Programming terminal

PT100N

_CE Parallel
_CE Synchronous serial
_CE Incremental serial
_CE MLD - cam switch 8 / 18 cams
_LA Parallel
_LA Synchronous serial
_LA Incremental serial
_LA Cam switch 8 cams

User Manual

TR - E - BA - GB - 0012 - 04 07/06/2015

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Font styles

Italic or **bold** font styles are used for the title of a document or are used for highlighting.

`Courier` font displays text, which is visible on the display or screen and software menu selections.

" < > " indicates keys on your computer keyboard (such as <RETURN>).

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First release	02/28/96	00
New soft version PT 100N V2.1a Supplementation: menu chart New: chapter "EPROG DIALOG (Version 2.1a and above)"	12.02.96	01
Correction: Page 38, chap. 4.3.1.17 Preset position: "The **CE-MLD (without version V001) cam switch with 18 cams** does not support the preset function" was deleted, since the encoder supports the preset function.	19.11.99	02
Additional notes for the LA-Camshaft-Gear (LA-NSW) Chapter "Steps / length", page 36 Chapter "Correction value", page 45	03.09.02	03
General updates	07/06/15	04

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1 Safety instructions

NOTICE means that damage to property can occur if the required precautions are not met.

indicates important information or features and application tips for the product used.

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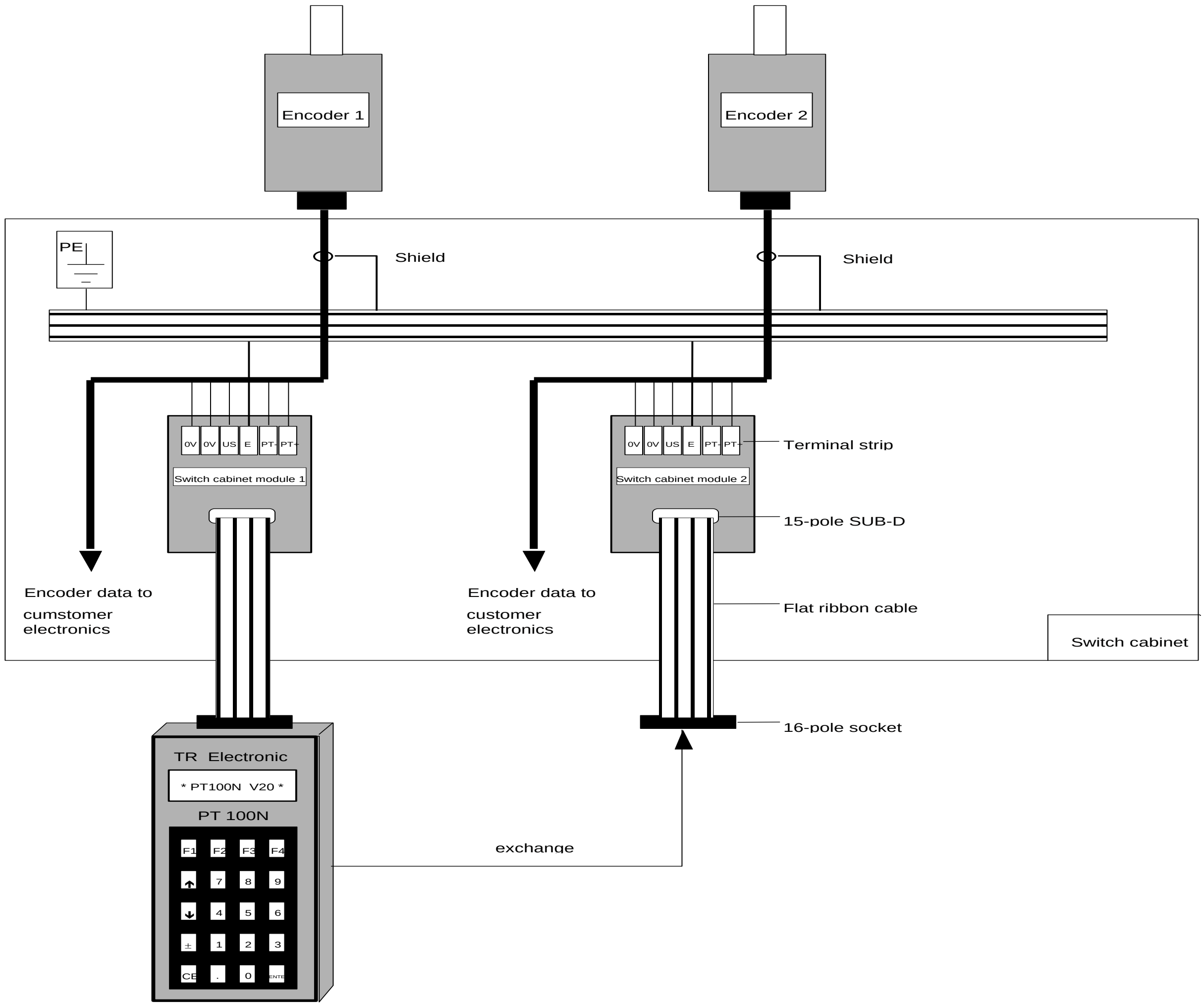
2 Wiring example for the programmable encoders



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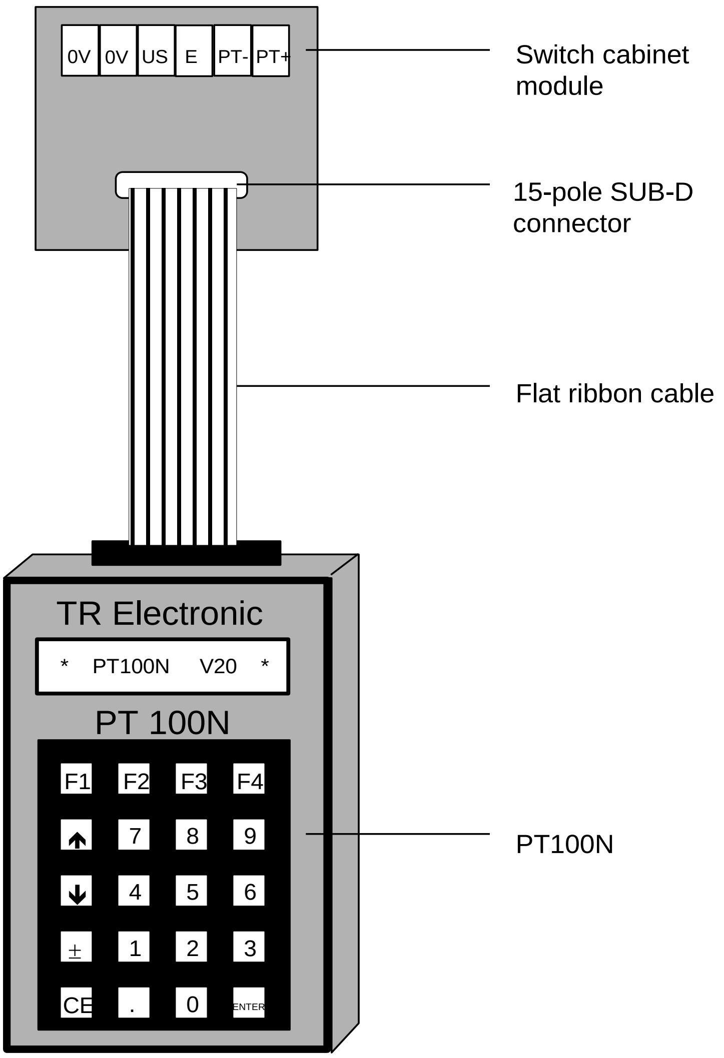
3 Switch on PT100N and encoder

- Connect PT100 with 15-pole SUB-D connector to switch cabinet module.
- Switch on the power supply.
- The display indicates: `*   PT100N   V20   *`



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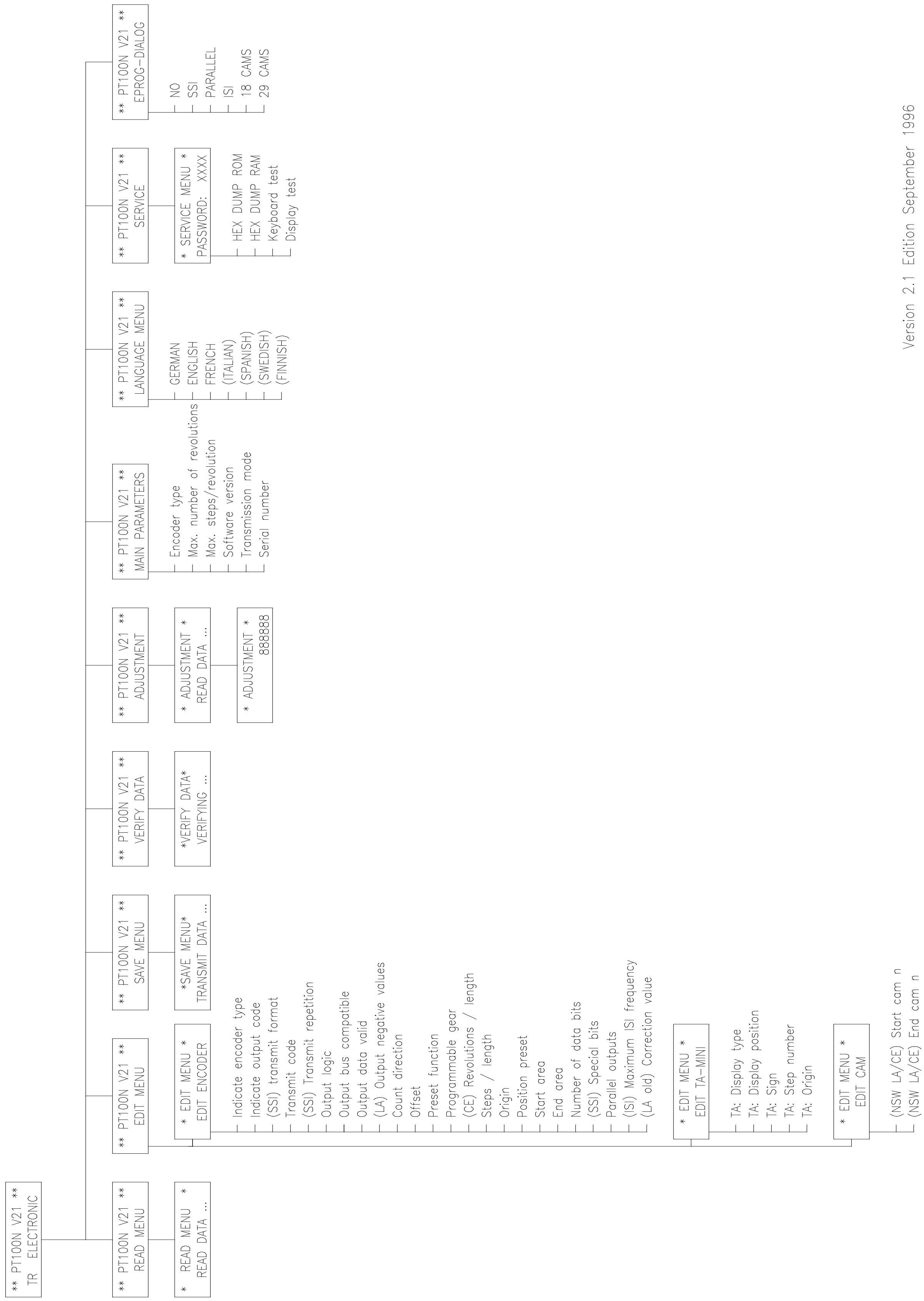
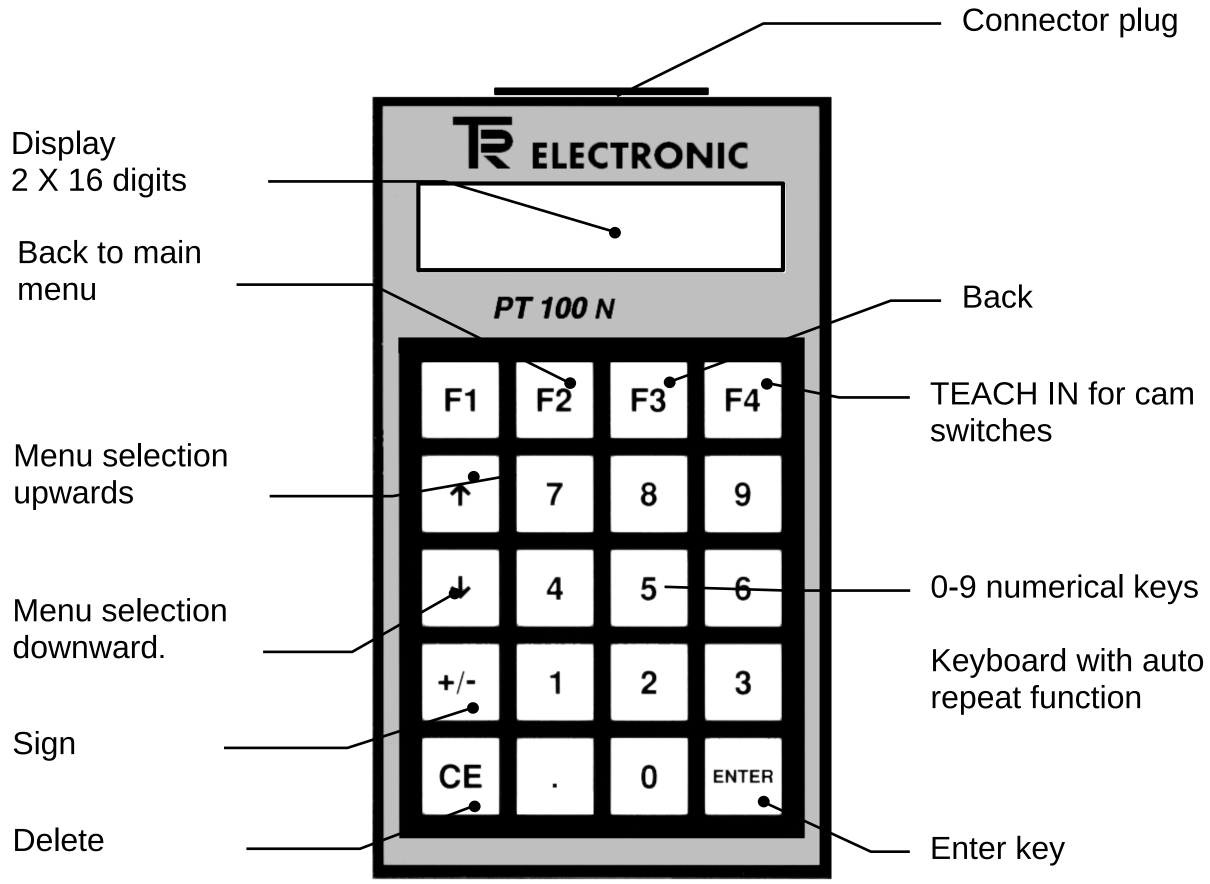
4 Menu chart



** PT100N V21 **
TR ELECTRONIC
** PT100N V21 **
READ MENU
* READ MENU *
READ DATA ...
** PT100N V21 **
EDIT MENU
* EDIT MENU *
EDIT ENCODER
Indicate encoder type
Indicate output code
(SSI) transmit format
Transmit code
(SSI) Transmit repetition
Output logic
Output bus compatible
Output data valid
(LA) Output negative values
Count direction
Offset
Preset function
Programmable gear
(CE) Revolutions / length
Steps / length
Origin
Position preset
Start area
End area
Number of data bits
(SSI) Special bits
Parallel outputs
(ISI) Maximum ISI frequency
(LA old) Correction value
* EDIT MENU *
EDIT TA-MINI
TA: Display type
TA: Display position
TA: Sign
TA: Step number
TA: Origin
* EDIT MENU *
EDIT CAM
(NSW LA/CE) Start cam n
(NSW LA/CE) End cam n
** PT100N V21 **
SAVE MENU
SAVE MENU
TRANSMIT DATA ...
** PT100N V21 **
VERIFY DATA
VERIFY DATA
VERIFYING ...
** PT100N V21 **
ADJUSTMENT
* ADJUSTMENT *
READ DATA ...
* ADJUSTMENT *
888888
** PT100N V21 **
MAIN PARAMETERS
Encoder type
Max. number of revolutions
Max. steps/revolution
Software version
Transmission mode
Serial number
** PT100N V21 **
LANGUAGE MENU
GERMAN
ENGLISH
FRENCH
(ITALIAN)
(SPANISH)
(SWEDISH)
(FINNISH)
** PT100N V21 **
SERVICE
* SERVICE MENU *
PASSWORD: XXXX
HEX DUMP ROM
HEX DUMP RAM
Keyboard test
Display test
** PT100N V21 **
EPROG-DIALOG
NO
SSI
PARALLEL
ISI
18 CAMS
29 CAMS
Version 2.1 Edition September 1996

4.1 Operation

Overview of the operating panel



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Operation:

After switch-on the main menu appears when pressing any key.

Use the cursor keys to change between the different menus.

Confirm any selection or entry with the ENTER key.

The actual menu quits automatically with the last confirmation. The next menu item is indicated automatically after correct operation. If a modification routine is interrupted the next menu will not be indicated.

Each function can be canceled with F2. Data which have been modified and confirmed with the ENTER key will be kept.
Go back by pressing key F2 several times.

The key assignment within the menu functions is as follows:

F2 :	**F3 :**	**CURSOR KEYS:**	**ENTER :**
Cancel	Back	Selection	Confirmation and next

Data can be transmitted as often as required, even if another encoder is used.
Modified data are available, until the power supply is switched off.

A direct selection of the language is possible with the keys F1, F2 or F3. The respective key must be pressed when switching on the power supply.

With EPROG encoders the data verification may lead to an error message because of different internal checks. Please read data again and check in „EDIT“ menu.

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4.2 Read Menu

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

The encoder data are normally saved in the encoder itself. In order to change them they have to be transmitted to the PT100N. This procedure is done in the Read menu.

If no valid data are loaded, some of the following menu items cannot be activated.

Data which have been loaded are available until the power supply is switched off. It is possible to copy data from one encoder to another encoder of the same design.

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4.3 Edit Menu

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

This central menu item has three further sub-menu items. Set the new encoder data here. Dependent on the encoder connected, the following sub-menu items are available:

- EDIT ENCODER
  Modification of all encoder-specific parameters

- EDIT CAMS
  Modification of the cam parameters for cam switches

- EDIT TA-MINI
  Modification of all TA-Mini-specific parameters

Use the cursor keys to select the corresponding sub-menu. The menu selected is indicated when pressing the Enter key.

Within these menus the Enter key must be used to change to the next function. Go back to the previous function with F3.

Selection is done with the cursor keys and confirmed with the Enter key.

Edit functions can be confirmed direct or, after a modification, must be completed with the Enter key. An invalid value is corrected automatically by the PT100N. Confirm the valid value then with the Enter key.

If an entry is canceled with F3, the previous function is indicated . Modified values of the canceled function are not accepted.

When the Edit menus are canceled with F2 the complete editing becomes invalid, the data confirmed so far, however, will be kept. To save the data after cancellation is not possible.

When the editing is proceeded continuously the next menu appears automatically after all data of the current menu have been edited. The „SAVE“ menu on a higher level appears after the last submenu has been edited.

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4.3.1 Edit Encoder

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

The functions which can be selected here are independent from the encoder connected and the parameters set. Functions which are not supported by the encoder will not be indicated.

Functions that are excluded by previous parameters will not be indicated as well.
E.g. preset values, if the preset inputs are locked, that means if „LOCKED“ has been selected in the function „PRESET REACTION“, the function „PRESET POSITION“ which normally follows, will not be indicated.

The following functions are available for the respective encoders:

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The following functions are available for the **encoder CE with parallel interface**:

Sub-menu: EDIT ENCODER

- Display encoder type	not changeable
- Display output mode	not changeable
- Transmit code	
- Output logic	
- Output bus compatible	
- Output data valid	
- Count direction	
- Offset	
- Preset function	
- Programmable gear	
- Revolutions / length (Numerator and denominator for gears)	
- Steps / length	
- Origin	
- Position preset	
- Start area	
- End area	
- Number of data bits	
- Parallel outputs	

Sub-menu: EDIT TA-MINI

- TA: Display type
- TA: Display position
- TA: Signs
- TA: Steps/length
- TA: Origin

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☐ CE-Parallel ☒ CE-SSI ☐ CE-ISI ☐ CE-NSW ☐ LA-Parallel ☐ LA-SSI ☐ LA-ISI ☐ LA-NSW

The following functions are available for the **encoder CE with synchronous-serial interface**:

Sub-menu: EDIT ENCODER

-	Display encoder type	not changeable
-	Display output mode	not changeable
-	Transmit format	
-	Transmit code	
-	Transmit repetition	
-	Count direction	
-	Offset	
-	Preset function	
-	Programmable gear	
-	Revolutions / length (Numerator and denominator for gears)	
-	Steps / length	
-	Origin	
-	Position preset	
-	Start area	
-	End area	
-	Number of data bits	
-	Special bits	

Sub-menu: EDIT TA-MINI

- TA: Display type
- TA: Display position
- TA: Signs
- TA: Steps/length
- TA: Origin

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The following functions are available for the **encoder CE with incremental-serial interface**:

Sub-menu: EDIT ENCODER

-	Display encoder type	not changeable
-	Display output mode	not changeable
-	Count direction	
-	Offset	
-	Preset function	
-	Programmable gear	
-	Revolutions / length (Numerator and denominator for gears)	
-	Steps / length	
-	Origin	
-	Position preset	
-	Start area	
-	End area	
-	Maximum transmission frequency	

Sub-menu: EDIT TA-MINI

- TA: Display type
- TA: Display position
- TA: Sign
- TA: Steps/length
- TA: Origin

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☐ CE-Parallel ☐ CE-SSI ☐ CE-ISI ☒ CE-NSW ☐ LA-Parallel ☐ LA-SSI ☐ LA-ISI ☐ LA-NSW

The following functions are available for the **encoder CE MLD (without version V001) with cam switch**:

Sub-menu: EDIT ENCODER

-	Display encoder type	not changeable
-	Display output mode	not changeable
-	Count direction	
-	Offset	
-	Preset function	
-	Programmable gear	
-	Revolutions / length (Numerator and denominator for gears)	
-	Steps / length	
-	Origin	
-	Position preset	

The following functions are only available for the **encoder CE MLD (without version V001) with cam switch with 8 cams**:

Sub-menu: EDIT TA-MINI

- TA: Display type
- TA: Display position
- TA: Sign
- TA: Steps/length
- TA: Origin

The following functions are available for the **encoder CE MLD (without version V001) with cam switch and 8 or 18 cams**:

Sub-menu: EDIT CAM DATA

- Start cam no..: xx
- End cam no.: xx

A TEACH-IN function for each cam is available with key F4.

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The following functions are available for the **encoder LA with parallel interface**:

Sub-menu: EDIT ENCODER

- Display encoder type	not changeable
- Display output mode	not changeable

- Transmit code
- Output of negative values
- Output logic
- Output bus compatible
- Output data valid
- Count direction
- Offset
- Preset function
- Correction value
- Steps / length
- Origin
- Position preset
- Start area
- End area
- Number of data bits
- Parallel outputs

Sub-menu: EDIT TA-MINI

- TA: Display type
- TA: Display position
- TA: Sign
- TA: Steps/length
- TA: Origin

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☐ CE-Parallel ☐ CE-SSI ☐ CE-ISI ☐ CE-NSW ☐ LA-Parallel ☒ LA-SSI ☐ LA-ISI ☐ LA-NSW

The following functions are available for the **encoder LA with synchronous-serial interface**:

Sub-menu: EDIT ENCODER

-	Display encoder type	not changeable
-	Display output mode	not changeable
-	Transmit code	
-	Count direction	
-	Offset	
-	Preset function	
-	Correction value	
-	Steps / length	
-	Origin	
-	Position preset	
-	Start area	
-	End area	
-	Number of data bits	
-	Special bits	

Sub-menu: EDIT TA-MINI

- TA: Display type
- TA: Display position
- TA: Sign
- TA: Steps/length
- TA: Origin

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The following functions are available for the **encoder LA with incremental-serial interface**:

Sub-menu: EDIT ENCODER

-	Display encoder type	not changeable
-	Display output mode	not changeable
-	Count direction	
-	Offset	
-	Preset function	
-	Steps / length	
-	Origin	
-	Position preset	
-	Start area	
-	End area	
-	Maximum transmission frequency	

Sub-menu: EDIT TA-MINI

- TA: Display type
- TA: Display position
- TA: Sign
- TA: Steps/length
- TA: Origin

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☐ CE-Parallel ☐ CE-SSI ☐ CE-ISI ☐ CE-NSW ☐ LA-Parallel ☐ LA-SSI ☐ LA-ISI ☒ LA-NSW

The following functions are available for the **encoder LA with cam switch**:

Sub-menu: EDIT ENCODER

-	Display encoder type	not changeable
-	Display output mode	not changeable
-	Count direction	
-	Offset	
-	Preset function	
	Correction value	
-	Steps / length	
-	Origin	
-	Position preset	

Sub-menu: EDIT TA-MINI

- TA: Display type
- TA: Display position
- TA: Sign
- TA: Steps/length
- TA: Origin

Sub-menu: EDIT CAM DATA

- Start cam no..: xx
- End cam no.: xx

A TEACH-IN function for each cam is available with key F4.

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4.3.1.1 Display encoder type

The user is informed about the encoder currently connected or for which encoder type the data loaded are valid.

The following indications are possible:

-	Multiturn	Absolute encoder with gear for revolutions
-	Multi NSW 8	Absolute encoder with cam switch 8 cams
-	Multi NSW 18	Absolute encoder with cam switch 18 cams
-	Singleturn	Absolute encoder for single turn
-	Single NSW 8	Absolute encoder with cam switch 8 cams
-	Linear transducer	Linear position sensing system
-	LA NSW 8	Linear position sensing system with cam switch

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

4.3.1.2 Display output mode

The user is informed about the data interface which is used by the connected encoder and which interfaces support the data loaded.

The following indications are possible:

-	Sync. Ser. rpt.	Synchronous-serial interface with repetition
-	Sync. Ser. 31 Bit	Synchronous-serial interface with 31 bit
-	Parallel w. bus	Parallel interface bus compatible
-	Parallel wo. bus	Parallel interface **not** bus compatible
-	Incremental Ser.	Incremental-serial interface
-	Asynchron Ser.	Asynchronous-serial interface

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4.3.1.3 Output mode

Two output modes are pre-defined for the **encoder CE with synchronous-serial** interface (SSI) and can be selected with the cursor keys.

Select between:

- Left binding or
- Tree format

When left binding is selected the data transfer starts with the most significant bit according to the number of data bits set later. There are no limitations with this setting.

When tree format is selected no gear can be realized as the data will be output symmetrically. This requires later for the measuring length parameters the setting in power of two.

A detailed explanation of the tree format can be found in the appendix.

In the tree format only power of two can be used for the number of revolutions and the number of steps per revolution, where the first 12 bits are always for the number of revolutions. If not all of the 12 bits are required for the revolutions or the number of steps per revolution, the remaining bits are filled with zeros, so that the position data always consist of at least 24 bits.

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4.3.1.4 Transmit code

The transmit code of the data can be set and selected with the cursor keys for encoders with data interface.

Select between:

- Binary
- Gray
- BCD *
- Gray-3-Excess
- Shifted Gray **
- Shifted Gray-3-Excess **

Dependent on the encoder type only a part of the mentioned possibilities appears.

Programming **Binary**:
Output of the data in binary code.

Programming **BCD**:
Output of the data in BCD-code. The BCD code (Binary Coded Decimal) has a length of 4 bits to represent one decimal figure (0-9). Therefore always 4 bits are required to transmit units, tens places, hundred places etc..

Programming **Gray** :
Output of the data in Gray-code. With the natural Gray-code the change-over from the largest to the smallest value (0000) is only one bit, e.g. for an encoder with 8 bit (256 steps) the largest value, in binary notation, is 1000 0000 and the smallest value is 0000 0000. The change-over is one bit

Programming **Gray-3-Excess"**:
Output of the data in Gray Excess 3 code. This code is often used in arithmetic units which do not calculate with the dual system but with the decimal system. Arithmetic operations, addition and subtraction can be carried out with a minimum of logic operations.

Programming **Shifted Gray**:
Output of the data in shifted Gray code. For steps numbers which are not automatically power of two, the change-over from the largest to the smallest value are several bits. In order to get a change-over with one bit, the natural Gray-code will be limited.

Programming **Shifted Gray-3-Excess**:
Output of the data in shifted Gray Excess 3 Code. This code is used for step numbers which are not within the decimal range but where the advantage of the Gray-Excess-3-Code shall be used.

[*] If data output is programmed with the 2^0 edge, binary-code and BCD-code are allowed only.

[**] Excess codes are allowed only if the origin is programmed with zero or origin is set to zero because of this selection.

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4.3.1.5 Transmit repetition

For SSI encoders (with the option transmit repetition) there is the possibility of a multiple data transfer by continued transmission of the clock pulse. In order to activate this option it must be selected from the menu.

Select between:

- SSI with repetition or
- SSI without repetition.

If SSI with repetition is selected, the SSI data are repeated after 26 clock pulses.
A break of more than 25 µs interrupts the repetition mode. Actual data are transmitted with the next request which then can be repeated as well.

If SSI without repetition is selected, zero bits are output after the last data bit (special bit).

It merely seems that a data transfer with repetition increases the data integrity. As disturbances may occur not only for data but also for clocking lines during the SSI transmission, there is the possibility that the pulse will be disturbed already after the first pulse transmission. This causes the output of an additional data bit.

As the following packet of data depends in time from the previous one (in case of transmission with repetition), it is deferred too. The most unfavorable case is that two identical but disturbed packets of data are transmitted.

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4.3.1.6 Output logic

Changing between the output logic, that means between high active or low active is possible for **encoders CE with parallel interface**.

Select between:

-	0V == LOW	high-active switching logic
-	0V == HIGH	low-active switching logic

For certain applications an inverted output of the data can be necessary. This is called negative or positive logic. Whether the encoder outputs the data accordingly is defined with this selection.

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4.3.1.7 Data bus active

The data interface can be activated permanently or dependent on the bus-input for **encoders with parallel interface** and the option "Bus compatible".

Select between:

-	Always active	Data outputs are always active
-	if Bus = low	Data are available when bus input is low
-	if Bus = high	Data are available when bus input is high

To transmit the position of several encoders with parallel interface in the multiplex operation via common data lines, the outputs of the users not inquired must be high-impedance. The data outputs of the inquired user must be activated only. To operate an encoder with this option without an additional wiring the bus function is switched off with „Always active ".

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4.3.1.8 Data valid

For **encoders with parallel interface** there are several possibilities to synchronize the data acceptance.

Select between:

-	Continue	Data are continuously active
-	Latch = low	Data "frozen in ", when Latch input is low
-	Latch = high	Data "frozen in ", when Latch input is high
-	Dyn. Strobe *****	The encoder sends a strobe signal
-	LSB-edge ***** (2^0 edge)	Data are synchronous to the edges of the LSB

Programming **"Continue"**:
New data are constantly transmitted to the output. The user must ensure that the data are valid. E.g. asynchronous read-out: The customer electronics reads out the output value (e.g.) three times. Two values must be identical, one value is rejected.

Programming **"Latch = low"**:
The output data are „frozen in“ via the Latch input (=0). The user electronic reads one static value without edge transition.

Programming**" Latch = high"**:
The output data are „frozen in“ via the Latch input (=1). The user electronic reads one static value without edge transition.

Programming **"Dyn. Strobe"**:
The encoder transmits a special signal (dyn. strobe). The signal indicates when the output data can be read out or not. The strobe is defined in the sub-menu item "outputs".

Programming **"LSB edge (2^0 edge)"**:
Siemens-specification: With this method the read-out is synchronized with the positive and negative edge of the 2^0 bit. The 2^0 bit changes for multistep codes (binary code) with each modification of another bit. When changing the 2^0 track the data word is read out after a short delay. Wrong values (pseudo tetrads) are not possible. If this function is active, 2^0 bit changes approx. 5 to 10 times from low to high.
As 2^0 bit does not change when switching on the power supply while the shaft stops (either "H" or "L"), valid source data before moving the encoder shaft would not be possible. Therefore the 2^0 bit has to change four times (high, low, high, low) after switch-on of the encoder.

*** not available for encoder LA**

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4.3.1.9 Negative values

Linear position sensing systems offer a number of representations of negative values.

Select between:

-	Complement	Negative data are output with two's complement
-	Value and sign	Negative data are output with value and sign

With value and sign, the MSB of the data is taken as sign. For positive data the MSB is low, for negative data the MSB is high.

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4.3.1.10 Count direction

In addition to the partly available hardware change-over the count direction can be changed for all encoders by programming the encoder.

For CE encoders select between:

- clockwise	with view to the flange and the shaft
- counterclockwise	with view to the flange and the shaft

For LA encoders select between:

- increasing to the end
- decreasing to the end

For encoders with option "External forward/backward" the programmed count direction is inverted.

Clockwise means that the values become larger, counterclockwise means that the values become smaller.

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4.3.1.11 Offset

Start of the counting can be shifted optional, except for cam switch with 18 cams.

Select between:

-	No	no offset
-	Symmetrical with sign	symmetrical offset
-	Free	Offset with free value possible.

If positive data are to be output by the encoder only, starting with zero, "no offset" has to be programmed. Start with zero after an overflow.

"Symmetrical offset" is a special case of "Free offset". The programmable gear is divided in two and arranged at the right and left of the central line. After a positive overflow counting continuous in the negative range and vice versa.

If the programmable gear must be asymmetrical in the maximum possible range, "Free offset" is set. The origin can be defined for any point in the area.

According to the transmit code there are the following limitations:

Range of values:

BINARY / GRAY	neg. final value	pos. final value	max. programmable gear
without offset	---	16777215	16777216
with offset	-8388607	8388607	16777215

BCD	neg. final value	pos. final value	max. programmable gear
without offset	---	999999	1000000
with offset	-799999	799999	1599999

3-Excess	neg. final value	pos. final value	max. programmable gear
without offset	---	999999	1000000
with offset	-799999	799999	1599999

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4.3.1.12 Preset function

All encoders, if option "External preset" is available, can be set to a defined position value by an input signal. If this function is not installed or will not be used, it must be switched off in order to avoid malfunctions or mal operation.

Select between:

-	not in use	Preset function is switched off
-	rising edge	Preset function is active

With active preset function the encoder is programmed with a new position, after the external input changed from low to high and an internal time control expired. This process lasts some time as the complete position parameters must be recalculated and stored in a memory which is safe from data loss.
If the input is reset during the time control, the preset request is rejected.

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4.3.1.13 Programmable gear

For best adaptation of the encoder to the application condition the binary position data can be converted already in the encoder.

Select between:

-	Gear	any conversion
-	Unlimited	conversion in power of two

The total capacity (Steps / length) of the encoder consists of the steps per revolution (0-360°) and the number of revolutions. For angular measurements within 360° one turn is needed = Singleturn. For displacement measurements 2-4096 (power of two) or 1-126976 (optional) revolutions = Multiturn are required depending on the distance.

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4.3.1.14 Revolutions / length

A programmable gear is defined in "Steps / length " and "revolutions". The number of revolutions is defined by the mechanics. The number of the total steps results from the desired resolution or the representation mode of the distance.

An editing function is concerned here, that means a numerical value is entered here.

If the parameter „gear“ was previously selected for „programmable gear", two kinds of possible entries appear here. Non-integer revolution ratios are perhaps required for a gear. Therefore the revolutions are entered as fraction. The numerator is entered first and then the denominator of the fraction.

Wrong entries can be corrected with the key CE. Use F3 to go back in single steps. When the value is entered correctly, confirm with the Enter key.

If "Gear" was selected, a number between 1 and 126976 can be entered. If the "Programmable gear in revolutions" is programmed as fracture, the nominator must not be larger than 126976.

When "Unlimited" was selected a number in power of two between 2 and 4096 can be entered. Other values are rounded off to the next lower power of two.

In most of the applications the "Revolutions" are programmed in power of two. If e.g. 410 revolutions are required, the next higher power of two 512 must be programmed.

For certain applications, e.g. rotary tables, tool changer etc. encoder systems for integer values are needed.

For freely selectable encoder systems the encoder must not be turned further than 512 revolutions maximum while it is in dead condition. Turning more than 512 revolutions may cause a loss of the adjustment value (preset value). Therefore it is recommended to program the next higher power of two than the calculated number of revolutions for distance measurement.

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4.3.1.15 Steps / length

The measuring length is the complete distance to be sensed.
This value is entered here via the numerical keys.
Wrong entries can be corrected with the key CE. Use F3 to go back in single steps. When the value is entered correctly, confirm with the Enter key.

The minimum measuring length is 16.

The maximum measuring length depends on the resolution of the encoder.

e.g. 4096 steps per revol. x 4096 revol..: max. meas. length = 16777216.
1024 steps per revol. x 4096 revol. : max. meas. length = 4194304

The following formula applies for the scaling parameters for an encoder:

$$\text{Steps/revolutions} = \frac{\text{Steps per length}}{\text{Number of revolutions per length}}$$

For the distance mode "Gear" the "Number of revolutions per length" is programmed as fraction!

The following formula applies for the scaling parameters for a LA encoder:

$$\text{Measuring length [steps]} = \frac{\text{Measuring length rod [mm]}}{\text{Resolution [mm]}}$$

The resolution of the rod is set by the Steps / length. The measuring length/S results from the measuring length indicated on the rod and the desired resolution.

Example:
Measuring length rod [mm] = 500, resolution = 0.01 mm, measuring length [steps] = 50 000
Measuring length rod [mm] = 500, resolution = 0.1 mm, measuring length [steps] = 5000

With the LA-NSW the displayed measuring length in steps is without meaning. The scaling is effected with the correction value see chapter "Correction value", page 45.

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4.3.1.16 Initial point of measurement

If an offset was selected, the respective value can be entered here. The corresponding values have already been calculated for "symmetrical offset", changing them later is possible but then the setting "symmetrical offset" will be changed in "free offset".

The value will be entered with the numerical keys.

Wrong entries can be corrected with the key CE. Use F3 to go back in single steps. When the value is entered correctly, confirm with the Enter key.

Depending on the transmit code there are the following limits:

Range of values:

BINARY / GRAY	neg. end value	pos. end value	max. measuring length
without displacem.	---	16777215	16777216
with displacement	-8388607	8388607	16777215

BCD	neg. end value	pos. end value	max. measuring length
without displacem.	---	999999	1000000
with displacement	-799999	799999	1599999

3-Excess	neg. end value	pos. end value	max. measuring length
without displacem	---	999999	1000000
with displacement	-799999	799999	1599999

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4.3.1.17 Preset position

Most of the encoders have two external preset inputs.

The corresponding values can be entered here with the numerical keys.

If the value displayed is correct it can be confirmed with the Enter key.

Wrong entries can be corrected with the key CE. Use F3 to go back in single steps. When the value is entered correctly, confirm with the Enter key.

After the corresponding input changed from Low to High for released preset inputs and is active long enough (internal time control), the new position value entered here appears on the data lines. The encoder calculates its new zero point and saves the data in a memory secured against data loss. This proceeding takes some milliseconds.

Please take care that the preset values are not out of the used area. Preset values out of the area are corrected automatically and displayed.

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4.3.1.18 Start area

Depending on the encoder used, one or two limit switches or static cams regardless of a cam switch function are supported. As special function one or two remaining data bits can be assigned to this area function.

The start positions of the areas can be entered here with the numerical keys.

If the value displayed is correct it can be confirmed with the Enter key.

Wrong entries can be corrected with the key CE. Use F3 to go back in single steps. When the value is entered correctly, confirm with the Enter key.

Please take care that the values are not out of the used area. Values outside the area are corrected automatically and displayed.

Area1 and Area2 were named safety range and operating range in the previous versions.

There is no assignment below and above the area for EPROG encoders but only outside or within the area.

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4.3.1.19 End area

Depending on the encoder used, one or two limit switches or static cams regardless of a cam switch function are supported. As special function one or two remaining data bits can be assigned to this area function.

The end positions of the area can be entered here with the numerical keys.

If the value displayed is correct it can be confirmed with the Enter key.

Wrong entries can be corrected with the key CE. Use F3 to go back in single steps. When the value is entered correctly, confirm with the Enter key.

Please take care that the values are not out of the used area. Values outside the area are corrected automatically and displayed.

Area1 and Area2 were named safety range and operating range in the previous versions.

There is no assignment below and above the area for EPROG encoders but only outside or within the area.

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4.3.1.20 Number of data bits

The number of data bits appears on the display. The value can be taken over or changed.

Position bits are digitized angular positions or distances which are available at the outputs as code word. 16 outputs are usually assigned for position data. The minimum number of data bits further depends on the Steps / length and the code used and may change. If an attempt is made to program a smaller value than required, the correct minimum value appears automatically. It now can be increased or taken over.

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4.3.1.21 Special bits

For SSI encoders special information can be added to the position data within the 31-bit data word during the data transfer.

Depending on the encoder used, select between:

-	Static 0V	The special bit is always zero
-	Even Parity	even parity for all data previously transmitted
-	Odd Parity	odd parity for all data previously transmitted
-	Even V Parity	even parity connected with the encoder monitoring
-	Odd V Parity	odd parity connected with the encoder monitoring
-	0 = encoder error	Error output as zero from the encoder monitoring
-	1 = encoder error	Error output as one from the encoder monitoring
-	0 = UP 1 = DOWN	Recognize count direction
-	1 = UP 0 = DOWN	Recognize count direction
-	0 = STOP 1 = GO	Standstill monitoring
-	1 = STOP 0 = GO	Standstill monitoring
-	0 = BELOW AREA2	Area monitoring
-	1 = BELOW AREA2	Area monitoring
-	0 = IN AREA2	Area monitoring
-	1 = IN AREA2	Area monitoring
-	0 = ABOVE AREA2	Area monitoring
-	1 = ABOVE AREA2	Area monitoring
-	0 = BELOW AREA1	Area monitoring
-	1 = BELOW AREA1	Area monitoring
-	0 = WITHIN AREA 1	Area monitoring
-	1 = WITHIN AREA1	Area monitoring
-	0 = ABOVE AREA 1	Area monitoring
-	1 = ABOVE AREA 1	Area monitoring
-	1 = NEG. SIGN	signalizes that a negative value is concerned
-	DATA BIT	Bit is data bit

For LA-rod the additional appears:

-	1 = OUT OF RANGE	Magnet at the top of the rod is out of measuring range
-	0 = OUT OF RANGE	Magnet at the top of the rod is out of measuring range

---

For encoders with the programming possibility SSI with repetition only 6 special bits in the data stream are available. The special bits 7. ... 8. are always zero for a synchronous-serial transmission. They are wired on the connector as hardware outputs instead.
The special functions are possible for all bits, which are not assigned for data bits.
Programming of the special bits 1. ... 6. and hardware outputs 1. ... 2. is done like for previous encoder designs with the special bits 1. ... 8. .
For data transfer in tree format the special bits are sometimes used to fill the signal with zero until 24 bits are reached. These special bits are automatically assigned to "logical 0" and cannot be changed.

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4.3.1.22 Parallel outputs

For **encoders with parallel interface** special information can be added for outputs not used.

Depending on the encoder select between:

-	static 0V	The special bit is always zero
-	Even Parity	even parity for all data previously transmitted
-	Odd Parity	odd parity for all data previously transmitted
-	Even V Parity	even parity connected with the encoder monitoring
-	Odd V Parity	odd parity connected with the encoder monitoring
-	0 = encoder error	Error output as zero from the encoder monitoring
-	1 = encoder error	Error output as one from the encoder monitoring
-	0 = UP 1 = DOWN	Recognize count direction
-	1 = UP 0 = DOWN	Recognize count direction
-	0 = STOP 1 = GO	Standstill monitoring
-	1 = STOP 0 = GO	Standstill monitoring
-	0 = BELOW AREA2	Area monitoring
-	1 = BELOW AREA2	Area monitoring
-	0 = WITHIN AREA2	Area monitoring
-	1 = WITHIN AREA2	Area monitoring
-	0 = ABOVE AREA2	Area monitoring
-	1 = ABOVE AREA2	Area monitoring
-	0 = BELOW AREA1	Area monitoring
-	1 = BELOW AREA1	Area monitoring
-	0 = WITHIN AREA1	Area monitoring
-	1 = WITHIN AREA1	Area monitoring
-	0 = ABOVE AREA1	Area monitoring
-	1 = ABOVE AREA1	Area monitoring
-	1 = NEG. SIGN	signaziles that a negative value is concerned
-	0 = DATA VALID	is required in connection with the function data valid
-		After appearance of this bit the data at the output are valid.
	1 = DATA VALID	is required in connection with the function data valid
		After appearance of this bit the data at the output are valid
-	DATA BIT	Bit is a data bit

For the LA rod the following appears in addition:

-	1 = OUT OF RANGE	Magnet at the top of the rod is out of measuring range
-	0 = OUT OF RANGE	Magnet at the top of the rod is out of measuring range

The low-significant outputs are assigned with the position data and a sign, if necessary, according to the number of data bits programmed.

Example: If the number of data bits is 21, the 21. output is the LSB bit or the sign.
"0/1=Dt. valid" can be selected for an output only if the data output was programmed with "Strobe".

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4.3.1.23 Maximum ISI frequency

Encoders with an incremental serial interface normally supply information to counting modules. These modules have a maximum input frequency.

To avoid exceeding of this frequency the corresponding value can be entered in kilohertz here. The maximum possible value is 125 kHz

Press the enter key if the value indicated is correct.

Wrong entries can be corrected with the key CE. Use F3 to go back in single steps. When the value is entered correctly, confirm with the Enter key.

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4.3.1.24 Correction value

Adaptation of linear position sensing systems with older design, installed in the actual system, is possible with a correction value.

Enter the encoder-specific value when this menu appears.
This value is a fractional number which is smaller than zero. An integer number is however entered, which is written as an index.

For example:

Correction value= 0.080045, enter: (EXP-6) 80045 equal 80045 * 10^{-6}

The correction value is determined and programmed by TR Electronic. This value differs for each linear transducer with older design. This value is the reference between distance and indicated steps.

In order to change the resolution of the rod the correction value must be reprogrammed accordingly.

e.g.:	0.876543	equal	1/100 mm
	0.087654	equal	1/10 mm
	0.008765	equal	1 mm

A 1 as correction value must not be changed.

For linear position sensing systems with soft-no. 50xx.xx the correction value is irrelevant and cannot be entered.

With the LA-NSW the scaling is effected further with the correction value. The correction value may be max. **six digits**.

It corresponds:
0.999 999 = Resolution 0.01 mm
0.100 000 = Resolution 0.1 mm

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4.3.2 Edit TA-MINI

A slave display, connected to the same interface as the PT100N is supported by all encoders, except the **CE-MLD (without version V001) cam switch with 18 cams**.

The display type is saved in the device and not in the display. The corresponding parameters are set with the PT100N.

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4.3.2.1 Display type

For an optimum adaptation of the display to the programmable gear the data can be output in decimal point presentation.

Select between:

- no decimal point
- 1 decimal point
- 2 decimal points
- 3 decimal points
- 4 decimal points

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

4.3.2.2 Display position

With the display the position data can be recalculated and displayed in another way than with the encoder. Set the parameter display position first.

Select between:

- same programme
- new scaling

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

4.3.2.3 Signs

If new scaling was selected for the position display, the sign can be changed here.

Select between:

- same programme
- inverted

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4.3.2.4 Step number

If new scaling was selected for the position display, the step number to which new scaling of the encoder is to be carried out, can be entered here with the numerical keys.

Press the enter key if the value indicated is correct.

Wrong entries can be corrected with the key CE. Use F3 to go back in single steps. When the value is entered correctly, confirm with the Enter key.

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

4.3.2.5 Start of measurement

If new scaling was selected for the position display, origin to which new scaling of the programmable gear is to be carried out can be entered here with the numerical keys.

Press the enter key if the value indicated is correct.

Wrong entries can be corrected with the key CE. Use F3 to go back in single steps. When the value is entered correctly, confirm with the Enter key.

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4.3.3 Edit cams

This menu item is available for **cam switches** only.

Operate and release points of the individual cams can be entered here with the numerical keys.

Press the enter key if the value indicated is correct.

Wrong entries can be corrected with the key CE. Use F3 to go back in single steps. When the value is entered correctly, confirm with the Enter key.

Use F4 for a TEACH IN function for each point. Confirm with the enter key if the indicated position shall be taken.
A later editing is possible. Confirm the value with the enter key.

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4.4 Save Menu

The encoder data in principle are saved in the encoder.
If all modification of the data are completed correctly, that means no editing function was canceled without confirmation, the data can be transmitted to the encoder now.

The data are still available after the transmission.
The data are kept, even if no transmission took place and you paged in the main menu.

The advantage is, that data can be copied from one encoder to another encoder of the same design using the PT100N.

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

4.5 Verify data

After successful transmission of the data to the encoder they can be verified.

If a data difference occurred a storage address and the corresponding storage contents is indicated on the display. This value cannot be interpreted and will be used only to indicate whether it changes with repeated error.

In case of a data difference it is recommended to read in the data again and to compare them with the edit function. The problem should be eliminated after saving the data once again.

With EPROG encoders the data verification can lead to another error message because of different internal checks. Read data again and check in the EDIT MENU.

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4.6 Adjustment Menu

To adjust the encoder installed in the current system, the current encoder positions can be indicated and readjusted with this mode.

The current position appears on the display and can be modified with the numerical keys. The encoder gets the new position after the Enter key has been pressed.

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4.7 Main parameters

To identify the encoder connected, specific parameters can be entered in this menu.

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

4.7.1 Encoder type

The encoder currently connected or for which type the data currently loaded are valid, is indicated here for the information of the user,.

The following can be indicated:

-	Multiturn	Absolute encoder with gear for revolutions
-	Multi NSW 8	Absolute encoder with cam switch 8 cams
-	Multi NSW 18	Absolute encoder with cam switch 18 cams
-	Singleturn	Absolute encoder for single turn
-	Single NSW 8	Absolute encoder with cam switch 8 cams
-	Linear transducer	Linear position sensing system
-	LA NSW 8	Linear position sensing system with cam switch

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☐ LA-Parallel ☐ LA-SSI ☐ LA-ISI ☐ LA-NSW

4.7.2 Maximum number of revolutions

The number of physical revolutions, which can be counted a the most, are indicated here.

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4.7.3 Maximum number of steps / revolutions

The number of physical steps per revolution (resolution), which can be counted the most, are indicated here.

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

4.7.4 Software version

The software version used by the encoder is indicated here.

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

4.7.5 Display transmission mode

The data interface available for the encoder currently connected or supported by the data currently loaded, is indicated here for the information of the user.

The following can be indicated:

- Sync. Ser. rpt. — Synchronous serial interface with repetition
- Sync. Ser. 31 Bit — Synchronous serial interface with 31 Bit
- Parallel w. bus — Parallel interface, bus compatible
- Parallel wo. bus — Parallel interface **not** bus compatible
- Incremental Ser. — Incremental serial interface
- Asynchron Ser. — Asynchronous serial interface

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4.8 Language Menu

Each device is delivered with 3 languages installed. The following configurations are available on demand:

Standard device
Article no.: 480-00001/V001

German
English
Francais

Italian
Article no.: 480-00030/V001

Italian
German
English

Spanish
Article no.: 480-00050/V001

Spanish
German
English

Swedish
Article no.: 480-00060/V001

Swedish
German
English

Finnish
Article no.: 480-00040/V001

Finnish
German
English

English
Article-no.: 480-00010/V001

English
German
Francais

Francais
Article-no.: 480-00020/V001

Francais
German
English

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4.9 Service Menu

This routine is exclusively intended for commissioning of PT100N and for trouble-shooting.

A password must be entered to get to the corresponding functions. The password is simply 8888.

The following functions are inquiry routines only. Modifications are not possible.

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

4.9.1 Hex Dump ROM

Changeable encoder parameters are called ROM data. The main parameters and the corresponding storage addresses are indicated in Hex format.

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

4.9.2 Hex Dump RAM

Unchangeable encoder parameters are called RAM data. The operating parameters and the corresponding storage addresses are indicated in Hex format.

The first eight addresses are the not-adjusted position and the internal zero point. They are read in permanently and vary with each change of the position and adjustment process.

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4.9.3 Keyboard test

The key operated is indicated on the display. Keyboard ok appears if all keys have been pressed and recognized.

Cancel the test by pressing F2 twice.

☒ CE-Parallel ☒ CE-SSI ☒ CE-ISI ☒ CE-NSW ☒ LA-Parallel ☒ LA-SSI ☒ LA-ISI ☒ LA-NSW

4.9.4 Display Test

The display is consecutively filled and deleted.

Cancel the function with F2.

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4.10 EPROG DIALOG (Version 2.1a and above)

The new generation of encoders offers a much wider range of functions than previous models.

In this context, you should consider the PT100's usability as a subset of the options provided by the EPROG PC program.

If the EPROG PC program switches a **Version 001** encoder (refer to the rating plate) to PT100-compatible mode, the extended functions are no longer available.

PT100 programming is also no longer available if you chose the complete range of functions.

In this case, the PT100N cannot connect to the encoder; up to now, programming was not possible in this way.

The new EPROG-DIALOG menu item makes it possible to switch to this option: this was previously only possible using the PC.

This means that a PT100N of Version 2.1a and above can switch an EPROG encoder that was not programmed by a PT100N to PT100-compatible mode.

NOTICE

When you choose this menu item, the current setting of the encoder is shown. You can only choose interfaces that are actually fitted on the device.

If, for example, you choose an encoder that only has an SSI interface fitted as a parallel device, the corrected setting No is shown on the display.

If you confirm this setting, PT100-compatible mode is switched off, i.e. data cannot be ready any longer. In this case, you must choose the EPROG-DIALOG again and set the option that matches the interface.

When switching operating modes, data may be changed. In any case, you should carry out complete reprogramming.

In the case of devices with several interfaces, it is possible to make several settings. This means that you can individually set every interface.

However, all the installed interfaces have a common effect on the switching outputs, i.e. they influence one another. In this case, it is advisable not to use switching outputs.

You can choose from the following:

-	SSI	Synchronous serial interface with repetition
-	Parallel	Parallel interface with bus function
-	ISI	Incremental serial interface
-	18 cams	18 cams
-	29 cams	29 cams

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5 Appendix

5.1 Programming examples

The following example shows which values and parameters are to be programmed for the assumed task. Programming itself is described in the chapter "Edit encoder".

Example 1

A spindle with a pitch of 0.5 mm is located at a machine. Spindle length is 1.9 m. The pitch of the spindle is to be resolved to 1/1000 exactly. The position data shall increase clockwise. The machine is retooled several times during the month. In order to facilitate the setup work (adjustment) the feature Ext. Preset input shall be available for the encoder. The preset value is determined with 1020. The encoder shall work in binary code. Output data inquiry via a latch input. A bus function is not required. The output data must be available in pos. logic. Further the encoder shall provide a control bit (even. parity), a rotational direction signal (low for increasing data, high for falling data) and a standstill signal (low for standstill, high for movement). A slave display shall be operated in automatic mode at the PT- programming interface. The second decimal point is activated in the display. The slave display shall indicate ever 10th step only.

Calculation:

1 revol. = 0.5 mm, accuracy = 1/1000,
Travel distance = 1.9 m
Meas. length/R. = ?, steps/R. = ?, Total num. of steps= ?

$$\text{Steps/Rev.} = \frac{\text{Length one rev.}}{\text{Accuracy}} = \frac{0.5\text{ mm}}{0.001\text{ mm}} = 500$$

$$\text{Meas. length/R.} = \frac{1900\text{ mm}}{0.5\text{ mm}} = 3800 \text{ -> next higher power of two} = 4096$$

Meas. length/S. = steps/R. * Meas. length/R. =

$$\frac{500\text{ steps} * 4096\text{ Rev.}}{\text{Rev.}} = 2048000$$

Number of data bits:

2^{21}=2 097 152 => for a total number of steps of
2 048 000 21 data bits are required.

Range	Values/Parameters
Code	Binary - Code
Output logic	0V = LOW
Data bus active	always active
Data transfer	Latch == Low
Count direction	Incr. clockwise
Offset	no
Preset function.	raising edge
Meas. dist.	unlimited
Meas. length / R.	4096
Meas. length / S.	2 048 000
Start of meas.	0
Pos. Preset 1	1020
Pos. Preset 2	0
Start area 1	1
Start area 2	1
End area 1	1
End area 2	1
Num. Pos. Bits	21
17. output	data bit
18. output	data bit
19. output	data bit
20. output	data bit
21. output	data bit
22. output	even Parity
23. output	0=Up 1=Down
24. output	0=Stop 1=Go
Display type	2 dec. places
TA : Pos. display	new scaling
TA : sign display	same program
TA : step no.	204 800
TA : Start of meas.	0

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Example 2

A rotary table is to be positioned to 0.01° exactly. The encoder is attached to a place, where one turn of the rotary table is equal to 100 revolutions of the encoder shaft.
Falling of the output data clockwise.
Further the encoder is to operate with a statically parity (High = encoder error), a dynamic strobe (Low = data valid), and a rotational direction signal (low for increasing data, high for falling data.
A bus function is not required. The output data must be available in neg. logic. In order to compensate mechanical tolerances, the encoder must have two preset inputs.
During the mechanical cross-over the value 0 is set for the forward movement, the value 35999 for the backward movement.
The encoder shall work in BCD - Code.
A slave display shall be operated in automatic mode at the PT- programming interface. The display shall indicate angular degrees.
Calculation of the steps per revolution, the total number of steps and the number of position data:

Accuracy = 0.01°
Meas. length/R. = 100
Steps/Rev. = ?
Tot. number of steps = ?
Accuracy:
0.01° = 36000 steps during one turn of the rotary table
Meas. length/S.:
36000
Steps/Rev.:

$$\frac{\text{Meas. length / S.}}{\text{Meas. length / R.}} = \frac{36000}{100} = 360$$

Number of data bits:
36000 steps = 4 1/2 decades in BCD-Code = 18 data bits

Range	Values/Parameters
Code	Binary - Code
Output logic	0V = HIGH
Data bus active	always active
Data transfer	Dyn. Strobe
Count. direction	decreas. clockwise.
Offset	no
Preset function.	raising edge
Meas. distance	gear
Meas. length / R.	100
Meas. length/ S.	36000
Start of meas.	0
Pos. Preset 1	0
Pos. Preset 2	35999
Start area 1	1
Start area 2	1
End area 1	1
End area 2	1
Num. Pos. Bits	18
17. output	data bit
18. output	data bit
19. output	0 = invalid data
20. output	1 = encoder error
21. output	0=Up 1=Down
22. output	statical 0
23. output	statical 0
24. output	statical 0
Display type	2 display places
TA : Pos. display	same program
TA : sign display	same program
TA : step number	36000
TA : start of meas.	0

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Example 3

A tool changer with 100 tools shall stop at the 1. Tool after one revolution of the encoder.
The encoder must transmit the output data in BCD - Code from 1 to 100. (The start of the measurement must be shifted by one step. Instead of 0 - 99 the data shall be transmitted from 1 - 100.)
The encoder shall be connected to a data bus. (Encoder switched on, active, with 0V at the BUS input).
The output data must be available as pos. logic.
Further the encoder must provide a control bit (odd parity).
A slave display is not required.
The adjustment of the encoder is not carried out with the preset inputs but with the PT100N.
Calculation of the measuring length /U.:
Meas. length in steps = 100
Rotary factor = 1:1.35
The value 1:1.35 must now be converted into a divisible numerical ratio below the value 100.

$$\frac{1.35}{1} = \frac{135}{100} = \frac{27}{20}$$

Enter the value 27 decimal point 20 in the range meas. length/R. 27/20 appears on the display.
The encoder now delivers the values 1 to 100 and returns to value 1 after 1.35 revolutions.

Range	Values/Parameters
Code	BCD - Code
Output logic	0V = LOW
Data bus active	always active
Data transfer	Dyn. Strobe
Count direction	increas. clockwise.
Offset	free
preset function	not in use
Meas. distance	gear
Meas. length/ R. Counter	27
Meas. length / R. Denominator	20
Meas. length/ S.	100
Start of meas.	1
Pos. Preset 1	1
Pos. Preset 2	1
Start area 1	2
Start area 2	2
End area1	2
End area2	2
No. Pos. Bits	16
17. Output	Odd Parity
18. Output	0 = invalid data
19. Output	statical 0
20. Output	statical 0
21. Output	statical 0
22. Output	statical 0
23. Output	statical 0
24. Output	statical 0
Display type	no decimal point
TA : Pos. display	same program
TA : Sign display	same program
TA : Step number	100
TA : start of meas.	1

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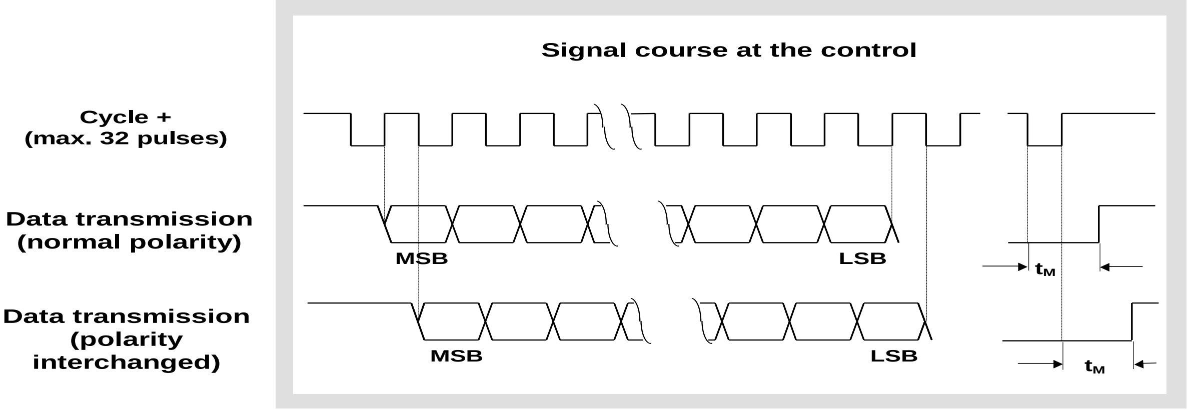
5.2 Synchronous serial interface SSI

In the resting condition the signal Data+ is on "High". With the first falling edge of the timing pulse the transmitter stores the current measurement. Data transfer is effected with the raising edge, beginning with the MSB (max. 32 cycles possible). After the last lowest significant data bit is transmitted, the data bit will be switched to "Low" or "0", until the encoder is ready for a new measurement. By interchanging the + and - cycles two different pulse formats are obtained
(see diagram 1).

Diagram 1:



The inverted data and timing signals are not displayed.

Monoflop time $\mathbf{t_M}$ is set to 20 µs and determines the lowest transmission frequency of approx. 50 kHz. The upper limit frequency is determined by the sum of the time control and is approx. 1.1 MHz.

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5.3 SSI output tree format

To transmit synchronous serial data with a certain structure, there is the possibility to use the tree format. The data bits are arranged consecutively (see diagram 2). 12 bits exactly, which contain the number of revolutions, are on the left side of the center line, at least 13 bits are on the right side, containing the steps per revolution. If less than 12 bits are required for the number of revolutions, the signal is filled with leading zeroes until the required length of 12 bits is reached. If not all 13 bits are required for the steps per revolution, zeroes are added to achieve the required length.
Up to eight special bits, freely programmable via the PT100N, can be added to these 25 data bits (six special bits for encoders with the programming possibility "with repetition"). In the case that zeroes must be added for steps/revolution, please consider, that these zeroes are generated by special bits and therefore not all eight (or six) special bits are available.

Diagram 2 (5 examples):

Z	2^Z			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	
12	4096	1	1	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	S1	4096
11	2048	1	1	0	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	0	S2	2048
10	1024	1	1	0	0	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	0	0	S3	1024
9	512	1	1	0	0	0	2^8	2^7	2^6	2^5	2^4	2^3	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	S4	512
8	256	1	1	0	0	0	0	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0	0	0	0	0	S5	256

Number of revolutions Data | **Steps per revolution Data**

Continuation with cycle 26

Cycle +

		25	26	27	28	29	30	31	32
Example 1		S1	S2	S3	S4	S5	S6	0	0
Example 2		S2	S3	S4	S5	S6	0	0	0
Example 3		S3	S4	S5	S6	0	0	0	0
Example 4		S4	S5	S6	0	0	0	0	0
Example 5		S5	S6	0	0	0	0	0	0

S = special bit

Special bit 7 and 8 are available as parallel outputs, but must be assigned to the connector!

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5.4 SSI transmit format left binding

Synchronous serial data without tree format consist of at least 16 Bit and eight (six for encoders with the programming possibility -with repetition) freely programmable special bits. It is possible to shift these data within the 32 cycles. The data can be transmitted right- or left justified, with or without leading zeroes. Leading zeroes are generated by programming the number of positions bits larger than required by the encoder. The eight (or six) special bits, which can be programmed by the user with different options, are added to the position bits.

Diagram 3: Example for synchronous serial data transfer without tree format

Cycle +			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
Example 1	1	1	0	0	0	0	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}	S1
Example 2	1	1	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}	S1	S2	S3	S4	S5	S6	0	0
Example 3	1	1	0	0	2^{21}	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}	S1
Example 4	1	1	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}	S1	S2	S3	S4	S5	S6

Continuation with cycle 26

Cycle +		25	26	27	28	29	30	31	32
Example 1		S1	S2	S3	S4	S5	S6	0	0
Example 2		0	0	0	0	0	0	0	0
Example 3		S1	S2	S3	S4	S5	S6	0	0
Example 4		S6	0	0	0	0	0	0	0

S = special bit

Special bit 7 and 8 are available as parallel outputs, but must be assigned to the connector!

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Example 1: Encoder with 20 data bits

	- 1024 Rev. multiplied with 1024 steps per rev.
or	- 256 Rev. multiplied with 4096 steps per rev.
or	- 4096 Rev. multiplied with 256 steps per rev.
or	- 512 Rev. multiplied with 2048 steps per rev.
or	- 2048 Rev. multiplied with 512 steps per rev.

Number of leading zeroes 4, number of data bits to be programmed 24, number of special bits to be programmed 8

Example 2: Encoder with 17 data bits

	- 128 Rev. multiplied with 1024 steps per rev.
or	- 256 Rev. multiplied with 512 steps per rev.
or	- 512 Rev. multiplied with 256 steps per rev.
or	- 32 Rev. multiplied with 4096 steps per rev.
or	- 64 Rev. multiplied with 2048 steps per rev.

Number of leading zeroes non, number of data bits to be programmed 17, number of special bits to be programmed 8

Example 3: Encoder with 22 data bits

	- 2048 Rev. multiplied with 2048 steps per rev.
or	- 1024 Rev. multiplied with 4096 steps per rev.
or	- 4096 Rev. multiplied with 1024 steps per rev.

Number of leading zeroes 2, number of data bits to be programmed 24, number of special bits to be programmed 8

Example 4: Encoder with 19 data bits

	- 512 Rev. multiplied with 1024 steps per rev.
or	- 1024 Rev. multiplied with 512 steps per rev.
or	- 128 Rev. multiplied with 4096 steps per rev.
or	- 4096 Rev. multiplied with 128 steps per rev.
or	- 256 Rev. multiplied with 2048 steps per rev.

Number of leading zeroes none, number of data bits to be programmed 19, number of special bits to be programmed 8

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Glossary

A

Absolute encoder — Optical rotary position sensing system. The delivered measured value is the complete analogue or digital position. If the encoder is moved mechanically while the encoder is switched off, the current position can be read out immediately after switching on the power supply.

B

Bus — Common transmission channel to which all users are connected; has two defined ends.

C

CE — Absolute encoder, programmable with the programming terminal PT100N or with the programming software "EPROG".

Code — Method to generate digital numbers. A code word is a bit pattern, which indicates a numerical value. The code describes the allocation of code words and their values.

(2) complement — Representation mode for negative binary numbers. In the two's complement representation a positive number is marked by a 0 in the most significant place and a negative number is marked by a 1.

D

Data interface — Encoder with parallel or synchronous serial interface; the data (referred to this operating manual) are transmitted in a certain code

Dynamical strobe — The encoder supplies a special signal (dyn. strobe). The signal indicates, when the output data can be read out or not.

E

"EPROG" — PC-Parameterization software for programmable CE or LA encoders.

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H

HEX-Dump	Memory dump (Hexadecimal format)

I

ISI	Incremental serial interface for absolute encoders. Position changes are transmitted by two incremental tracks.
Interface	Interface; connection for data transfer

L

Latch	The output data can be "frozen in" via the latch function. The user's electronics reads a statical value without edge transitions.
LA encoder	Linear absolute encoder for linear measurement.
LSB	**L**east **S**ignificant **B**it
Linear position sensing system	Acquisition of linear movements; LA encoder
Limit switch	Switch output which is set after a certain condition is fulfilled (programmable).

M

Monoflop	Mono-stable multivibrator; a trigger pulse at the input generates a single pulse at the output. The duration of the output signal does not depend on the input pulse.
MSB	**M**ost **S**ignificant **B**it
MLD	Internal designation for encoders which cannot be programmed with the "EPROG" software. Programming is possible with the programming terminal PT 100 N only. (Encoders without version no. V001)
Multiturn	Encoder which does not only resolve the number/revolutions, but can also acquire multiple revolutions.
Multiplex operation	Operation of several encoders. Position transfer via common data lines (see also bus).

N

NSW	Cam switch

O

Out of range	The magnet is at the top of the rod, out of measuring range; for LA encoders only

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OLD	Encoders which be programmed with the "EPROG" software. (Encoders with version no. V001)

P

Position bits	Digitized angular positions or distances, available as code word at the outputs (see also code).
Preset	The output data of the encoder are set to the programmed value when activating this input (adjustment between mechanics and electronics).
Parity	Simple procedure to recognize data transfer errors.
Pseudotetrade	Invalid bit pattern of a code.

R

RAM	**R**andom-**A**ccess-**M**emory
ROM	**R**ead-**O**nly-**M**emory
Resolution	Measuring accuracy of the encoder. CE-encoder: [number of steps per revolution] LA-encoder: [mm]

S

SSI	Synchronous serial interface for absolute encoders.
Singleturn	Rotary encoder, which resolves the number of steps/revolution only.

T

Tree format	Data transfer format for a synchronous serial interface (see also chapter "*SSI Output tree format* ")
TA-MINI	6 or 8 digit seven segment display, to indicate the actual positions of the encoder.
Teach In	The current actual value of the encoder is programmed directly as cam switch point.

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