

I N F R A N O R

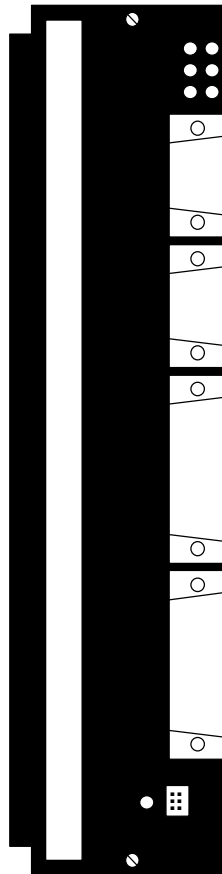
PRELIMINARY SPECIFICATIONS

SERIES SMTBD2

DIGITAL BRUSHLESS SERVO CONTROLLERS

(Version 0.3)

European version 0.2



These are preliminary information describing a series of servo amplifiers having output capability suitable for driving AC brushless servo motors equipped with an encoder only or an encoder with Hall effect sensors for position feedback. Infranor Inc reserves the right to change any informations contained in this paper without notice

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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1.0.0 GENERAL

1.1.0 Introduction

Series **SMT-BD2** digital servo modules are sinusoidal PWM power amplifiers that provide speed and torque/force control for AC brushless motors equipped with encoder only or encoder with Hall Effect Sensors (HES) for the position feedback. The speed or torque/force input command is a $\pm 10V$ analog signal voltage.

The pluggable **SMT-BD2** 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 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

The **SMT-BD2** amplifiers have their own DC/DC converter to provide the appropriate logic voltage (+5V, +15V, -15V). The source supply voltage for the logic board can be either the 310VDC power supply voltage bus of or an auxiliary 310VDC supply voltage. Auxiliary supply voltage is necessary when the position output information need to be maintained in case of power supply voltage failures.

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** amplifier directly controls the motor torque/force and speed by means of the information provided by an encoder only or encoder+HES feedback device. The sinusoidal current commutation based on encoder feedback provides smooth motor torque/force control. The use of HES feedback avoids to have a motor phasing procedure at the amplifier power up. Without HES feedback a motor phasing procedure must be executed at each amplifier power up.

The motor speed or torque/force input command is a $\pm 10V$ analog voltage. The motor position output is available as two A and B channels in quadrature, and one Z marker pulse per revolution via RS422 line drivers.

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 basic software **BPCW**, which is IBM-PC compatible with the WINDOWS® operating system, allows the clear display and easy modification of all amplifier parameters. The **BPCW** software also includes a digital oscilloscope function that is particularly useful for the drive commissioning and maintenance.

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 < U _{aux} < 340 VDC)
Motor phase-phase output voltage	200 Vrms for DC bus 310 VDC

Output currents for the **Fusing mode** of the I²t protection

AMPLIFIER	U rated (Vrms)	I _{max} (A rms) 1 s	Amplifier max. rated current (Arms)		
			WITHOUT FAN*	FAN TYPE 1*	FAN TYPE 2*
SMT-BD2 - 220/04	240	4,4	2		
SMT-BD2 - 220/08	240	8,8	4		
SMT-BD2 - 220/12	240	13,8	6		
SMT-BD2 - 220/17	240	17,7	8,5		
SMT-BD2 - 220/30	240	30,8	10	12	15
SMT-BD2 - 220/30r	240	30,8	10	15	
SMT-BD2 - 220/45	240	48,6	10	15	20
SMT-BD2 - 220/45r	240	48,6	10	20	23
SMT-BD2 - 220/60	240	61	10	19	25
SMT-BD2 - 220/60r	240	61	12	26	30
SMT-BD2 - 220/70	240	70	25	30	35
SMT-BD2 - 220/100	240	100	25	30	35

Output currents for the **Limiting mode** of the I²t protection

AMPLIFIER	U rated (Vrms)	I _{max} (Arms) 1 s	Amplifier continuous current (Arms)		
			WITHOUT FAN*	FAN TYPE 1*	FAN TYPE 2*
SMT-BD2 - 220/04	240	4,4	2		
SMT-BD2 - 220/08	240	8,8	4		
SMT-BD2 - 220/12	240	13,8	6		
SMT-BD2 - 220/17	240	17,7	8,5	8,5	
SMT-BD2 - 220/30	240	30,8	8,5	12	15
SMT-BD2 - 220/30r	240	30,8	10	15	
SMT-BD2 - 220/45	240	48,6	8,5	15	18
SMT-BD2 - 220/45r	240	48,6	10	20	23
SMT-BD2 - 220/60	240	61	8,5	17	20
SMT-BD2 - 220/60r	240	61	12	26	30
SMT-BD2 - 220/70	240	70	17	30	35
SMT-BD2 - 220/100	240	100	25	30	35

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

Note: SMT-BD2-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	I _{max} : 20% to 100 % I _{rated} : 20% to 100 % of I _{max} I _{max} duration = 1 second
External current limitation	0 to 10 V (resolution = 12 bits) 100 to 0 % of the internal I _{max} 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
Speed range	2048 : 1 with 12 bits input command 32768 : 1 with 16 bits input command
Max motor speed	Adjustable from 100rpm to 14000rpm
Hall sensors input	Selectable 120° or 60° HES type 5V, 15V or ±15V supply voltage HES sequence error detection
Encoder input	Quadrature TTL A and B channels with Z marker pulse. RS-422 live receiver Maximum frequency: 1MHz Resolution 10 ³ to 10 ⁶ pulses/revolution
Encoder position output	Quadrature TTL A and B channels with Z marker pulse RS 422 line driver.

Note:

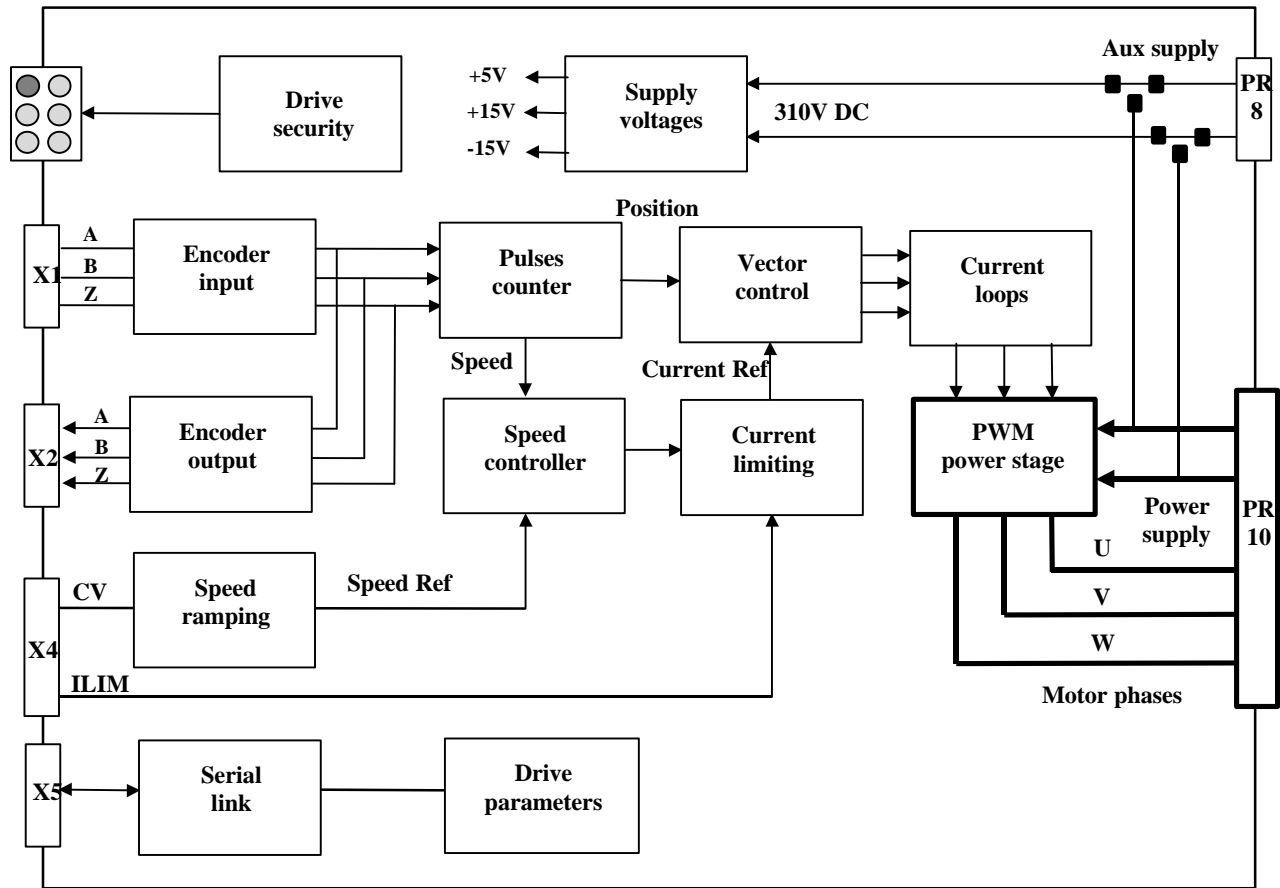
The Max. motor speed value not only depends on the motor specification but also on the encoder specification. The following condition must be answered taking into account the encoder pulse frequency limit:

Max. motor speed (rpm) < or = 60 x Encoder maximum pulse frequency (Hz) / Number of encoder pulses per revolution

For example with the ROD426 (Heidenhein) series encoder, the pulse frequency limit is 300 KHz, so a ROD426 encoder with a 5000 ppr resolution cannot exceed 3600 rpm.

Logic inputs	<p>Optoisolated inputs. Positive logic only. Enable / Disable: ENABLE Limit switch +: FC+ Limit switch - : FC- Current command: CI Stop and phasing command: CV0 Reset: RAZ</p>
Logic outputs	<p>Relay contact $U_{max} = 50\text{ V}$, $I_{max} = 100\text{ mA}$, $P_{max} = 10\text{ W}$</p> <ul style="list-style-type: none"> • "Amp ready": closed if amplifier OK, open if default • "Power ready": closed if power OK, open if default • "IDYN": open if I^2t threshold is reached • "Servo OK": closed if motor phasing OK
Monitor outputs	<p>2 channels ANout1 & ANout2 $\pm 10\text{V}$ full scale, 8 bit resolution Programmable output signals: current ref (IDC), current mes (ID,IQ,IMES) speed ref (CV), speed mes (GT)</p>
Error display	LED on front panel and diagnostic by serial link
Parameter setting	Serial link RS232 (standard) or RS422 / 485 (option)
Automatic functions	<p>Amplifier adjustment to the motor (AUTOPHASING) Automatic regulator tuning (AUTOTUNING) Offset compensation on analog input CV</p>
Electromagnetic compatibility Conducted and radiated disturbances Electrical standards for industrial machines	<p>IEC standards 801- 2 - 3 - 4, level 4 EN 5011 Group 1, class A EN 60204.1: 1500 VAC - 1min insulation Current leakage >3mA (EMI filters)</p>
Temperature	<p>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</p> <p>altitude: 1000 m (3300 feet) moisture: < 50 % at 40° C and < 90 % at 20° C (EN 60204.1 standard)</p>
Cooling	Natural convection or forced air, according to the rated current (see current table)

3.0.0 BLOCK DIAGRAM



The PR8 and PR10 connectors are not accessible for direct wiring; they are plugged into the SMTBM-20A single axis rack or on the multi axes RBF rack (see chapter Inputs & Outputs section Connectors location).

4.0.0 MAIN PROTECTIONS

PROTECTION	ERROR DISPLAY	LED*
Amplifier rated current overload: <ul style="list-style-type: none"> flashing display = Idyn signal (I^2t threshold is reached) continuous display = amplifier inhibited (I^2t default) 	$I^2 t$	● ○ ○ ○
Encoder cable interruption	Encoder	○ ● ○ ○
Power stage failure: <ul style="list-style-type: none"> power supply overvoltage internal switch protection short-circuit between phases 	Power stage	● ● ○ ○
Position feedback error <ul style="list-style-type: none"> Encoder pulses error HES sequence error 	Sensor	○ ○ ● ○
Amplifier overtemperature	°C Amp	● ○ ● ○
Power supply undervoltage	Undervolt.	○ ● ● ○
Motor overtemperature	°C Motor	● ● ● ○
Default of the amplifier parameter storage	EEPROM	● ○ ● ●
Amplifier automatic procedure: <ul style="list-style-type: none"> flashing display = procedure operating continuous display = operating error 	Busy	● ● ● ●

* ○ = LED is unlit; ● = LED is lit.

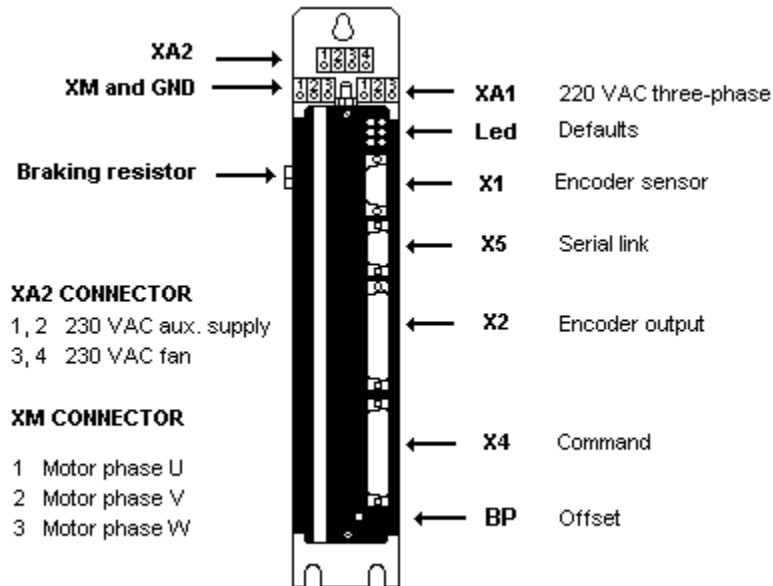
Reset of a stored default can be made:

- 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.

5.0.0 INPUTS / OUTPUTS

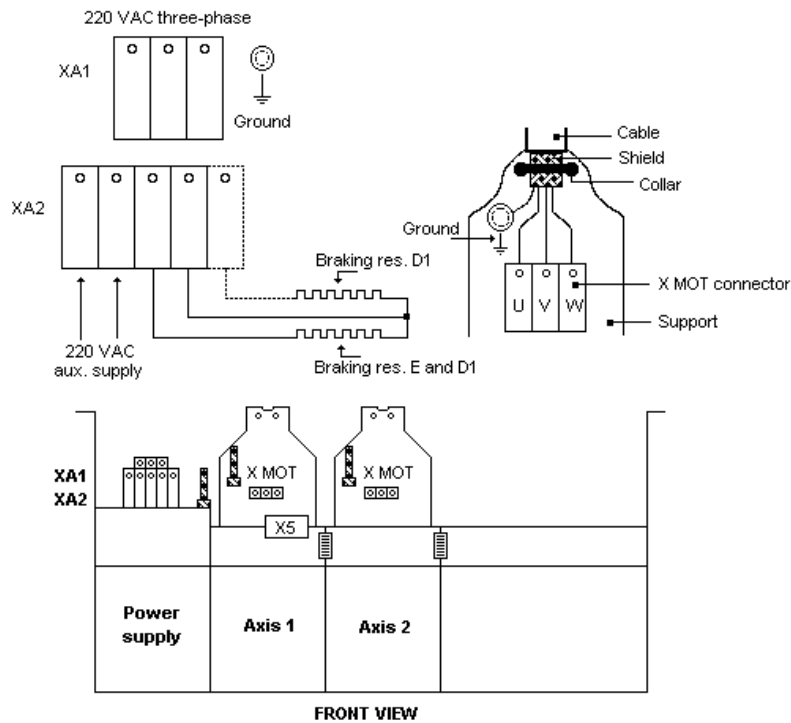
5.1.0 Connector locations

5.1.1 Front connector SMTBM-20A single axis block



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

5.1.2 RBF rack connectors

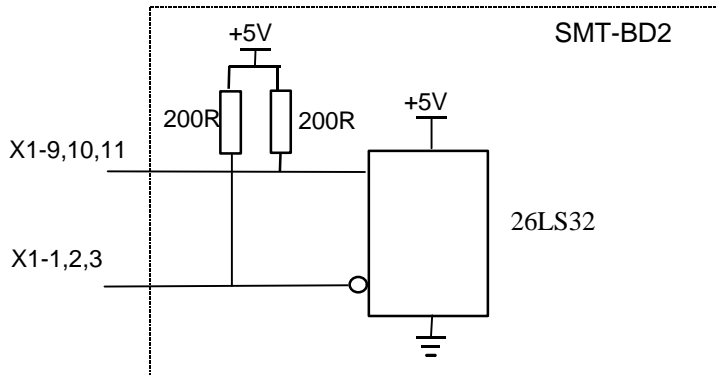


For more detailed information regarding the power connection, please see **BF Rack** manual

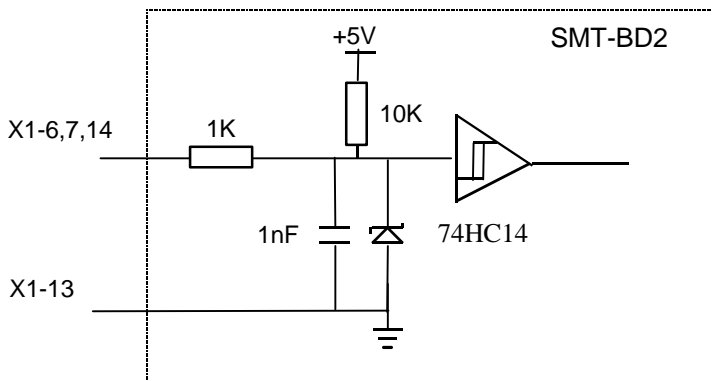
5.2.0 X1 Encoder and HES sensors connector (Sub-D 15 points female)

PIN	FUNCTION	I / O	REMARKS
1	Marker Z/	I	Differential input of the encoder marker pulse/
9	Marker Z	I	Differential input of the encoder marker pulse
2	Channel A/	I	Differential input of the encoder channel A/
10	Channel A	I	Differential input of the encoder channel A
3	Channel B/	I	Differential input of the encoder channel B/
11	Channel B	I	Differential input of the encoder channel B
5	+5V	O	Encoder supply voltage
4	GND		
14	HALL U	I	Hall sensor input signal phase U
6	HALL V	I	Hall sensor input signal phase V
7	HALL W	I	Hall sensor input signal phase W
15	+15V	O	Hall sensor positive supply voltage
8	-15V	O	Hall sensor negative supply voltage
12	TC	I	Motor thermal switch input
13	GND		Hall sensors/thermal switch GND

5.2.1 Specification of the encoder input



5.2.2 Specification of the Hall sensors input



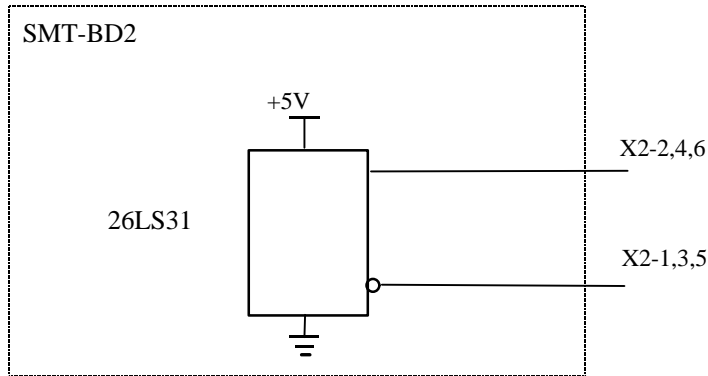
5.3.0 X5 serial link (Sub-D 9 points male)

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

5.4.0 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	
3	Channel A/	O	Differential output of the encoder channel A/ (5 V, 20 mA max.)
4	Channel A	O	
5	Channel B/	O	Differential output of the encoder channel B/ (5 V, 20 mA max.)
6	Channel B	O	
7	0 V	O	
8 to 25	reserved		

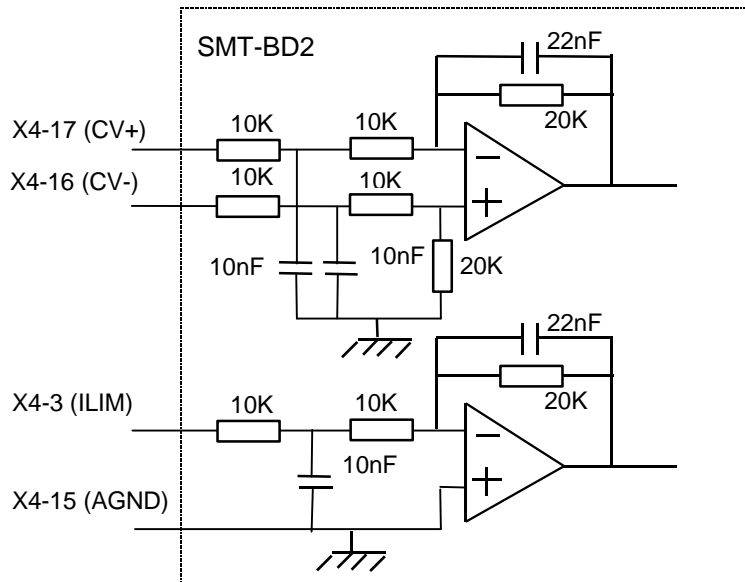
5.4.1 Specification of the encoder output

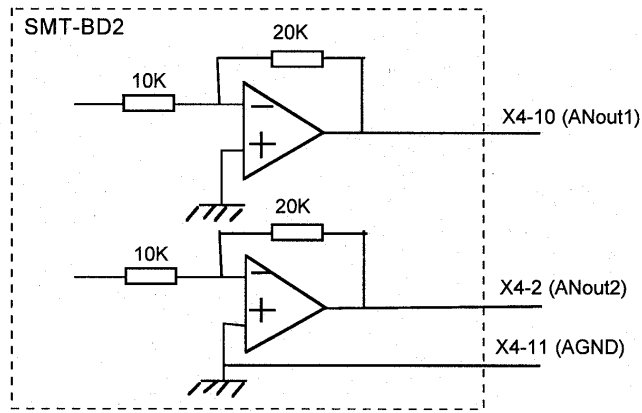


5.5.0 X4 input - output command connector (Sub-D 25 points male)

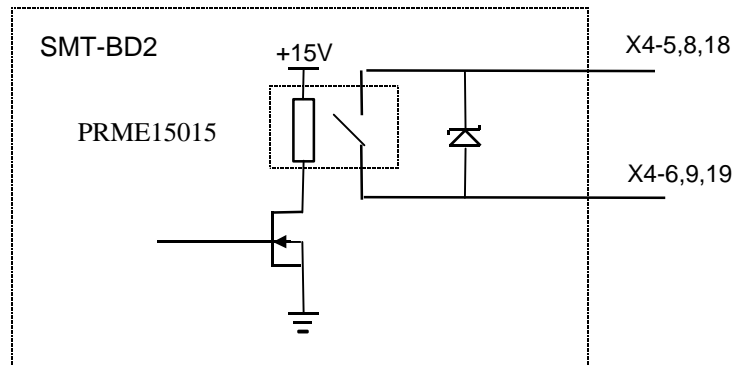
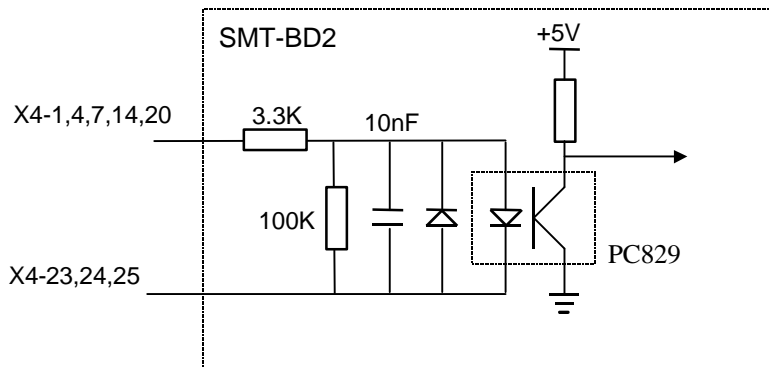
Pin	Function	I / O	REMARKS
1	Limit switch +	I	Opto isolated input, positive logic
14	Limit switch -	I	Opto isolated input, positive logic
4	Current command CI	I	Opto isolated input, positive logic
7	Stop & Phasing command CV0	I	Opto isolated input, positive logic
20	ENABLE	I	Opto isolated input, positive logic
23 to 25	0V opto isolated input		
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 or current ± 10 V input command for I_{max} with "CI" input active
16	Input command CV -	I	
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 I_{max}
10	Anout1	O	± 10 V: resolution 8 bits: load 10mA
2	Anout2	O	
11	0 Volt analog output	O	
8, 9	I dyn signal	O	Relay contact: open if I dyn threshold is reached $P_{max} = 10$ W with $U_{max} = 50$ V or $I_{max} = 100$ mA
18, 19	Amplifier ready	O	Relay contact: closed if amplifier OK, open if fault. $P_{max} = 10$ W with $U_{max} = 50$ V or $I_{max} = 100$ mA
5,6	Servo OK	O	Relay contact: closed if motor phasing OK $P_{max} = 10$ W with $U_{max} = 50$ V or $I_{max} = 100$ mA
21	+ 15 V	O	50 mA maximum output current
22	- 15 V	O	50 mA maximum output current

5.5.1 Specification of the analog inputs/outputs





5.5.2 Specification of the logic inputs/outputs



5.6.0 Motor phasing procedure

The amplifier will make an "initialization" at power up when the motor is fitted with the encoder feedback only, as follow:

