I N F R A N O R

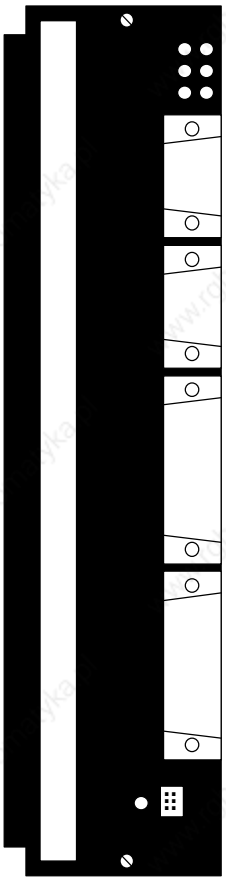
OPERATING MANUAL

SERIES SMTBD1

DIGITAL BRUSHLESS SERVO CONTROLLERS

(Version 3.1)

European version 3.1



This is a general manual describing a series of servo amplifiers having the capability for driving AC Brushless servo motors. It concerns only the basic amplifier version SMT-BD1. The options and other amplifier versions are described in the complementary manuals. This manual may be used in conjunction with appropriate and referenced drawings pertaining to the various specific models.

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

RECEIVING AND HANDLING

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

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

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

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OPERATING MANUAL
INFRANOR
SERIES SMTBD1
"STANDARD"
(March 1999)

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1.0.0 GENERAL

1.1.0 Introduction

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

The pluggable **SMT-BD1** system is available as a single-axis block version or as a multi-axis version that can receive up to seven axes in a standard 19" rack including the power supply.

The basic amplifier module **SMT-BD1 / A** or **B** provides speed control for AC synchronous motors.

- **SMT- BD1 / C** version with option card SMT - Ix allows the direct position control of the motor by means of an incremental position input command (stepping motor emulation).
- **SMT- BD1 / D** version with option card SMT - Ix allows the direct position control of the motor by means of an incremental encoder position input command for applications such as electronic gearing.
- **SMT- BD1 / E** version with option card SMT - Ix allows the tension control of a material (thread or film) by means of an analog tension sensor for winding/unwinding applications master/slave drives.
- **SMT- BD1 / F** version with option card SMT - Ix allows the indexing of a spindle motor axis for tool changes, according to four programmable positions over one revolution.
- **SMT- BD1 / G** version with option card SMT - Ix allows product registration function using master/slave operation.
- **SMT- BD1 / H** version with option card SMT - Ix allows all communication with the CAN interface instead of the ± 10V.

The parameter setting software **BPCW**, which is IBM-PC compatible with the WINDOWS® operating system, allows the display of all amplifier parameters as well as their easy modifications.

1.2.0 General description

SMT-BD1 amplifiers have their own DC/DC converter to provide appropriate logic voltage. This power supply provide the bus power voltage of 310 VDC as well as the auxiliary power supply which is necessary particularly when the position output information needs to be saved.

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

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

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

The motor speed or torque input command is an analog command (± 10 V). The motor position is available as two channels (A and B) and their complements, and one or several marker pulse(s) per revolution.
The number of pulses per revolution is programmable. Errors are displayed on the amplifier front panel.

All control parameters are programmable by means of a serial link and saved in a single EEPROM memory. The auto-configuration and auto-tuning functions allows for easy and quick commissioning of the amplifier.

The basic software **BPCW**, which is IBM-PC compatible with the WINDOWS® operating system, allows the display and modification of all amplifier parameters. The *extended* version of the **BPCW** software include the digital oscilloscope, the simulation function as well as the cogging torque compensation.

2.0.0 SPECIFICATIONS

2.1.0 Technical specifications

Operating voltage	DC bus 310 VDC (270 V < DC bus < 340 VDC)
Auxiliary supply voltage	310 VDC (200 V < Uaux < 340 VDC)
Motor phase-phase output voltage	200 Vrms for DC bus 310 V

Output currents for the **Fusing mode** of the I^2t protection (see chapter 8.3.3)

AMPLIFIER	U rated (Vrms)	Imax (A rms) 1 s	Amplifier max. rated current (Arms)		
			WITHOUT FAN*	FAN TYPE 1*	FAN TYPE 2*
SMT-BD1 - 220/04	240	4,4	2		
SMT-BD1 - 220/08	240	8,8	4		
SMT-BD1 - 220/12	240	13,8	6		
SMT-BD1 - 220/17	240	17,7	8,5		
SMT-BD1 - 220/30	240	30,8	10	12	15
SMT-BD1 - 220/30r	240	30,8	10	15	
SMT-BD1 - 220/45	240	48,6	10	15	20
SMT-BD1 - 220/45r	240	48,6	10	20	23
SMT-BD1 - 220/60	240	61	10	19	25
SMT-BD1 - 220/60r	240	61	12	26	30
SMT-BD1 - 220/70	240	70	25	30	35
SMT-BD1 - 220/100	240	100	25	30	35

Output currents for the **Limiting mode** of the I^2t protection (see chapter 8.3.3)

AMPLIFIER	U rated (Vrms)	Imax (Arms) 1 s	Amplifier continuous current (Arms)		
			WITHOUT FAN*	FAN TYPE 1*	FAN TYPE 2*
SMT-BD1 - 220/04	240	4,4	2		
SMT-BD1 - 220/08	240	8,8	4		
SMT-BD1 - 220/12	240	13,8	6		
SMT-BD1 - 220/17	240	17,7	8,5	8,5	
SMT-BD1 - 220/30	240	30,8	8,5	12	15
SMT-BD1 - 220/30r	240	30,8	10	15	
SMT-BD1 - 220/45	240	48,6	8,5	15	18
SMT-BD1 - 220/45r	240	48,6	10	20	23
SMT-BD1 - 220/60	240	61	8,5	17	20
SMT-BD1 - 220/60r	240	61	12	26	30
SMT-BD1 - 220/70	240	70	17	30	35
SMT-BD1 - 220/100	240	100	25	30	35

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

Note: SMT-BD1-X/X**r** amplifiers are equipped with an additional heatsink in order to increase the rated current. The width of these amplifiers is then 18 TE instead of 12 TE.

PWM Switching frequency	10 KHz
Minimum inductance between phases	1 mH
Current regulator (PI)	adjusted to motor
Current loop bandwidth	Cut-off frequency for 45° phase shift: > 1 KHz
Internal current limitation 100 % of Imax	Imax: 20% to 100 % Irated: 20% to Imax duration = 1 second
External current limitation	0 to 10 V (resolution = 12 bits) 100 to 0 % of the internal Imax limitation
Analog speed input command	±10 V, standard resolution = 12 bits and 16 bits in option
Motor accel/decel ramp range	From 0 to 30 s between zero speed and max. speed
Speed regulator PI^2	Sampling period = 0,5 ms Integrator anti-saturation system Antiresonance filter Adjustable numerical gains
Speed loop bandwidth	Cut-off frequency for 45° phase shift Programmable : 50 Hz, 75 Hz or 100 Hz
Max. motor speed	Adjustable from 100 rpm to 14000 rpm
Speed range	2048 : 1 with 12 bits input command 32768 : 1 with 16 bits input command
Encoder position output * resolution:	Quadrature output A and B channels with n marker pulse(s) per revolution. Programmable max. 8192 ppr up to 900 rpm max. 4096 ppr up to 3600 rpm max. 1024 ppr up to 14000 rpm Accuracy: 8 arc minutes + ¼ point (2 arc minutes + ¼ point on special request)
Analog outputs (test points)	Speed input command (CV): ±10 V for ± max. speed Speed monitor (GT) ±8 V for ±14000 rpm Current input command (IDC): ±10V, DAC OUT 1 8 bits resolution. Current monitor (Imon.): ± 10 V, DAC OUT 2: 8 bits resolution
Logic inputs	Enable / Disable: ENABLE Limit switch +: FC+ Limit switch - : FC- Current command: CI Zero speed input command: CV0 Reset: RAZ

* The total position accuracy must take into account the accuracy of the resolver used

Logic outputs	Relay contact Umax = 50 V, Imax = 100 mA, Pmax = 10 W • "Amp ready": closed if amplifier OK, open if default • "Power ready": closed if power OK, open if default • IDYN signal: open if I^2t threshold is reached
Error display	LED on front panel and diagnostic by serial link
Motor and application parameter setting	Serial link RS232 (standard) or RS422 / 485 (option)
Automatic functions (AUTOPHASING)	Amplifier adjustment to the motor Automatic regulator tuning (AUTOTUNING) Offset compensation on analog input CV
Electromagnetic compatibility Conducted and radiated disturbances Electrical standards for industrial machines	IEC standards 801- 2 - 3 - 4, level 4 EN 5011 Group 1, class A N 60204.1: 1500 VAC - 1min insulation Current leakage >3mA (EMI filters)
Temperature	storage - 20° C to + 70° C operation 5° C to +40° C From 40°C on, the rated currents must be reduced of 3 %/°C. Max. temperature: 50°C altitude: 1000 m (3300 feet) moisture: < 50 % at 40°C and < 90 % at 20°C (EN 60204.1 standard)
Cooling	Natural convection or forced air, according to the rated current (see current table)

2.1.1 Standard compatibility

SMT-BD1 amplifiers operating either in the RBF rack equipped with the mains filter BF-35/70, or the SMTBM-20A single axis and BF-35, have been approved for their conformity with the Electromagnetic Compatibility standards:

- EN 55011, Group 1, Class A (conducted and radiated radioelectric disturbances)
- IEC 801 - 2 - 3 - 4 (noise immunity).

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

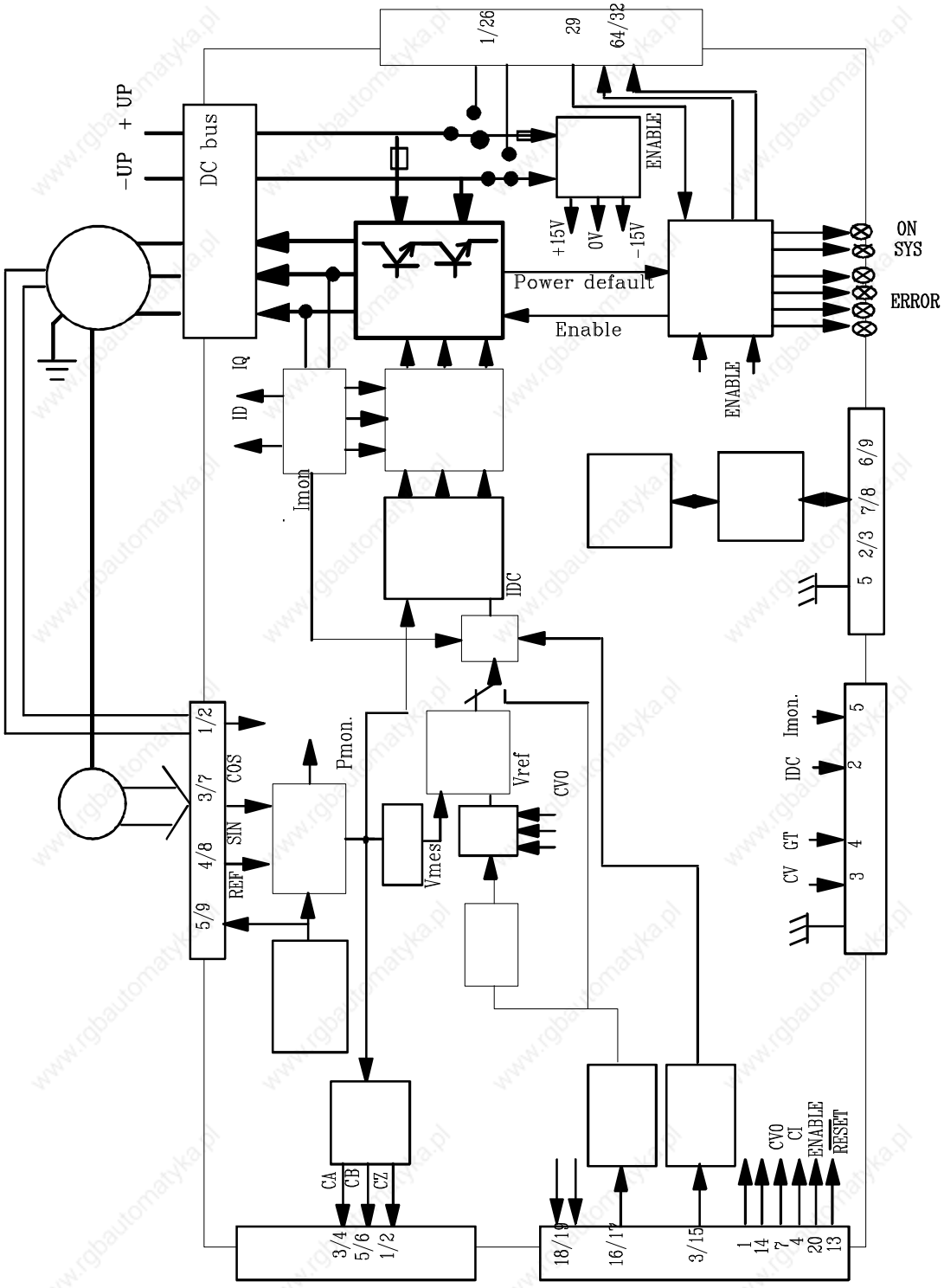
Results of the tests made according to the Low Voltage directive is referenced in the LCIE report n° 413777.

Standard to be applied to the electrical equipment's of industrial machines: EN 60204.1.

2.1.2 "CE" Marking

CE recognition marking has been affixed since 1995.

2.2.0 **Block diagram**



2.3.0 Main protections

2.3.1 Stored protections

PROTECTION	ERROR DISPLAY	LED*
Amplifier rated current overload #: • flashing display = Idyn signal (I^2t threshold is reached) • continuous display = amplifier inhibited (I^2t default)	I^2 t	● ○ ○ ○
Resolver cable interruption	Resolver	○ ● ○ ○
Power stage failure: • power supply overvoltage • internal switch protection • short-circuit between phases	Power stage	● ● ○ ○
Resolver converter failure	R. D. C	○ ○ ● ○
Amplifier overtemperature	°C Amp	● ○ ● ○
Power supply undervoltage	Undervolt.	○ ● ● ○
Motor overtemperature	°C Motor	● ● ● ○
Default of the amplifier parameter storage	EEPROM	● ○ ● ●
Amplifier automatic procedure: • flashing display = procedure operating • continuous display = operating error	Busy	● ● ● ●

The operation mode of the I^2t protection is described in chapter 8.3.3.
* ○ = LED is unlit; ● = LED is lit.

Reset of a stored default can be made:

- by means of the RESET function in the BPCW software
- via the default RESET input (pin 13 of the X4 connector)
- by switching off the amplifier power supply.

2.3.2 Fuse protections

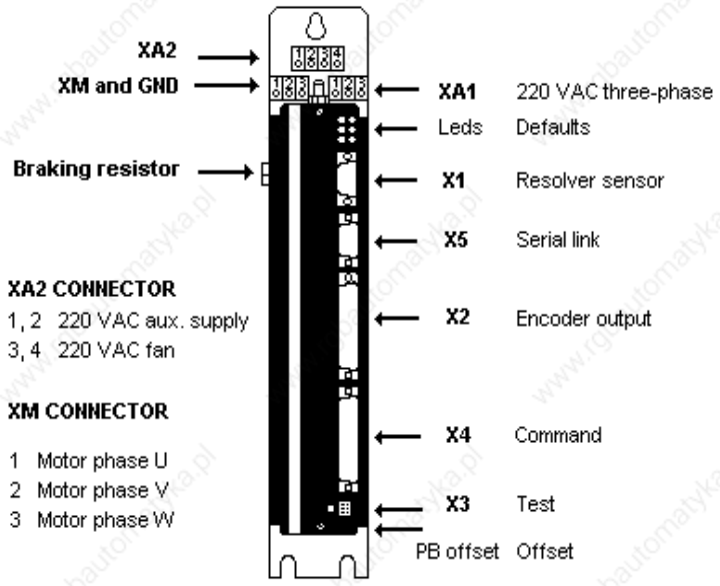
F1 : Control of average DC current of the power board supply.
F2 : Control of average DC current of the logic board supply.

AMPLIFIER TYPE	F1 Power	F2 Logic
SMTBD1-220/04 to 12	10 AT	1 A
SMTBD1-220/17 to 30	15 AT	1 A
SMTBD1-220/45	20 AT	1 A
SMTBD1-220/60	20 AT	1 A
SMTBD1-220/70	40 AT	5 AT
SMTBD1-220/100	40 AT	5 AT

3.0.0 INPUTS / OUTPUTS

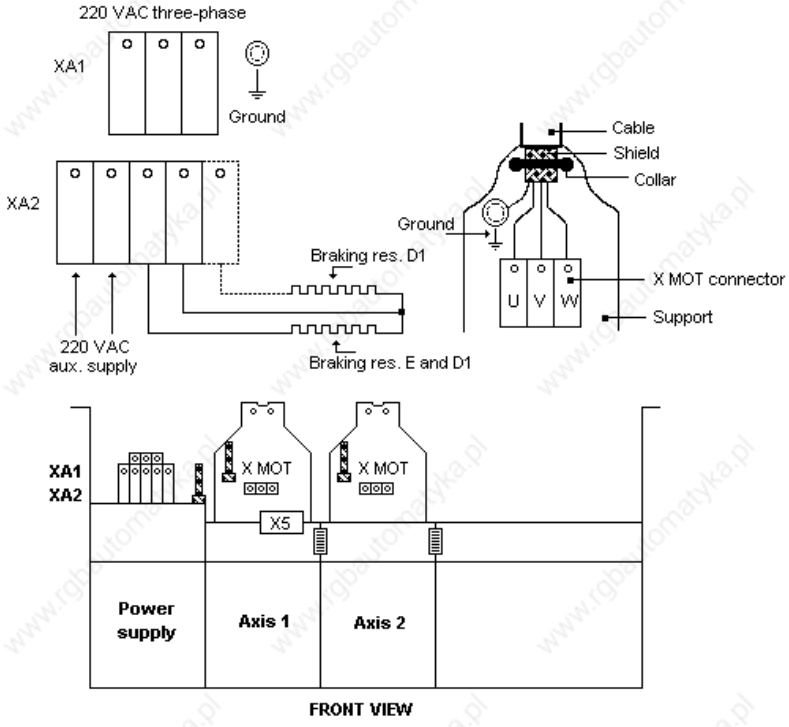
3.1.0 Connector locations

3.1.1 Front connectors SMTBM-20A single axis block



For more detailed information regarding the power connection, please see the **SMTBM-20A** manual

3.1.2 RBF rack connectors



For more detailed information regarding the power connection, please see **BF Rack** manual

3.2.0 **X1 resolver connector** (Sub-D 9 points female)

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

For resolver connections other than the MAVILOR motors, see resolver wiring table in chapter 8.2.0.

3.3.0 **X2 position connector** (Sub-D 25 points 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	0 V	O	
8 and 9	reserved		A
10 and 11	0 V	O	
12,13,14	reserved		B
15,16,17	reserved		
18 and 19	0 V	O	Z
20,21,22	reserved		
23,24	reserved		
25	0 V	O	

3.4.0 **X3 test connector**

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

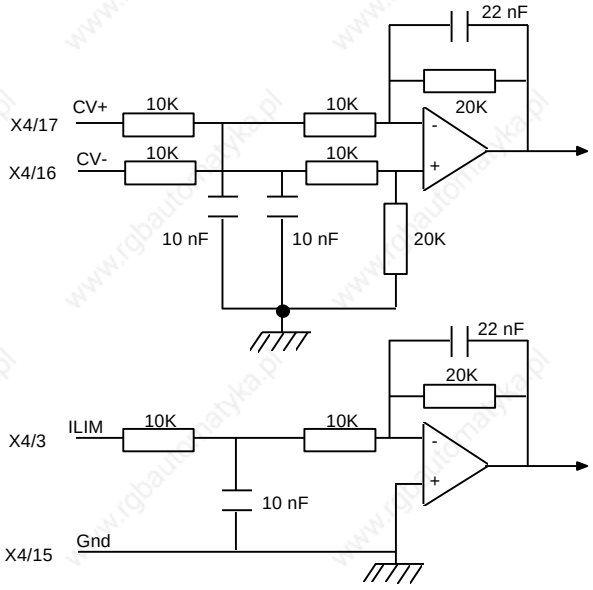
* See “BPCW Options” manual, section “Digital Oscilloscope”
Linearity = 10 % for logic board type 01612A, 01612B or 01612C.

3.5.0 **X4 input - output command connector** (Sub-D 25 points male)

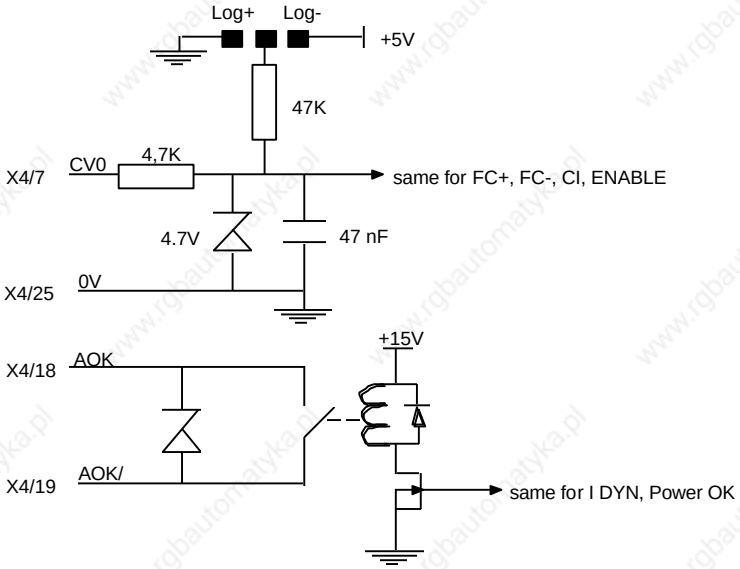
Pin	Function	I / O	REMARKS
1	Limit switch +	I	Positive or negative logic (see chapter 8.4.1)
14	Limit switch -	I	Positive or negative logic (see chapter 8.4.1)
24	0 Volt of limit switch	I	
20	ENABLE	I	Positive or negative logic (see chapter 8.4.1)
23	0 Volt ENABLE	I	
4	Current command CI	I	Positive or negative logic (see chapter 8.4.1)
7	CV0 Zero speed input command	I	Positive or negative logic (see chapter 8.4.1)
25	0 Volt	I	
13	RESET	I	Amplifier reset (contact between 13 and 12)
12	0 Volt of RESET input	I	
17	Input command CV +	I	± 10 V speed input command for max. speed
16	Input command CV -	I	or current ± 10 V input command for Imax with "CI" input active
15	0 Volt speed input command CV	I	
3	Current limitation I limit	I	External current limitation 0 to 10 V for 100 % to 0 % of Imax
10	Speed monitor output	O	± 8 V for ± 14000 rpm; linearity: 10% max. load: 10 mA
2	Current monitor output	O	± 10 V; resolution: 8 bits; load: 10 mA; (DAC out 2)
11	0 Volt analog output	O	10 V for amplifier current size.
8, 9	I dyn signal	O	Relay contact: open if I dyn threshold is reached Pmax = 10 W with Umax = 50 V or Imax = 100 mA
18, 19	Amplifier ready	O	Relay contact: closed if amplifier OK, open if fault. Pmax = 10 W with Umax = 50 V or Imax = 100 mA
21	+ 15 V	O	50 mA maximum output current
22	- 15 V	O	50 mA maximum output current
5, 6	not connected		

For the use of "negative" command logic, see chapter 8.4.1.

3.5.1 Analog input specification



3.5.2 Logic inputs / outputs specification



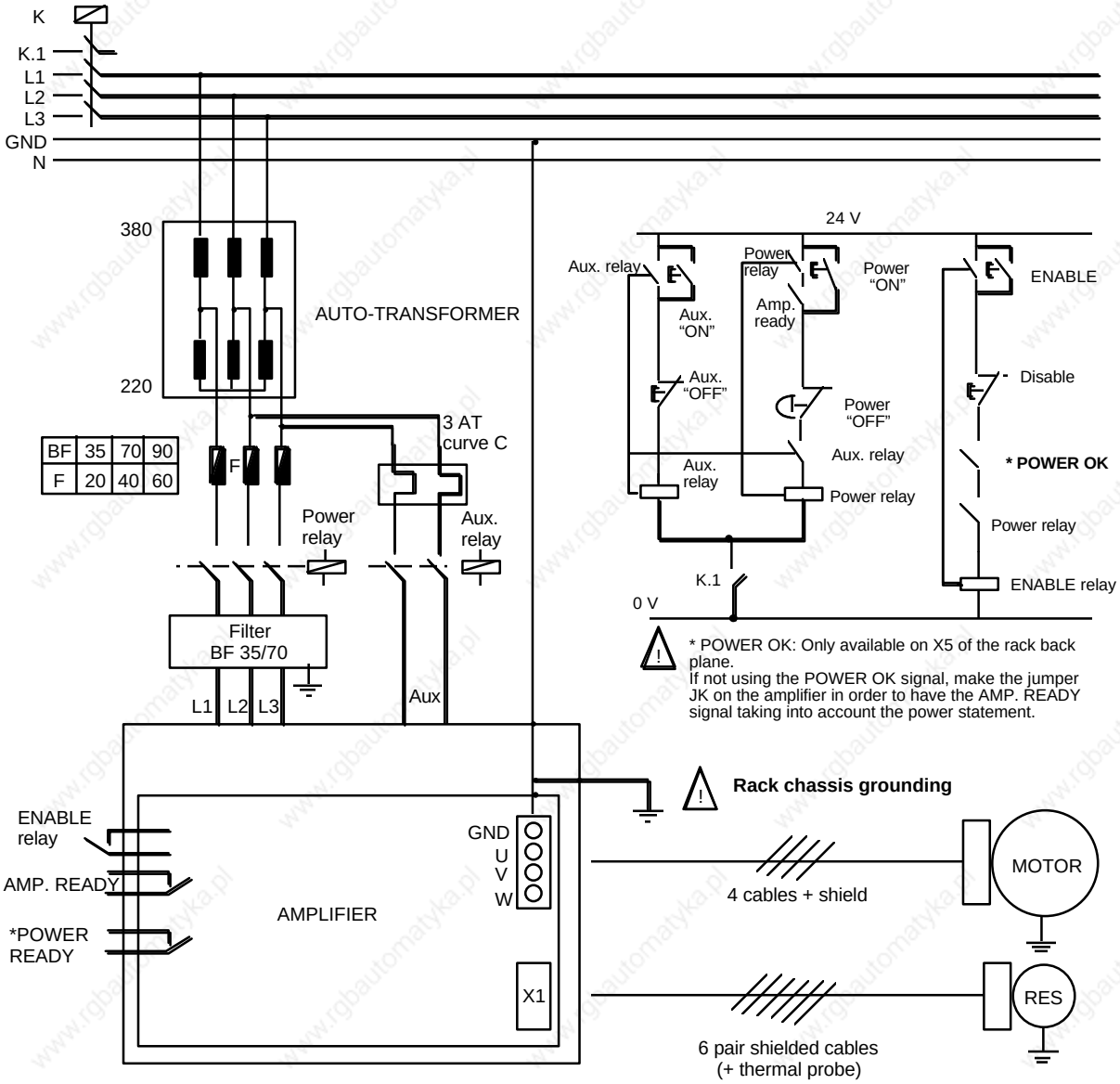
3.6.0 X5 serial link (Sub-D 9 points male)

PIN	FUNCTION	REMARKS
5	0 Volt	GND (connection of the shield if no "360°" connection on the connector)
2	TXD	Transmit data RS 232
3	RXD	Receive data RS 232
6	TXH	Transmit data RS422/485
7	TXL	Transmit data RS422/485
8	RXL	Receive data RS422/485
9	RXH	Receive data RS422/485

4.0.0 CONNECTIONS

4.1.0 Connection diagrams

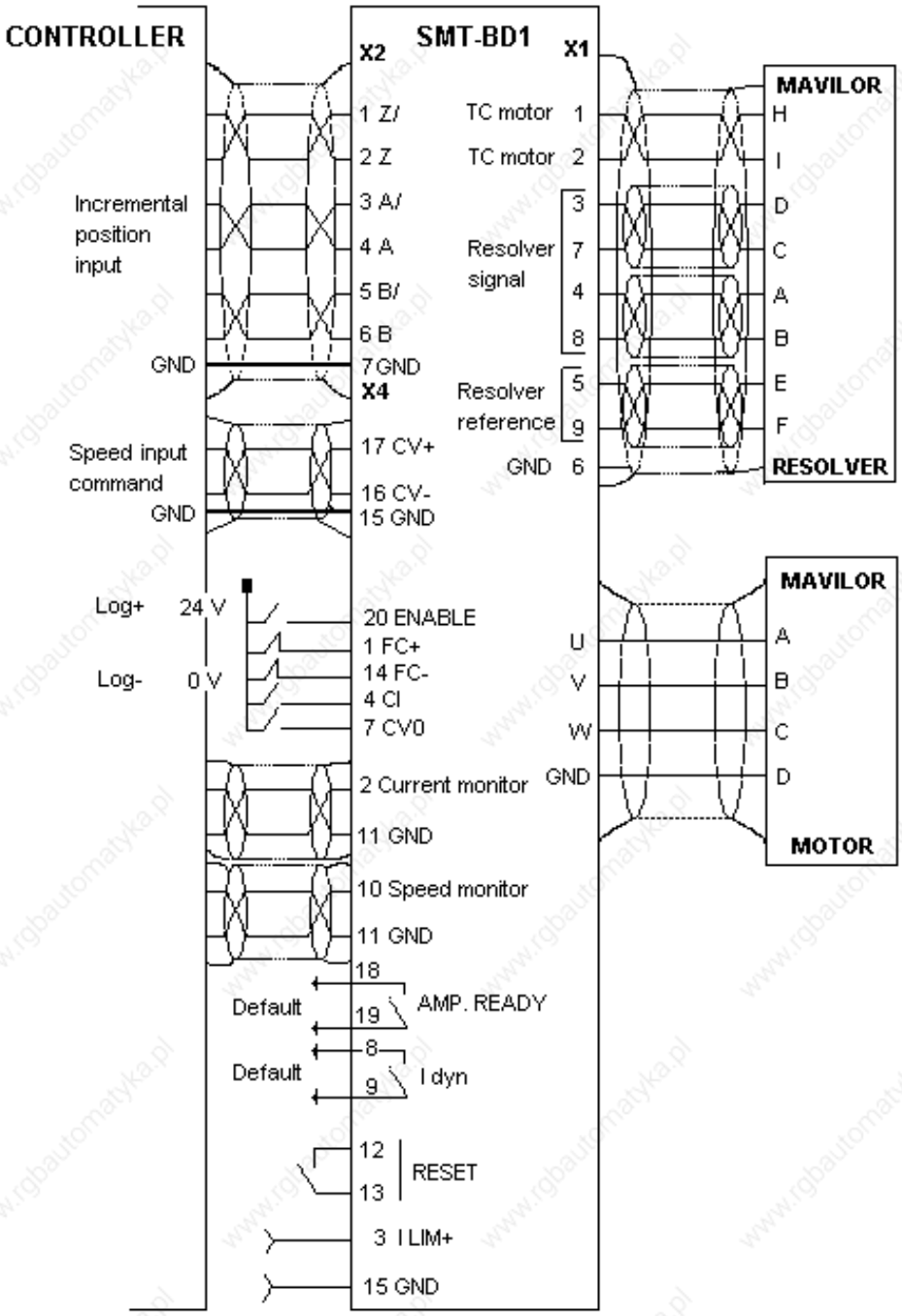
4.1.1 Power connection with the RBF rack or the SMTBM-20A single axis module



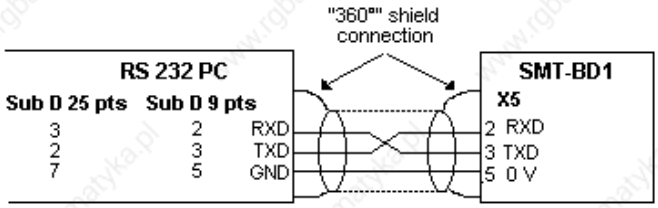
(*): Only for BF rack

For more details about the power connection, see SMTBM 20 A single axis rack or RBF rack manual.

4.1.2 Logic connection



4.1.4 Serial link connection



4.2.0 Wiring recommendation (according to IEC 801 and EN 55011 standards)

4.2.1 GND wiring and grounding

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

Long reference potential connections are suitable ONLY if these connections have a very low impedance (< 0.1Ω).
Cables with low potential must 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 IEC 801 standard, the connectors must be metallic or metal plated and must have a 360° shield connection (see chapter 8.6.0).

4.2.2 Motor and resolver cables

Cable ends should have a metallic collar allowing a 360° shielded connection.
Motor cables (four wires) must be shielded to avoid common mode effects (Mavilor p/n 410-0051, 410-0052, Belden p/n 9367).
The recommended resolver cable is a three pair twisted with an individual shield on each pair (Mavilor p/n 410-0053, Belden p/n 9728, Oflex p/n 34252).

4.2.3 Input command and serial link cables

Analog input command signal (CV) requires a twisted and shielded pair cable. The shield must have a "360°" connection via metallic collars at both ends. If the shield is connected by means of a pig tail, 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.

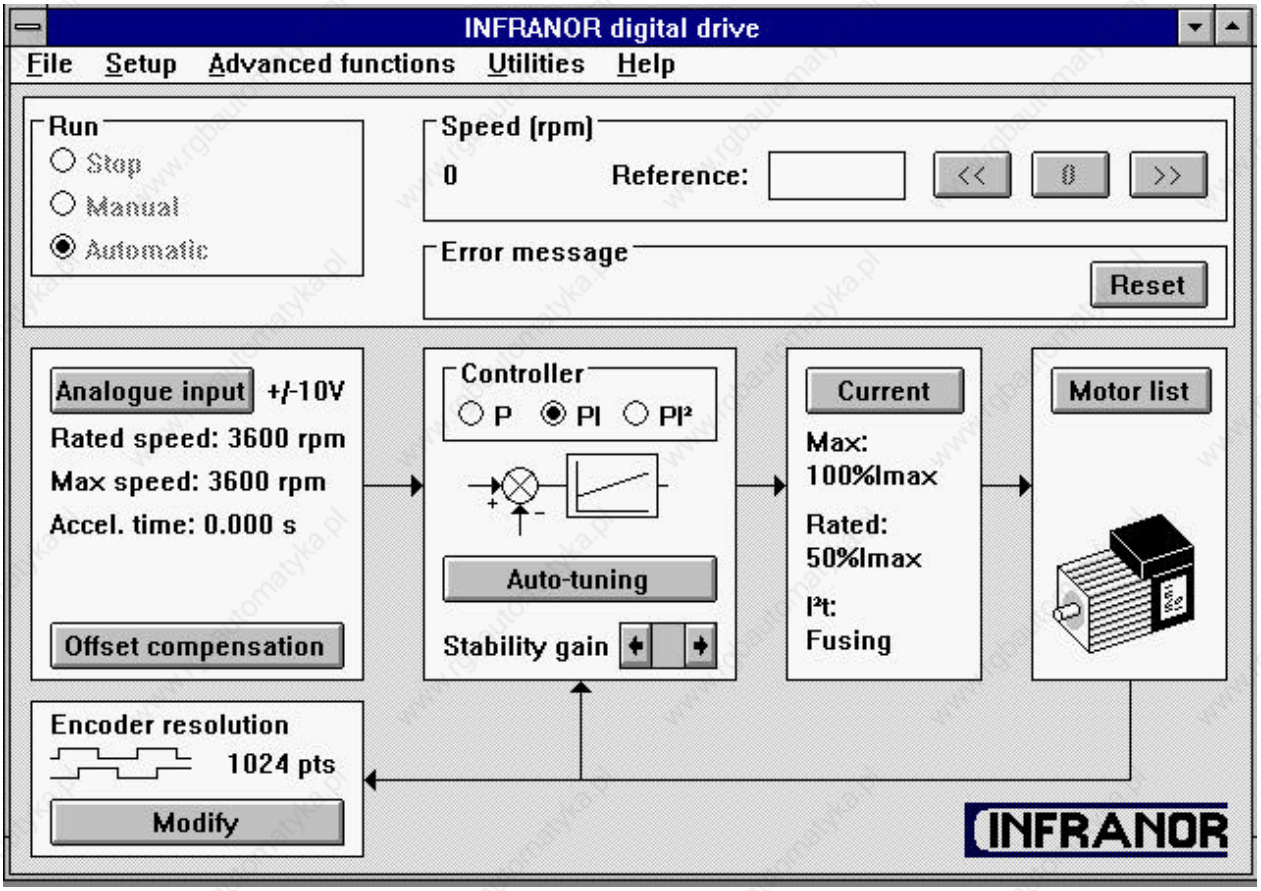
Input command (CV) wiring must be made according to the polarity between the controller and the amplifier (CV on "diff high" of the controller). Logic 0 Volt is directly connected to the amplifier housing. The connection continuity is ensured by the fastening screws on the front panels. The amplifier 0 Volt and the controller 0 Volt MUST be connected by means of a wire. The shield MUST NEVER be used as a conductor of the 0 Volt potential.

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

CAUTION: The command cables (input command, serial link, position, resolver) as well as the power cables MUST only be connected and/or disconnected with the amplifier TURNED OFF.

5.0.0 ADJUSTABLE FUNCTIONS

The BPCW program is IBM PC compatible with WINDOWS® operating system and allows an easy amplifier adjustment.



5.1.0 PC Graphical window (Infranor Digital Drive)

The INFRANOR Digital Drive graphic window has an adjustment panel, a control panel and functions accessible via menus. This presentation allows a quick adjustment of the system's main parameters during the commissioning and the adjustment phases.

5.1.1 Control panel

This panel allows the direct control of the motor by means of the PC during the commissioning phase. The **RUN** and **SPEED** functions must be confirmed by means of the Software control function in the Setup menu of the BPCW software version 2.x (see chapter 5.2.0).

RUN: This function starts and stops the amplifier and the motor during the commissioning and adjustment phases.

- **STOP**: The amplifier is disabled and the motor is not under power.
- **MANUAL**: A digital speed input command is directly entered by the **SPEED** function of the PC.
- **AUTOMATIC**: The analog speed or torque input command is entered via the CV input of X4.

SPEED: This function allows the control of the motor speed by means of the PC during the commissioning and adjustment phases.

- The digital speed input command value (in rpm) is entered into the **Reference** block.
- The three buttons in the **Speed** block give a positive (>>), negative (<<) or zero (0) speed input command.

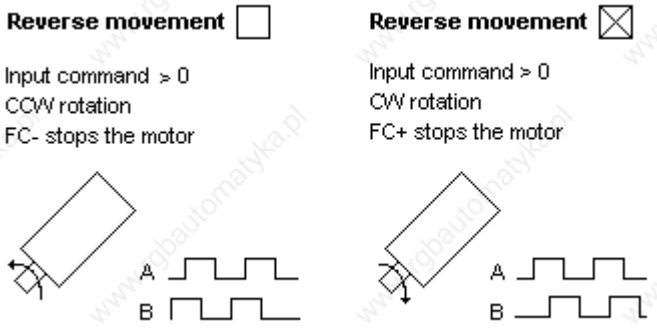
ERROR MESSAGE: This function displays the error information. The stored errors can be canceled by the **Reset** function.

5.1.2 Adjustment panel

The main adjustable parameters as well as the automatic commissioning aid functions are accessible in the adjustment panel. The whole system is represented as a block diagram for a better display of the parameters.

ANALOG INPUT: This module concerns the adjustable parameters for motor speed input command.

- The **Max speed** parameter defines the maximum motor rotation speed for an input command voltage of 10 V on the CV input of X4. The adjustment range is between 100 and 14000 rpm. This parameter is automatically calculated with regard to the rated speed value (Rated speed) entered by the operator.
- The **Rated speed (rpm)** parameter defines the motor rated speed for an input command of 8, 9V or 10V on the CV input of X4. The adjustment range is between 80 and 11200 rpm for an 8 V input command and between 90 and 12600 rpm for a 9 V input command. If this parameter is modified after the encoder programming output, check that the new **max. speed** value is compatible with the **Encoder resolution** parameter.
- The **Accel time** parameter defines the motor acceleration or deceleration time between 0 and the **max speed** value defined above. The adjustment range is between 0 and 30 s.
- The **Reverse movement** function allows the reversal of the motor rotation according to the speed input command CV polarity. The encoder position output signals with regard to the motor rotation are not modified. The following diagram shows the standard configuration of the MAVILOR motors according to the wiring set by the manufacturer.



- The **Offset compensation** function identifies the offset voltage value on the CV analog input and eliminates its effect on the input speed command. It is also accessible via the OFFSET push button on the amplifier front panel.

CONTROLLER: This module allows the adjustment of the amplifier digital speed regulator.

- The choice of the regulator type (**P**, **PI** or **PI²**) is programmable in the upper part of the **CONTROLLER** block.
  P: the speed regulator is only a proportional regulator.
  PI: the speed regulator is a proportional and integral regulator.
  PI²: the speed regulator is a proportional plus two integral terms regulator. The use of the second integral term allows to increase the axis stiffness and a better regulation accuracy at very low speeds.

- The **Autotuning** control identifies the motor and load specifications and calculates the gain parameters of the regulator. During the procedure, the **Bandwidth** box allows to select the speed loop (**Low** = 50 Hz, **Medium** = 75 Hz and **High** = 100 Hz) and the filter box allows to select the low pass filter on the speed error (**Standard** = 1st order, **Antiresonance** = 3rd order). The filter box is accessible from the **BPCW** version 2.6 and the amplifier EPROM version **5.7**.

- Both **Stability Gain** buttons at the bottom of the **CONTROLLER** module allow to increase (➔) or decrease (🡐) the loop gain.

CURRENT: This module allows the adjustment of the amplifier current limitation.

- The amplifier type is selected in the **Drive list** table.

- The fan type is selected in the **Fan** list table.

- The amplifier rated current limitation mode is selected in the part **I^2t** mode. In **Fusing** position, the amplifier is disabled when the current limitation threshold is reached (see chapter 8.3.3). In **Limiting** position, the current is only limited at the value defined by the parameter **Rated current** when the limitation threshold is reached (see chapter 8.3.3).

- **Maximum current** (%) parameter defines the maximum current of the amplifier. It can vary from 0% to 100% of the amplifier current rating. This parameter is defined according to the amplifier and motor specifications (see chapter 2.1.0).

- **Rated current** (%) parameter defines the threshold of the amplifier RMS current limitation (**I^2t**). It can vary from 20 % to 50 % of the amplifier current rating. This threshold is defined according to the amplifier and motor specifications (see chapter 2.1.0).

MOTOR LIST allows the automatic initialization of all motor parameters (except for Maximum current and Rated current) by choosing a motor in the appropriate table.

ENCODER RESOLUTION concerns the amplifier encoder output. The **Modify** function allows to define the specifications of the A, B and Z signals that are available on the X2 connector.

- The **Encoder resolution** parameter defines the number of pulses on channels A and B for one revolution of the motor shaft. Binary and decimal values are both accepted. The maximum resolution per revolution is limited by the motor speed as shown in the table below:

MAXIMUM POSSIBLE SPEED (rpm)	900	3600	14000
MAXIMUM ENCODER RESOLUTION	8192	4096	1024

- **Number of zero pulse** parameter defines the number of zero pulses on channel Z for one revolution of the motor shaft. The adjustment range is between 1 and 16.

- **Zero pulse origin shift** parameter defines the shift between the first zero pulse on channel Z and the resolver marker pulse. The adjustment range is between 0 and 32768 points. 32768 points correspond to one revolution of the motor shaft.

- **Zero pulse width** parameter defines the width (as a resolution) of the zero pulses on channel Z. The adjustment range is between 8 and 32768 pulses. 32768 corresponds to one revolution of the motor shaft.

- **Programmation** function modifies the encoder output memory according to the new parameters entered by the operator.

5.2.0 Parameter file menu (Files)

Save parameter file function saves all amplifier parameters in a file [Name].PAR.

Load parameters file function loads all amplifier parameters from a file [Name].PAR stored in the PC.

Save parameters to eeprom function saves all parameters in the amplifier EEPROM. These parameters are kept in the amplifier even after power off. They are automatically loaded in the BPCW software when starting the amplifier. Only the parameters of the **Encoder resolution** module are automatically stored in the amplifier EEPROM, after modification and saving.

The **Exit** function allows leaving the BPCW software and returning to WINDOWS® . If you do not want to save the parameter modifications, leave the software without saving the parameters in the amplifier EEPROM. After switching off and reapplying power, the amplifier is initialized with the previous EEPROM parameters. When starting the BPCW software again, the parameters of the amplifier are automatically loaded in the software.

5.3.0 Software configuration menu (Setup)

Communication menu allows the definition of the PC communication port connected to the amplifier (COM1 or COM2) as well as the transmission speed of the serial link.

- The communication port (**Com. port**) is selected in the left part of the Communication setup block. The port number can be stored in the PC via the **Save configuration** function.

- The transmission speed (**Baud rate**) is selected in the right part of the Communication setup block. When an amplifier is connected, the BPCW software automatically acquires the communication speed saved in the amplifier. This value can be modified by the operator and saved into the PC via the **Save configuration** function.

Save configuration function saves the serial port configuration in the PC file *BPCW.CFG* for a quicker restarting of the BPCW software.

Verify hardware option visualize the amplifier hardware options and the software firmware version.

Software control menu (in the BPCW software versions 2.0 and greater) allows direct control of the amplifier by means of the PC via the functions **RUN** and **SPEED** during the commissioning phase (see chapter 5.1.1). This operation mode is also necessary for the use of the **AUTOPHASING PROCEDURE** function (see chapter 6.3.4).

5.4.0 Advanced functions menu

5.4.1 Motor parameters

AUTO-PHASING PROCEDURE function identifies the parameters Pole pairs, Phase order and Resolver offset for a motor type which is not contained in the module MOTOR LIST.

MOTOR PARAMETERS DEFINED BY USER function allows the access to all motor parameters described below:

Pole pairs parameter defines the number of motor pole pairs.

Phase order parameter defines the sequence of the motor phases.

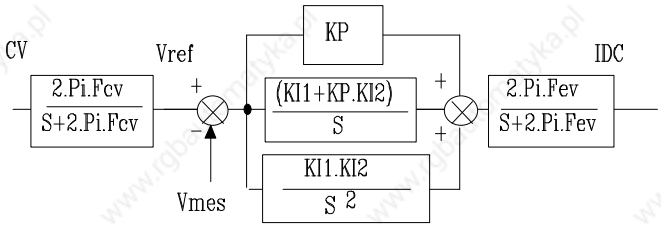
Resolver offset parameter defines the electrical shift between the motor and the resolver reference.

Current phase lead parameter defines the current phase lead for the maximum speed of the motor. This phase lead is proportional to the motor speed and compensates the phase shift of the current loops in order to keep a maximum torque / current ratio in the motor.

CURRENT PHASE LEAD CALCULATION function calculates the Current phase lead parameter according to the following motor specifications: Motor torque constant (Nm/A), Motor terminal inductance (mH) and Motor maximum speed (rpm). This procedure is used for motors which are not included in the **MOTOR LIST** module.

5.4.2 Controller parameters

The structure of the speed regulator is shown below:



Adjustable gain parameters

- **Error low pass filter** parameter defines the cut off frequency at - 3 db (Fev) of the first order filter (speed error). The value of this parameter depends on the selected band width.

- **Proportional gain** parameter defines the proportional gain (KP) of the regulator (speed error). The adjustment range is between 0.06 and 4095.

- **Integral 1 gain** parameter defines the first integral gain (KI1) of the regulator (speed error). The adjustment range is between 0.004 and 255.

- **Integral 2 gain** parameter defines the second integral gain (KI2) of the regulator (speed error). The adjustment range is between 0.000015 and 1.

All these gain parameters are automatically calculated during the execution of the **AUTOTUNING** function.

5.4.3 Analog input filter

The parameter **ANALOG INPUT LOW PASS FILTER** defines the cut off frequency at - 3 db (Fcv) of the first order filter which acts on the speed input command CV received by the amplifier. In standard, the value is set at 1000 Hz.

5.4.4 Reduced shaft stiffness at standstill

The function **REDUCED SHAFT STIFFNESS AT STANDSTILL** allows to divide the gains and the speed regulator bandwidth by a factor of 3 when the motor speed is lower than 100rpm. This function is accessible in the **BPCW** (version 2.5 and greater with the EPROM firmware version 2.8 and greater) and allow to cancel motor vibrations at standstill, which are due to the load backlashes.

5.4.5 Pulse input mode

PULSE INPUT MODE function enables the pulse input mode selected for the "**C**" and "**D**" options (electronic gearing and stepping motor emulation) and disables the standard speed mode.

5.5.0 Utilities menu

5.5.1 Read Drive status

This function allows the access to the display window of the logic inputs Enable, FC+, FC-, CI and CV0 and to ALL amplifier faults (only the 1st priority fault is displayed on the amplifier panel

Remark: The information on his window correspond to the amplifier status when opening the window. The amplifier status modifications during the display of the window are not taken into account.

5.5.2 Digitizing oscilloscope

This function is accessible without the hardware key form the **BPCW** version 2.6. It allows the access to the graphic window of the digitizing oscilloscope for the display of the amplifier control signals. The digitizing oscilloscope functions description is accessible in the **Help** menu of the BPCW software (select the **Help** menu, then the **Software menu** submenu, **Utilities** and **Digitizing** oscilloscope)

5.6.0 Help Menu

This menu allows the access to the information regarding the use of the **BPCW** software and the SMT-BD1 amplifier

6.0.0 COMMISSIONING

6.1.0 Checking the amplifier configuration

The **standard** amplifier configuration for MAVILOR motors with resolvers are the following:

- Personalization board PRES resolver: 4 x 12,7 KΩ 1 %.
- Adjustment of the current loops according to the table of chapter 8.1.0.
- Motor thermal switch PTC : jumper MN.
- Negative logic: jumpers E F G open.
- No auxiliary supply: jumper JK closed and jumper KL open.

See chapter 8 sections 2, 3 and 4 for the amplifier adjustment to other motor or resolver types or to another logic control.

6.2.0 Putting into operation

- Check the secondary voltage of the power transformer: Rated value 220 Vrms between phases, maximum value without load < 260 Vrms (including all variations, especially line fluctuations).
- Check the DC bus voltage on back of the rack: VDC ≈ 310V, VDC max < 370 V, VDC min > 200 V.
- The braking resistor must remain cool (**CAUTION !** This resistor is under high voltage).
- Turn power off and wait until voltage drops below 10 V before plugging in the first amplifier.
- **ENABLE** input open and analog input command CV open or shorted.
- Plug in the amplifier and apply power.

1st CASE

Use without auxiliary power supply. When applying power, the green LED **ON** must lit and the red **ERROR** LEDs must be off after the selftesting procedure of the amplifier.

2nd CASE

Use with auxiliary power supply (see chapter 8.4.2). When applying logic power, the **Undervolt** default may be displayed. Apply main power: the default is eliminated.

CAUTION

- In case of power shut down, **WAIT 5 SECONDS MININIMUM** before switching on the amplifier again.
- **WAIT 30 SECONDS** after power down before handling the rack and/or the amplifiers (residual voltage)

6.3.0 Amplifier commissioning and adjustment

6.3.1 Communication via serial link

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

ENABLE input must be open and the analog input command CV open or shorted.

Turn amplifier on and start the BPCW software in the WINDOWS® environment of the PC by clicking twice on BPCW (see chapter 8.5.0 for loading BPCW software).

If the message **Drive is not on line** appears on the screen, click on **OK** and check following points:

- 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 Baud rate) in the **Communication** menu via **Setup** menu is correct.

Leave the **Communication** menu window by means of the **Save configuration** button.

6.3.2 Amplifier adjustment

- Select the appropriate motor type in the **MOTOR LIST**. If the motor used is not in the **MOTOR LIST** module, see paragraph 6.3.4.

- Select the amplifier type in the **Drive list** and the **fan** type in the module **CURRENT**.

- Select the amplifier current limitation mode (**I^2t** mode) in the menu **CURRENT**. The **Fusing** mode should be selected for commissioning procedures.

- Check that the value of the **Maximum current** and **Rated current** parameters of the **CURRENT** module are compatible with the motor and the amplifier. Otherwise, modify them according to the appropriate motor and amplifier specifications.

- Check that the value of the **Max. speed** and **Accel. Time** parameters of the **ANALOG INPUT** module are compatible with the motor and the application. Otherwise, modify them according to the appropriate motor and application specifications.

- Select the speed regulator type **P**, **PI** or **PI^2** in the **CONTROLLER** module. In the case of an axis with an unbalanced load (constant torque due to a vertical load), see paragraph 6.3.5.

- Select the **Software control** function accessible in the **Setup** menu of the BPCW software version 2.x and switch on **STOP** position in the **RUN** module.

- 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, redue the **AUTO-TUNING** procedure by selecting a lower bandwidth (**Bandwidth** = Medium **or Low**). If the problem remains, redue the **AUTO-TUNING** procedure by activating the antiresonance filter (**Filter = Antiresonance**). The antiresonance filter is accessible from the **BPCW** version 2.6 and amplifier EPROM version **5.7**.

- Before doing the **Autotuning** command of the **CONTROLLER** module, check that the motor shaft is free (min one revolution) and that is not dangerous for the operator and the machine.

- After the **Autotuning** procedure, check that the motor correctly runs in both directions in **MANUAL** control mode with the **SPEED** function and a digital speed input command in the **Reference** block.

- Check the response at a low speed without IDC saturation in **MANUAL** control (with the **SPEED** function) or in **AUTOMATIC** control with an analog input speed command on CV of X4.

- Accurately adjust the speed loop response stability by means of the **Stability gain** buttons in the lower part of the **CONTROLLER** module, if necessary.

- Short-circuit the CV input of the X4 connector or enter a zero speed input command in the NC to compensate the offset of the whole system.

- Start the **Offset compensation** function of the **ANALOG INPUT** module or by means of the **OFFSET** button on the amplifier front panel.

- Start the **Modify** function in the module **ENCODER RESOLUTION** and select the encoder signal specifications on the channels A, B and Z of the connector X2 (see chapter 5.1.2).

- Select the **Programmation** function to initiate the new encoder output

6.3.3 Amplifier parameters saving

- Save all parameters in the amplifier EEPROM by means of the **Save parameter to EEPROM** function of the **FILE** menu.

- Save all parameters in a file File [Name].PAR by means of the function **Save parameter file** of the **FILE** menu. This file can then be loaded into the BPCW software by the function **Load parameter file** of the **FILE** menu.

- Leave the BPCW software via the **Exit** function of the **FILE** menu.

6.3.4 Amplifier adjustment to a new motor

If the motor used is not in the **MOTOR LIST** module, proceed as follows:

- Select an amplifier type in the **Drive list** and the **fan** type in the module **CURRENT**.

- Select the amplifier current limitation mode (**I^2t** mode) in the menu **CURRENT**. The **Fusing** mode should be selected for commissioning procedures.

- Check that the value of the **Maximum current** and **Rated current** parameters of the **CURRENT** module are compatible with the motor and the amplifier. Otherwise, modify them according to the appropriate motor and amplifier specifications.

- Check that the value of the **Max. speed** and **Accel. Time** parameters of the **ANALOG INPUT** module are compatible with the motor and the application. Otherwise, modify them according to the appropriate motor and application specifications.

- Uncouple the motor from the mechanical load and check that the motor shaft is free (one revolution or more) and that is not dangerous for the operator.

- Select the **Software control** function of the **SETUP** menu in the BPCW software version 2.x and switch on **STOP** position in the **RUN** module.

- Select the function **AUTOPHASING PROCEDURE** in the menu **ADVANCED FUNCTIONS** for defining the Pole pairs, Phase order and Resolver offset parameters.

- Select the **CURRENT PHASE LEAD CALCULATION** function of the **ADVANCED FUNCTIONS** menu for the calculation of the Current phase lead parameter according to the specific motor parameters (this function is especially useful for motors with a low inductance and running at high speeds).

6.3.5 Speed loop adjustment with a vertical load

In the case of an axis with an unbalanced load (constant torque due to a vertical load), proceed as follows:

1st method: control by the PC:

- Select the **Limiting** current mode in the **CURRENT** module.

- Select the speed regulator type **PI** or **PI^2** in the **CONTROLLER** module.

- Select the **Software control** function of the **SETUP** menu in the BPCW software version 2.x and switch on **STOP** position in the **RUN** module.

- Start the **AUTOTUNING** function of the **CONTROLLER** module with the motor uncoupled in order to initialize the speed loop gains.

  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, redue the **AUTO-TUNING** procedure by selecting a lower bandwidth (**Bandwidth** = Medium **or Low**). If the problem remains, redue the **AUTO-TUNING** procedure by activating the antiresonance filter (**Filter = Antiresonance**). The antiresonance filter is accessible from the **BPCW** version 2.6 and amplifier EPROM version **5.7**.

- Couple the motor to the load and move the shaft in **MANUAL** control and a low digital speed input command in the **Reference** block until it maintain position. Check that the free rotation (one revolution or more) is not dangerous for the operator and the machine. Use the **MANUAL** function and select a low digital speed input command in the **Reference** box for moving the shaft.

- Start the **AUTOTUNING** function in the **CONTROLLER** module with the motor enabled at its maintaining position (zero input speed command).

- Check the response at a low speed level without IDC saturation as in the traditional case without vertical load.

- Go back to the shaft standstill position before switching to **STOP** or **AUTOMATIC** mode.

2nd method: control by the NC:

This method is only possible with BPCW software version 2.0 or later and Firmware memory version 2.4 or later of the SMT-BD1 amplifier.

- Select the **Limiting** current mode in the **CURRENT** module.

- Select the speed regulator type **PI** or **PI^2** in the **CONTROLLER** module.

- Start the **AUTOTUNING** function of the **CONTROLLER** module with the motor uncoupled in order to initialize the speed loop gains.

- Start the **Modify** function of the module **ENCODER RESOLUTION** and select the encoder signal specifications on the channels A, B and Z of the connector X2 according to the position resolution of the NC.

- The **Programmation** function will save the encoder output of the amplifier.

- Couple the motor to its load and connect the amplifier with the NC. If possible, make an open loop control by means of the NC, otherwise close the position loop with a stable gain.

- Move the shaft by means of the NC until it maintain position where one motor revolution is not dangerous for operator and machine (far enough from the mechanical stops).

- Start the **Autotuning** function of the **CONTROLLER** module with the motor at standstill. If the shaft is moving, then the **Autotuning** function has not been accepted by the amplifier.

  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, redue the **AUTO-TUNING** procedure by selecting a lower bandwidth (**Bandwidth** = Medium **or Low**). If the problem remains, redue the **AUTO-TUNING** procedure by activating the antiresonance filter (**Filter = Antiresonance**). The antiresonance filter is accessible from the **BPCW** version 2.6 and amplifier EPROM version **5.7**.

- Adjust the position loop gains in the NC in order to get the necessary response.

- If necessary, accurately adjust the response stability of the speed loop by means of the **Stability gain** buttons of the **CONTROLLER** module.

7.0.0 FAULT FINDING

7.1.0 System default

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

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

7.2.0 Stored defaults

In order to simplify the diagnostic and the maintenance, the defaults are displayed and processed with the priority described below. For safety reasons, the power must be turned off to reset some defaults that require the handling of the amplifier; in this case, the reset is automatic when power is turned on again. If power is not turned off, do not forget to make a RESET immediately after the fault reset (pin 13 of X4 or **Reset** command in the BPCW software).

7.2.1 "Busy" default

- If the **BUSY** default is continuously displayed after applying power to the amplifier, the selftesting procedure has failed and the board is not ready for operation.

- If the **BUSY** default is continuously displayed after the execution of the **AUTOPHASING** function, the procedure has failed because of an external cause or the calculated parameters are wrong. Check that the ENABLE input is open. Then check that the motor is uncoupled and the shaft movement is free during the procedure.

- If the **BUSY** default is continuously displayed after the execution of the **AUTOTUNING** function, the procedure has failed because of an external cause or the calculated parameters are wrong. Check that the ENABLE input is open. Then check that the motor is uncoupled and the shaft movement is free during the procedure.

- If the **BUSY** default is continuously displayed after the execution of the **Offset compensation** function, the offset voltage is exceeds 1 Volt. Check the voltage on the speed input command during the procedure.

- If the **BUSY** default is continuously displayed after the execution of the **Programmation** function in the **ENCODER RESOLUTION** module, the amplifier encoder output memory is out of operation.

7.2.2 "EEPROM" Default

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

- If the default remains, the EEPROM is not correctly initialized or is not compatible with the amplifier software.

7.2.3 Motor overtemperature

If the default appears when starting the amplifier:

- Check the configuration of the MN and OP jumpers with regard to the motor type.

- Check the connection between the thermal switch and the amplifier on the front panel X1 connector or the X6 connector on the back of the rack.

If the default appears during the operation:

- Check the motor temperature and look for the reason of this overheating (mechanical shaft overload, duty cycle too high, ...)

7.2.4 Undervoltage default

If the default appears when starting the amplifier: Check that the power supply is on.

7.2.5 "°C Amplifier" default

Check that correct fan is installed with regard to the rated current required (see chapter 2.1.0).

7.2.6 "Power stage" default

If the default appears when starting the amplifier:

- Check the DC bus voltage and the terminal voltage of the power transformer secondary (DC bus < 370VDC).

If the default appears during operation:

- Check the braking system during the deceleration phases,
- Check the sizing of the braking resistor with regard to the deceleration phases.
- Check that the duty cycle corresponds to the current table (see chapter 2.1.0).
- Check for short-circuit in the motor wiring and at the motor terminals.

7.2.7 "Resolver" default

- Check the resolver connection on the amplifier connector X1.
- Check the presence of the P-RES components.
- Check that the resolver type is correct with regard to the P-RES components;
- Check the connections between the resolver and the amplifier.

7.2.8 "R.D.C" default

If the default appears when starting the amplifier:

- Check that the values of the P-RES components and the resolver transformation ratio are correct.

If the default appears during operation:

- Check that the motor speed does not exceed the speed limits defined below:
    - If **Max. speed** < 900 rpm, then the speed is limited to 900 rpm.
    - If 900 rpm < **Max. speed** < 3600 rpm, then the speed is limited to 3600 rpm.
    - If 3600 rpm < **Max. speed** < 14000 rpm, then the speed is limited to 14000 rpm.
    - Be careful in torque mode operation (CI command activated on X4) where the motor speed is determined by the load.

7.2.9 "I^2t" default

- Check the continuous current value required with regard to the table of currents authorized in pulse mode cycle (see chapter 2.1.0).

- Check the continuous current of the amplifier defined in the **Rated current** parameter with regard of the current required for the operation cycle.

7.3.0 Operating problems

7.3.1 No motor movement

- Check that the power supply is on.
- Check the amplifier fuses (F1 and F2) and the motor connection.
- Check the logic wiring of the signals FC+, FC- and ENABLE (see chapter 8.4.0).

7.3.2 Motor movement, but no torque

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

- Check that the amplifier is not operating in torque mode (CI command active on X4) with zero input command.

7.3.3 Shaft locked, erratic oscillations or rotation at maximum speed

- Check that the **PULSE INPUT MODE** is disabled in the Advanced functions menu (see chapter 5.4.4).

- Check that the proper motor is chosen in the **MOTOR LIST** module.

- Check the resolver wiring on the X1 connector and the mechanical mounting of the resolver on the motor.

- Check the value of the **MOTOR PARAMETERS** in the **ADVANCED FUNCTIONS** menu and execute the **AUTOPHASING** command again, with uncoupled motor, if necessary (see chapter 6.3.0).

7.3.4 Erratic motor rotation with zero torque positions

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

7.3.5 Motor drift with analog input command at zero speed

- Check that the input command wiring between the controller and the amplifier corresponds to the recommendations of chapter 4.2.3 (CV at diff. low of the NC and 0 Volt cable).

- Check the offset compensation and, if necessary, execute the **Offset compensation** command.

7.3.6 Loud crackling noise in motor at standstill

- Check that the motor-amplifier-controller ground connections correspond to the recommendations of chapter 4.0.0.

- Check that the input speed command wiring between controller and amplifier correspond to the recommendations of chapter 4.0.0 and check the shield connection of the resolver cables.

7.3.7 Loud noise in the motor at standstill and when running

- Check the rigidity of the mechanical coupling between motor and load (backlash and elasticity in the gearbox and coupling).
- Activate the function **REDUCED SHAFT STIFFNESS AT STANDSTILL** in the **ADVANCED FUNCTIONS** of the **BPCW** (version 2.5 and higher).
- Execute the **AUTOTUNING** command again by choosing a lower band width (Medium or Low).

If the problem remains, redue the **AUTO-TUNING** procedure by activating the antiresonance filter (**Filter = Antiresonance**). The antiresonance filter is accessible from the **BPCW** version 2.6 and amplifier EPROM version **5.7**.

7.3.8 Position control not possible

- Check the presence of the A, B and Z signals on the amplifier X2 connector by manually turning the motor shaft and check the wiring between NC and amplifier.
- Check that the **Max. speed** and **ENCODER RESOLUTION** parameters are correct (see chapter 5.1.2).
- Check the couting direction of the NC with respect to the sigh of the input command. If direction need to be reversed, use the function **Reverse movement** in the **BPCW** software to get correct operation.

7.3.9 Loss of serial port communication during operation

- Check that serial port cable is properly connected to the amplifier and the PC (see chapter 3.6.0 and 4.1.4)
- Verify that the serial port on the PC side is operational.
- Some custom VGA video drivers are incompatible with the serial port interrupt and it may be necessary to use a standard Windows video driver such as: ***VGA (Version 3.0)*** located in the *Windows Setup* menu.

7.4.0 Service and maintenance

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

- Check that the new amplifier has the **same hardware** configuration as the old amplifier,
- Plug in the parameter EEPROM (or a copy of it) of the old amplifier onto the new one,
- Apply a zero speed input command and start the automatic **offset compensation** procedure by means of the OFFSET button on the amplifier front panel.

The new amplifier is then configured like the old one.

NOTE: The encoder output of the new amplifier must be re-programmed by means of the **Programmation** function of the **ENCODER RESOLUTION** module in the **BPCW** software if the circuit 01612A is used. This is not necessary on the amplifiers with circuit version 01612B and beyond.

8.0.0 APPENDIX

8.1.0 Hardware adjustments

All hardware adjustments of the **SMT- BD1** amplifier module are located on the hardware location diagram (see next page).

For the BL and MA MAVILOR motor series, the current loop adjustments are made by means of jumpers B1, B2, B3 or by the Personalization boards PC1, PC2, PC3, PC4 according to the table below:

AMPLIFIER / MOTOR	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	PC1	
MA 45				B2	B2	B1	PC2	PC1
MA 55					B2	B2	PC4	PC3
BL 71	B2	B1						
BL 72	B2	B2	B1					
BL 73	B2	B2	B1					
BL 74	B2	B2	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	PC4	
BL 141			B2	B2	B2	B1	PC2	
BL 142			B3	B3	B2	B2	PC3	
BL 143			B3	B2	B2	B1	PC2	PC1
BL 144			B2	B2	B2	B1	PC1	PC1

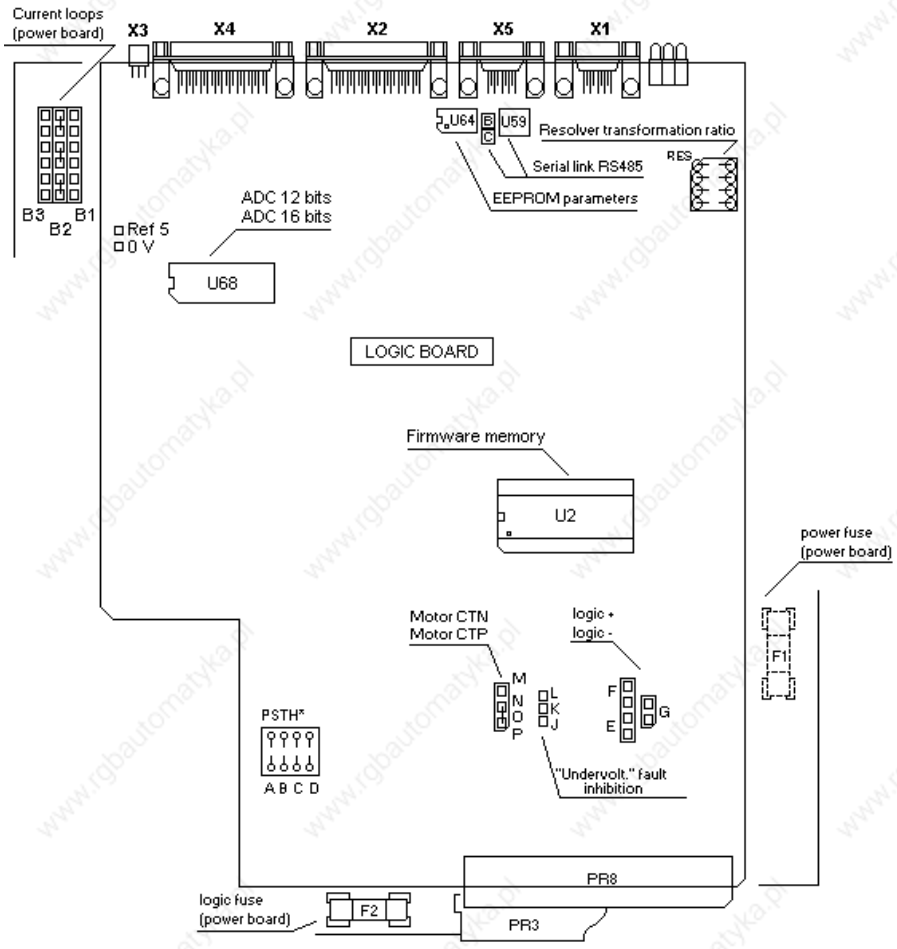
PC1: RA = 270 kΩ CA = 470 pF C14 = 82 pF
PC2: RA = 220 kΩ CA = 560 pF C14 = 100 pF
PC3: RA = 160 kΩ CA = 680 pF C14 = 150 pF
PC4: RA = 120 kΩ CA = 820 pF C14 = 150 pF

The standard analog-digital converter (ADC) of the analog speed input command has a 12 bits resolution (ADS 7804). Optionally, the amplifier is available with a 16 bit converter (ADS 7805).

The standard serial link is the RS-232 link, with jumper B closed. Optionally, the amplifier can be delivered with a RS-485 serial link, with jumper C closed.

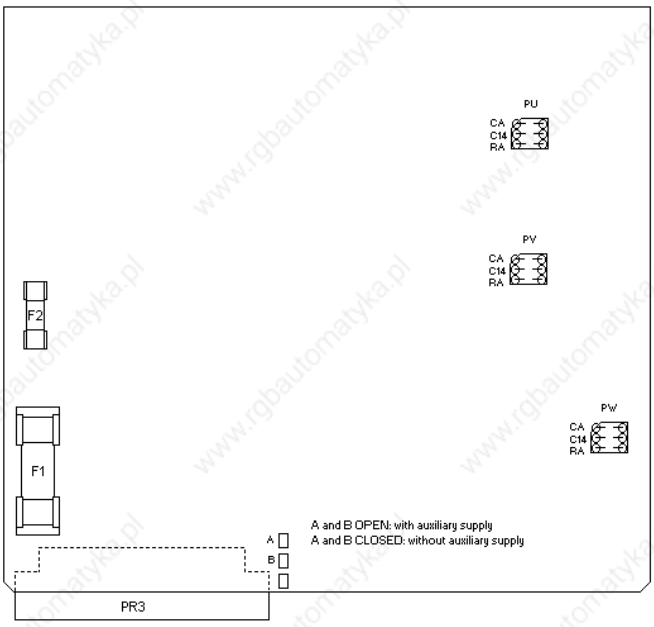
The **Firmware memory** of the amplifier standard version is **X.XA**"with the logique board 01612A, **X.XB** with the logic board 01612B, **X.XC** with the logic board 01612C and **X.XC** with **X.X** greater than 5.0 with the logic board 01640A.

For amplifiers 4A to 60A:



PSTH: Threshold adjustment for NTC thermal probe on logic board 01640 only

For amplifiers 70A to 100A:



8.2.0 Resolver connections

INFRANOR		MOOG	MAVILOR MA / BL	MAVILOR BLS 05/07	BALDOR BSM	GETTY	ID 206
SMTB X1	CABLE	all					
4 (+sin)	yellow	C	A	2	D	N	B
8 (-sin)	blue	D	B	1	N	P	A
3 (+cos)	black	B	D	4	M	C	D
7 (-cos)	red	A	C	3	E	D	C
5 (+ref)	red/white	E	E	5	G	A	F
9 (-ref)	yellow/white	F	F	6	F	B	E
Shield	Shield	-	G	9	L	R	-

Caution: Refer to chapter 4.2.2.

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

	P RES			
TRANSFORMATION RATIO	0.3	0.45	0.5	1
A - B - C - D 1 %	21 K	14.3 K	12.7 K	6.34 K

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

8.3.0 Motor connections

INFRANOR		MOOG	MOOG	MAVILOR	MAVILOR	BALDOR	GETTY	ID
SMTB	CABLE	303	304-306	MA/BL	BLS 05/07	BSM		206
Phase U	brown	L	F	A	1	1	B	B
Phase V	black	J	D	B	2	2	A	A
Phase W	blue	K	E	C	3	3	C	C
GND/Shield	yell/green	M	H	D	4		D	D
Ther. switch	black	D	B	H*	7*		E*	
Ther. switch	black	E	G	I*	8*		F*	
Brake +	red	-	A	E	5			
Brake -	black	-	C	F	6			

* These pins are in the resolver cable

8.3.1 Motor thermal sensor

For motors where the thermal sensor output is on the resolver connector, the thermal switch is connected to the X1 connector (terminals 1 and 2). On motors where the thermal switch output is on the power connector, the thermal switch can be connected via the back of the rack ..

On motors with an NTC thermal sensor, the amplifier configuration is the following: OP jumper closed and MN jumper open.

On motors with a PTC thermal sensor, the amplifier configuration is the following: MN jumper closed and OP jumper open.

The threshold adjustment for the NTC thermal probes 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) en kΩ.
RNTC (120°C): ohmic value of the NTC thermal probe resistor at 120°C.

Example: BLS74 motor
RNTC (120°C) = 3 kΩ
PSTH-A = 10 kΩ, PSTH-B = 28 kΩ, PSTH-D = 14,3 kΩ.

8.3.2 Current loops

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

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

Calculation of G = 1.4 x Amplifier current (A) x Inductance between phases (mH),
- If G < 60, current loop jumpers on B3 position,
- If 60 < G < 100, current loop jumpers on B2 position,
- If G > 100, current loop jumpers on B1 position.

30A, 45A AND 60A AMPLIFIERS

Calculation of G = 1.4 x Amplifier current (A) x Inductance between phases (mH),
- If G < 100, current loop jumpers on B3 position,
- If 100 < G < 250, current loop jumpers on B2 position,
- If G > 250, current loop jumpers on B1 position.

70A AND 100A AMPLIFIERS

Calculation of G = 1.4 x Amplifier current (A) x Inductance between phases (mH),
Calculation of the RA, CA and C14 components of the current loops,
RA = G (KΩ), CA = 130 /G (nF), C14 = CA /G (nF).

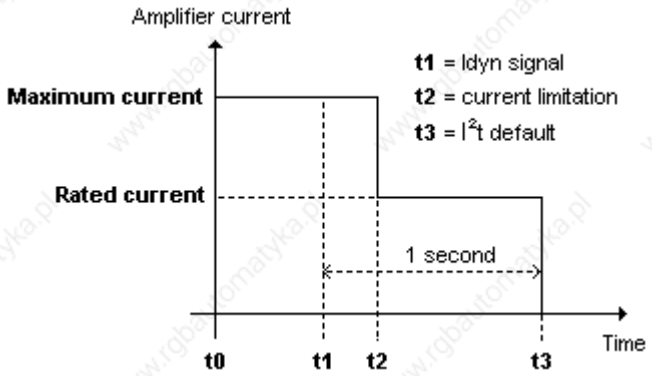
8.3.3 I^2t protection

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 flashes 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 default is released and the amplifier is disabled (otherwise, the Idyn signal and the flashing I^2t error display are both eliminated).

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

The amplifier current limitation diagram in an extreme case (motor overload or blocked 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 = 200 x **Rated current** (%) / **Maximum current** (%) ^{2}

The maximum current duration before the **limitation** to 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 = 240 x **Rated current** (%) / **Maximum current** (%) ^{2}

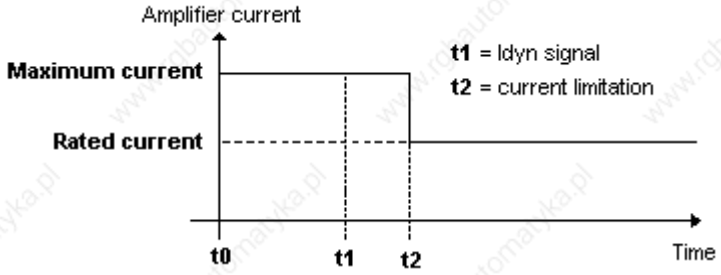
NOTE: When the **Maximum current** / **Rated current** ratio is close to 1, the values of Tdyn and Tmax calculated above are below the real values. This formula remains very precise as long as **the Maximum current** / **Rated current** ratio is higher than 3/2.

Current limitation in **Limiting** mode (BPCW version 2.0 and amplifier EPROM version 2.4 or greater)

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 flashes on the amplifier front panel. When the RMS current (I^2t) drops below 85% of the Rated current, the Idyn signal and the flashing I2t error display are both eliminated.

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

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

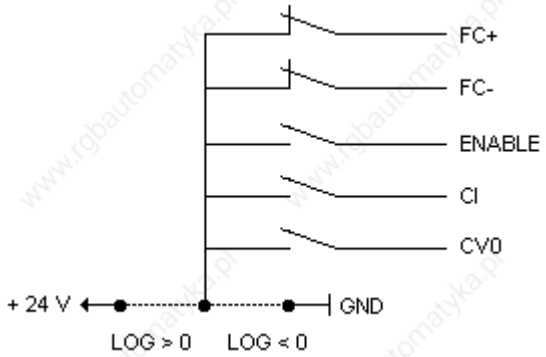


The maximum current duration before the **release** of the Idyn signal output (t1 - t0) and before the rated current limitation (t2 - t0) is calculated the same way as for the **Fusing** mode.

8.4.0 Logic control adjustment

8.4.1 Positive or negative logic inputs

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



POSITIVE LOGIC: E-F-G jumpers closed. Range: active at level 5 < V < 30 V.
Input impedance: 10 KΩ. Response time: 500 µs

NEGATIVE LOGIC: E-F-G jumpers open. Range: inactive or open at level 5 < V < 30 V.
Input impedance: 10 KΩ. Response time: 500 µs

Remark: The five inputs (FC +, FC -, ENABLE, CI, CV0) of the X4 connector **must** all be in positive logic, or all in negative logic.

8.4.2 Limit switch inputs

During the amplifier operation in speed mode (**CI** logic input disabled), the enabling of the **FC**+ limit switch stops any CW motor rotation and the enabling of the **FC**- limit switch stops any CCW motor rotation.

During the amplifier operation in torque mode (**CI** logic input enabled), the enabling of the **FC**+ limit switch locks the amplifier torque input commands between 0 V and + 10 V and the enabling of the **FC**- limit switch locks the amplifier torque input commands between 0 V and - 10 V. In the amplifier EPROM versions **5.7** and before, the limit switches have no effect in torque mode.

8.4.3 “Amp ready” and “Power ready” outputs

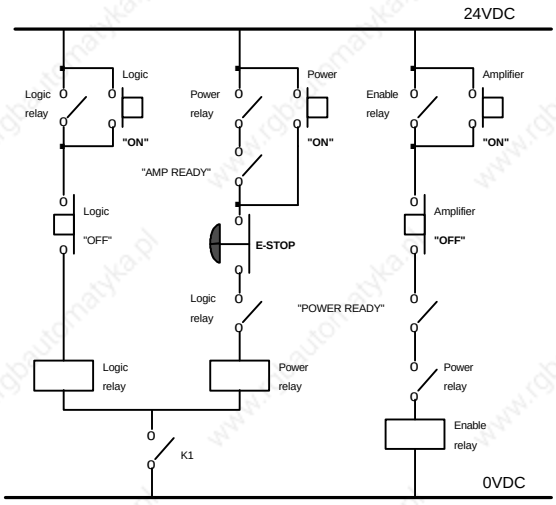
If the position references have to be kept when a stored fault is released on the amplifier or when the power supply is shut down or interrupted, it is possible:

- to reset the defaults via pin 13 of X4 without interrupting the logic supply,
- to have a logic supply which is independent of the power supply (auxiliary supply) in order to be able to cut the power supply without cutting the logic supply.

If the amplifier has an auxiliary supply on the PR8 connector, which is independent of the power supply, the J K L jumper on the logic board allows the **Undervolt** default when switching on the auxiliary supply before switching on the main power supply.

JK jumper closed and KL jumper open. With the auxiliary supply applied before the main power supply, the "Undervolt." default is displayed and can hide a default 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. The "Undervolt." default 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. In this case, the amplifier control must have the following relay logic:



Amp ready	**Amp ready** signals of all axis
Power ready	**Power ready** signals of all axis
Power relay	Relay for power ON
Logic relay	Relay for logic ON
ENABLE relay	Servo control relay
K1	Auxiliary contact of the main isolation switch

8.5.0 BPCW software installation

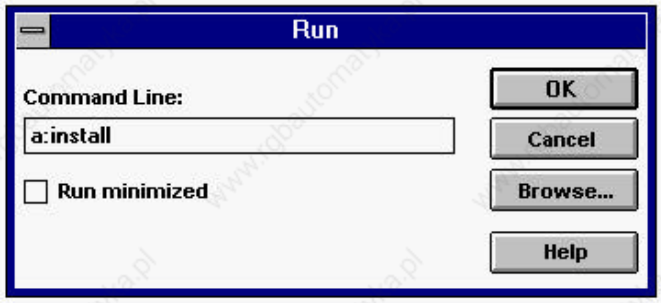
8.5.1 System requirements (minimum)

To run the INFRANOR Digital Drive software, you need:

- A computer with a 80386DX or greater processor
- 4 Mbytes of RAM
- Hard disk with at least 5 Mbytes of free space
- VGA or higher resolution monitor
- Mouse or other pointing device
- Microsoft Windows, Version 3.1 or higher

8.5.2 Installing BPCW on your computer

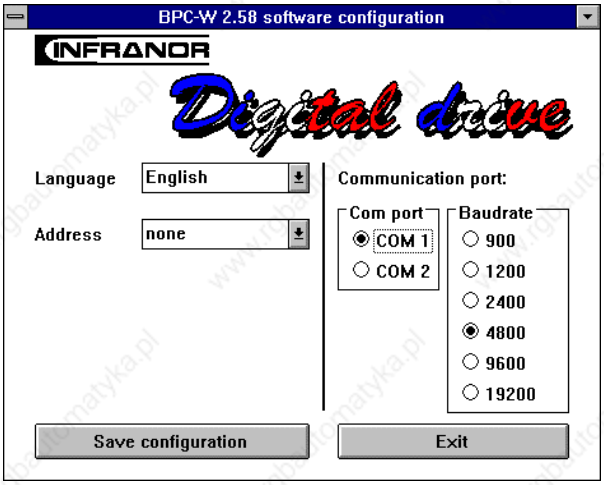
- Start Windows. The Windows **Program Manager** appears.
- Insert Disk in the appropriate drive
- From Program Manager's FILE menu, choose **Run**. The run dialog box appears. (see below)
- In the Command Line text box, type **A: install** and click OK (Or substitute Drive A with a different floppy drive letter, if necessary).



- The BPCW screen appears (see below).
- Modify the inputs **Source**, **Destination** and **Group** as necessary
- Click on **Install** to start the software installation
- After the copy of all files, click on **Exit** to close the installation procedure.

Source	indicates the directory of the software original files.
Destination	indicates the directory where the files will be loaded.
Group	is the name of the software group under **Program Manager**.

Under **Program Manager**, click on **BPCW Configuration** in the **Smtbd** group for starting the software configuration.

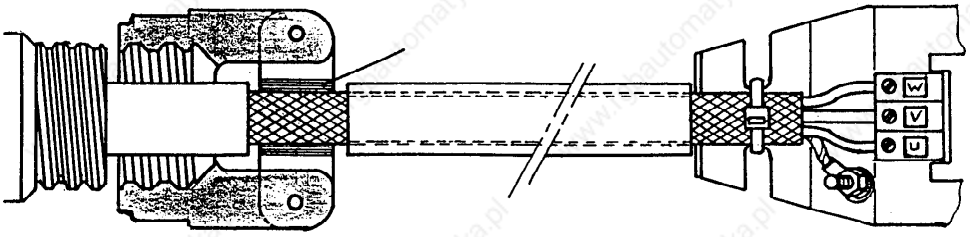


- Configure the **Communication port** (port number and transmission speed)
- Select the appropriate language.
- Click on **Save configuration**.
- Leave the configuration program by clicking on **Exit**
- Click on **Bpcw** for starting the INFRANOR Digital Drive software.

8.6.0 360º shield on the connectors

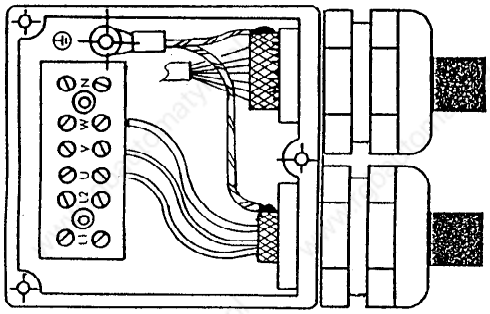
There must never be a shield interruption on the whole cable length.

Self-sticking copper ribbon if necessary for increasing the shield diameter to get properly tightened under the clamp



Connector on MAVILOR motor for resolver and motor

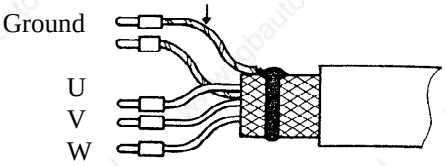
RBF RACK



Connector box on the MAVILOR motor

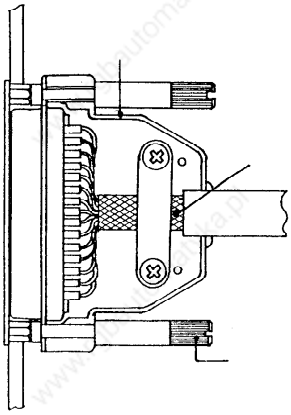
The cable can be soldered on the shield because the connector box is metalic
This solution does not correspond exactly to the IEC requirements, but it is acceptable

As short as possible



SMTBM-20A

Metallic or metal plated plastic Sub-D pin package



360 degrees shield ensured by the tightening clamp

The fastening screw must be tightened in order to ensure the shield continuity on the amplifier housing

Sub-D connector

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