I N F R A N O R

OPERATING MANUAL

SERIES SMTBD1

OPTIONAL FUNCTIONS

(Version 2.3)

European version 2.2

WINDING/UNWINDING TENSION CONTROL

OPTION “I”

This manual describes the option "I" of the SMT-BD1 amplifier: **Winding/Unwinding tension control**. The general information about the digital amplifier commissioning are described in the standard SMT-BD1 manual.

Maintenance procedures should be attempted only by highly skilled technicians 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.

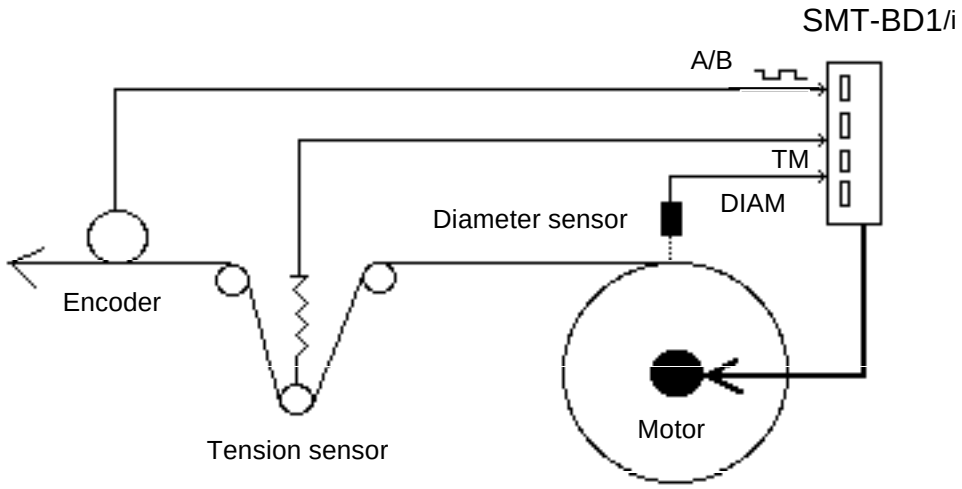
Claims for loss or damage in shipment must not be deducted from your invoice, nor should payment be withheld pending adjustment of any such claims.

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.

OPERATING MANUAL
INFRANOR
SERIES SMTBD1
OPTION "I"
(March 1998)

1.0.0 GENERAL DESCRIPTION

The tension control for winding/unwinding systems requires the **SMT-I3-BD1** daughter board and the **X.X 6** EEPROM. In this configuration, the **SMT-BD1/i** amplifier controls the speed of the motor driving the spool, in order to maintain a constant material tension independently of its line speed and of the spool diameter. The material tension is controlled by the amplifier via a ± 10V analog signal **TM** provided by a tension sensor. The spool diameter measurement **DIAM** is also received by the amplifier as an analogue voltage between 0V and 10V. These signals are entered on the amplifier command connector X4. The material line speed is measured by an encoder which differential signals A, /A and B, /B in quadrature are received on the amplifier command connector X2. The system structure is described below.



The rotation speed of the empty spool is defined by the ratio between the line encoder resolution and the motor resolution (Empty spool speed = Line encoder speed x Line encoder resolution / Motor resolution). The motor encoder resolution is programmable between 1 and 8192 ppr. The maximum motor rotation speed (corresponding to the empty spool) is adjustable between 100 rpm and 14000 rpm.

The motor speed reference value is continuously calculated in the amplifier according to the material line speed and the spool diameter (Motor speed = Line encoder speed x Line encoder resolution / Spool diameter / Motor resolution). A poportional "**P**" and proprtional/integral "**PI**" speed regulator continuously adjusts the motor speed to this reference value. The speed regulator gains are automatically matched according to the spool diameter in order to keep the dynamic performances and the stability of the servo loop in all load conditions.

The calibration, in the amplifier, of the diameter measurement allows an easy adjustment to various sensor types. The ratio between maximum diameter of the full spool and minimum diameter of the empty spool is adjustable between 1 and 100. In case of bad operation, if the diameter measurement **DIAM** is out of the normal variation range defined in the amplifier, the logic output **DER** is disabled on the command connector X2.

When placing the spool, it is possible to manually wind and unwind the material by using the logic inputs **JOG+** and **JOG-** when the tension regulator is disabled (logic input **TDI** active).

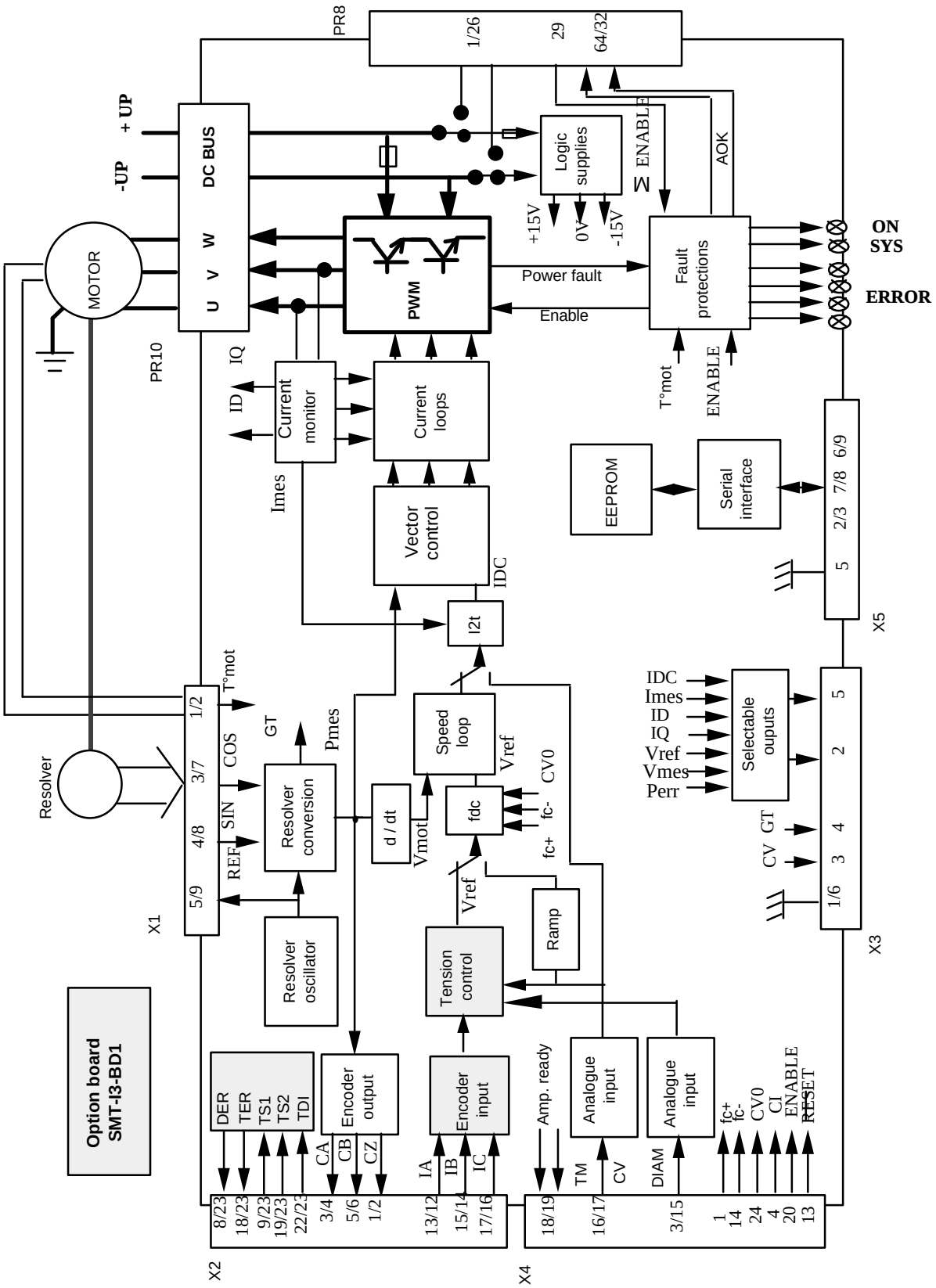
When the tension regulator PID is on (**TDI** input disabled), the motor speed is continuously adjusted in order to maintain a constant material tension **TM**. Three different tension input command values can be programmed in the amplifier and are selectable by means of the logic inputs **TS1**and **TS2** on the command connector X2. In case of material breaking, when the tension measurement **TM** is below the reference, the logic output **TER** is disabled on connector X2. The enabling of the logic input CV0 on the command connector X4 allows to quickly stop the spool.

2.0.0 SPECIFICATIONS

2.1.0 Technical specifications

Line speed measurement	Differential encoder input A, A/ and B, B/ Max. frequency = 250 kHz
Motor / encoder speed ratio (empty spool)	LER / MER LER = Line encoder resolution MER = Motor encoder resolution
Programmable motor encoder resolution	Max. 8192 ppr up to 900 rpm Max. 4096 ppr up to 3600 rpm Max. 1024 ppr up to 14000 rpm
Spool diameter measurement	0V to 10V analogue input Resolution: 11 bits (15 bits optional) Low-pass filter: 10 Hz
Calibration of the spool diameter sensor	Voltage for minimum and maximum diameter: adjustable between 0V and 10V
Spool diameter ratio = max. diameter / min. diameter	Adjustable parameter from 1 to 100 Resolution = 0.005
P or PI speed regulator	Sampling period: 0,5 ms Anti-resonance filter Auto-tuning at setup Automatic gains-spool diameter matching
Speed loop bandwidth	Adjustable cut-off frequency: 50, 75 or 100 Hz
Material tension measurement	Analog input: - 10 V to + 10 V Resolution: 12 bits (16 bits optional) Adjustable frequency low-pass filter
Material tension regulator PID	Sampling period: 0,5 ms Adjustable digital gains Adjustable tension ramping
Logic inputs	CV0: Spool stop TDI: Tension regulator disabling JOG+: Motor rotation direction + JOG-: Motor rotation direction - TS1: Tension reference selection (1 of 3) TS2: Tension reference selection (1 of 3)
Logic outputs	DER: Diameter measurement error TER: Tension measurement error

2.2.0 Amplifier block diagram



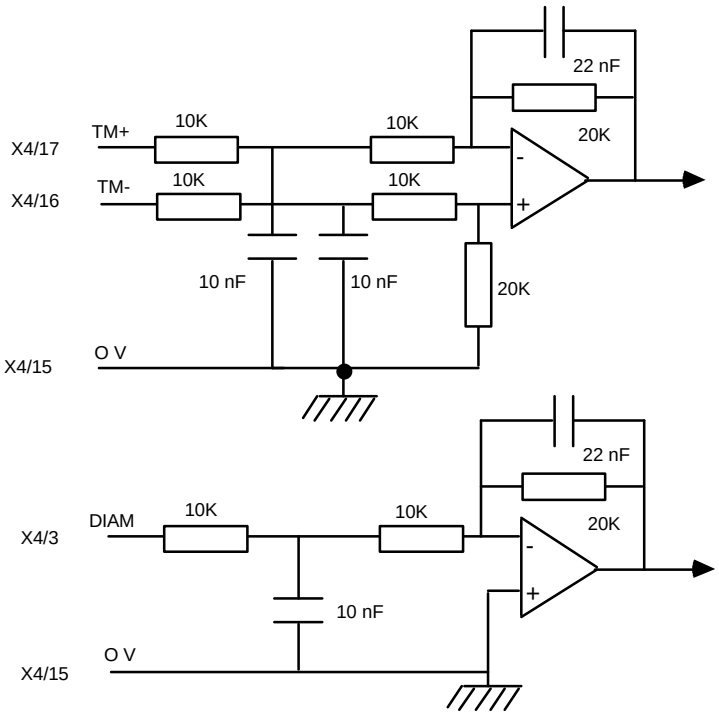
3.0.0 INPUTS - OUTPUTS

3.1.0 X4 Command connector

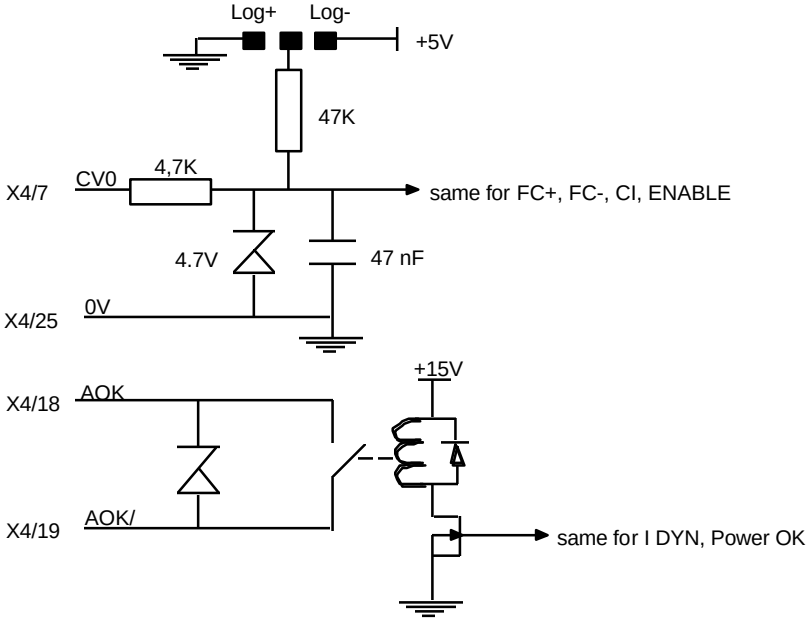
3.1.1 Terminal connections

PIN	FUNCTION	I/O	REMARKS
1	Limit switch +	I	Positive or negative logic (see standard manual SMTBD1)
14	Limit switch -	I	Positive or negative logic (see standard manual SMTBD1)
24	0 V limit switch		
20	ENABLE	I	Positive or negative logic (see standard manual SMTBD1)
23	0 V ENABLE		
4	Torque control CI	I	Positive or negative logic (see standard manual SMTBD1)
7	P mode braking CV0	I	Positive or negative logic (see standard manual SMTBD1)
25	0 Volt logic input		
13	Amplifier fault RESET	I	Resets amplifier via 0V (contact between 13 and 12)
12	0 V RESET input		
17	Tension measurement TM+	I	Differential input of material tension measurement
16	Tension measurement TM-	I	between - 10V and + 10V
3	Diameter measurement DIAM	I	Spool diameter measurement input between 0V and + 10V
15	0 V analog input		
10	Speed monitor output	O	± 8V for ± 14000 rpm; linearity = 10 %; max. load: 10mA
2	Current monitor output	O	± 10V; resolution: 8 bits; load: 10mA; (DAC out 2)
11	0 V analogue output		(10V for amplifier current rating).
8, 9	I dyn warning of I^2t	O	Relay contact: open if I dyn threshold is reached Pmax = 10W with Umax = 50V or Imax = 100mA
18, 19	Amp. Ready	O	Relay contact: closed if amplifier OK, open if fault. Pmax = 10W with Umax = 50V or Imax = 100mA
21	+ 15 V	O	Max. 50mA available
22	- 15 V	O	Max. 50mA available
5, 6	not connected		

3.1.2 Analog input specifictaion



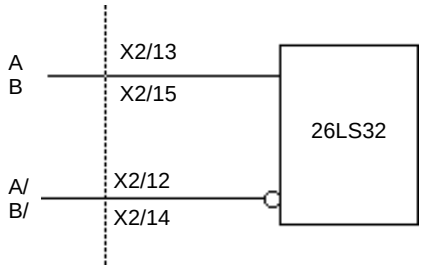
3.1.3 Logic inputs / outputs specification



3.2.0 X2 Position connector

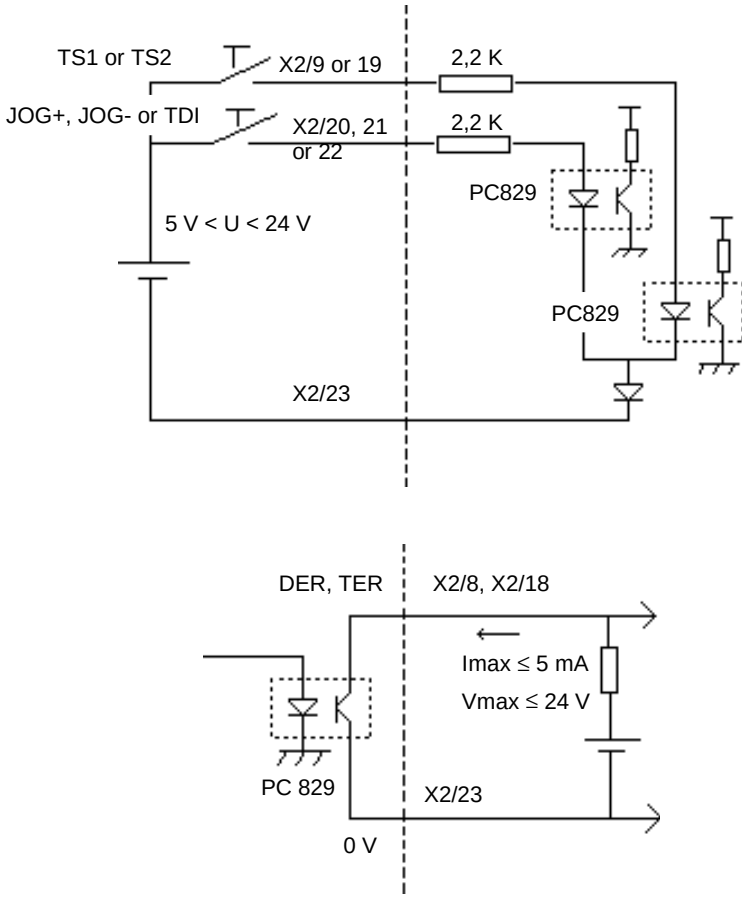
PIN	FUNCTION	I/O	REMARK
1	CZ/	O	Motor encoder output of the marker pulse (5V, 20mA)
2	CZ	O	Motor encoder output of the marker pulse
3	CA/	O	Motor encoder output channel A (5V, 20mA)
4	CA	O	Motor encoder output channel A
5	CB/	O	Motor encoder output channel B (5V, 20mA)
6	CB	O	Motor encoder output channel B
7,10,11	0 V		GND
12	IA/	I	Master encoder input channel A (5V, consumption 2mA)
13	IA	I	Master encoder input channel A
14	IB/	I	Master encoder input channel B (5V, consumption 2mA)
15	IB	I	Master encoder input channel B
24	+ 5 V		± 5 % 300mA available with jumper 5V closed, for master
25	0 V		encoder supply (if necessary)
16, 17	Reserved		Reserved
18	TER	O	Logic output: Tension measurement error
8	DER	O	Logic output: Diameter measurement error
23	0 V I/O	I	0 V of inputs/outputs
9	TS1	I	Logic input > 0: Selection of tension reference
19	TS2	I	Logic input > 0: Selection of tension reference
20	JOG+		Logic input > 0: Motor rotation direction +
21	JOG-	O	Logic input > 0: Motor rotation direction -
22	TDI		Logic input > 0: Tension disabling

3.2.1 Encoder inputs



3.2.2 Logic inputs/outputs specifications

The JOG+, JOG- and TDI inputs are "optocoupled" and operate in positive logic, as shown below. The input voltage corresponding to level 1 is between 5 and 24V.



The **DER** and **TER** outputs (error indication) are "open collector" and "optocoupled". The transistor is inhibited when a default occurs. The application scheme is shown below. The maximum output current is 5 mA.

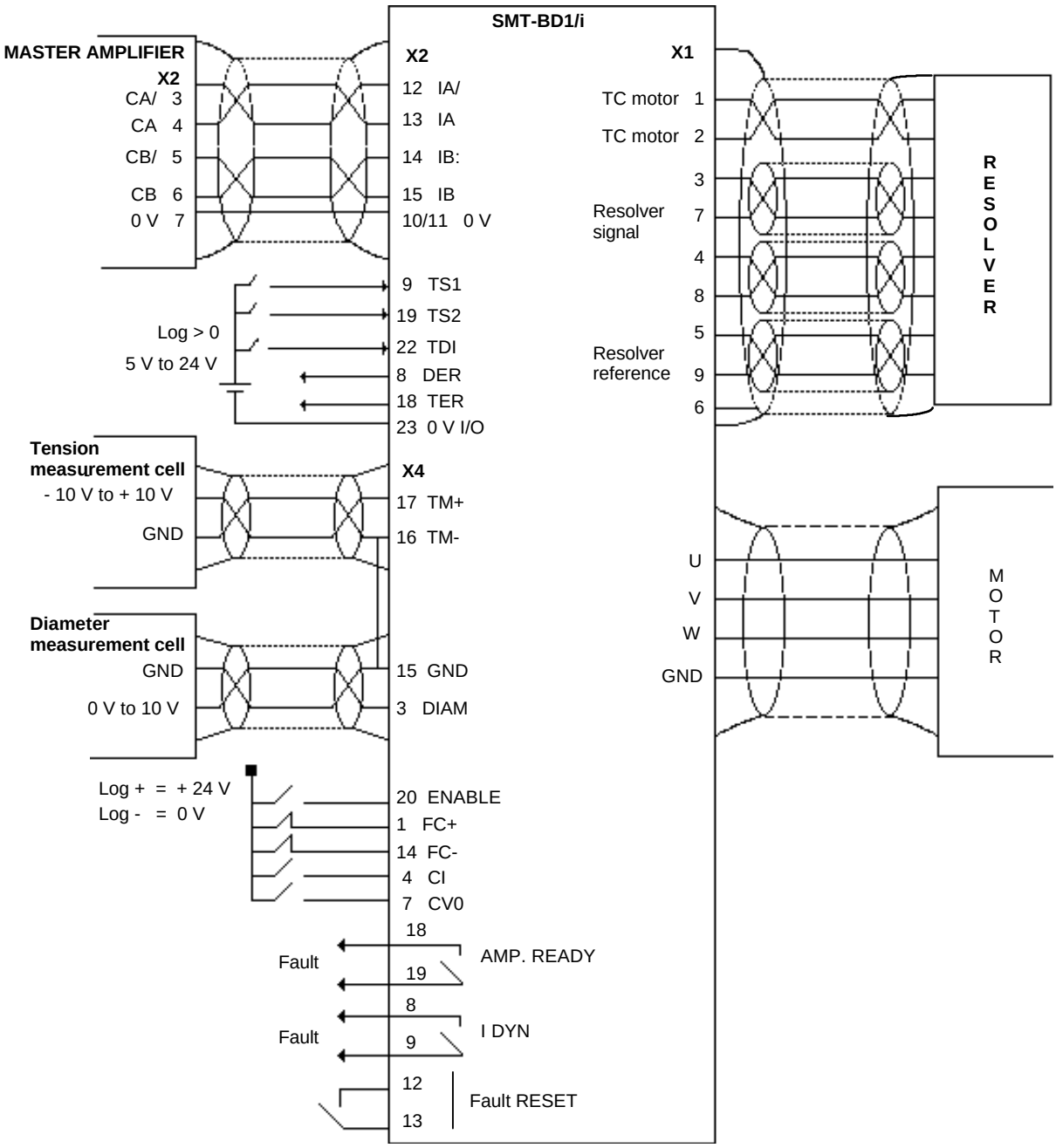
3.3.0 X3 Test connector

PIN	FUNCTION	CHARACTERISTICS
1 - 6	0 V	
2	DAC 1 output	±10 V resolution 8 bits, linearity: 2% (IDC, Imon., ID, IQ, Vref, Vmon., Pos err) *
3	Speed input command CV	±10 V for ± maximum speed
4	Speed signal GT	±8 V for ±14000 rpm
5	DAC 2 output	±10 V resolution 8 bits, linearity: 2% (IDC, Imon., ID, IQ, Vref, Vmon., Pos err) *

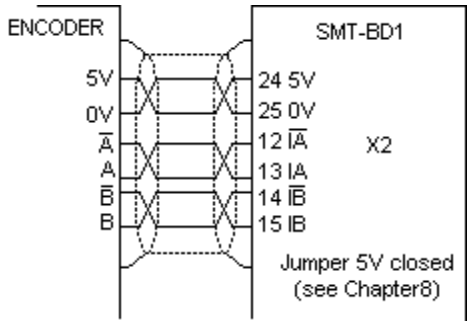
* See part "Digital oscilloscope" of the **BPCW Options** manual.
Linearity: 10 % on logic boards 01612A, 01612B and 01612C

4.0.0 CONNECTIONS

4.1.0 Connection diagram



4.2.0 Connection to the master encoder



4.3.0 Wiring recommendations

It is recommended to use a shielded cable for the master axis incremental input signals A and B. Cable ends should have a **360° shielded connection by means of the metallic X2 connector** (refer to Chapter 8, section 6 of the SMTBD1 standard manual). The amplifier Zero Volt (X2, pins 10/11) and the master Zero Volt (Gnd) must be connected together.

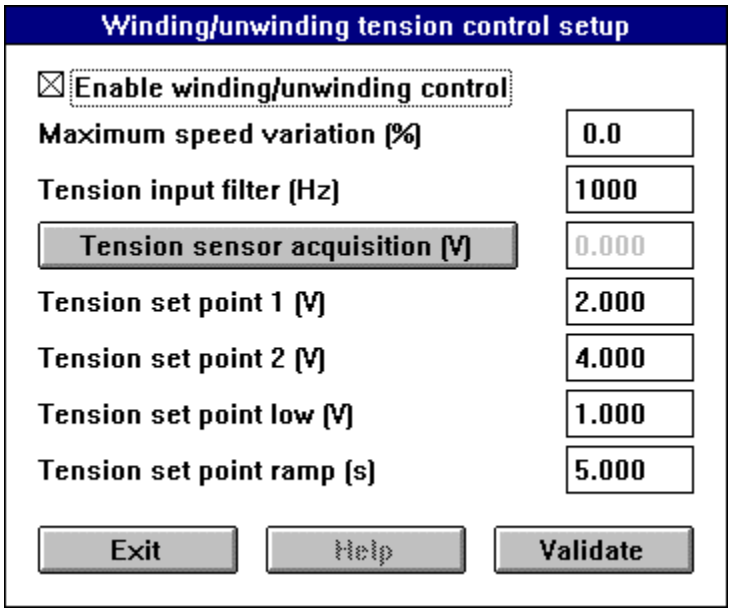
The crossing of the A and B, A and A/ or B and B/ signals on the master axis incremental input changes the rotation direction of the slave motor with regard to the master motor.

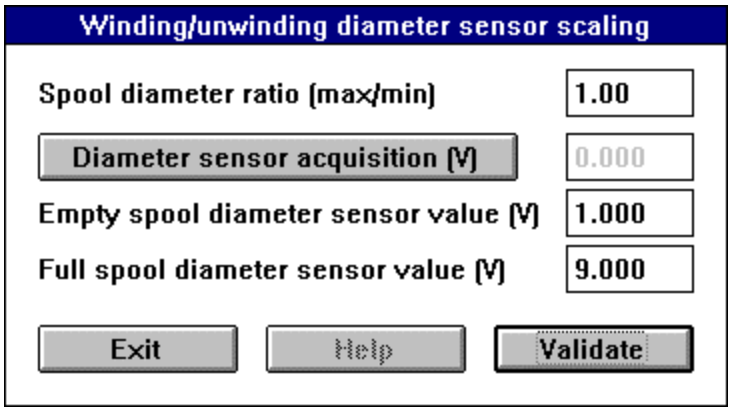
It is recommended to use a shielded cable for the analogue tension measurement signal **TM**. . Cable ends must have **a 360° shield connection by means of the metallic connectors at both cable ends**. Otherwise, make a connection as short as possible only at the end on amplifier side with a 0V pin of the X4 connector (refer to Chapter 8, section 6 of the SMTBD1 standard manual). The amplifier Zero Volt (X4, pin 15) and the load cell Zero Volt (GND) must be connected together.

The load cell signal **TM** and **DIAM** wiring must be made according to the polarity between the load cell and the amplifier (**TM+** and **DIAM** on "diff high" of the load cell). The amplifier 0Volt **MUST** be connected to the cells 0Volt by means of a cable (pins 15 and 16 must be connected together on the X4 connector at the amplifier end). If necessary, the motor rotation direction can be reversed in the amplifier (see SMTBD1 standard manual).

5.0.0 ADJUSTABLE PARAMETERS

The specific parameters used for the tension control of winding/unwinding systems are accessible via the **Winding/unwinding tension control setup** and **Winding/unwinding diameter sensor scaling** submenus of the **Advanced functions** menu, in the **BPCW** software version 2.52 and greater.





5.1.0 Operation mode

The operation in winding/unwinding tension control is selected by the **Enable winding/unwinding control** function in the **Winding/unwinding tension control parameters** submenu of the **Advanced functions** menu.

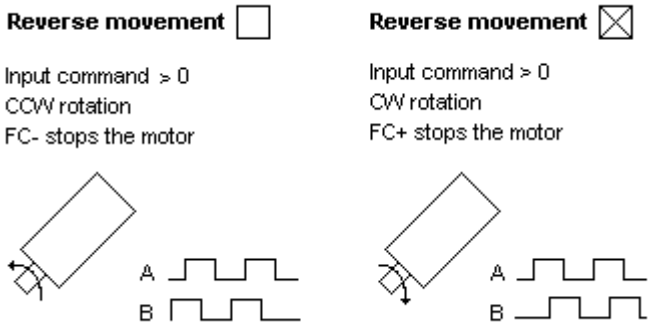
This mode corresponds to speed control of the motor that drives the spool, in order to maintain a constant material tension independently from its line speed and from the spool diameter. The motor speed reference is then calculated according to the material line speed, the spool diameter measurement and the material tension measurement.

5.2.0 Application parameters

The following parameters are accessible in the main window of **BPCW**.

The parameter **Maximum speed (rpm)** defines the maximum motor rotation speed (for the minimum spool diameter). The adjustment range is between 100 and 14000 rpm.

The function **Reverse movement** reverses the motor rotation direction with regard to the rotation direction of the material line speed measurement encoder, as shown below:



Encoder resolution parameter is accessible in the **Encoder resolution** module of the adjustment panel in the BPCW software. It defines the number of encoder pulses for one revolution of the slave motor shaft. The limit value of this parameter according to the maximum motor speed (**Maximum speed**) is indicated in the chart below:

MAX. SPEED (rpm)	900	3600	14000
MAX. ENCODER RESOLUTION	8192	4096	1024

The parameters allowing the sizing of the spool diameter sensor are accessible via the submenu **Winding/Unwinding diameter sensor scaling** of the menu **Advanced Functions**.

Spool diameter ratio (Max/Min) parameter defines the ratio between the maximum and the minimum diameters of the spool to be unwinded. The adjustment range is between 1 and 100.

Diameter sensor acquisition (V) allows the reading of the voltage given by the diameter sensor. The reading range is between 0V and 10V.

Empty spool diameter sensor value (V) defines the voltage value provided by the diameter sensor when the spool is empty (minimum diameter). The adjustment range of this parameter is between 0V and 10V.

Full spool diameter sensor value (V) defines the voltage value provided by the diameter sensor when the spool is full (maximum diameter). The adjustment range of this parameter is between 0V and 10V.

The parameters regarding the winding / unwindung tension control are accessible via the submenu **Winding / unwinding tension control setup** of the menu **Advanced Functions**.

Maximum speed variation defines the maximum value of the differential speed input command given by the PID tension regulator for the material tension control. This parameter also defines the motor rotation speed when activating the inputs **JOG+** and **JOG-** for the manual spool unwinding. The adjustment range is between 0 % and 100 % of the maximum motor speed defined by the parameter **Maximum speed**.

Tension input filter defines the cut-off frequency at -3db (Fcv) of the first order low-pass filter acting on the tension measurement signal issued from the tension cell. The value of this parameter is chosen according to the noises and disturbances of the analogue tension cell signal. The adjustment range is between 20 Hz and 1000 Hz.

Tension sensor acquisition allows the reading of the voltage **TM** issued from the tension sensor. The range is between - 10 V and + 10 V.

Tension set point 1 defines the tension input command **TS** for the tension regulator, when the logic inputs **TS1** and TS2 are both inhibited. The adjustment range is between - 10V and + 10V.

Tension set point 2 defines the tension input command **TS** for the tension regulator, when the logic input **TS1** is enabled and TS2 inhibited. The adjustment range is between - 10V and + 10V.

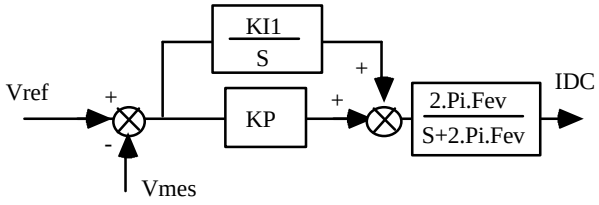
Tension set point low defines the tension reference value **TS** for the tension regulator when the logic input **TS2** is enabled. This parameter also defines the threshold corresponding to the minimum tension measurement for the detection of material breaking. The adjustment range is between - 10V and + 10V.

Tension set point ramp defines the minimum authorized response time **TL** for a variation of the tension adjustment point between 0 and the maximum value (10V). The adjustment range is between 0 and 32 seconds.

5.3.0 Regulator parameters

5.3.1 Speed regulator

The PI speed regulator structure is shown below:



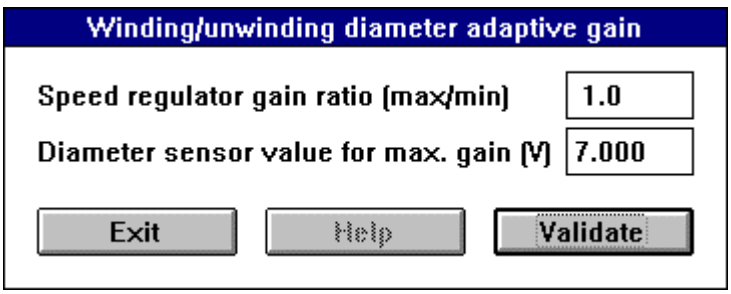
The gain parameters are automatically calculated during the **AUTOTUNING** procedure and are accessible via the submenu **Controller parameters** of the menu **Advanced Functions**.

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

Proportional tension gain parameter defines the proportional gain (KP) of the tension regulator. The adjustment range is between 0 and 128.

Integral tension gain parameter defines the integral gain (KI) of the tension regulator. The adjustment range is between 0 and 1.

The parameters regarding the automatic gain adjustment of the speed regulator according to the spool diameter are accessible via the submenu **Winding/Unwinding diameter adaptive gain** of the menu **Advanced functions**:

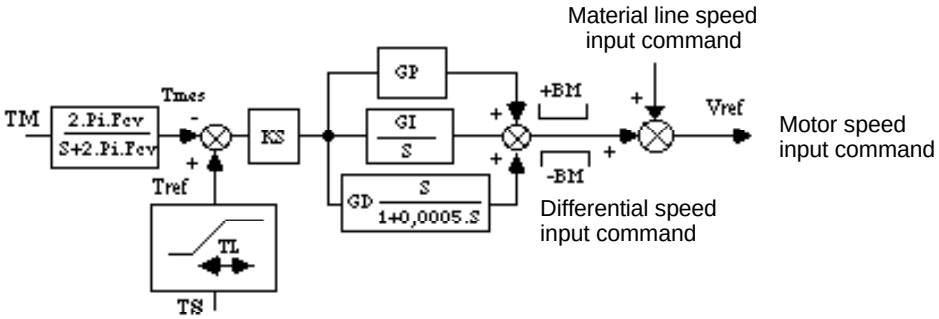


Speed regulator gain ratio (Max/Min) defines the ratio between the maximum gain of the speed regulator corresponding to the full spool (maximum diameter) and the minimum gain of the speed regulator corresponding to the empty spool (minimum diameter). The adjustment range of this parameter is between 1 and 1000.

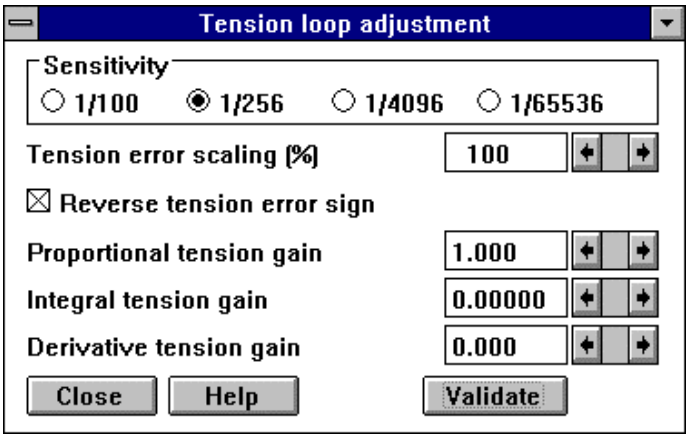
Diameter sensor value for maximum gain (V) defines the voltage value provided by the diameter sensor for which the speed regulator gain is maximum. The adjustment speed of this parameter is between 0 V and 10 V.

5.3.2 Tension regulator

The structure of the PID tension regulator is shown below:



The gain parameters of the tension regulator are accessible in the submenu **Tension loop adjustment** of the menu **Advanced Functions** of the BPCW software:



Tension error scaling defines the reduction factor **KS** acting on the tension error in order to adjust the tension regulator gains to the application specifications.The adjustment range is between 10 % and 100 %.

Reverse tension error sign function allows to reverse the tension regulator error sign according to the polarity of the tension measurement provided by the tension sensor in order to ensure servo loop stability.

Proportional tension gain parameter defines the proportional gain **GP** of the tension regulator. The adjustment range is between 0 and 256.

Integral tension gain parameter defines the integral gain **GI** of the tension regulator. The adjustment range is between 0 and 1.

Derivative tension gain parameter defines the derivative gain **GD** of the tension regulator. The adjustment range is between 0 and 256.

6.0.0 COMMISSIONING

6.1.0 Checking the configuration

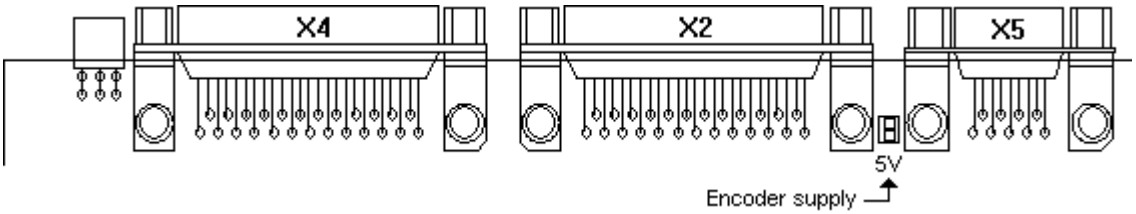
Check the amplifier standard configuration as described in Chapter 6 of the standard SMT-BD1 manual.

Check for the presence of the SMT-I3 daughter board between both logic and power boards (see chapter 8.0.0).

Check that the E and S jumpers are open on the logic board (see chapter 8.0.0)

Check for the version of the firmware memory that must be **X.X6**.

If using an external encoder for the master motor, check that the 5 V jumper is correctly made on the logic board for the encoder supply, as shown below.:



6.2.0 Applying power

Turn on the amplifier as described in Chapter 6 of the standard SMT-BD1 manual.

6.3.0 Master / Slave starting and adjustment

Start the amplifier commissioning and adjustment procedure as described in Chapter 6 of the standard **SMTBD1** manual, by means of the **BPCW** software.

6.3.1 Adjustment with empty spool

- Select the **MODIFY** function of the **ENCODER RESOLUTION** module accessible in the main BPCW window. The value of the **Encoder resolution** parameter is calculated as follows:

$$\textbf{Encoder resolution (ppr)} = \text{Line encoder resolution (ppr)} \times \frac{\text{Line encoder speed (rpm)}}{\text{Motor speed with empty spool (rpm}}$$

  Execute the function **Programmation** before leaving the module **ENCODER RESOLUTION**.

- Enter the maximum motor speed corresponding to the empty spool in the box **Rated speed** of the **Analog input** module of BPCW by selecting **Reference voltage** = **10 V**. This speed is calculated according to the minimum spool diameter and the maximum material line speed.

- Mount an empty spool corresponding to the minimum diameter and check that the motor shaft free rotation is not dangerous for operator and machine.

- Select the submenu **Winding/unwinding diameter sensor scaling** in the menu **Advanced functions**.

- Read the voltage value given by the diameter sensor (**DIAM**) for the minimum spool diameter by using the push button **Diameter sensor acquisition** and enter this value in the parameter box **Empty spool diameter sensor value**.

- Select the function **Enable winding/unwinding control** in the module **Winding/unwinding tension control setup**.

- Set at 0 the parameter **Maximum speed variation** or activate the logic input **TDI** on connector X2.

- Execute the function **AUTOTUNING** in the module **CONTROLLER** to calculate the regulator gains.
  Important note: *The **AUTOTUNING** function must always be executed with empty spool corresponding to the minimum inertia reflected to the motor.*

- Enable the motor in order to check its stability. In case of loud noises in the controlled motor, execute again the **AUTOTUNING** procedure by selecting a lower bandwidth. If the problem remains, redue the **AUTOTUNING** function by activating the antiresonance filter (**Filter = Antiresonance)**. The antiresonance filter is accessible in the BPCW software version **2.6** and up and the amplifier EPROM version **5.7** and up.

- When using a proportional speed regulator **P**, cancel the parameter **Integral 1 speed gain** in the module **Controller parameters** of the menu **Advanced functions**.

- Check the motor rotation direction with regard to the rotation direction of the line speed measurement encoder. If necessary, change the motor rotation direction by means of the function **Reverse movement** accessible in the module **Analog input**.

6.3.2 Adjustement with full spool

Use a full spool corresponding to the maximum diameter and check that the motor shaft free rotation is not dangerous for operator and machine.

- Select the submenu **Winding/unwinding diameter sensor scaling** in the menu **Advanced functions**.

- Read the voltage value given by the diameter sensor **DIAM** for the maximum spool diameter by using the push button **Diameter sensor acquisition** and enter this value in the parameter box **Full spool diameter sensor value** and then in the box **Diameter sensor value for maximum gain** of the module **Winding/unwinding diameter adaptive gain**.

- Enter the ratio value between both maximum and minimum spool diameters in the parameter **Spool diameter ratio (Max/Min)** of the module **Winding/unwinding tension control setup** in the menu **Advanced functions**.

- Enable the motor and check its stability. In case of loud noises in the controlled motor, remove the full spool and re-engage the empty one. Then, redue the **AUTOTUNING** procedure by selecting a lower bandwidth (**Bandwidth = Medium** or **Low**). If the problem remains, redue the **AUTOTUNING** procedure by activating the antiresonance filter (**Filter = Antiresonance**).

- Increase progressively the parameter **Speed regulator gain ratio (Max/Min)** in the module **Winding/unwinding diameter adaptive gain** up to the maximum possible value without noises in the motor. Do not exceed the limit value calculated by to the ratio between both full and empty spool inertias reflected to the motor shaft (Jmax motor / Jmin motor). If it is not possible to enough increase the parameter **Speed regulator gain ratio (Max/Min)** in order to obtain the required stability, remove the full spool and re-engage the empty one and renew the **AUTOTUNING** procedure by activating the antiresonance filter (**Filter = Antiresonance**).

- Check the adjustment stability up to the maximum speed of the full spool corresponding to the maximum line encoder speed. If it is not possible to move the line encoder, disable the function **Enable winding/unwinding control** in the module **Winding/unwinding tension control setup** and send manually the speed input command (**Manual**) in the box **Reference** of the main BPCW window.

- Enter the value of the parameter **Diamenter sensor value for maximum gain (V)** in the module **Winding/unwinding diameter adaptive gain** in order to define accurately the gain adjustment range according to the spool diameter. This parameter must be reduced when the value of the parameter **Speed regulator gain ratio (Max/Min)** adjusted before remains quite below the ratio between both full and empty spool inertias reflected on the motor shaft (Jmax motor / Jmin motor). This parameter can be calculated as follows:

Diameter sensor value for maximum gain (V) = Empty spool diameter sensor value (V)
+
[Full spool diameter sensor value (V) - Empty spool diameter sensor value (V)]
x
$[(\text{Speed regualtor gain ratio (Max/Min)} - 1) \times (\text{Jmin motor / Jmax motor})]^{0,25}$

6.4.0 Tension control adjustment

It is advisable to limit the motor torque (**Maximum current** parameter) during the commissioning phase in order to avoid a materiel braking in case the tension regulator becomes unstable.

- Engage the materiel in the machine and fasten it to the downstream traction system

- Read the value given by the tension sensor **TM** in the module **Winding/unwinding tension control setup** by using the push button **Tension sensor acquisition** and enter this value in the parameter box **Tension set point 1** with logic inputs TS1 and TS2 inhibited.

- Set the parameter **Maximum speed variation** at 5 % and initialize the parameter **Tension input filter** at 1000 Hz.

- Set the **Tension set point ramp** parameter at a few seconds in order to get a progressive material tension.

- Select the submenu **Tension loop adjustment** accessible via the **Advanced functions** menu of the **BPCW** software.

- Set the **Tension error scaling** parameter at 10 %.

- Set the parameters **Integral tension gain** and the **Derivative tension gain** at 0.

- Set the **Proportional tension gain** parameter at its minimum value.

- Disable the **TDI** input to enable the tension regulator and activate the ENABLE input.

- If the tension loop is instable (continuous material unwinding or saturated motor torque), select the **Reverse error sign** function.

- If the tension loop is oscillating, reduce the value of the **Tension error scaling** parameter until the loop remains stable.

- When the system is stable, increase the **Proportional tension gain** parameter up to the value where its starts oscillating; then reduce the parameter **Proportional tension gain** in order to ensure the tension stability.

- Increase progressively the parameters **Derivative Tension gain** and **Integral tension gain** in order to optimize the tension loop response in the case of a manual jerking of the spool or of the material.

- Adjust the parameter **Maximum speed variation** according to the differential speed input command that is necessary for regulating the material tension over the whole speed range (generally 5 to 10 %).
- Increase progressively the material line speed in order to check the correct operation of the winding/unwinding system over the whole speed range.

- In case of loud noises on the material tension measurement signal, reduce the parameter **Tension input filter** in the submenu **Winding/unwinding tension control setup** of the menu **Advanced functions**.

- If necessary, wire the logic input **CV0** in order to emergency stop the spool with the maximum motor torque in both rotation directions.

- When the adjustment procedure is done, select **Save parameters to EEPROM** function to store all parameters into the amplifier EEPROM.

7.0.0 FAULT FINDING

7.1.0 Operating problems

7.1.1 Loud crackling noise in the motor at standstill

Check that the Motor-Amplifier-Controller ground connections meet the requirements in Chapter 4.0.0
Check that the wiring of the incremental input meet the requirements in Chapter 4.0.0
Check that the wiring of the load cell device meet the requirements in Chapter 4.0.0

7.1.2 Loud noise in the motor at standstill and when running

Check for the rigidity of the mechanical coupling between motor and load (backlashes and elasticity's in the gearbox and coupling).

Execute the **Autotuning** function again by selecting a lower bandwidth (**Medium** or **Low**).

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

7.1.3 Loud noise in the motor when running

Select the highest position resolution on the slave motor (Encoder resolution) according to the maximum rotation speed (see chapter 5.2.0). It is also necessary to modify the master motor resolution in order to keep the same reduction ratio.

Decrease the **Tension input filter** parameter value in the **Tension control parameters** module accessible via the **Advanced Function** menu to filter the tension measurement if necessary.

8.0.0 APPENDIX

LOCATION DIAGRAM OF THE HARDWARE OPTIONS