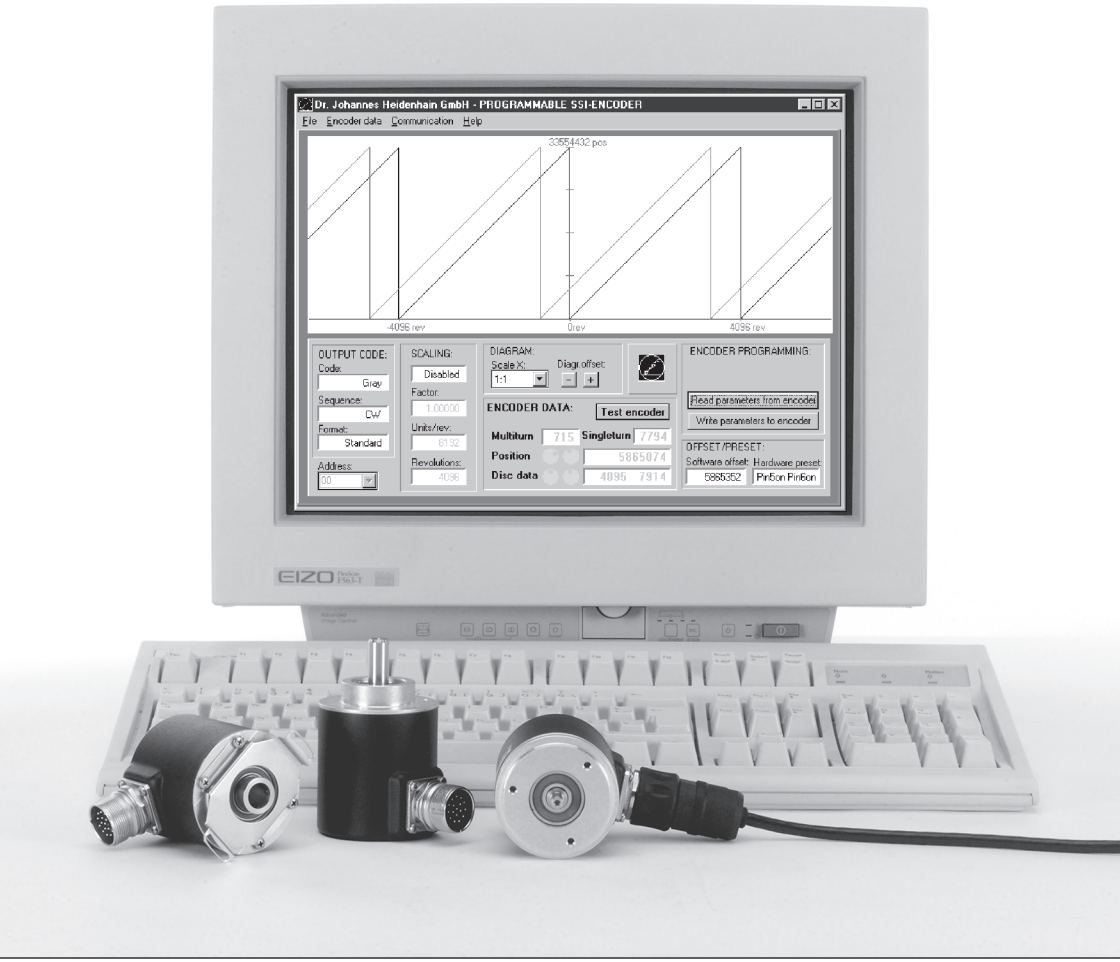


HEIDENHAIN

User's Manual

Software
for programmable
SSI encoders
Version 1.0

7/99

General Conditions for Use

1. By paying the purchase price, the buyer does not acquire the program, but rather only a temporally unlimited right to use the program.

2. The buyer is permitted to make copies of the installation disks only for backup and to copy it to his hard disk. It is prohibited to sell such copies to a third party. All rights of possession are retained by the manufacturer.

3. The transfer of the right to use the program to a third party requires the express written consent of the manufacturer. The transfer cancels the right of use for the original buyer. All backup copies must be either given along with the originals or destroyed without delay, and the manufacturer must also be informed of this accordingly.

4. The manufacturer is not liable for damages of any kind that might result from the use of this program.

Trademarks

Windows 3.1, Windows 95 and Windows NT are registered trademarks.

Contents

1 Introduction

1.1 Brief description

This software permits simple programming of HEIDENHAIN's absolute rotary encoders with programmable SSI interface using a PC. You need to program the following parameters and functions:

Interface variables	• Output format of the position values in Gray or pure binary code • Data format: tree (Tannenbaum) format (SSI) or standard synchronous-serial right-aligned • Direction of rotation for increasing position values*
Scaling setting	• Singleturn resolution up to max. 8192 positions per revolution • Multiturn resolution up to max. 4096 distinguishable revolutions
Offset/preset values	For zero reset, preset or compensation*

*) Also possible with hardware programming via connecting element

In addition, you can check the values you have set. This is particularly important for exchange of units.

Before commissioning, ensure that the programmable encoders have the correct settings. Otherwise under certain circumstances, the default settings may lead to serious malfunction of the machine!

The programming software with user's manual can be ordered from your HEIDENHAIN agent under the Ident-Nr. 331 423-01.

1.2 PC requirements

You need the following hardware:

- ➤ Minimum requirement: IBM or 100% IBM-compatible PC
- ➤ Recommended hardware: 486 or later

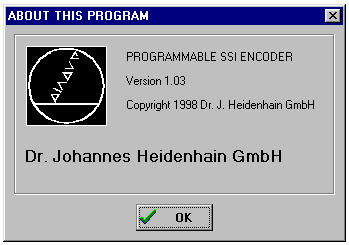
You need the following software:

- ➤ Windows 3.1
- ➤ Windows 95
- ➤ Windows NT

1.3 Software information

You can check the version number of the programming software under the menu item *Help – About*.

The following screen appears:



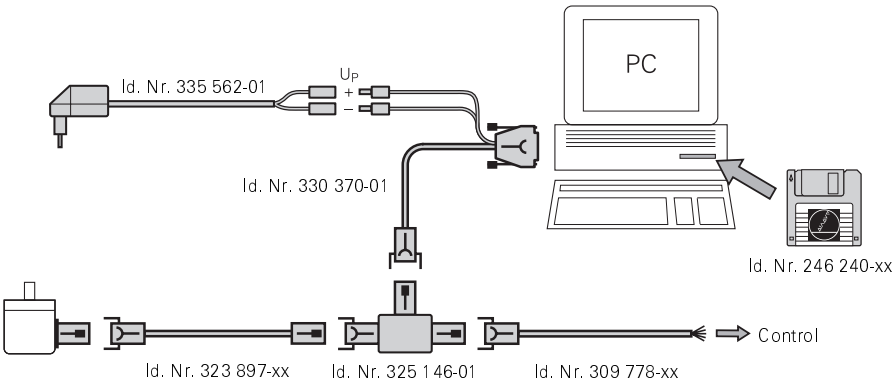
If problems occur when you are programming SSI encoders, please contact your nearest HEIDENHAIN agent.

2 Programming Accessories and Assembly

The following items can be ordered as accessories:

Programming cable	Id. Nr. 330 370-01
Power cord (220 V ac)	Id. Nr. 335 562-01
T-junction	Id. Nr. 325 146-01
Cable assembly encoder to T-junction	Id. Nr. 323 897-xx
Cable assembly T-junction to PLC	Id. Nr. 309 778-xx

Assembly



Connections

The programming cable connects the encoder with the COM interface of the PC either directly or via T-junction. It also serves as a power supply (Up = 10 to 30 V) if no control is connected.

The encoder can then be programmed or checked, while locked in a closed loop.

3 Commissioning the Software

3.1 Installing under Windows 3.x

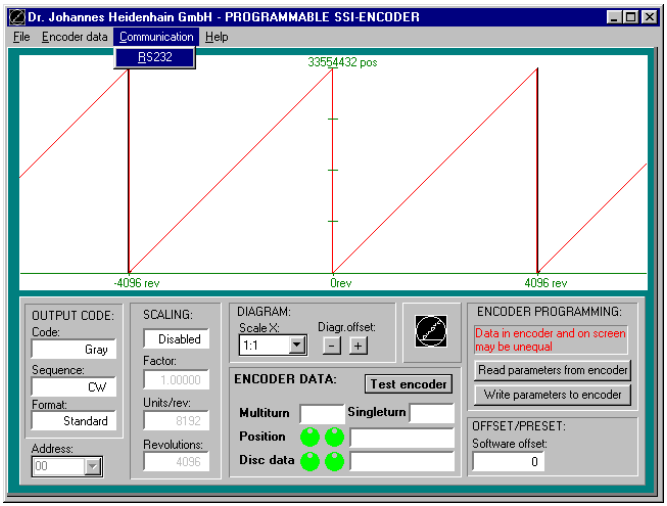
Place the disk in your disk drive.
Select the disk drive in the File Manager.
In the directory `..:\English`, select the file `Setup.exe` and follow the installation program.
To start the program, call `"PROGSSI.exe"`.

3.2 Installation under Windows 95/NT

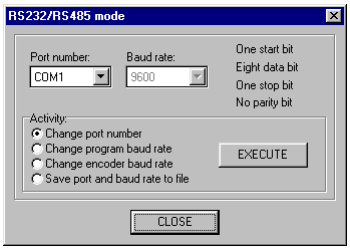
Place the disk in your disk drive.
Select the disk drive in the Explorer.
In the directory `..:\English`, select the file `Setup.exe` and follow the installation program.
To start the program, call `"PROGSSI.exe"`.

3.3 Setting RS-232-C transfer

Once you have started the programming software, you need to set the parameters for the RS-232-C interface on the PC.
Select the menu item *Communication – RS232*.



The following window opens:



In the roll-down menu *Port number*, select the COM address to which the programming cable is connected.

The functions *Change program baud rate* and *Change encoder baud rate* are not active. The baud rates may not be changed by the user.

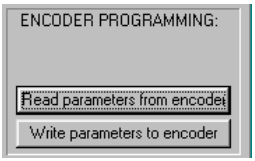
Default setting:
Port: COM 2
Baud rate: 9600 kilobaud

If you want to save the set interface parameters on your PC, activate the function *Save port and baud rate to file,* and press *EXECUTE.*

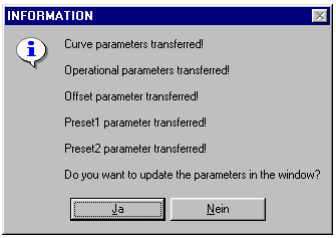
4 Programming

Programming is carried out by entering all of the desired parameter data in the corresponding Windows input masks and then transferring this data to the absolute rotary encoder.

Before you begin entering data, you must upload the parameters of the encoder to be programmed into your software. Activate the function *Read parameters from encoder*. The parameter fields of the program mask now adapt to suit the software version of the encoder.



If the parameters are uploaded successfully, the following display appears:

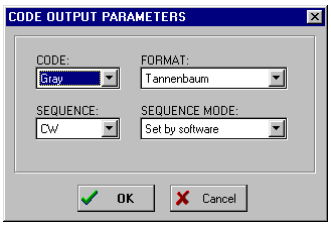


Press *Ja* to show the transferred parameters in the display windows of the program mask.

4.1 Interface variables

To set the interface variables, click on one of the white text fields under *OUTPUT CODE*.

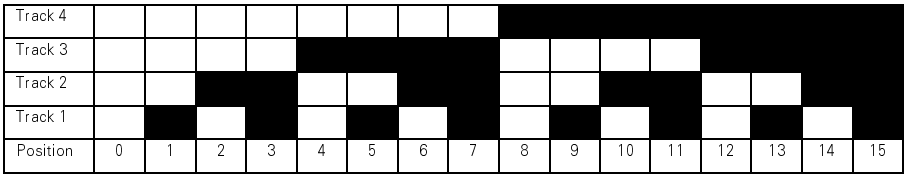
The following input mask appears:



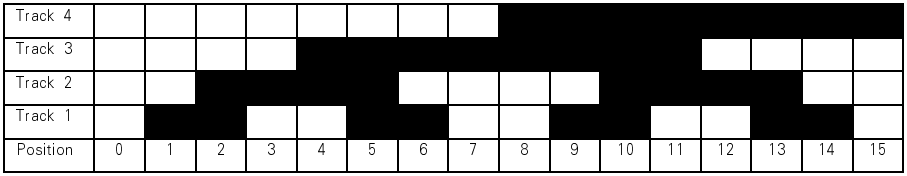
4.1.1 Codes

The rotary encoders offer two possibilities for transferring the absolute position values.

Pure binary code
With the pure binary code, the numerical value is formed of powers to the base 2. Thus the integer value 13 is equal to **1** x 2^3 + **1** x 2^2 + **0** x 2^1 + **1** x 2^0 = 13,
i.e. 13 is represented in pure binary code as 1101.



Gray code
The characteristic feature of the Gray code is its unit distance, which means any two successive position values differ only in one code value. Thus the maximum read error between one position and the next corresponds to 1/4 grating period of the finest track.



To select the correct code, please read the description of your interface card to check which code can be processed.

4.1.2 Data format

Two transfer formats are possible with synchronous serial interfaces.

Tree (Tannenbaum) format (SSI)
With SSI transfer of the position values in tree format, a distinction is always made between the multiturn part (12 bits = 4096 revolutions) and the singleturn part (13 bits = 8192 positions per revolution). Thus, data bits are always transferred in 25 clock pulses, the data assignment of which however can vary. A reduced resolution of the multiturn part due to scaling is filled in with preceding zeros. If the singleturn resolution is reduced, the zeros are filled in at the end.

Example: 12 bits singleturn; 9 bits multiturn (Gray code)

Clock	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
4096	U12	U11	U10	U9	U8	U7	U6	U5	U4	U3	U2	U1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	**8192**
2048	0	U11	U10	U9	U8	U7	U6	U5	U4	U3	U2	U1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	0	**4096**
1024	0	0	U10	U9	U8	U7	U6	U5	U4	U3	U2	U1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	0	0	**2048**
512	0	0	0	U9	U8	U7	U6	U5	U4	U3	U2	U1	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	0	0	0	**1024**
8	0	0	0	0	0	0	0	0	0	U3	U2	U1	P1	P2	P3	P4	0	0	0	0	0	0	0	0	0	**16**
4	0	0	0	0	0	0	0	0	0	0	U2	U1	P1	P2	P3	0	0	0	0	0	0	0	0	0	0	**8**
2	0	0	0	0	0	0	0	0	0	0	0	U1	P1	P2	0	0	0	0	0	0	0	0	0	0	0	**4**
Multiturn Number of revolutions													**Singleturn** Positions per revolution													

Example for non-binary scaling:
Singleturn: 360 positions,
Multiturn: 5 revolutions (pure binary code)

Clock	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
	0	0	0	0	0	0	0	0	0	2^2	2^1	2^0	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	0	0	0	0	
	0	0	0	0	0	0	0	0	0	Values from 1 to 5			Values from 0 to 359									0	0	0	0	
Multiturn Number of revolutions													**Singleturn** Positions per revolution													

Synchronous-serial right-aligned data format
Like with SSI/tree format, the encoder also outputs data bits in 25 clock pulses with standard right-aligned format. If the output is scaled however, all of the filled-in zeros precede the data bits of the total position information (= multiturn positions x singleturn positions).

Example: 12 bits singleturn; 9 bits multiturn (pure binary code)

Clock	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	0	0	0	0	2^{20}	2^{19}	2^{18}	2^{17}	2^{16}	2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
	0	0	0	0	Values from 0 to 2 097 151 Positions per revolution x number of revolutions																				

Example for non-binary scaling:
Singleturn: 360 positions,
Multiturn: 5 revolutions (pure binary code)

Clock	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2^{10}	2^{9}	2^{8}	2^{7}	2^{6}	2^{5}	2^{4}	2^{3}	2^{2}	2^{1}	2^{0}
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Values from 0 to 1799 Positions per revolution x number of revolutions										

To select the correct code, please read the description of your interface card to check which code can be processed.

Note:
If the total resolution (measuring steps/revolution x number revolutions) set during scaling < 8192, the position value is transferred automatically with 13 clock pulses.
If the total resolution > 8192, the position value is transferred with 25 clock pulses.

4.1.3 Direction of rotation

You can set the direction of rotation for increasing position values in the input box *SEQUENCE*.

- **Clockwise (CW):**
  Increasing position values with clockwise rotation, viewed from encoder shaft side.
- **Counterclockwise (CCW):**
  Increasing position values with counterclockwise rotation, viewed from encoder shaft side.

Setting the direction of rotation
You can change the direction of rotation for increasing position values either via software programming or via hardware programming.

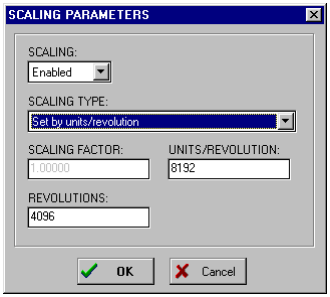
Software programming
If programming via software is selected, the direction of rotation for increasing position values cannot be changed when the encoder is in operation.

Hardware programming (pin 2)
If pin 2 (hardware) is selected, and the voltage is permanently supplied to pin 2 of the connecting element, the direction of rotation for increasing position values can be changed without any software programming.

4.2 Scaling setting

To set the scaling factor, click on one of the white text fields under *SCALING*.

The following input mask appears:



Activate scaling by setting the SCALING to Enabled.

Type of scaling
There are two possibilities for scaling the encoder:

- **Units/revolution**
  Enter the number of measuring steps per revolution in the corresponding text field. The encoder calculates the corresponding scaling factor and outputs the programmed number of measuring steps per revolution.

- **Scaling factor**
  Enter the scaling factor less than 1. The encoder uses this factor to calculate the basic resolution with 8192 increments according to the formula:

  Measuring steps/revolution = scaling factor x 8192 increments

  The accuracy of the internal calculation is ± 1 measuring step per revolution.

Number of revolutions
Here you set the number of revolutions which should be completed before the encoder returns to position value 1. In this way it is possible to limit the total measuring range or generate defined zero crossovers.

4.3 Offset/Preset values

Offset

The offset value is used to correct the current position value. The result is a new position value.

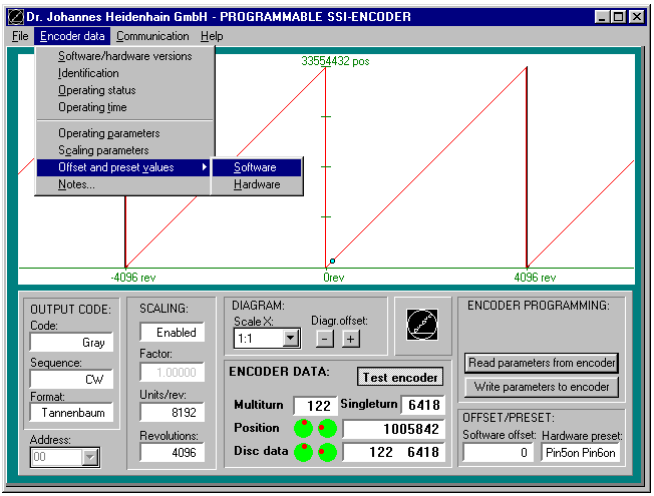
New position value = position value minus offset

Preset value

The preset value function sets the current position value to the desired preset value. Thus adjusting the encoder to the machine axis is possible.

New position value = preset value

When programming offset and preset values, you first need to define whether the functions will be executed via *software programming* or via *hardware pins* on the connecting element. This setting can be made under *Encoder data — Offset and preset values*.



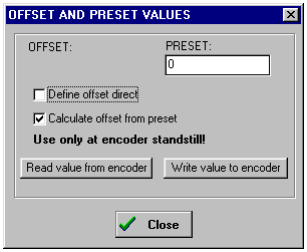
If you select *Software*, you can set just **one** preset or offset value. The value may only be set in programming mode.

If you select *Hardware*, you can store any **two** preset values in the encoder. These values are transferred if U_P (t > 1 ms) is supplied for a short time to the corresponding hardware pins (pin 5 or pin 6) of the connecting element.

4.3.1 Offset and preset values ... via *Software*

You can set the software programming option by selecting *Software* under the roll-down menus *Encoder data* and *Offset and preset values*, or by clicking on the white input box **Software offset.**

The following input mask appears:

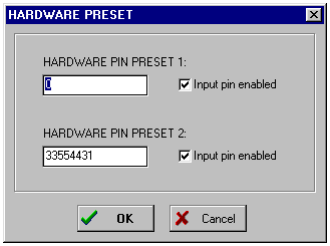


Select *Define offset direct* or *Calculate offset from preset* and enter the required value in the corresponding field. Press *Write value to encoder* and the encoder carries out the position calculation.

4.3.2 Offset and preset values ... via *Hardware*

You can set the hardware option by selecting *Hardware* under the roll-down menus *Encoder data* and *Offset and preset values*, or by clicking on the white input box **Hardware preset.**

The following input mask appears:



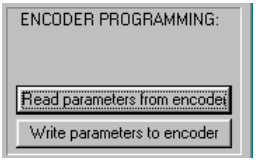
You can store any two position values as preset value 1 and preset value 2. To activate the two preset values, mark the corresponding control fields and close the window by clicking on *OK*.

Default setting:

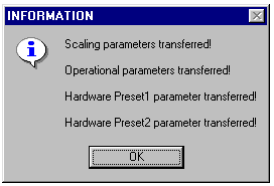
Preset value 1:		
Hardware pin 5	0	(preassigned with the encoder zero position)
Preset value 2:		
Hardware pin 6	33554431	(preassigned with the encoder end position)

4.4 Parameter transfer

Once you have set or changed data in the corresponding parameter input fields, the new parameters are transferred when you press *Write parameters to encoder*.

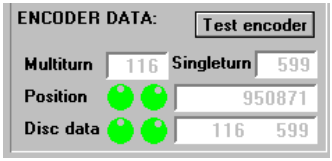


Successful transfer is confirmed with the following message, which you acknowledge with *OK*:



5 Checking the Encoder

When you click on the field *Test encoder*, the position fields are activated and the graphic display updated:



5.1 Position fields

The position values have the following meaning:

- **Multiturn** Current revolution of the programmed number of revolutions
- **Singleturn** Current singleturn position value of the programmed resolution per revolution
- **Position** Current position value = revolution number x singleturn position value
- **Disc data** Non-scaled encoder position value

5.2 Graphic display

The programmed parameters are illustrated in the graphic display. In particular we can see the position of the scaled position value in relation to the basic value.

The values represented in green show the maximum resolution and the maximum number of possible revolutions for the encoder being used.

The scaled resolution is represented in red. The increasing edge of the sawtooth curve shows the scaled measuring range.

The blue point shows the current scaled position value of the rotary encoder.

6 Storing the Encoder Parameters

You are advised to store the set encoder parameters in a data file. This is particularly useful when the encoder is being exchanged.

Click on *File* in the main menu and then on *Save as* in the roll-down menu which appears.
Make sure that you have saved **all** of the different parameter values, so that in the future all of the data (unit designation, series no., etc.) can be retraced.

7 Further Encoder Information

Using the programming software, it is also possible to interrogate encoder-internal data via the RS-232-C interface. Select the information you wish to poll under *Encoder data.*

7.1 Software and hardware version

Under the menu item *Software/hardware versions*, you will find the versions of the software and hardware of the encoder being used.

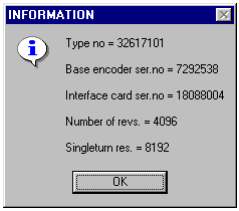
7.2 ID and series numbers

Under the menu item *Identification,* the following information can be interrogated:

- ID number of the encoder
- Series number of the encoder
- Series number of the microprocessor board
- Maximum number of distinguishable revolutions
- Maximum number of programmable steps per revolution

This information allows you to identify clearly the encoder you are using, but **does not provide any insight into the programmed parameters**.

The following mask appears:



7.3 Operating status

Programmable encoders offer reliable diagnosis possibilities. A differentiation is made between alarms and warnings.

Alarms

Alarms are triggered if proper functioning of the encoder is being impaired by some disturbance. The reliability of the position value can no longer be guaranteed.

Possible alarm messages are as follows:

- Position error:
  The code connection in the encoder is no longer correct.
- Supply voltage error:
  The power supply is outside the specified range.
- Current too high:
  The unit is drawing too much current.
- Commissioning diagnostics:
  An error occurred in the system diagnosis during setup procedure.
- Memory error:
  The parameters could not be stored in the memory IC.

Warnings

Warnings are triggered if the encoder is no longer functioning properly. The reliability of the position value can no longer be guaranteed.*)

Possible warning messages are as follows:

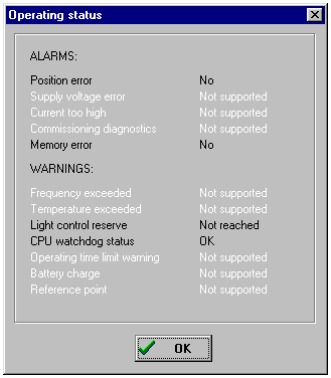
- Frequency exceeded:
  The number of revolutions per minute is outside the specified range.
- Temperature exceeded:
  The operating temperature is outside the specified range.
- Light control reserve:
  The light unit can no longer be adjusted.*)
- CPU watchdog status:
  The CPU unit has revealed an operating defect.*)
- Operating time limit warning:
  The maximum specified operating time for the encoder has been reached.*)

*) Exchange of the encoder unit is recommended at the next servicing.

- Battery charge:
  The charging strength of the battery is no longer sufficient.
- Reference mark:
  The reference mark has been reached on the unit.

Different programmable encoders support different alarms and warnings. The functions supported on a particular unit are shown in black. Functions not supported are shown in white.

The following mask appears:



7.4 Operating time

While the encoder is under power, the operating time of the unit is stored every 6 minutes in 0.1h intervals.

The following mask appears under *Operating time:*