1024x768
Drives	:	3.5” disk drive hard disk with 6 MB free space
Main memory	:	at least 8 MB
Interface	:	One free serial interface (COM1, COM2, COM3 or COM4)

CHAPTER 6 - COMMISSIONING

During the machine adjustments, some drive connection or parameter setting errors may involve dangerous axis movements. It is the user's responsibility to take all necessary steps in order to reduce the risk due to uncontrolled axis movements during the operator's presence in the concerned area.

1 - CHECKING THE AMPLIFIER CONFIGURATION

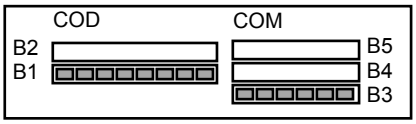
1.1 - STANDARD AMPLIFIER CONFIGURATION

The standard SMT-BD2/m amplifier configuration is given below. See chapter 5, section 1 "Hardware adjustments" for the jumpers location.

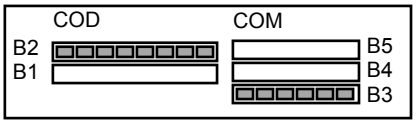
* Inputs 0 V reference jumper I/O is open (optoisolated inputs)
* Current loops adjustment jumpers in B2 position (medium gain)
* Motor temperature sensor jumper in MN position (PTC sensor type)
* Undervolt fault inhibition jumper in JK position ("Undervolt." fault enabled)
* Serial link communication jumper in B position (RS-232 protocol)
* Drive address selection jumpers in OFF position (address 0 selected)
* Encoder signal jumpers COD in B1 position (TTL incremental encoder configuration)
* Encoder marker pulse jumper in ZM position (encoder marker pulse enabled)
* Commutation signal jumpers COM in B3 position (incremental encoder configuration without HES)

1. 2 - ENCODER CONFIGURATION

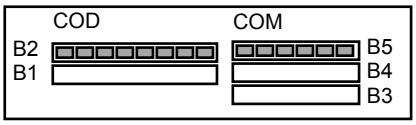
If the motor is equipped with a "TTL incremental encoder", select the following COD and COM jumpers setting.



If the motor is equipped with a "Sin/Cos incremental encoder", select the following COD and COM jumpers setting.

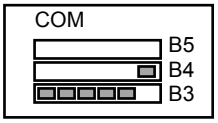


If the motor is equipped with an "Absolute single turn Sin/Cos encoder" (Heidenhain ERN 1085 or compatible), select the following COD and COM jumpers setting.

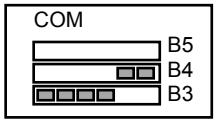


1. 3 - HALL EFFECT SENSORS CONFIGURATION

If the motor is equipped with Hall Effect Sensors devices, select the following COM jumpers setting according to the HES type (60° or 120°).

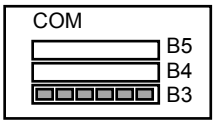


60° HES type



120° HES type

If the motor is not equipped with Hall Effect Sensors devices, the following COM jumpers setting must be selected. In this case a motor phasing procedure must be executed at each amplifier power up.



1. 4 - MOTOR THERMAL SENSOR CONFIGURATION

Select the right MN or OP jumper setting according to the motor thermal sensor type (PTC or NTC).

1.4.1 - PTC thermal sensor

On motors equipped with a PTC thermal sensor (triggering on high impedance), the amplifier configuration is the following: MN jumper closed and OP jumper open. The triggering threshold adjustment for the PTC thermal sensor is made by means of the PSTH components, as described below : PSTH-D = 14,3 kΩ; PSTH-B = 28 kΩ; PSTH-A = 3 x RPTC (120°C) in kΩ. RPTC (120°C) = ohmic value of the PTC thermal sensor resistor at 120°C; the default adjustment is RPTC (120°C) # 3 kΩ with PSTH-A = 10 kΩ.

1.4.2 - NTC thermal sensor

On motors equipped with a NTC thermal sensor (triggering on low impedance), the amplifier configuration is the following: OP jumper closed and MN jumper open. The triggering threshold adjustment for the NTC thermal sensor is made by means of the PSTH components, as described below: PSTH-D = 14,3 kΩ; PSTH-B = 28 kΩ; PSTH-A = 3 x RNTC (120°C) in kΩ. RNTC (120°C) = ohmic value of the NTC thermal sensor resistor at 120°C; the default adjustment is RNTC (120°C) # 3 kΩ with PSTH-A = 10 kΩ.

1.5 - CURRENT LOOPS ADJUSTMENTS

1.5.1 - Current loops adjustments for the 400 VAC amplifier version

Select the right current loops jumpers setting (B1, B2 or B3 position) according to motor and amplifier specifications.

For the 400VAC version of the BL MAVILOR motor series, the current loops adjustments are made according to the following selection table.

AMPLIFIER / MOTOR	15 A	30 A	45 A	60 A	100 A
BL 113	B2				
BL 114	B2				
BL 115	B2	B1			
BL 141	B1	B1			
BL 142	B2	B1			
BL 143	B1	B1	B1		
BL 144	B1	B1	B1		
BL 191			B3	B3	B2
BL 192			B3	B3	B2

For other motors, the current loops adjustment according to the **amplifier current rating** and to **the inductance between the motor terminals** is made as follows:

15 A and 30 A amplifier current ratings
Calculation of **G = 0.8 x Amplifier current rating (A) x 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.

45 A, 60 A and 100 A amplifier current ratings
Calculation of **G = 0.8 x Amplifier current rating (A) x 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.

1.5.2 - Current loops adjustments for the 220 VAC amplifier version

Select the right current loops jumpers setting (B1, B2 or B3 position) according to motor and amplifier specifications.

For the BL and MA MAVILOR motor series, the current loops adjustments are made according to following selection table.

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

For other motors the current loops adjustment according to the **amplifier current rating** and to **the inductance between the motor terminals** is made as follows:

4 A, 8 A, 12 A and 17 A amplifier current ratings
Calculation of **G = 1,4 x Amplifier current rating (A) x 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, 60 A , 70 A and 100 A amplifier current ratings
Calculation of **G = 1,4 x Amplifier current rating (A) x 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.

2 - PUTTING INTO OPERATION

The "Enable" and “RUN” inputs must be open (X2, X4, X 6, X7 connector can be disconnected).

Test the auxiliary supply voltage :
Rated value = 230 Vrms single-phase.
Maximum value (must never be exceeded) = 260 Vrms, all mains variation tolerances included.

Switch on the auxillary supply. The green ON Led must be lit and the UNDERVOLT error must be displayed.

Test the power supply voltage :
- For the 220 VAC amplifier version: **Rated value = 230 Vrms between phases.**
Maximum value (must never be exceeded) = 260 Vrms, all mains variation tolerances included.
- For the 400 VAC amplifier version: **Rated value = 400 Vrms between phases.**
Maximum value (must never be exceeded) = 480 Vrms, all mains variation tolerances included.

Switch on the power supply. The UNDERVOLT error Leds must be unlit. The braking resistor must remain cool.

CAUTION ! This resistor is under high voltage

Check that the amplifiers front panel screws are correctly fastened on the rack.

3 - AMPLIFIER COMMISSIONING AND ADJUSTMENT

3.1 - AMPLIFIER SETUP

Connect the encoder feedback cable between the motor and the amplifier X1 connector.

Connect the X4 command connector : the Enable and Run inputs must be open, the FC+ and FC- limit switches inputs must be connected and closed.

Connect the serial link RS 232 between the PC and the amplifier X5 connector.

Switch on the PC and the monitor and then start the WINDOWS® interface.

Start the **Visual Drive Setup** software installation and follow the instructions.

Turn on the SMT-BD2/m amplifier and start the **Visual Drive Setup** software.

If the message "**No serial communication found**" appears on the screen, click on **OK** and check following points before connecting again the **Visual Drive Setup** software:
- the amplifier is on (green LED **ON** must be lit),
- the amplifier and the PC are correctly connected via the RS 232 link,
- the software configuration (**Com. port and Baudrate**) is correct.

The **Connect** and **Disconnect** commands in the **Setup** menu allow to change the serial link connection from one amplifier to the other without leaving the **Visual Drive Setup** software.

The amplifier command cables (input command, serial link, encoder, HES) as well as the power cables must be connected and disconnected with the amplifier turned off.

3.2 - MOTOR HALL EFFECT SENSORS ADJUSTMENT

If the motor is using Hall Effect Sensors, check that the COM jumpers setting is correct according to the motor HES type (60° or 120°).

Check that the Enable and Run inputs are disabled and the amplifier turned on.

If the " HES " error is displayed, turn off the amplifier and check the following points before turning it on again:

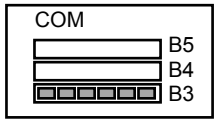
- The HES are correctly wired on the amplifier X1 connector (if 60° type HES are used, check the different HES signals wiring combinations to find the right wiring order).
- The commutation signal jumpers COM are correctly set according to the HES type.
- The HES supply voltage value is correct.

Move the motor manually over one revolution, or one pole pitch for a linear motor.

If the " HES " error is displayed turn off the amplifier and check the following points before turning it on again:

- The HES are correctly wired on the amplifier X1 connector (if 60° type HES are used, check the different HES signals wiring combinations to find the right wiring order).
- The commutation signal jumpers COM are correctly set according to the HES type.
- The HES supply voltage value is correct.
- The **Motor encoder resolution** parameter value is correct.

If the motor HES are not working correctly, select the following COM jumpers setting to run the motor without the HES devices.



In this case a motor phasing procedure must be executed at each amplifier power up.

3.3 - ABSOLUTE SINGLE TURN SIN/COS ENCODER ADJUSTMENT

If the motor is using an absolute single turn Sin/Cos encoder (Heidenhain ERN 1085 or compatible), check that the COD and COM jumpers setting is correct.

Check that the Enable and Run inputs are disabled and the amplifier turned on, and move the motor manually over one revolution.

If the " HES " error is displayed, turn off the amplifier and check the following points before turning it on again:

- The Sin/Cos encoder commutation channels are correctly wired on the amplifier X1 connector.
- The commutation signal jumpers COM are correctly set.
- The Sin/Cos encoder supply voltage value is correct.
- The **Motor encoder resolution** parameter value is correct.

3.4 - AMPLIFIER PARAMETER SETTING

Check that the Enable input is activated and the Run input desactivated.

Select the motor to be used in the **Motor list** and check the **Motor encoder resolution** value, the **Speed limit** and the **Current limits** according to the motor and amplifier specifications.

Select **Fusing** mode for the I^2t protection during all commissioning phases.

If the incremental encoder configuration without HES is selected, check that the free motor movement over 1 revolution, or 1 pole pitch for linear motors, is not dangerous for the operator. Then execute the motor phasing procedure (see section 3.7 of this chapter).
If the motor used is not in the **Motor list**, proceed as described below :

- Enter the servo motor **Encoder resolution** value.
- Adjust the **Speed limit** according to the motor and encoder specifications.
- Adjust the **Current limits** according to the motor and amplifier specifications.
- Uncouple the motor from the mechanical load and check that the free motor movement over 1 revolution, or 1 pole pitch for linear motors, is not dangerous for the operator. Then execute the **Auto-phasing** procedure.
- Calculate the **Current phase lead** value (this parameter is especially useful for motors with a low inductance and running at high speeds).

Select the **Encoder output** resolution.

For a Sin/Cos encoder type, select the **Pulse interpolation** mode.

Couple the motor to the load ; in the case of an axis with an unbalanced load (constant torque due to the gravity effect on a vertical axis), see paragraph 3.5 of this chapter. Desactivate the motor brake if used. Check that the free motor movement over 1 revolution, or 1 pole pitch for linear motors, is not dangerous for operator and machine. Select the most apropriate filter and bandwidth; then execute the **Auto-tuning** procedure.
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 (**Bandwidth = Medium** or **Low**). If the problem remains, renew the **Auto-tuning** procedure by activating the **Antiresonance** filter.

The **Auto-tuning** procedure should be executed with the Enable input activated and the Run input desactivated. If the **Auto-tuning** procedure must be executed with the drive under servo control (Enable and Run input both activated). It is the user's responsibility to take all necessary steps in order to reduce the risk due to uncontrolled axis movements during the **Auto-tuning** procedure.

Adjust the **manual mode** parameters : Jog speed, Jog accel and decel time, then test the motor running in both directions by using the Jog inputs. If required, adjust with more accuracy the servo loop response stability by means of the **Stability gain** buttons or by means of the adjustable gain values.

3.5 - AMPLIFIER AUTO-TUNING WITH AN UNBALANCED LOAD

In the case of an axis with an unbalanced load (constant torque due to the gravity effect on a vertical axis), the incremental encoder configuration without HES is not valid because the motor phasing procedure at power up cannot be executed.

Check that the Enable input is activated and the Run input desactivated.

Execute a first **Auto-tuning** procedure with the motor uncoupled from its mechanical load in order to initialize the gain values before coupling the motor to the load again.

Select the current limitation in **Limiting** mode. Check that the limit switches and the motor brake are correctly operating before starting the **Auto-tuning** procedure.

Activate both Enable and Run inputs. Move the shaft in Jog mode until a maintaining position (far enough from the axis limit switches) where a free movement over 1 revolution, or 1 pole pitch for linear motors, is not dangerous for operator and machine. Then execute the **Auto-tuning** procedure. 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 (**Bandwidth = Medium** or **Low**). If the problem remains, renew the **Auto-tuning** procedure by activating the **Antiresonance** filter.

During the **Auto-tuning** procedure execution with an unbalanced load (constant torque due to the gravity effect on a vertical axis), a wrong operation may involve dangerous axis movements. It is the user's responsibility to take all necessary steps in order to reduce the risk due to uncontrolled axis movements during the operator's presence in the concerned area.

Test the motor running in both directions in Jog mode. If required, adjust with more accuracy the servo loop response stability by means of the **Stability gain** buttons or by means of the adjustable gain values.

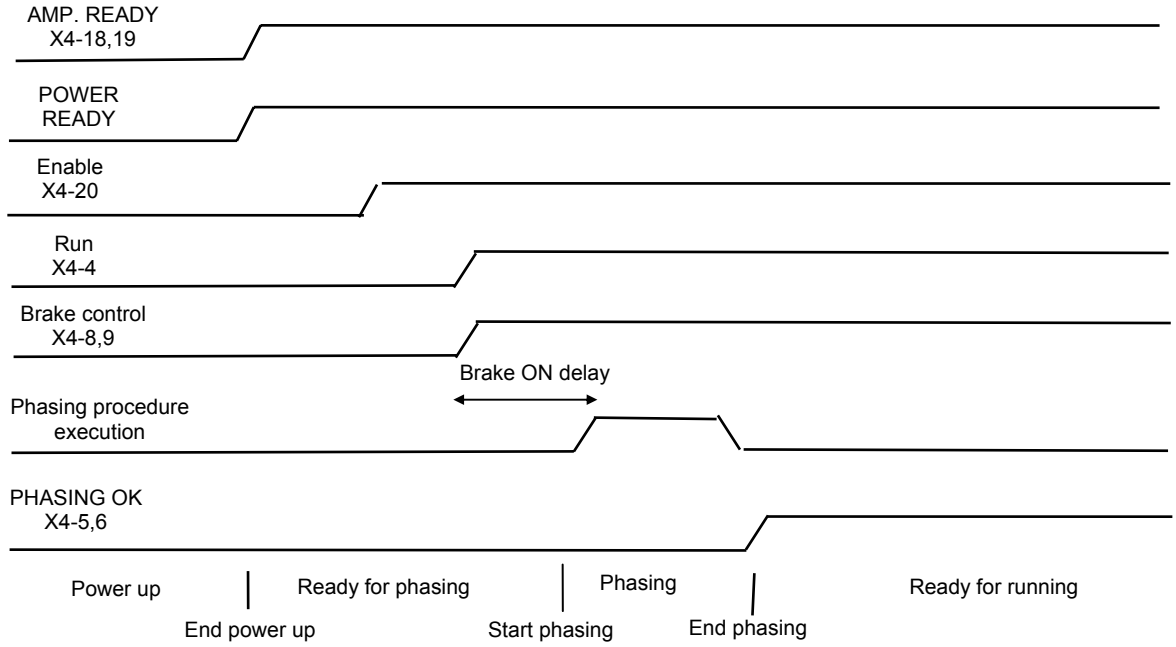
Go back to the motor standstill position before desactivating the Run or the Enable input.

3.6 - SAVING OF THE AMPLIFIER PARAMETERS

Save all parameters in the amplifier EEPROM by means of the **Save parameter to EEPROM** procedure.

3.7 – MOTOR PHASING AT POWER UP

In the incremental encoder configuration without HES, the motor phasing procedure must be executed according to the following diagram at each amplifier power up:



In the case of an axis with an unbalanced load (constant torque due to the gravity effect on a vertical axis), the motor phasing procedure is not valid. The motor must be equipped with an incremental encoder + HES or an absolute single-turn Sin/Cos encoder.

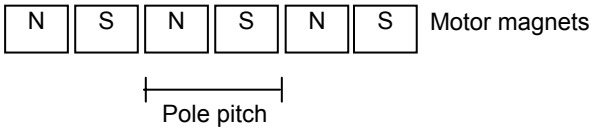
3.8 – AMPLIFIER ADDRESSING

The SMT-BD2/m amplifier has got 4 micro-switches (S1) that allow to define an address from 0 to 15 (see location of these switches in chapter 5, section 1: Hardware adjustments).

The allocation of an address ≠ 0 to an amplifier allows to communicate, from one single host, with several SMT-BD2/m amplifiers via the serial link (RS-232 or RS-422).

3.9 – PARAMETERS ADJUSTMENT TO A LINEAR MOTOR

The **Motor encoder resolution** parameter is calculated as described below:



$$\text{Motor encoder resolution} = 1000 \times \frac{\text{Motor pole pitch (mm)}}{\text{Encoder signal pitch (µm)}}$$

1 encoder signal pitch = 4 counting increments

The motor **Maximum speed** parameter value in rpm is calculated according to following formula:

$$\text{Maximum speed (rpm)} = 60 \times \frac{1000}{\text{Motor pole pitch (mm)}} \times \text{Maximum motor speed (m/s)}$$

The linear speed value in m/s is calculated according to following formula:

$$\text{Linear speed (m/s)} = \frac{\text{Motor speed (rpm)}}{60} \times \frac{\text{Motor pole pitch (mm)}}{1000}$$

The motor **Current phase lead** parameter value is calculated by using an equivalent motor torque constant value according to the following formula:

$$\text{Torque constant (Nm/A)} = \text{Force constant (N/A)} \times \frac{\text{Motor pole pitch (mm)}}{6000}$$

CHAPTER 7 - PROGRAMMATION

1 - GENERAL DESCRIPTION

The SMT-BD2/m amplifiers can have up to 128 pre-programmed sequences. Each sequence can be either :

- a homing sequence (HOME) or
- an absolute positioning sequence (ABSOLUTE) or
- an incremental positioning sequence (RELATIVE) or
- a speed profile sequence (SPEED) or
- a torque control sequence (TORQUE).

The control sequences can be automatically linked up: as soon as a sequence is over, another one can be executed. This allows to easily solve complex axis control applications by chaining several basic control sequences.

The SMT-BD2/m amplifiers have got 8 programmable logic outputs (triggering at the sequences execution) and 8 programmable logic inputs allowing to control a sequence start or stopping. The logic input 1 to 8 are entering the X7 connector. The logic output 1 to 8 are located on the X6 connector. The programmation consists in initializing the sequence parameters with the desired values. A control sequence can then be selected by using the programmable logic inputs activation and its execution is started by using the START logic input.

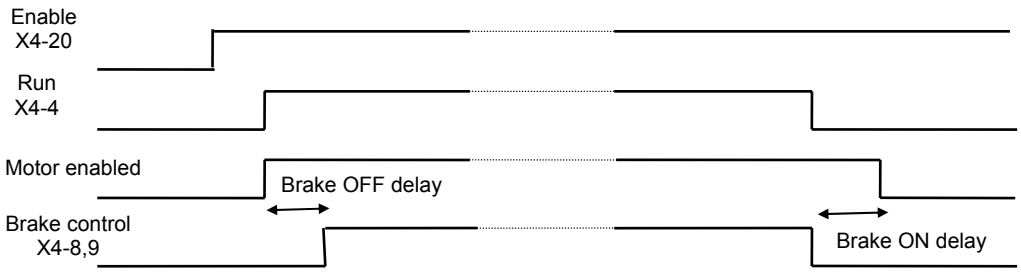
2 - DESCRIPTION OF THE LOGIC I/Os

2.1 - LOGIC INPUTS

ENABLE Enabling authorized. This signal is a necessary conditions for the motor enabling (see also signal RUN).

RUN Enabling signal.

The motor can be enabled only when the signals ENABLE and RUN are activated. Use in priority the RUN signal if using the brake control.

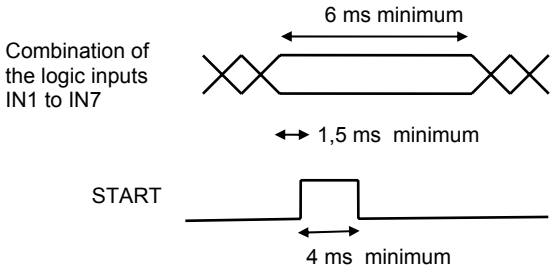


INDEX/CLR Index input for the axis homing. This input can be used for resetting the position counter when this function is configurated.

FC+ Limit switch input, positive direction.

FC- Limit switch input, negative direction.

START This signal starts the sequence which number is defined by inputs IN1 to IN7. This signal must be disabled before the sequence is over.



STOP This input stops the motor with the deceleration given by the JOG motion parameters.

WAIT When this signal is activated, it inhibits the execution of a sequence. The sequence will start when this signal is disabled.

TEACH This input allows to read the value of the current motor position and to program the sequence number defined by the logic inputs (IN1 to IN7) with this value. This function is only valid for an absolute positioning sequence.

JOG+ Manual movement in positive direction according to the JOG motion parameters.

JOG- Manual movement in negative direction according to the JOG motion parameters.

IN1 to IN8 These inputs allow to define, in natural binary code, the number of the sequence to be executed. They also allow to define a sequence starting condition.

2.2 - LOGIC OUTPUTS

Amp OK This signal indicates that the amplifier is ready (without error).

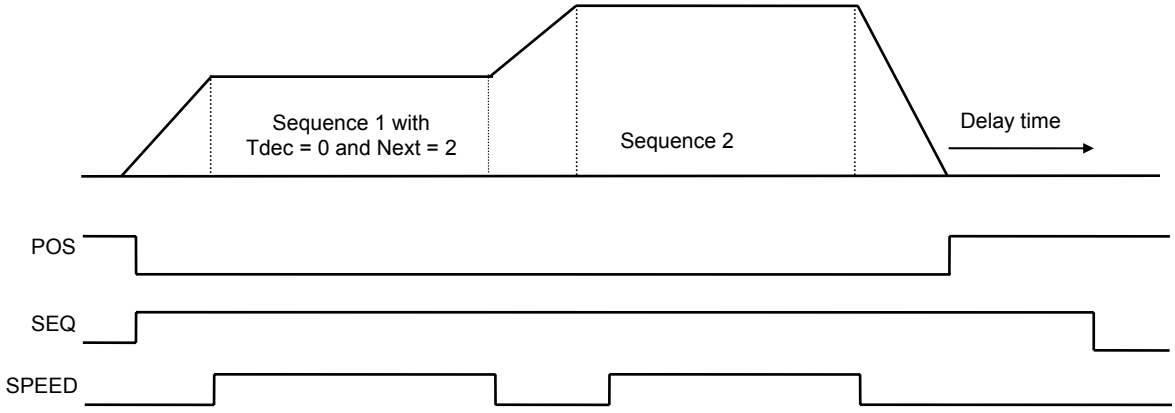
BRAKE This output controls the motor brake activation/desactivation.

SEQ This signal indicates that a sequence is presently executed.

POS This signal is activated when the motor reaches the position, and remains enabled until the next motor movement.

SPEED This signal indicates that the speed set point is reached during a movement of the motor.

OK This signal indicates that the amplifier is ready for a movement (no error and amplifier enabled).



OUT1 to OUT8 Programmable logic outputs. These outputs are only operating during a programmed sequence.

3 - POSITIONER PARAMETERS

3.1 - CONFIGURATION OF THE PROGRAMMABLES I/Os

Inputs polarity: defines the polarity of the optocoupled inputs START, STOP, WAIT, TEACH, JOG+, JOG-, IN1 to IN8: a signal that is not checked off with an X corresponds to an active 24 V input.

Sequence control: The inputs IN1 to IN7 can be used for selecting sequences (checked off with an X). There are maximum 128 sequences that can be selected this way by the inputs IN1 to IN7 (in binary code). The other inputs can be used for the start condition.

Output polarity: defines the polarity of the optocoupled outputs SEQ, POS, SPEED, OK, OUT1 to OUT8: a signal that is not checked off with an X, corresponds to an active 24 V output.

Output pulse: the outputs OUT1 to OUT8 can be defined as pulse outputs (checked off with an X) which duration is defined by the parameter **output pulse duration** (1 to 16000 ms).

3.2 - AXIS POSITION SCALING

Position resolution: defines the number of position increments for one motor revolution (or one motor pole pitch for a linear motor). The value range is between 400 and 4000000 pts.
The maximum possible value of the **Position resolution** parameter for a given application depends on the **Maximum speed** parameter value. The following condition must be answered for taking into account the positioner speed limitation: Position resolution < 19 x 10^8 / Maximum speed (rpm). If this condition is not answered, the positioner speed scaling gain will be reduced according to the previous speed limitation (all the sequences speed values will be reduced).

Decimal: number of decimals for the position resolution (1, 2 or 3).

Unit: defines the unit used for the position resolution (maximum 4 characters).

Example: For a resolution of 4 mm / motor revolution, if the number of decimals = 3, the parameters are: Resolution = 4000, Decimal = 3, Unit = mm.

Following error threshold: defines the triggering threshold of the position following error. When the servo loop position error value is higher than the **following error threshold** parameter value, the position following error is released. This parameter value must be adjusted correctly in order to get a good protection. Execute first the desired operating cycles and reduce progressively the **following error threshold** value until the fault is triggered. Then set the following error threshold at this value plus a margin of 30 to 50 %.

Maximum braking distance: defines the limit value for the motor braking distance when the position following error is released. This parameter value must be set according to the maximum motor speed and the available amplifier current. When the position following error is released, the amplifier speed reference value is set at zero and the motor is braking in the shortest time according to the available amplifier current. The amplifier is then disabled as soon as the zero speed is reached. However, if the motor braking distance exceeds the **maximum braking distance** parameter value during the braking phase, the amplifier is immediately disabled. This braking distance monitoring function allows to protect the operator and the machine against uncontrolled motor movements that could be generated by a drive failure. If the **maximum braking distance** parameter value is set at zero, when the position following error is released, the amplifier is immediately disabled without the braking phase and the motor freewelling.
The **maximum braking distance** parameter is also taken into account when an hardware limit switch (FC+ or FC-) is activated. In this case, the amplifier speed reference value is set at zero and the motor is braking in the shortest time according to the available amplifier current. During the braking phase, the following error detection is not active. However, if the motor braking distance exceeds the **maximum braking distance** parameter value during the braking phase, the amplifier is immediately disabled and a position following error is released. If the **maximum braking distance** parameter value is set at zero, when an hardware limit switch is activated, the following error detection is still active. So, if a position following error is released during the braking phase, the amplifier is disabled and the motor freewelling.

Deadband: defines the deadband for the position controller. The deadband is desactivated when the parameter is set at 0.

CLR input enable: when activated (checked off), allows to use the INDEX input for re-initializing the position counter: at the inactive-active transition of this signal, the **Clear position** parameter value will be loaded in the position counter.

Reset counter/Modulo: this function allows to reset the position counter when it reaches a pre-defined value. If the value is set at 0, this function is not activated.

Forward: when the function **Reset counter/Modulo** is activated, if **Forward** is selected (ticked off), the motor runs only in the positive direction for an absolute displacement lower than the value of the **Reset counter** parameter. When the function **Reset counter/Modulo** is activated, if **Forward** is not selected (not ticked off), for an absolute displacement lower than the value of the **Reset counter** parameter, the motor follows the shortest way.

Software limit switches + and -: this function is only active if the HOME sequence has been previously executed. When the motor passes the software limit position value, it is stopped with a controlled braking. The deceleration ramp value is given by the jog deceleration time.

3.3 - POSITIONER CONFIGURATION

Speed profile: trapezoidal or S-curve shape selection.

Analog input limitation: enables the motor speed limitation by the analog input on pin 17 of the X4 connector. The axis displacement speed is then limited with regard to the programmed speed value. For the TORQUE, SPEED and positioning sequences (ABSOLUTE or RELATIVE), the programmed speed can be continuously modified according to the analog input voltage value, if **speed modulation** is selected. For the HOME sequence, the programmed speed is limited during the entire sequence execution according to the analog input voltage value at the sequence starting. The speed reduction can be proportional or inversely proportional to the analog input value according to the **reversed limitation** parameter.

Reversed limitation: defines the polarity of the speed limitation with regard to the analog input voltage value. The reversed limitation activation allows to get the speed limitation proportional to the analog input value. When reversed limitation is not selected, the speed limitation is inversely proportional to the analog input value (for 0 V, the motor runs at the programmed speed and for 5 V the motor runs at half of the programmed speed).

Speed modulation: enables the continuous modulation of the motor speed according to the analog input voltage value during a TORQUE, SPEED or positioning (ABSOLUTE or RELATIVE) sequence execution. When **speed modulation** is disabled, the programmed speed is limited during the entire sequence execution according to the analog input voltage value at the sequence starting.

Input filter : defines the cut-off frequency value for the low pass filter on the analog input (pin 17 of X4).

Brake ON delay: defines the time between the brake activation and the amplifier disabling according to the following timing:

- brake ON (contact open),
- delay time,
- amplifier disabled.

The brake ON delay value must be higher than the brake response time.

Brake OFF delay: defines the time between the amplifier enabling and the brake desactivation according to the following timing:

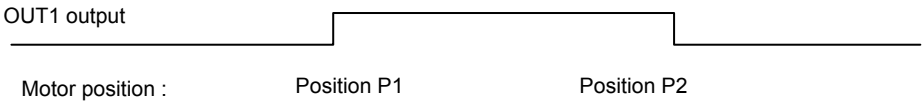
- amplifier enabling,
- delay time,
- brake OFF (contact closed).

The brake off delay value must be higher than the amplifier servo loop response time.

Minimum SEQ pulse: when activated, this function defines the minimum duration of the SEQ output. This function is useful for the detection of a sequence with a short duration.

InPos window: when activated, this function defines the position window in which the **POS** output is activated: window = arrival position +/- programmed value. This parameter is only valid for a positioning sequence. If this function is not enabled, the **POS** output is activated at the end of the position trajectory regardless of the real position value.

Digital CAM: when activated, this function activates the logic output OUT1 when the motor passes an area defined by positions P1 and P2.

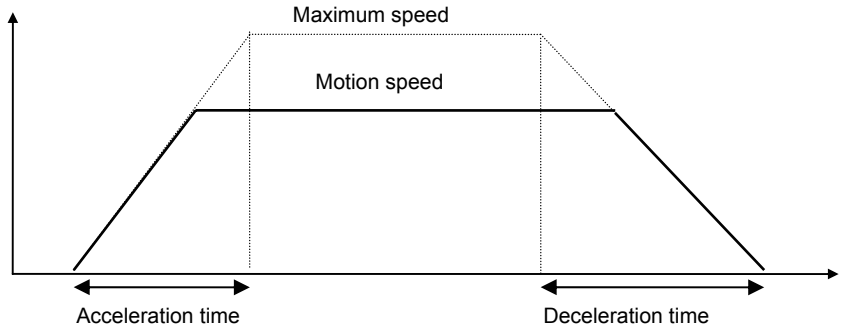


3.4 - MANUAL MODE PARAMETERS

There are 2 types of manual motion:
- manual positioning: moving of the motor until a given position via the serial link.
- manual jog: continuous movement when the JOG signal is activated.
  (JOG+ for a movement in the positive direction and JOG- for a movement in the negative direction)

The motion profile parameters are:
- motion speed,
- acceleration time,
- deceleration time.

The parameters **acceleration time** and **deceleration time** define the time with regard to the **maximum speed** parameter value. When the **motion speed** is lower than the maximum speed, the trajectory acceleration and deceleration times are proportionally reduced.



Remark : The JOG deceleration time parameter value is also used when the STOP input is activated.

4 - EDITION OF A SEQUENCE

Parameters of a sequence:

Type Defines the motion type.
ABSOLUTE: absolute positioning.
RELATIVE: relative positioning.
HOME: axis homing.
SPEED: speed profile.
TORQUE: torque control.

Position Position to be reached in absolute or relative positioning mode.
For a HOME sequence, this parameter indicates the value to be loaded in the position counter when the home position is found.

Speed Defines the motion speed in rpm.

Torque For a TORQUE sequence, this parameter defines the torque set point in % of the **Maximum current** parameter value.

Acceleration Defines the acceleration time in ms with regard to the **Maximum speed** parameter value. When the motion speed is lower than the maximum speed, the acceleration time is proportionally reduced.
For a SPEED or TORQUE sequence, this parameter defines the acceleration time in ms from the initial speed at the sequence starting up to the speed set point.

Deceleration Defines the deceleration time in ms with regard to the **Maximum speed** parameter value. When the motion speed is lower than the maximum speed, the deceleration time is proportionally reduced. This parameter can be equal to 0 if a sequences linkage can be made without stopping the motor.
For a SPEED sequence, this parameter defines the deceleration time in ms from the sequence speed set point up to 0. This parameter can be equal to 0 if a sequences linkage can be made without stopping the motor.

Delay Time / TimeOut Defines the delay time in ms at the end of the positioning.
For a SPEED sequence, this parameter defines the motor running time in ms at the speed set point value. If this parameter value exceeds 16000 ms, then a sequence stop condition can be used to leave the speed control sequence.
For a TORQUE sequence, this parameter defines the torque holding time in ms when the torque set point value has been reached. If this parameter value exceeds 16000 ms, then a sequence stop condition can be used to leave the torque control sequence.
For a HOME sequence, this parameter defines the time-out in seconds. The time-out is the time after which the positioner releases a Busy error if it does not find the home position. When this value is 0, the time-out protection is not activated.

Next sequence Defines the number of the sequence to be executed after the current one.

Counter Defines how many times the sequence must be executed. This counter is decremented each time a sequence is over.

Counter link / Jump Defines the number of the sequence to be executed when the counter is not at 0.

Logic outputs Defines the possible effect on the outputs.

Triggering Defines the outputs triggering moment.

Triggering position Defines the outputs triggering position.

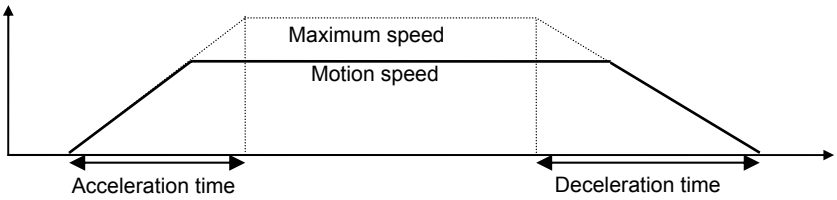
Start condition Defines the possible effect of the logic inputs. **Stop** selection allows to use the logic inputs as a sequence stop condition. A sequence stop condition is only valid for a SPEED or TORQUE sequence when the running time or the holding time value is higher than 1600 ms. When **Stop** is desactivated, the logic inputs are used as a sequence start condition for any sequence type.

Home control For a HOME sequence, this parameter defines the amplifier configuration for the homing sequence execution.

4.1 - HOMING SEQUENCE

A homing sequence is defined by:
- the motion speed,
- the acceleration time,
- the deceleration time,

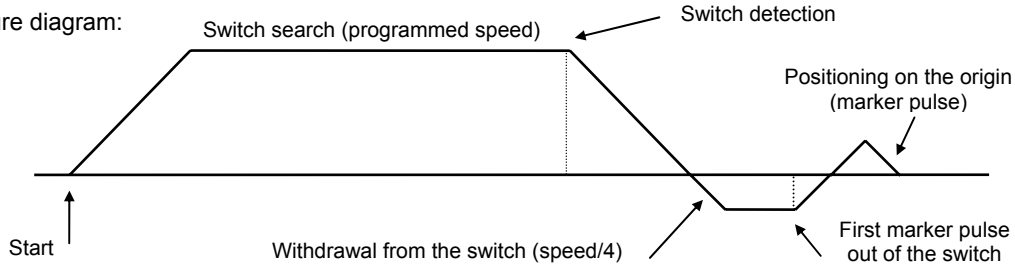
The parameters acceleration and deceleration times define the time with regard to the maximum speed parameter value. When the motion speed is lower than the maximum speed, the trajectory acceleration and deceleration times are proportionally reduced in order to maintain the same acceleration and deceleration values.



- a time out,
- a position reset value,
- the control (5 bits):

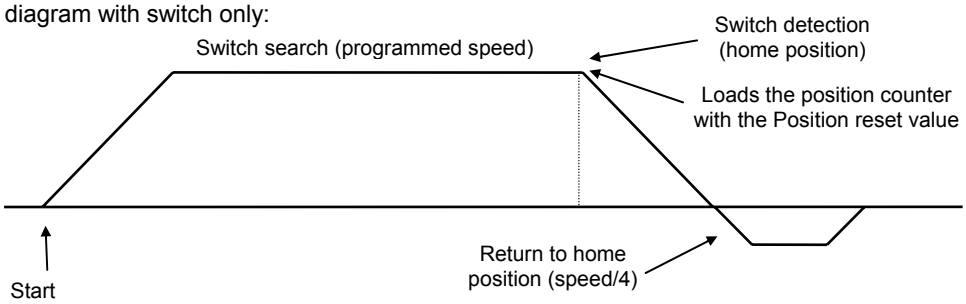
Dir	Searching direction: 0 for the positive direction and 1 for the negative direction.
Switch	Homing with switch detection.
Zero	Homing with marker pulse detection.
0rigin	This parameter allows to come back to the home position (motion reversal); otherwise the motor will be stopped after the braking.
Reset	Load the position reset value in the position counter at the home position.

Homing procedure diagram:



If Switch=1 and Zero=1 or Origin=1, the speed can be reversed by the switch detection or by a limit switch.

Homing procedure diagram with switch only:

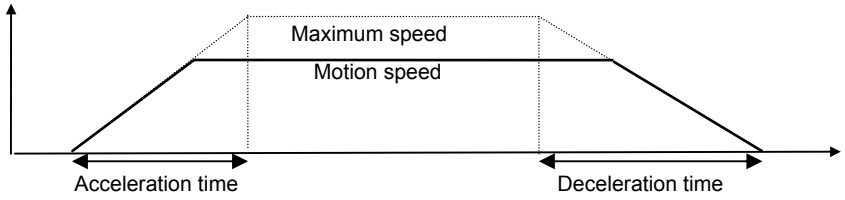


When the sequence 0 contains a homing procedure, at power on, no other sequence can be executed before sequence 0.

4.2 - POSITIONING SEQUENCE

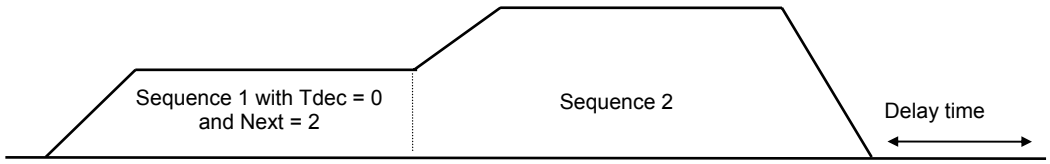
A positioning sequence is defined by:
- the position to be reached (absolute or relative),
- the motion speed,
- the acceleration time,
- the deceleration time,

The parameters acceleration and deceleration times define the time with regard to the maximum speed parameter value. When the motion speed is lower than the maximum speed, the trajectory acceleration and deceleration times are proportionally reduced in order to maintain the same acceleration and deceleration values.

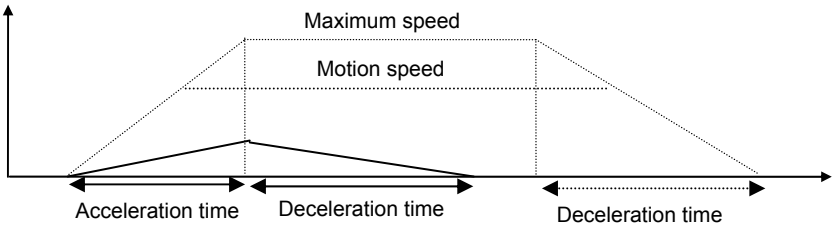


- a delay time at the end of the motion.

Linkage example of 2 positioning sequences without stopping (the deceleration ramp of the first sequence is 0):



Remark : For a small displacement, when the programmed motion speed value cannot be reached, the trajectory acceleration and deceleration are reduced and the profile is calculated according to the programmed acceleration and deceleration time values.



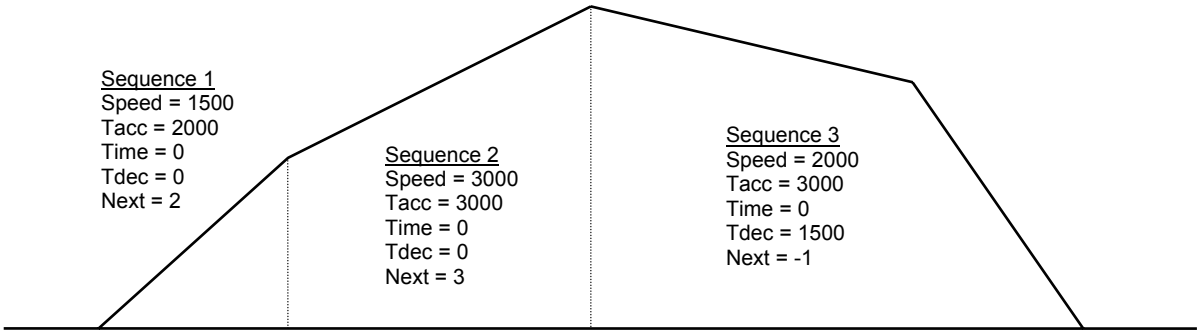
4.3 - SPEED SEQUENCE

A speed sequence is defined by:
- the speed set point
- the running time
- the acceleration time
- the deceleration time.

When the running time exceeds 16000 ms, the stop condition can be used for stopping the sequence.

Note: The **Acceleration time** and **Deceleration time** parameters are the real acceleration and deceleration times values and not acceleration and deceleration ramps with regard to the **Maximum speed** value as they are in a positioning sequence or a homing sequence.

The sequences linkage allows to create speed profiles.



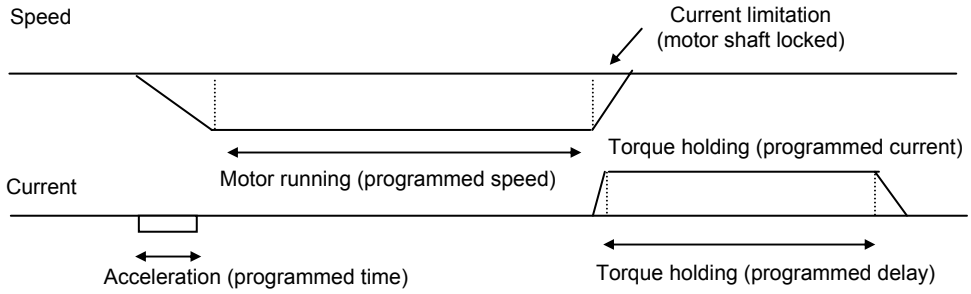
Remark: "Next" = -1 corresponds to an empty field on the PC software.

4.4 - TORQUE SEQUENCE

A torque sequence is defined by:

- the speed set point
- the acceleration time (define the time with regard to the maximum speed parameter value, when the speed set point is lower than the maximum speed, the acceleration time is proportionally reduced)
- the torque set point
- the torque holding time (delay).

Torque sequence execution:



In the torque control sequence, the motor is running at the speed set point value until the current raises up to the limit value defined in percentage of the **Maximum current** parameter value. The motor running direction depends on the sign of the speed set point. When the current limitation is reached, the amplifier is holding this current during the time interval defined by the **Delay time** parameter. If the **Delay time** exceeds 16000 ms, the torque holding time is infinite. In this case the sequence can be left by a stop condition.

The **Hold** triggering condition allows the outputs activation when the current limit is reached.

4.5 - SEQUENCES CHAINNING

4.5.1) Counter loop

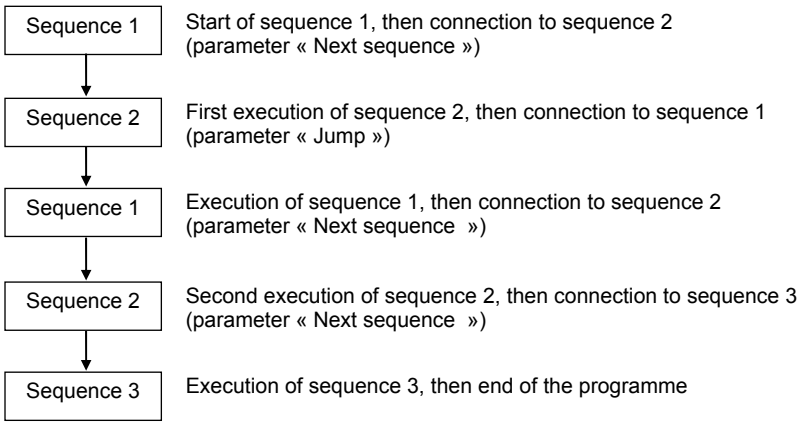
The sequences linkage is controlled by the parameters “Next sequence”, “Counter” and “Jump”.

Application example:

Sequence 1: Next sequence = 2
Counter = 0
Jump = -1
Sequence 2: Next sequence = 3
Counter = 2
Jump = 1
Sequence 3: Next sequence = -1
Counter = 0
Jump = -1

Remark: "Next" = -1 or "Jump" = -1 corresponds to an empty field on the PC software.

If the execution starts at sequence 1, the programme will be the following:



4.5.2) Conditional jump

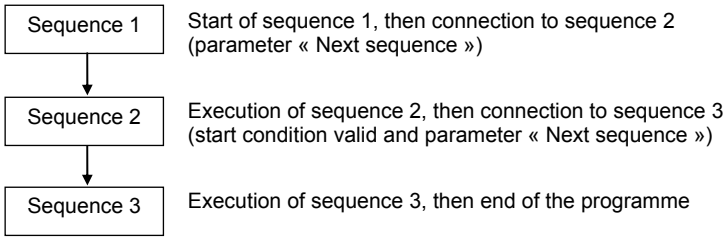
Conditional jump is controlled by using the “Start condition” and the parameters “Next sequence”, “Counter” and “Jump”.

Application example:

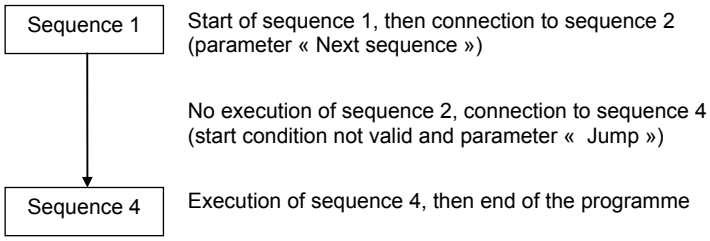
Sequence 1: Next sequence = 2
Counter = 0
Jump = -1
Sequence 2: Next sequence = 3
Counter = 0
Jump = 4
Start condition = Logic input 8 activated
Sequence 3: Next sequence = -1
Counter = 0
Jump = -1
Sequence 4: Next sequence = -1
Counter = 0
Jump = -1

Remark: "Next" = -1 or "Jump" = -1 correspond to an empty field on the PC software.

If the execution is starting at sequence 1 and logic input 8 is activated, the programme will be the following:



If the execution is starting at sequence 1 and logic input 8 is desactivated, the programme will be the following:



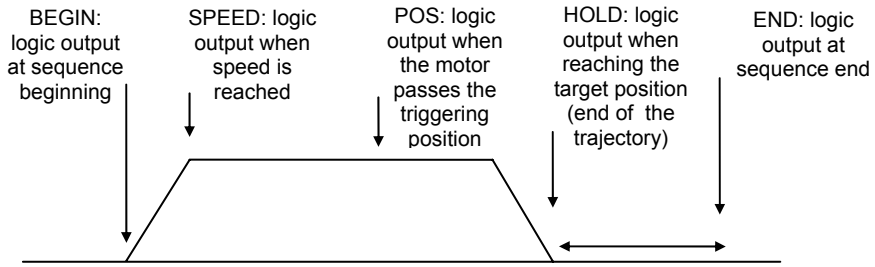
4.6 - PROGRAMMABLES OUTPUTS

Outputs

The action on the 8 logic outputs can be defined as follows:
- do not modify the output status,
- set the output at 1,
- set the output at 0,
- reverse the output (toggle).

Triggering

The outputs triggering moment can be defined, during a motion, according to 1 of the 5 different ways described below:



In a homing sequence, the outputs trigger only at the end of the sequence.
In a speed sequence, the HOLD and POS triggering are not possible.
In a torque sequence, the POS triggering is not possible.

The outputs can be configurated as pulse outputs with a preset duration. This function only concerns the outputs set at 1 or toggle.

Triggering position:

Defines the position where the logic output must be triggered when it is programmed in POS triggering.

4.7 - PROGRAMMABLE INPUTS

Start condition

The possible effect of the 8 logic inputs can be selected as follows:

- ignore the input status,
- trigger on positive level (input activated),
- trigger on negative level (input desactivated).

The inputs can be used either as a sequence start condition or as a sequence stop condition. When **Stop** is desactivated, the logic inputs are used as a sequence start condition for any sequence type. The **Stop** selection allows to use the logic inputs as a sequence stop condition. A sequence stop condition is only valid for a SPEED or TORQUE sequence when the delay time value is higher than 1600 ms.

NOTE : The programmable inputs configurated for the sequence selection cannot be used for a starting condition (see section 3.1 of this chapter: configuration of the programmable I/Os).

5 - PROGRAMME EXECUTION

The execution of a sequence can be made:

- via the START logic input: this input triggers the execution of the sequence number defined by inputs IN1 to IN7 (in natural binary code),

- via the serial link. The PC software allows the execution of any sequence number.

NOTE : A sequence execution requires the **OK** output to be active.

6 - SPEED AND TORQUE LIMITATION

The sequence speed values can be reduced according to the analog input voltage value on pin 17 of the X4 connector. This functionality can be enabled or disabled by the selection of the **Analog input limitation** parameter. For the TORQUE, SPEED and positioning sequences (ABSOLUTE or RELATIVE), the programmed speed can be continuously modified according to the analog input voltage value if **speed modulation** is selected. For the HOME sequence, the programmed speed is limited during the entire sequence execution according to the analog input voltage value at the sequence start. The speed reduction can be proportional or inversely proportional to the analog input value according to the **reverse limitation** parameter.

The torque set point value programmed in the torque control sequences can be reduced according to the analog input voltage value on pin 3 of the X4 connector. This functionality is only valid during the torque sequences execution. The programmed current limit in % of the amplifier **Maximum current** value can be continuously modified according to the analog input voltage value (torque modulation). The current reduction is inversely proportional to the analog input voltage value (for 0 V, the full programmed current limit value is available and for 5 V the current limit is half of the programmed value).

CHAPTER 8 - TROUBLESHOOTING

1 - SYSTEM FAULT

If the red **SYS** led is lit when the amplifier is on, the logic board is off duty.

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

2 - 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 initial one. In order to simplify diagnostic and maintenance, the faults are displayed and processed with the priority described below. For safety reasons, the power must be turned off before cancelling some faults that require the handling of the amplifier or the connectors.

2.1 - "BUSY" FAULT

- If the BUSY fault is continuously displayed after power on, the auto-test procedure has failed and the control board is not operating correctly.

- If the BUSY fault is continuously displayed after starting the motor phasing procedure by the **RUN** input at power up (incremental encoder configuration without HES) , the procedure has failed because of an external cause and the calculated phase value is wrong. Check that the **Motor encoder resolution** parameter value is correct. Check that the **Motor parameters** (**Pole pairs** and **Phase order**) values are correct. Check that the **ENABLE** input is activated. Check that the limit switches inputs are not activated. Check that the motor is not locked and the shaft movement is free during the procedure execution.

- If the BUSY fault is continuously displayed after the execution of the **Auto-phasing** procedure, the procedure has failed because of an external cause and the calculated parameters are wrong. Check that the **Motor encoder resolution** parameter value is correct. Check that the **ENABLE** input is activated. Check that the limit switches inputs are not activated . Check that the motor is unloaded and the shaft movement is free during the procedure execution.

- If the BUSY fault is continuously displayed after the execution of the **Auto-tuning** procedure, the procedure has failed because of an external cause and the calculated parameters are wrong. Check that the **ENABLE** input is activated. Check that the limit switches inputs are not activated. Check that the motor shaft movement is free during the procedure execution.

- If the BUSY fault is continuously displayed after the execution of the **Offset compensation** procedure, the offset is exceeding +/- 0.3 Volts. Check for the voltage value on the analog speed limitation input during the procedure execution. Check that the analog inputs wiring answers the requirements of chapter 4.

- If the BUSY fault is continuously displayed after the execution of a **HOME** sequence, the homing procedure has failed because of an external cause. Check that the homing sequence **Time out** parameter value is compatible with the application. Check that the encoder marker pulse is enabled by the **ZM** jumper if a homing sequence with the **Zero** detection is programmed.

2.2 - "EEPROM" FAULT

- Check for the presence of the EEPROM and check its correct orientation and mounting.

- If the fault remains, the EEPROM is not correctly initialized (CHECKSUM error) or is not compatible with the amplifier software version. In this case, renew the parameters setting and the sequence transfer from the PC to the amplifier, then execute the **Save parameters to EEPROM** procedure.

2.3 - "°C MOTOR" FAULT

- If the fault occurs when starting the amplifier:
  - Check the configuration of the **MN** and **OP** jumpers with regard to the type of thermal sensor used in the motor.
  - Check the connection between thermal sensor and amplifier on the front panel connector X1.

- If the fault occurs during the operation:
  - Check the motor temperature value and look for the reason of the motor overheating (mechanical overload, duty cycle too high, ...)

2.4 - "UNDERVOLT." FAULT

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

- If the fault occurs during the operation:
  - Check that the power supply connections are correct
  - Check that the power supply voltage value is correct

2.5 - "°C AMPLIFIER" FAULT

Check that the fan and the heatsink configurations are correct with regard of the required rated current (see current table, Chapter 2, section 1).

Remark : This fault is only valid on amplifiers with current ratings 220/70 and 220/100.

2.6 - "POWER STAGE" FAULT

- If the fault occurs when starting the amplifier:
  - Check the DC bus voltage and the terminal voltage of the power transformer secondary :
    For the 220VAC version of the amplifier DC bus < 370 VDC and V secondary < 260 VAC
    For the 400VAC version of the amplifier DC bus < 800 VDC and V secondary < 480 VAC

- If the fault occurs during the operation:
  - Check the braking system operation during the deceleration phases is correct,
  - Check the sizing of the braking resistor with regard to the deceleration phases.
  - Check for no short-circuit in the motor wiring and at the motor terminals.
  - For amplifiers with 220/04 to 220/60 current ratings and 400 VAC range, check that the fan and the heatsink configuration is correct with regard to the required rated current (see current table, Chapter 2, section 1).

2.7 - "HES" FAULT

For the incremental encoder & HES configuration:

- Check that the HES are correctly wired on the amplifier X1 connector (with a 60° HES type, check the different wiring combinations in order to find the right wiring order)
- Check that the commutation signal jumpers COM are correctly set according to the HES type
- Check for the correct HES supply voltage value
- Check for the correct **Motor encoder resolution** parameter value
- Check that the HES-amplifier-motor ground connections and shield answer the requirements of chapter 4.

For the "Absolute single turn Sin/Cos encoder" configuration:

- Check that the Sin/Cos encoder commutation channels are correctly wired on the amplifier X1 connector
- Check that the commutation signal jumpers COM are correctly set
- Check for the correct Sin/Cos encoder supply voltage value
- Check for the correct Sin/Cos encoder C and D channel signal amplitude value
- Check that the **Motor encoder resolution** parameter value is correct
- Check that the encoder-amplifier-motor ground connections and shield answer the requirements of chapter 4.

2.8 - "ENCODER" FAULT

For the incremental encoder configuration:

- Check the encoder supply connection on the amplifier connector X1.
- Check that the encoder signal jumpers COD are correctly set.
- Check the encoder A and B channel and marker pulse connections on the amplifier connector X1.

If the motor encoder is not providing a marker pulse channel output, the amplifier marker pulse channel must be disabled in order to cancel the "Encoder" fault. In this case the encoder marker pulse jumper ZM must be set in the disabled position as described below.

Encoder marker pulse enabled

Encoder marker pulse disabled

When the amplifier marker pulse channel input is disabled, the encoder counting protection is disabled (see section 2.9 "Counting" fault). In this case an incorrect encoder pulses counting can involve uncontrolled motor movements that may be dangerous for operator and machine.

For the " Absolute single turn Sin/Cos encoder" configuration:

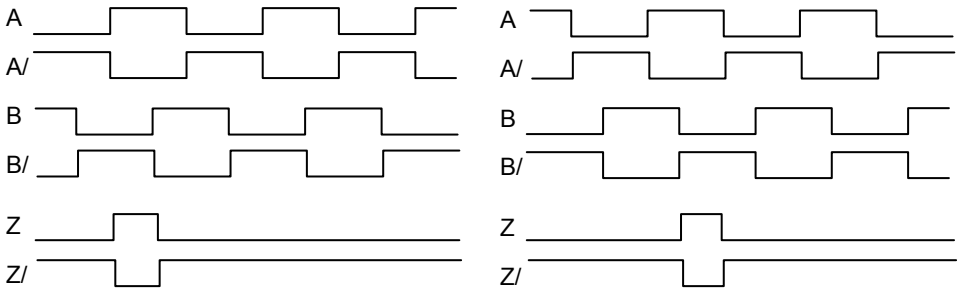
- Check the encoder supply connection on the amplifier connector X1.
- Check that the encoder signal jumpers COD are correctly set.
- Check the encoder A and B channel connections on the amplifier connector X1.

When the amplifier programme includes a HOME sequence at sequence 0, no other sequence can be executed before sequence 0 after an ENCODER fault release.

2.9 - "COUNTING" FAULT

For the "TTL incremental encoder" configuration:

- Check that the encoder signal jumpers COD are correctly set (position B1)
- Check for the correct encoder supply voltage value
- Check for the correct encoder-amplifier-motor ground and shield connections with regard to the recommendations of chapter 4.
- Check for the correct encoder A channel, B channel and Z marker signal waveforms



- Check that followings condition are answered for taking into account the maximum value of the encoder pulse frequency at the maximum motor speed value :
  Max. motor speed (rpm) < 60 x 10^6 / Number of encoder pulses per revolution
  Max. motor speed (rpm) < 60 x Encoder pulse frequency limit (Hz) / Number of encoder pulses per revolution

- Check that the **Motor encoder resolution** parameter value is correct.

- Check that the number of encoder pulses between two successive Z marker pulses is an entire multiple of the **Motor encoder resolution** value. If this condition is not fulfilled, the encoder counting protection must be disabled in order to cancel the "Counting" fault. The encoder counting protection can be disabled by disabling the encoder marker pulse by means of the ZM jumper (see section 2.8 "Encoder fault"). The encoder counting protection can also be software disabled if the encoder marker pulse is required for the **HOME** sequence. In

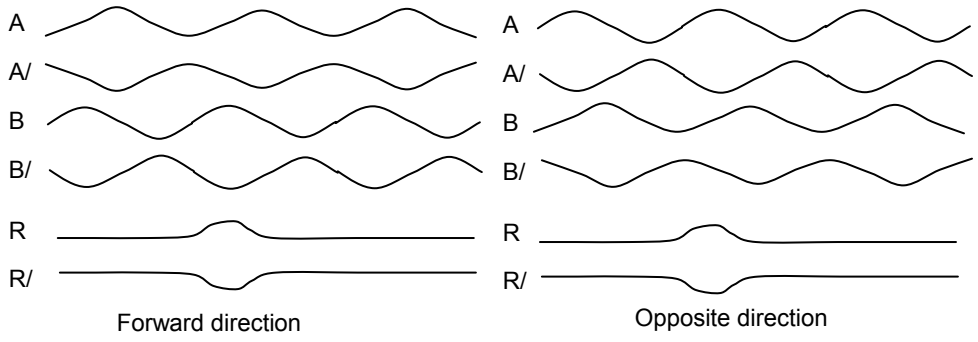
this case, the **ZM pitch** parameter value must be set at 0.

The encoder counting protection is checking that the encoder pulses number between two successive Z marker pulses is an entire multiple of the **Motor encoder resolution** value. When the encoder counting protection has been disabled, the amplifier is only checking that the encoder pulses frequency is lower than 1.5 times the maximum encoder frequency. The maximum encoder frequency is calculated into the amplifier according to the **Motor encoder resolution** parameter value and the **Maximum speed** parameter value. In this case, encoder pulse noise at a frequency lower than 1.5 times the maximum encoder frequency may involve uncontrolled motor movements that may be dangerous for operator and machine.

When the amplifier programme includes a **HOME** sequence at sequence 0, no other sequence can be executed before sequence 0 after a COUNTING fault release.

For the Sin/Cos encoder configuration:

- Check that the encoder signal jumpers COD are correctly set (position B2)
- Check for the correct encoder supply voltage value
- Check for the correct encoder-amplifier-motor ground and shield connections with regard to the recommendations of chapter 4.
- Check for the correct encoder A channel, B channel and R reference signal waveforms.



- Check for the correct **Motor encoder resolution** parameter value.
- Check that the number of encoder pulses between two successive R reference signals is an entire multiple of the **Motor encoder resolution** value. If this condition is not fulfilled, the encoder counting protection must be disabled in order to cancel the "Counting" fault. The encoder counting protection can be inhibited by disabling the encoder reference channel by means of the ZM jumper (see section 2.8 "Encoder fault"). The encoder counting protection can also be software disabled if the encoder marker pulse is required for the **HOME** sequence. in this case, the **ZM pitch** parameter value must be set at 0.

The encoder counting protection is checking that the encoder pulse number between two successive R reference signals is an entire multiple of the **Motor encoder resolution** value. When the encoder counting protection has been disabled, the amplifier is only checking that the encoder pulse frequency is lower than 1.5 times the maximum encoder frequency. The maximum encoder frequency is calculated into the amplifier according to the **Motor encoder resolution** parameter value and the **Maximum speed** parameter value. In this case, encoder pulse noise at a frequency lower than 1.5 times the maximum encoder frequency can involve uncontrolled motor movements that may be dangerous for operator and machine.

When the amplifier programme includes a **HOME** sequence at sequence 0, no other sequence can be executed before sequence 0 after a COUNTING fault release.

2.10 - "I^2T" FAULT

- Check the rated current value required with regard to the current table (see chapter 2, section 1).
- Check the amplifier rated current defined in the **Rated current** parameter with regard to the current required for the operation cycle.

2.11 - "POSITION" FAULT

Check that the **following error threshold** parameter value is compatible with the required amplifier operating cycle (speed profile and servo loop adjustments). If necessary, increase the **following error threshold** value.

2.12 - "ADC" FAULT

- Check that the analog input command wiring corresponds to the recommendations of chapter 4, and repeat the **Offset compensation** procedure.
- If the fault still remains, the amplifier control board is not operating correctly.

3 - OPERATING PROBLEMS

3.1 - MOTOR SUPPLIED BUT NO TORQUE

- Check the **Maximum current** and **Rated current** parameters.
- Check that the current limitation input (X4 pin 3) is not activated.
- Check that the amplifier is not operating in torque mode (X4 pin 4 active) with zero input command or with CV0 input activated.

3.2 - 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 wiring of the signals FC+, FC-, Enable, Run and Wait.

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

- Check the encoder wiring on the X1 connector and the mechanical mounting of the encoder on the motor.
- Check the value of the **Motor parameters** parameter in the **Advanced Functions** menu and repeat the **Auto-phasing** procedure with unloaded motor.

3.4 - DISCONTINUOUS MOTOR ROTATION WITH ZERO TORQUE POSITIONS

Check the connection of the 3 phase cables between motor and amplifier.

3.5 - LOUD CRACKLING NOISE IN THE MOTOR AT STANDSTILL

- Check that the motor-amplifier ground connections correspond to the recommendations of chapter 4.
- Check the shield connection of the encoder cable.

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** procedure again by choosing a lower bandwidth (**Medium** or **Low**).
- If the problem remains, renew the **Auto-tuning** procedure by activating the **Antiresonance** filter.

4 - SERVICE AND MAINTENANCE

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

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

The new amplifier is configurated like the old one.

CHAPTER 9 - APPENDIX

1 - USE OF THE LIMIT SWITCHES & "CVO" INPUTS

During the amplifier operation, the enabling of the **FC+** limit switch stops any motor displacement in the positive direction and the enabling of the **FC-** limit switch stops any motor displacement in the negative direction. The motor is decelerating with the amplifier **Maximum current** value in order to get the shortest possible braking time.

Positive and negative directions depend on the encoder and motor wirings. So, before mounting and wiring the limit switches, it is recommended to find the positive and negative directions of the motor.

2 - USE OF THE "AMP. READY" & "POWER READY" OUTPUTS

When an amplifier fault is released, the **AMP. READY** output is immediatly disabled (contact is open). After elimination of the error source, the amplifier can be reset via pins 12 and 13 of the X4 connector.

If the position initialization reference must be kept when a stored fault is released on the amplifier and the power supply turned off, it is necessary to have an auxiliary supply for the logic board which is independent from the power supply. In this case, the **JK** and **KL** jumpers of the logic board allow to inhibit or to release the "Undervolt." fault when the amplifier is turned on.

JK jumper closed and **KL** jumper open configuration :

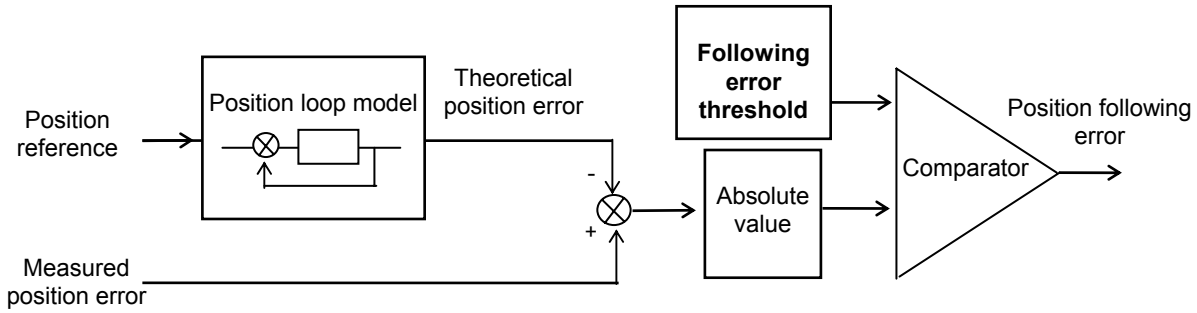
If the auxiliary supply is turned on before the main power supply, the "Undervolt." fault is displayed and can hide a fault of lower priority. The **AMP READY** and **POWER READY** outputs are both inactive (contact is open) until the power supply in on.

JK jumper open and **KL** jumper closed configuration :

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.

3 - FOLLOWING ERROR PROTECTION

The positioner following error detection is operating as described below.



The measured position error is continuously compared with the theoretical position error given by the position loop model. When the difference exceeds the **following error threshold** value, the position following error is released. This following error detection scheme allows to adjust the **following error threshold** to a minimum value when a very sensitive following error detection is required for safety reasons.
When the position following error is released, the amplifier speed reference value is set at zero and the motor is braking in the shortest time according to the available amplifier current. The amplifier is then disabled as soon as the zero speed is reached. However, if the motor braking distance exceeds the **maximum braking distance** parameter value during the braking operation, the amplifier is immediately disabled. This braking distance monitoring function allows to protect the operator and the machine against uncontrolled motor movements that could be generated by a drive failure. If the **maximum braking distance** parameter value is set at zero, when the position following error is released, the amplifier is immediately disabled and the motor freewelling.

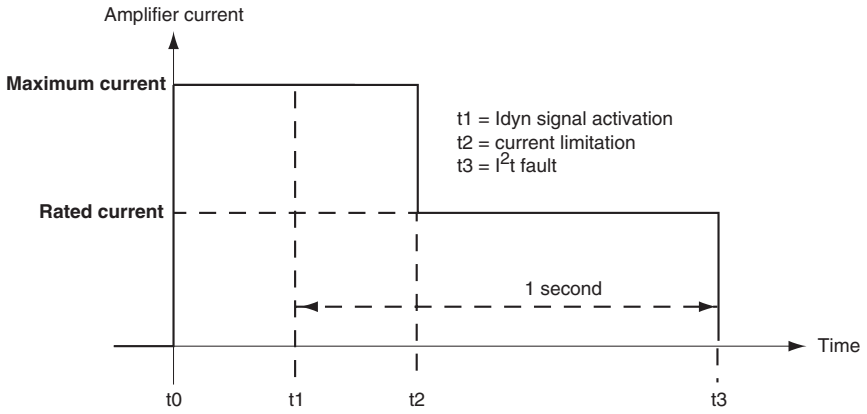
4 - I²t PROTECTION

4.1 – CURRENT LIMITATION IN FUSING 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. If the RMS current (I^2t) has not dropped below 85 % of the **Rated current** within 1 second, the I^2t fault is released and the amplifier is disabled (otherwise, 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 depends on the value of the **Rated current** and **Maximum current** parameters. This value is calculated as follows:

T dyn (second) = t1 - t0 = 3.3 x [**Rated current (%)** / **Maximum current (%)**] ^{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 max (second) = t2 - t0 = 4 x [**Rated current (%)** / **Maximum current (%)**] ^{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 Tdyn and Tmax are quite below the real values. For example when **Maximum current** / **Rated current** = 1.2, the measured Tdyn = 3.4 seconds and the measured Tmax = 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:

Idyn signal activation threshold (%) = [**Rated current (%)**] ^{2} / 70
Current limitation threshold (%) = [**Rated current (%)**] ^{2} / 50

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

Amplifier RMS current (%) = [**I²t signal value (%)** x 50]$^{1/2}$

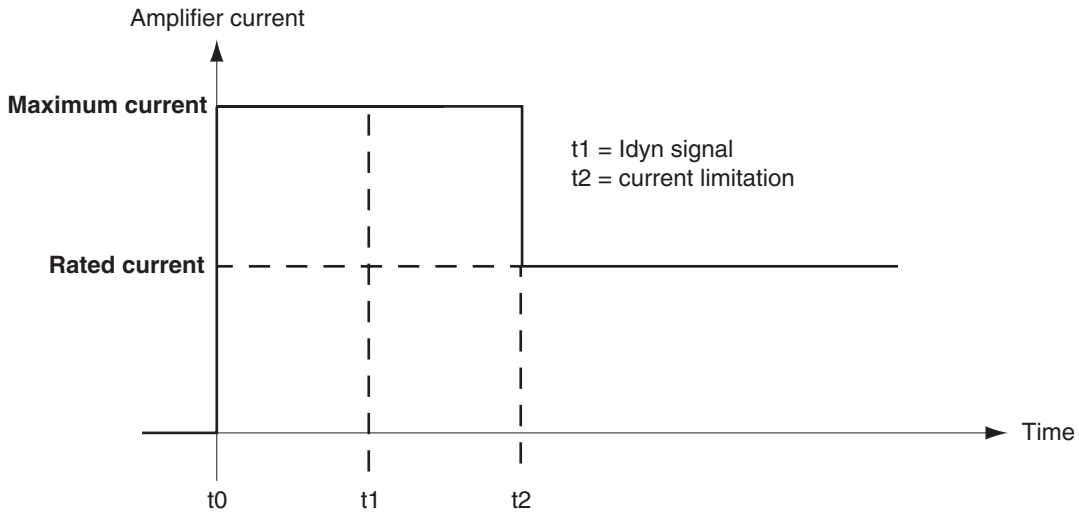
In Fusing mode, the amplifier **Rated current** value must be adjusted lower or equal to the **Maximum authorized rated current** of the amplifier (see Chapter 2, section 1).

4.2 - 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.

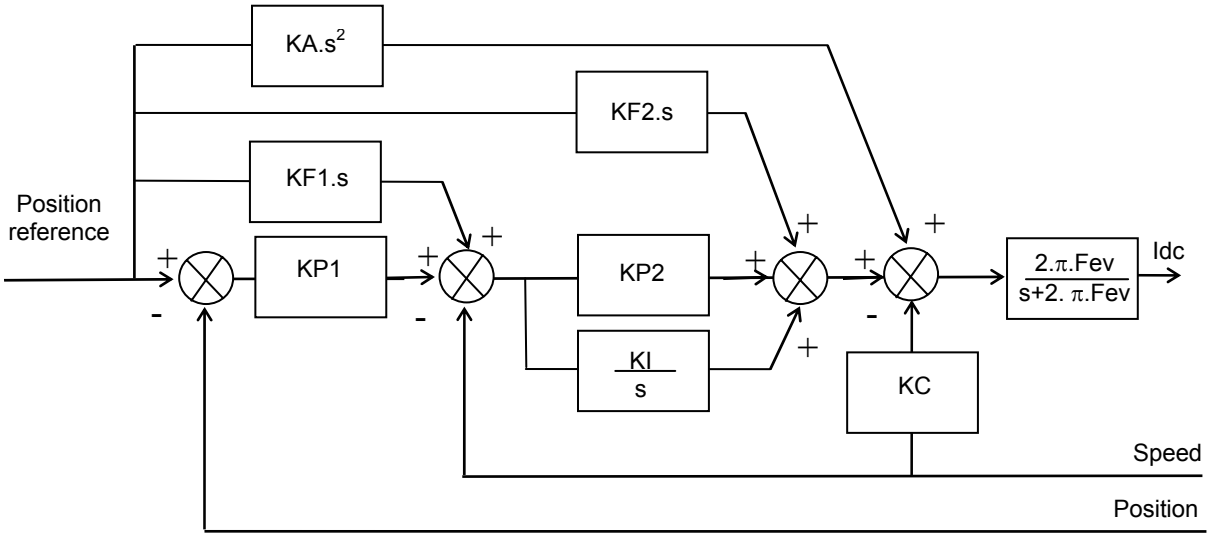


The maximum current duration before the release of the Idyn signal output (t1 - t0) and before limitation at the rated current (t2 - t0) is calculated the same way as for the **Fusing** mode.

The I²t 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).

5 - SERVO CONTROLLER STRUCTURE



Speed error low-pass filter (Fev): defines the cut-off frequency at -3dB of the first order filter which acts on the current command (Idc). This value is calculated by the amplifier during the auto tuning procedure and depends on the selected bandwidth and the selected filter type.

Proportional speed gain (KP2): defines the proportional gain of the controller which acts on the speed error. Its value is calculated by the amplifier during the auto tuning procedure. It can then be modified by the user if required.

Integral speed gain (KI) : defines the integral gain of the controller which acts on the speed error. Its value is calculated by the amplifier during the auto tuning procedure. It can then be modified by the user if required.

Damping gain (KC) : defines the proportional gain of the controller which acts only on the speed feedback. Its value is calculated by the amplifier during the auto tuning procedure. It can then be modified by the user if required.

Proportional position gain(KP1) : defines the proportional gain of the controller which acts on the position error. Its value is calculated by the amplifier during the auto tuning procedure. It can then be modified by the user if required.

Feedforward speed 1 gain(KF1) : defines the feedforward speed amplitude corresponding to the speed input command. This term allows to reduce the following error during the motor acceleration and deceleration phases. Its value is set at 1 after the auto tuning procedure if minimum following error is required. It can then be modified by the user if required.

Feedforward speed 2 gain(KF2) : defines the feedforward speed amplitude corresponding to the viscous frictions. This term allows to reduce the viscous frictions effect during the motor acceleration and deceleration phases. The gain value is equal to the damping gain value + the viscous friction compensation term. After the auto tuning procedure, the feedforward speed 2 gain is set equal to the damping gain value if minimum following error is required. The viscous friction compensation term can be calculated by measuring the current /speed ratio at various motor speed values.

Feedforward acceleration gain(KA) : defines the feedforward acceleration amplitude corresponding to the acceleration input command. This term allows to reduce the following error during the motor acceleration and deceleration phases. Its value is calculated by the amplifier during the auto tuning procedure if minimum following error is required. It can then be modified by the user if required.

The auto tuning procedure identifies the characteristics of motor and load and calculates the controller gains. During the procedure, various choice are available to the user.

The choice of the time interval for speed measurement allows to select the speed measurement resolution value according to the position sensor resolution value : speed resolution (rpm) = 60000 / position sensor resolution / time interval (ms). The higher the time interval value, the better the resolution, but also the lower the servo loop gains because of the increased speed measurement delay.

The choice of the anti-resonance filter is necessary in case of loud noise in the motor due to the motor/load coupling elasticity.
The choice of the maximum stiffness filter allows to get the maximum stiffness on the motor shaft with regard to the torque disturbances. However, this choice is only possible without any resonance due to the motor/load coupling elasticity.

The choice of the speed loop bandwidth defines the cut-off frequency value of the closed loop frequency response (Low = 50 Hz, Medium = 75 Hz, High = 100 Hz).

The choice “minimum following error” allows to get an accurate following of the position reference value during the entire motor displacement. In this case, all feedforward gain values are calculated.

The choice “minimum position overshoot” allows to get a motor positioning without any overshoot of the target position. In this case, all the feedforward gain values are set at 0, and the motor position is laging with regard to the position reference value during the entire motor displacement.

6 - ASCII INSTRUCTIONS LIST

6.1 - OVERVIEW

Specifications of the SMT-BD2/m amplifier serial link:
- 8 data bits, 1 stop bit, no parity,
- 19200 baud.

The parameters can be sent to the amplifier by an ASCII terminal using the instructions list given in this manual. Each instruction is coded as 2 ASCII characters with or without parameter.

Each instruction, which can be followed by one or two parameters sent to the amplifier, must end with a "carriage return" character (ASCII code 13). The parameters must be separated by a ',' (ASCII code 44).

All these characters, except for the "carriage return", will be sent back by the amplifier (echo).

The amplifier answer starts with a separation character ":" (ASCII code 58) possibly followed by a value. The amplifier will then send a "carriage return", a "line feed" (ASCII code 10) and ">" (ASCII code 62).

These instructions allow to modify or to read the value of a variable. If there is a parameter, the variable corresponding to the instruction will take this value. Otherwise, the amplifier will send back the actual variable value.

Notes :
- If the amplifier does not know the instruction, it will send back "?" instead of ":".
- Some instructions are only valid when the amplifier is disabled.
- If the entered parameter is out of the appropriate variable range or if the restrictive condition (amplifier disabled) is not answered, the parameter will not be taken into account (the amplifier will keep the former variable value).
- The amplifier must work in hexadecimal mode to communicate with the PC based parameter setting software. The switch SW2.1 allows to select the hexadecimal mode or the decimal mode at the amplifier power up (see chapter 5: Adjustable functions).
  SW2.1 = OFF hexadecimal mode,
  SW2.1 = ON decimal mode.
  However, when the terminal mode is selected (SW2.4 = ON), the amplifier communicates with the VT-100 terminal in decimal mode regardless of the SW2.1 switch selection.

Dialog examples:
The user sends the NP instruction (number of motor pole pairs):
NP4
and a « carriage return » character for ending the instruction.
The amplifier will answer with:
NP4:
>
"NP4" is the echo of the characters sent. ":" indicates that the instruction has been decoded. The value 4 is stored in the variable corresponding to the number of motor pole pairs. After the character "carriage return", the amplifier will also send the ">" character in order to indicate that it is ready for a new instruction.

If the user sends the instruction:
NP

The amplifier will answer with:
NP:4
>
As there is no parameter in the instruction, the amplifier sends back the actual number of pole pairs.

6.2 - INSTRUCTIONS LIST

6.2.1 – Positioning instructions

Modify position of a sequence

Instruction	UP
Parameters	1st parameter: sequence number. 2nd parameter: position value. If there is no 2nd parameter, the amplifier will return the actual position value of the sequence (1st parameter).
Conditions	This instruction can be sent only if there is no sequence executed. The sequence must exist.
Unit	The unit of the position value is defined by "position resolution" and "decimal number" defined in the BD2m software. The value must be sent without the decimal point. Example : position resolution : 5000 decimal number : 3 unit : mm If the user wants to set a value 100 mm to sequence 3, the instruction will be: UP3,100000 (in decimal mode)

Modify speed of a sequence

Instruction	US
Parameters	1st parameter: sequence number. 2nd parameter: speed. If there is no 2nd parameter, the amplifier will return the actual speed of the sequence (1st parameter).
Conditions	This instruction can be sent only if no sequence is executed. The sequence must exist. The minimum speed is 2 rpm.
Unit	rpm

Modify acceleration of a sequence

Instruction	UA
Parameters	1st parameter: sequence number. 2nd parameter: acceleration time. If there is no 2nd parameter, the amplifier will return the actual acceleration time of the sequence (1st parameter).
Conditions	This instruction can be sent only if no sequence is executed. The sequence must exist.
Unit	Millisecond
Range	16 ms - 16000 ms
Remark	The parameters **acceleration time** and **deceleration time** define the time with regard to the maximum speed parameter value. When the motion speed is lower than the maximum speed, the trajectory acceleration and deceleration times are proportionally reduced.

Modify deceleration of a sequence

Instruction	UD
Parameters	1st parameter: sequence number. 2nd parameter : deceleration time. If there is no 2nd parameter, the amplifier will return the actual deceleration time of the sequence (1st parameter).
Conditions	This instruction can be sent only if no sequence is executed. The sequence must exist.
Unit	Millisecond
Range	16 ms - 16000 ms
Remark	The parameters **acceleration time** and **deceleration time** define the time with regard to the maximum speed parameter value. When the motion speed is lower than the maximum speed, the trajectory acceleration and deceleration times are proportionally reduced.

Execution of a sequence

Instruction	GO
Parameters	1st parameter : sequence number.
Conditions	This instruction can be sent only if no sequence is executed. "Enable" and "Run" signals are activated. "Wait" and "Stop" inputs are not activated. The sequence must exist.
Remark	This instruction executes a sequence (with parameter as sequence number) regardless of the logic inputs status.

Position feedback

Instruction	PF
Parameters	none
Conditions	Read only
Remark	This instruction reads the position of the motor.
Unit	see « *modify position of a sequence* ».

Inputs/Outputs status

Instruction	IO
Parameters	None
Conditions	Read only
Remarks	This instruction reads the logic inputs and outputs status

bit	meaning
0	START
1	STOP
2	WAIT
3	TEACH
4	JOG+
5	JOG-
8	SEQ
9	POS
10	SPEED
11	OK
16	IN1
17	IN2
18	IN3
19	IN4
20	IN5
21	IN6
22	IN7
23	IN8
24	OUT1
25	OUT2
26	OUT3
27	OUT4
28	OUT5
29	OUT6
30	OUT7
31	OUT8

- Bit SEQ indicates that the positioner is running a sequence.
- A sequence can be executed when bit OK is set and bit STOP is reset, and also if the security of the first sequence (HOME) is disabled.

Absolute move

Instruction	MP
Parameters	absolute position
Conditions	"Enable" and "Run" signals are activated.
Remark	
Unit	see « *modify position of a sequence* ».

Speed (absolute movement)

Instruction	DS Defines the speed for absolute movement (MP).
Parameters	Speed
Conditions	
Remark	This parameter is saved in the positioner memory.
Unit	rpm

Acceleration (absolute movement)

Instruction	DA defines the acceleration for absolute movement (MP).
Parameters	acceleration time
Conditions	
Remark	The parameters **acceleration time** and **deceleration time** define the time with regard to the maximum speed parameter value. When the motion speed is lower than the maximum speed, the trajectory acceleration and deceleration times are proportionally reduced. This parameter is saved in the positioner memory.
Unit	Millisecond

Deceleration (absolute movement)

Instruction	DD defines the deceleration for absolute movement (MP).
Parameters	Deceleration time
Conditions	
Remark	The parameters acceleration time and deceleration time define the time with regard to the maximum speed parameter value. When the motion speed is lower than the maximum speed, the trajectory acceleration and deceleration times are proportionally reduced. This parameter is saved in the positioner memory.
Unit	Millisecond

Stop

Instruction	SOFF
Parameters	
Conditions	
Remark	Stops all movements except for jog.
Unit	

6.2.2 – Parameter setting instructions

The standard ASCII instructions for the parameter setting are described in the "SMT-BD2 ASCII instructions" manual.

Positioner configuration Variable

Instruction CF
Remarks This variable allows to set/reset the indicators for the positioner operation mode.

Bit(0-15)	Meaning
0	Soft FC+
1	Soft FC-
2	
3	
4	Clear input enable
5	Reset counter forward only
6	
7	
8	Analog input limitation
9	Speed modulation
10	Analog input reversal
11	
12	Minimum seq pulse
13	Inpos window
14	Digital CAM
15	

Following error threshold Variable

Instruction ET
Parameter Possible values: between 1 and 7FFF FFFF (1 to 2147483647)
Conversion Must be diplayed in the position unit according to the position resolution and the decimal number

Maximum braking distance Variable

Instruction EF
Parameter Possible values: between 0 and 7FFF FFFF (0 to 2147483647)
Conversion Must be diplayed in the position unit according to the position resolution and the decimal number

Zero Mark pitch Variable

Instruction ZN
Parameter Possible values: between 0 and F (0 to 15)
Condition Amplifier disabled.
Remarks Number of motor revolutions (rotating motor) or motor pole pairs (linear motor) between two consecutive Zero Mark pulses.
When this parameter value is set at 0, the encoder counting protection is disabled.

Pulses interpolation Variable

Instruction I C
Parameter 0 or ≠ 0
Condition Amplifier disabled.
Conversion IC ≠ 0 --> pulses interpolation selected ; IC= 0 --> pulses interpolation not selected
Remarks The value is 0 or ≠ 0

7 - USING A DISPLAY TERMINAL

7.1 - CONFIGURATION

7.1.1 – Terminal configuration

- A display with 4 lines of 20 characters each:

- A keyboard with:
  0 to 9 numerical keys,
  ENTER key,
  arrow keys.

- A serial link RS232:
  19200 baud, 1 stop bit, no parity,
  Protocol VT-100.

7.1.2 - Positioner configuration

The switch SW2.4 allows to select the amplifier serial link communication mode (see the chapter 5 : Adjustable functions).
Switch SW2.4 = OFF PC mode to communicate with the PC parameter setting software.
Switch SW2.4 = ON Terminal mode to communicate with a VT-100 terminal.

It is also possible to switch between these modes by means of the push button (Offset) on the front panel.

Remark : When the Terminal mode is selected, the amplifier communicate with the VT-100 terminal in decimal mode regardless of the SW2.1 switch selection.

7.2 - USE

7.2.1 – Main menu

```
1     Display position
2     Modify sequence
3     Run sequence
4     Move_
```

In the main menu, it is possible, with keys 1, 2, 3 or 4:
1 - to display the motor position and the user can move the motor (Jog+ or Jog-) by means of the arrow keys.
2 - to modify a defined sequence:
    modification of the position of a defined sequence: the operator enters the sequence number and its new programmed position.
    modification of the speed of a defined sequence: the operator enters the sequence number and its new programmed speed.
3 - to run a sequence: the operator enters the number of the sequence to be executed.
4 - to move to a position: the operator enters the position to move to.

7.2.2 – Display position

```
SMT-BD2/m
      103.ØØØ mm
```

The arrow keys [←] [→] [↓] [↑] allow to move the motor (jog+ or jog-), when the ENABLE and RUN signals are active.

The [RETURN] key allows the operator to go back to the main menu.

While in this screen, the user can stop the motor (if running) by pressing key [0].

```
STOP?_
```

The user must press the [RETURN] key to confirm motor stop or any other key to abort.

7.2.3 – Modification of a sequence

This menu gives the operator the possibility to modify position or speed of a defined sequence.

```
MODIFY SEQUENCE
1     POSITION
2     SPEED_
```

The operator enters first the sequence number (this sequence must exist):

```
MODIFY POS
Sequence:_
Pos:
Pos:
```

The former position is displayed, and the operator can then enter a new position or cancel by pressing only the ENTER key.

```
MODIFY POS
Sequence: 1
Pos: 45.ØØØ
Pos:_
```

The operator can modify the same way the speed of a defined sequence

```
MODIFY SPEED
Sequence: 1
Pos: 1ØØØ
Speed:_
```

7.2.4 – Execute a sequence

When - the positioner is not executing any sequence,
- signals ENABLE and RUN are active.

the operator can enter a sequence number to be executed:

```
RUN SEQUENCE
Sequence:_
```

7.2.5 - Movement

When - the positioner is not executing any sequence,
- signals ENABLE and RUN are active,

the operator can enter the position to move to:

```
MOVEMENT
POS:_
```

8 - AMPLIFIER TYPES

SMT-BD2 / _ m - _ / _ _ / _ - T - _

Serial link :
1 = RS 232 / 2 = RS 422

Amplifier voltage rating: 220 VAC or 400 VAC

Amplifier current rating:
4 A to 100 A (220 VAC) or 15 A to 100 A (400 VAC)

r = Additional heatsink for 220 VAC amplifiers (30 A to 60 A)
(total width = 18 TE)

w = Braking resistor for 220 VAC amplifiers (single-axis rack)

BS = Synchronous motor