

I N F R A N O R

OPERATING MANUAL

SERIES SMTBD1

OPTIONAL FUNCTIONS

(Version 2.0)

European version 2.0

SPINDLE ORIENTATION

OPTION “F”

This manual describes the option "F" of the SMT-BD1 amplifier: **Spindle orientation**. 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.

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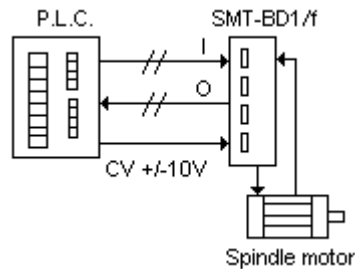
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OPERATING MANUAL
INFRANOR
SERIES SMTBD1
OPTION "F"
(July 1997)

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1.0.0 GENERAL DESCRIPTION

Applications with spindle motor indexing require the **SMT-I2** daughter board on the **SMT-BD1** amplifier. In this configuration, the **SMT-BD1/f** amplifier controls the positioning of the spindle motor shaft during tool change based on four programmable positions. The spindle motor must be fitted with a one pole pair resolver (speed 1) for the absolute definition of the four indexing positions over one motor revolution. The logic inputs and outputs which are necessary for this kind of operation, are wired on the amplifier X2 connector as shown below:



- Both logic inputs **IDX0** and **IDX1** allow the selection of the desired indexing position among the four programmed positions. When the logic input **STOP** is activated, the motor shaft stops on the position previously selected.
- The programming of the four indexing positions can be performed in teach mode by moving the motor shaft manually or by using the logic inputs JOG+ et JOG- of the X2 connector. By pressing the **OFFSET** push button of the amplifier front panel allows to store the present indexing position into the amplifier EEPROM. The four indexing positions can also be programmed by means of the **BPCW** software and stored in the amplifier.
- During the amplifier operation in speed mode, the logic output **VEL** is enabled when the motor speed is equal to the speed input command.
- During the amplifier operation in indexing mode, the logic output **POS** is enabled when the motor shaft is on the indexing position.

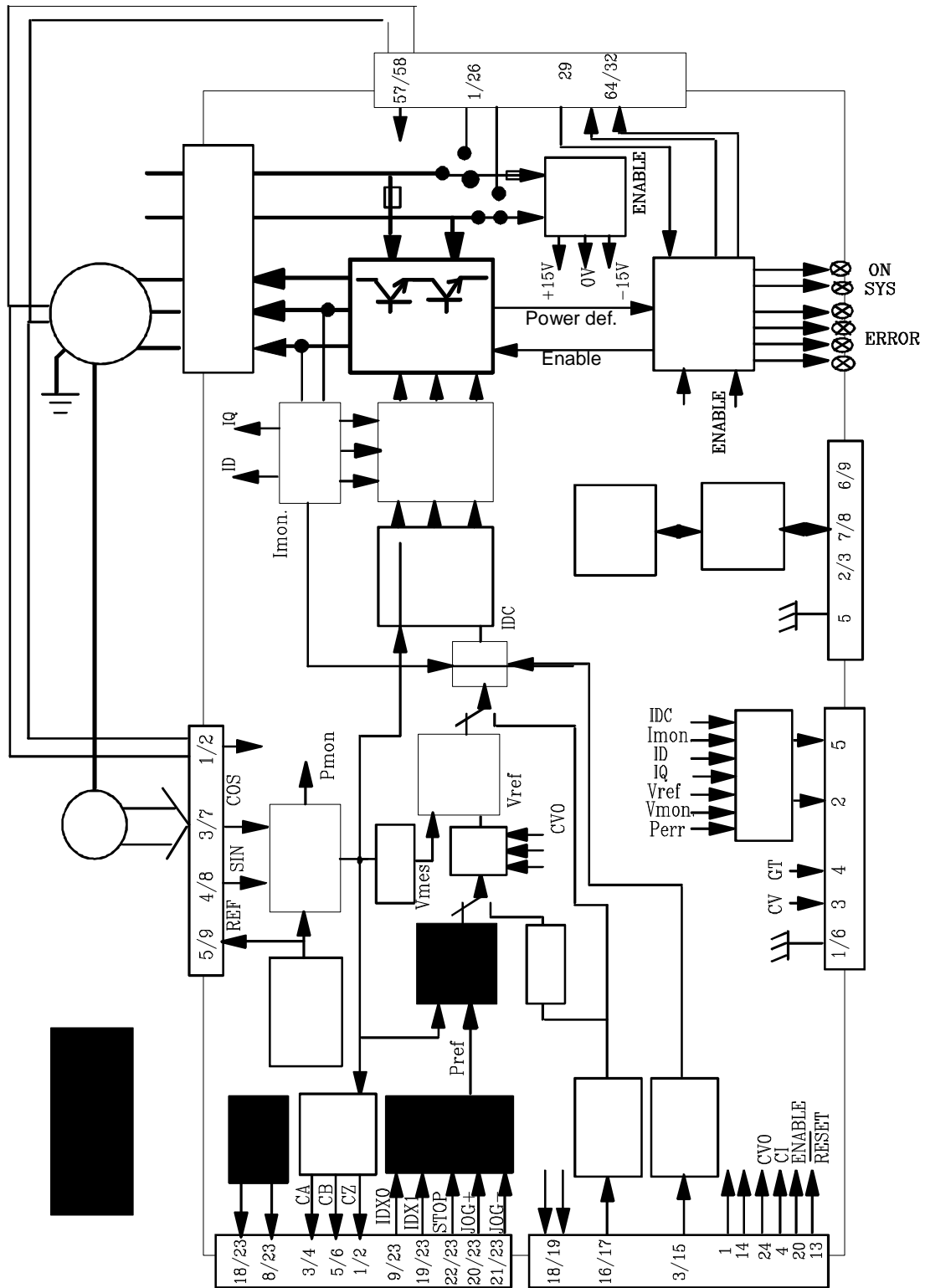
2.0.0 SPECIFICATIONS

2.1.0 Technical specifications

Logic inputs	IDX0 : Axis indexing selection (4 positions) IDX1 : Axis indexing selection (4 positions) STOP: Stop on selected indexing JOG +: Indexing displacement in positive direction JOG -: Indexing displacement in negative direction Optocoupled inputs: 5 V to 24 V
Logic outputs	VEL : "Speed input command is reached" indication. POS : "Indexing position is reached" indication. Optocoupled outputs current: 5 mA
Drive position repeatability	1 motor shaft revolution / 65536 (resolver speed 1)
Drive position accuracy *	8 Arc mins as standard (2 arc mins on special request)
Speed / position regulator	Sampling period of 0,5 ms Integrator antisaturation system Adjustable digital gains
Speed / position bandwidth	Cut-off frequency for 45° phase shift Selectable : 50 Hz, 75 Hz, 100 Hz

(*) The total accuracy must take into account the resolver accuracy

2.2.0 Amplifier block diagram



3.0.0 INPUTS - OUTPUTS

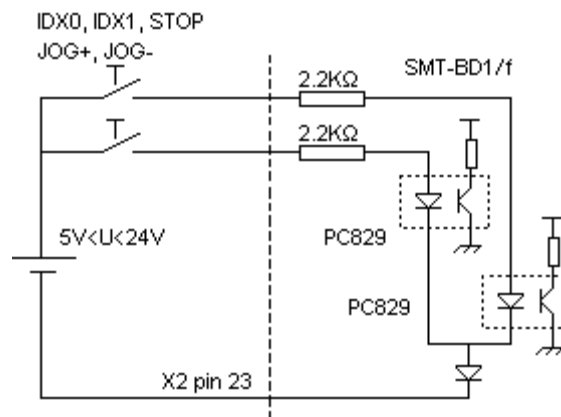
3.1.0 X2 Position connector

3.1.1 Terminal connections

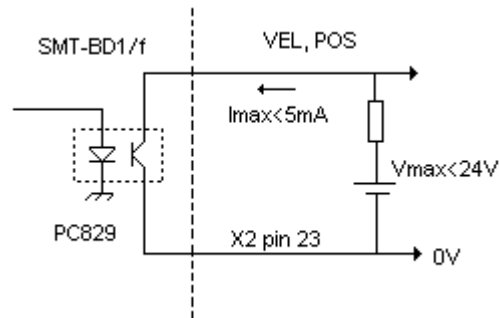
PIN	FUNCTION	I / O	REMARK
1	CZ/	O	Motor encoder output channel Z/ (5V max. current 20 mA)
2	CZ	O	Motor encoder output channel Z
3	CA/	O	Motor encoder output channel A/ (5 V max. current 20 mA)
4	CA	O	Motor encoder output channel A
5	CB/	O	Motor encoder output channel B/ (5 V max. current 20 mA)
6	CB	O	Motor encoder output channel B
7,10,11	0 V		GND
12,13,14	Reserved		Reserved
15,16,17	Reserved		Reserved
9	IDX0	I	Logic input IDX0 : Indexing selection
19	IDX1	I	Logic input IDX1 : Indexing selection
22	STOP	I	Logic input STOP : Stop on indexing
20	JOG+	I	Logic input JOG+ : Indexing displacement positive direction
21	JOG-	I	Logic input JOG- : Indexing displacement negative direction
18	VEL	O	Logic output VEL : Speed input command is reached
8	POS	O	Logic output POS : Indexing position is reached
23	0 V I/O		0 Volt logic inputs and outputs
24	+ 5 V	O	+/- 5 %, 300 mA available with jumper 5 V closed
25	0 V		

3.1.2 Logic inputs/outputs specifications

The **IDX0**, **IDX1**, **STOP**, **JOG+** and **JOG-** are optocoupled and operate in positive logic according to the diagram shown below. The input voltage corresponding to the high level 1 is between 5 and 24 V.



The **VEL** and **POS** outputs are "open collector" and "optocoupled" outputs. The transistor is inhibited as long as the output is not activated. The application scheme is shown below. The maximum output current is 5 mA.



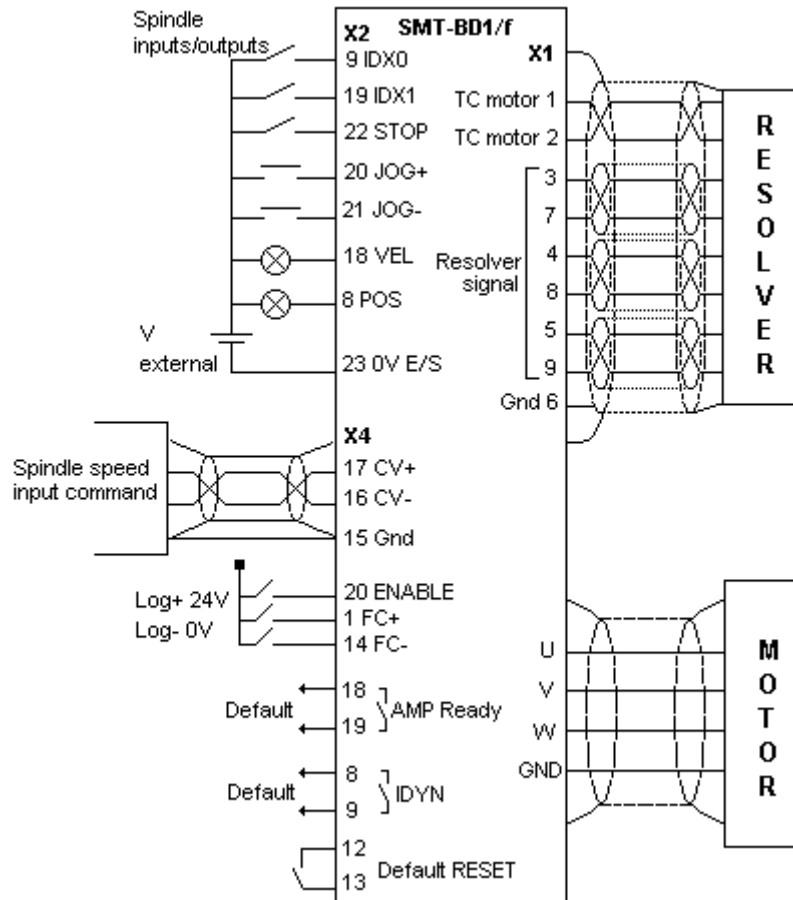
3.2.0 X3 Test connector

PIN	FUNCTION	REMARK
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 \pm max. speed
4	Speed monitor GT	± 8 V for $\pm 14\ 000$ rpm
5	DAC 2 output	± 10 V resolution 8 bits, linearity: 2% (IDC, Imon., ID, IQ, Vref, Vmon., Pos err) *

* See manual **BPCW Options**, part 2 "Digital oscilloscope".
Linearity = 10 % on logic boards 01612A, 01612B and 01612C.

4.0.0 CONNECTIONS

4.1.0 Connection diagram



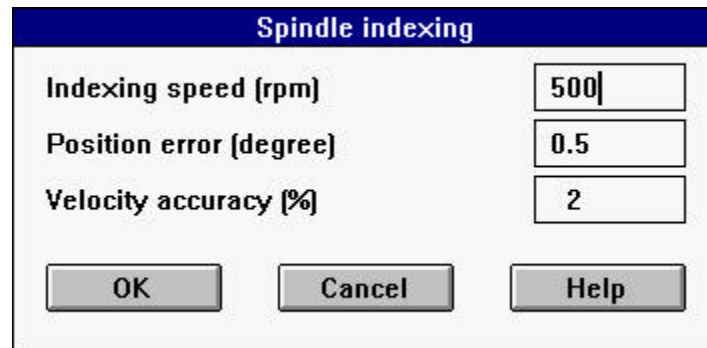
4.2.0 Wiring recommendations

For the analog input command signal CV, use a shielded twisted pair cable with a **360° shield connection via the metal plated connectors at both cable ends** (see standard manual SMT-BD1 digital drive, chapter 8, part 6). The amplifier 0 Volt (X4, pin 15) **MUST** be connected to the NC ground

The input command wiring (CV) must be made according to the polarities between both NC and amplifier (CV+ on "diff. high" of the NC).

5.0.0 ADJUSTABLE PARAMETERS

The parameters concerning the spindle drive function with axis indexing are accessible via the **Spindle indexing** and **Indexing positions** submenus of the **Advanced functions** menu in the **BPCW** software version 2.x.



The image shows a dialog box titled "Spindle indexing" with a blue header. It contains three input fields: "Indexing speed (rpm)" with the value "500", "Position error (degree)" with the value "0.5", and "Velocity accuracy (%)" with the value "2". At the bottom, there are three buttons: "OK", "Cancel", and "Help".

5.1.0 Operation mode

When the logic input **STOP** is not activated, the operation in speed mode with a **PI** or **PI²** mode is identical to the standard amplifier. The logic output **VEL** indicates that the motor speed has reached the value of its input command with the accuracy defined by the **Velocity accuracy** parameter.

When the logic input **STOP** is activated, the motor decelerates according to the ramp defined by the **Accel/Decel Time** parameter. It then moves to the indexing position selected by means of the logic inputs **IDX0** and **IDX1** according to the speed value defined by the **Parameter Indexing speed** parameter. The motor position is then controlled at this indexing position by a PID + feedforward regulator. The logic output **POS** indicates that the motor has reached the indexing position with the accuracy defined by the **Position error** parameter.

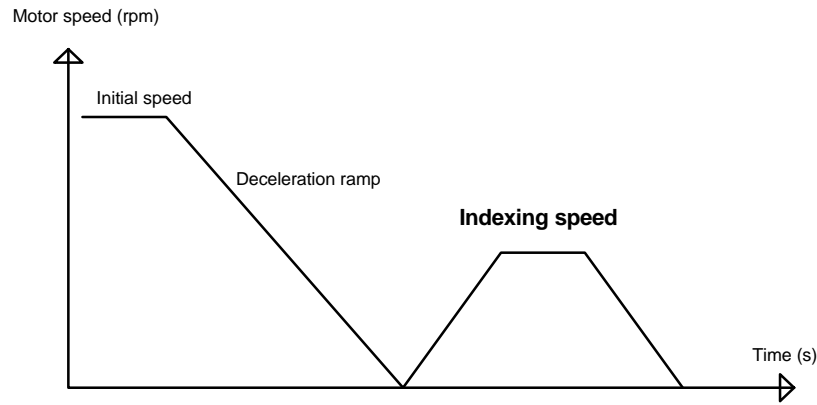
5.2.0 Application parameters

The following parameters are accessible via the **Spindle indexing** submenu in the menu Advanced functions of the **BPCW** software 2.x.

Position error parameter defines the **Position error** tolerance for the activation of the **POS** output in the indexing mode. When the logic input **STOP** is activated and when the error between both motor and indexing position is below this value, the **POS** output is activated in order to indicate that the motor has reached the indexing position. This parameter is expressed in mechanical degrees of the motor shaft (with a one pole pair resolver "speed 1"). The adjustment range is between 0 and 180°.

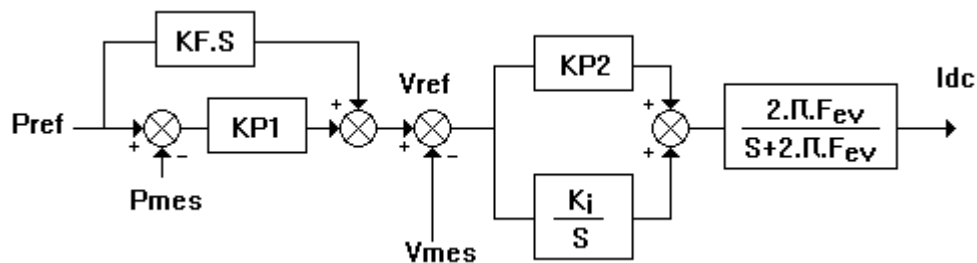
Velocity accuracy parameter defines the motor speed accuracy in % for the activation of the **VEL** output in speed control (logic input **STOP** disabled). At speeds higher than 200 rpm and when the error between the motor speed and its input command remains within the tolerance (speed input command x Velocity accuracy), the **VEL** output is activated in order to indicate that the motor has reached its input speed command. At speeds lower than 200 rpm, the **VEL** output is not activated. This parameter is expressed in %, the adjustment range is between 1 % and 50 %.

Indexing speed parameter defines the motor rotation speed during the indexing positioning mode, when the logic input **STOP** is activated. The motor decelerates according to the ramp defined by the **Accel/Decel Time** parameter. The move to the indexing position is then made according to the trapezoidal curve shown below. The deceleration and acceleration are automatically calculated in order to avoid a current saturation in the amplifier. This parameter is expressed in rpm. The adjustment range is between 2 rpm and the value of the Maximum speed parameter.



5.3.0 Position regulator parameters

The structure of the regulator used in the indexing mode with the logic input **STOP** activated is shown below.



The function Controller parameters of the menu **Advanced functions** in the **BPCW** software allows the access to all regulator parameters:

Speed error low pass filter parameter defines the cut-off frequency $a - 3 \text{ db}$ (F_{ev}) of the first order filter acting on the speed error. The value of this parameter depends on the selected bandwidth.

Proportional speed gain parameter defines the proportional gain ($KP2$) of the regulator acting on the speed error. The adjustment range is between 0 and 4095.

Integral 1 speed gain parameter defines the first integral gain (KI) of the regulator acting on the speed error. The adjustment range is between 0 and 255.

Proportional position gain parameter defines the proportional gain acting on the position error ($KP1$). The adjustment range is between 0 and 1.

Feedforward position gain parameter defines the amplitude of the anticipating term (KF) corresponding to the speed input command (derivation of the position input command). This anticipating term allows to reduce the following error during the motor acceleration and deceleration phases. The adjustment range is between 0 and 1.

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

5.4.0 Indexing positions

The four indexing position values are accessible via **the Indexing positions** submenu of the **menu Advanced functions** in the **BPCW** software version 2.x. The value range is between 0 and 360°.

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-I2** daughter board between both logic and power boards (see chapter 8.0.0).

Check for the **X.XF** firmware memory version.

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

6.2.0 Applying power

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

6.3.0 Start and adjustment

- Start the amplifier commissioning and adjustment as described in chapter 6 of the standard **SMT-BD1** manual by selecting a **PI** or **PI²** speed regulator with the **BPCW** parameter setting software.
- In case of loud noise in the motor at standstill and when running, check the transmission rigidity between motor and load (backlashes and elasticities in gearings and couplings).

If necessary, reduce the **AUTOTUNING** procedure by choosing a lower bandwidth (**Bandwidth = Medium** or **Low**). If the problem remains, reduce 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**.

- Display the **Spindle motor indexation** module accessible in the menu Advanced functions of the **BPCW** software version 2.x.
- Initialize the **Indexing speed** parameter at low value (i.e. 50 rpm) if you want a soft indexing positioning.
- Initialize the **Position error** and **Velocity accuracy** parameters according to the application.

6.4.0 Indexing positions programming

6.4.1 Programming in teach mode

- Select the code of the first indexing position on the logic inputs **IDX0** and **IDX1**.
- Activate the logic input **STOP**:
 - When the amplifier input **ENABLE** is activated, the slave motor will be controlled at the indexing position presently stored in the amplifier EEPROM. Then, use the inputs **JOG+** and **JOG-** for moving the motor shaft to the desired indexing position.
 - When the amplifier input **ENABLE** is not activated, manually move the motor shaft to the desired indexing position

- When the motor shaft is on the desired position, push the **OFFSET** push button to make the acquisition of the indexing position and store its value into the amplifier EEPROM.
- Disable the logic input STOP.
- Select the next indexing position code on the logic inputs **IDX0** and **IDX1**.
- Activate the logic input **STOP** and use the same procedure as for the first indexing position.

6.4.2 Programming with the BPCW software (version 2.x)

Indexing motor shaft positions		
Position 1 (degree)	<input type="text" value="0.00"/>	(IDX0=ON IDX1=ON)
Position 2 (degree)	<input type="text" value="90.00"/>	(IDX0=ON IDX1=OFF)
Position 3 (degree)	<input type="text" value="180.00"/>	(IDX0=OFF IDX1=ON)
Position 4 (degree)	<input type="text" value="270.00"/>	(IDX0=OFF IDX1=OFF)
<input type="button" value="OK"/> <input type="button" value="Cancel"/> <input type="button" value="Help"/>		

- Select the **Indexing positions** submenu in the **Advanced functions** menu.
- Set the four indexing position values and click "OK".
- Execute the command **Store parameters to EEPROM** before quitting the **BPCW** software.

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-Amplifiers-PLC ground connections meet the requirements of chapter 4.0.0.
Check that the wiring of the speed input command meet the requirements of 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 gearboxes and couplings).

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

If the problem remains, reduce 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 EEPROM version **5.7**.

7.1.3 Motor position oscillation at standstill

Check for the rigidity of the mechanical coupling between motor and load (backlashes and elasticity in the gearboxes and couplings).

Reduce the value of the **Proportional position gain** parameter in the **Controller parameters** submenu accessible via the **Advanced Function** menu.

8.0.0 APPENDIX

LOCATION DIAGRAM OF THE HARDWARE OPTIONS

