User's manual

LD250 – LD251 – LD252 - LD253

Description

LD25x is a SSI display for connecting single-turn or multi-turn SSI encoders. The user's interface is a multi-function keyboard fitted with 3 keys and a 7-segment and 6-digit LED display.
Model LD250 is a SSI display only version; model LD251 provides an analogue output in addition; model LD252 further offers two presets and two switching outputs; finally model LD253 is equipped with a RS-232/RS-485 serial interface for connection with a PC.

Table of contents

1 Safety summary

1.1 Safety

- Always adhere to the professional safety and accident prevention regulations applicable to your country during device installation and operation;
- installation and maintenance operations have to be carried out by qualified personnel only, with power supply disconnected and stationary mechanical parts;
- device must be used only for the purpose appropriate to its design: use for purposes other than those for which it has been designed could result in serious personal and/or the environment damage;
- high current, voltage and moving mechanical parts can cause serious or fatal injury;
- warning ! Do not use in explosive or flammable areas;
- failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the equipment;
- Lika Electronic s.r.l. assumes no liability for the customer's failure to comply with these requirements.

1.2 Electrical safety

- Turn OFF power supply before connecting the device;
- connect according to explanation in section "4 - Electrical connections";
- in compliance with 2004/108/EC norm on electromagnetic compatibility, following precautions must be taken:

- before handling and installing the equipment, discharge electrical charge from your body and tools which may come in touch with the device;
- power supply must be stabilized without noise; install EMC filters on device power supply if needed;
- always use shielded cables (twisted pair cables whenever possible);
- avoid cables runs longer than necessary;
- avoid running the signal cable near high voltage power cables;
- mount the device as far as possible from any capacitive or inductive noise source; shield the device from noise source if needed;
- minimize noise by connecting the unit to ground (GND). Make sure that ground (GND) is not affected by noise. The connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user.

1.3 Mechanical safety

- Install the device following strictly the information in the section "3 - Mounting instructions";
- do not disassemble the unit;
- do not tool the unit;
- delicate electronic equipment: handle with care; do not subject the device and the shaft to knocks or shocks;
- respect the environmental characteristics of the device.

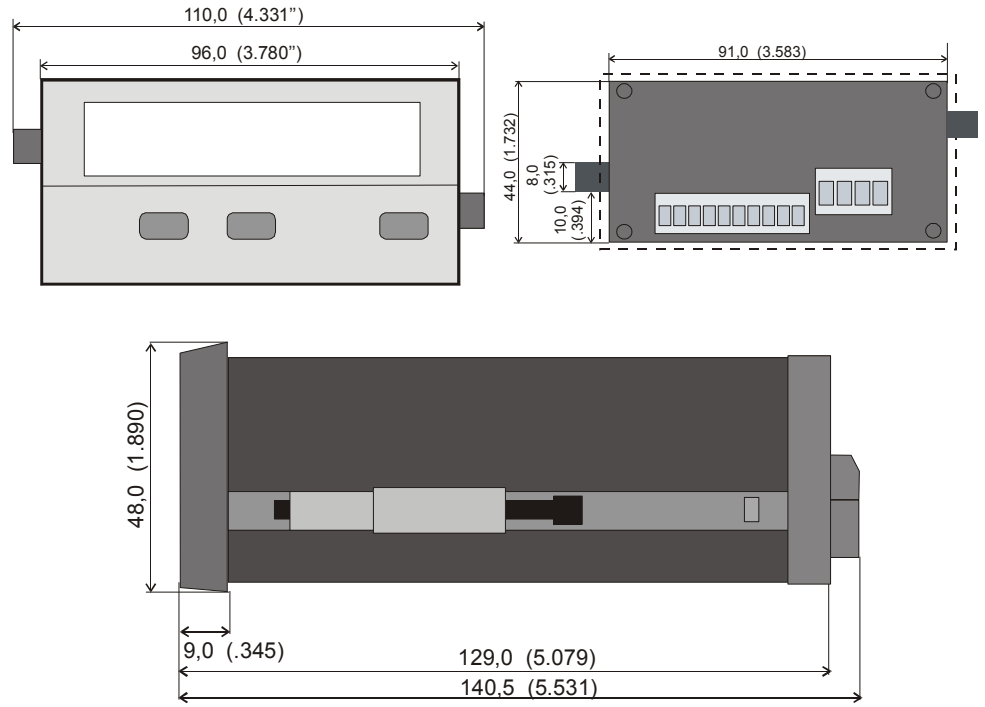
2 Identification

Device can be identified through the **ordering code** and the **serial number** printed on the label applied to its body. Information is listed in the delivery document too. Please always quote the ordering code and the serial number when reaching Lika Electronic s.r.l. for purchasing spare parts or needing assistance. For any information on the technical characteristics of the product, refer to the technical catalogue.

3 Mounting instructions

WARNING
Mount the unit with power supply disconnected.

Mount the display into the provided cut-out (approx. 91 x 44 mm) without panel clips.
Install panel clips on the display housing and screw until fixed.



Panel cut out: 91 x 44 mm (3.583 x 1.732")

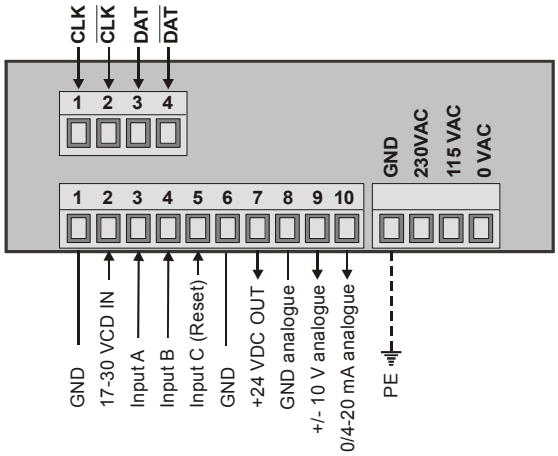
4 Electrical connections

WARNING
Turn OFF the power supply before connecting the device.

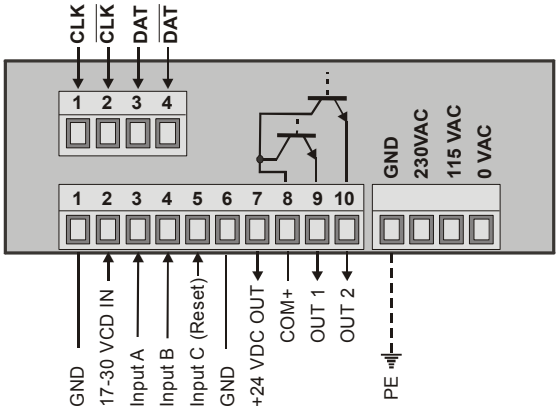
LD250
Display unit only

All connections are as shown below, except for terminals 8, 9 and 10 which are not connected.

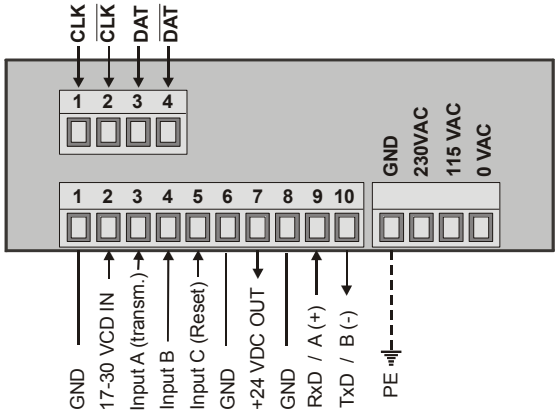
LD251
Display unit with analogue output



LD252
Display unit with 2 presets and transistor outputs



LD253
Display unit with serial interface



4.1 Power supply

The unit accepts DC power supply from 17 V to 30 V when using terminals 1 and 2. The consumption depends on the level of the supply voltage (typically 130mA at 30V or 190mA at 17V, plus current taken from aux. output).
For AC supply the terminals 0 VAC, 115 VAC or 230 VAC can be used. The total AC power is 7.5 VA.
The pictures in the previous page show a dotted line for grounding to PE. This connection is not really necessary, neither for safety nor for EMC. However, for specific applications, it may be useful to ground the common potential of all signal lines.

NOTE
When using this earthing option, please note that:
1. all terminals and potentials marked "GND" will be earthed;
2. you should avoid multiple earthing, e.g. when you use a DC power supply where the Minus is already connected to earth etc.

4.2 Auxiliary voltage output

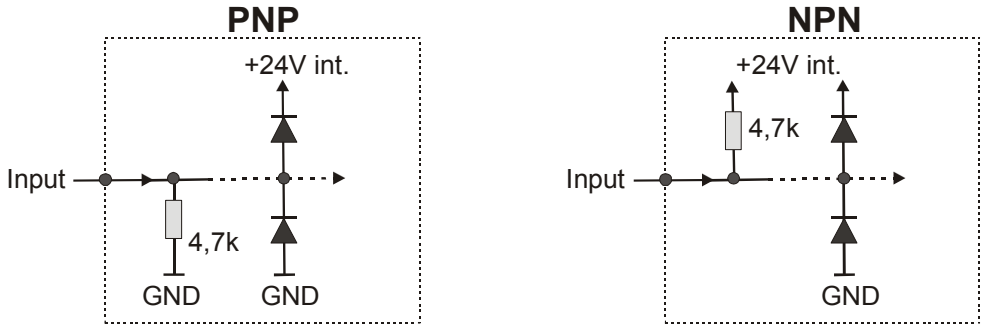
Terminal 7 provides a 24 VDC / 120 mA max. auxiliary output for supply of sensors and encoders.

4.3 Control inputs A, B and C

In LD253 model input A is used to activate a serial transmission (rising edge, see section "7.5.2 Printer-Mode" on page 26). Input B is not used.
Input C operates as a Set / Reset input (static function, active "HIGH", see section "8.3 Scaling of the display" on page 29).
In the basic set-up menu, the inputs can be configured to PNP (signal must switch to +) or to NPN (signal must switch to -). This configuration is valid for all three inputs at the same time.
The factory setting is always PNP.

NOTE
1. When NPN setting is used, please be aware that open NPN inputs will always represent a logical HIGH state. Consequently, Input C has to be connected to GND externally to allow normal operation. If unconnected, the unit would be kept in a continuous Reset state. In model LD253, also Input A must be connected to GND and opening this connection will generate a rising edge to start a serial transmission.
2. When you use 2-wire NAMUR type sensors, please select NPN, connect the negative wire of the sensor to GND and the positive wire to the corresponding input.

Typical input circuit of control input:



The minimum pulse duration on the Reset input (C) must be 5 msec.

4.4 Adjustable analogue output (LD251 model only)

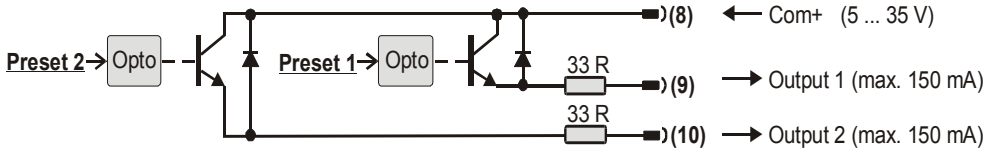
A voltage output is available, operating in a range of 0 ... +10 V or –10 V ... +10 V according to setting. At the same time, a current output 0/4 – 20 mA is available. Both outputs refer to the GND potential and the polarity changes with the sign in the display. The outputs are proportional to the display value and provide a 14-bit resolution.
The maximum current for the voltage output is 2 mA and the load on the current output can vary between 0 and max. 300 ohms.

The response time of the analogue output at each change of the encoder position is approx. 7 msec.

4.5 Optocoupler (transistor) outputs (LD252 model only)

Outputs provide programmable switching characteristics and are potential-free. Please connect terminal 8 (COM+) to the positive potential of the voltage you want to switch (range 5V....35V). You must not exceed the maximum output current of 150 mA. If you switch inductive loads, please provide filtering of the coil by means of an external diode.

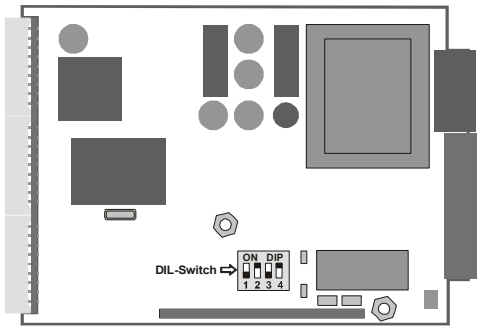
The optocoupler outputs provide a response time of approx. 5 msec with resistive load.



4.6 Serial RS-232 / RS-485 interface (LD253 model only)

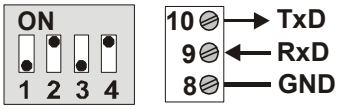
Ex factory the unit is set to RS-232 communication. This setting can be changed to RS-485 (2-wire) by means of an internal DIL switch. To access the DIL switch, you must remove the screw terminal connectors and the back panel. Then pull the board to the rear to remove the PCB from its housing.

Removal of the back panel

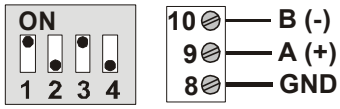


Location of the DIL switch

RS-232

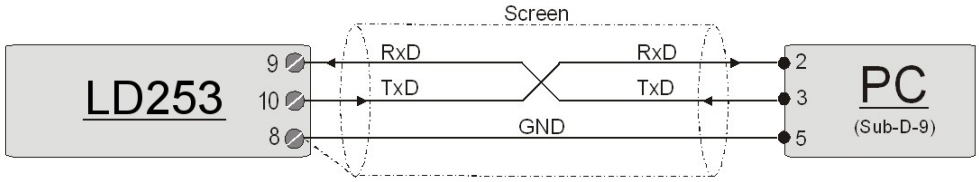


RS-485

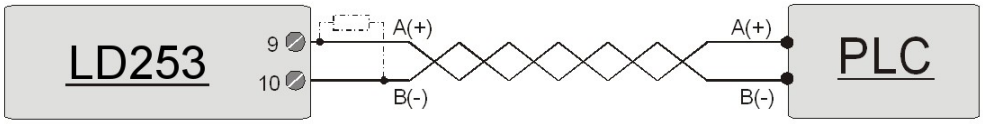


WARNING

1. Never set DIL switch positions 1 and 2 or DIL switch positions 3 and 4 to ON at the same time!
2. After setting the switch, shift the print carefully back to its housing, in order to avoid damaging the front pins for connection with the front keypad plate.



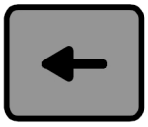
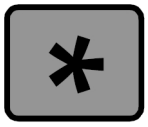
Connection of the RS-232 interface



Connection of the RS-485 interface

5 Operating the front keys

For set-up and other operations the unit is fitted with three front keys which will be denominated as follows in the next pages:

		
ENTER (Input)	**SET** (Setting)	**CMD** (Command)

The functions of the keys are depending on the actual operating state of the unit.
The following three operating states apply:

- Normal display state (see section "5.1 Normal display state" on page 8)
- Set-up state (see section "5.2 Selection and setting of parameters" on page 9)
  - Basic set-up (see section "7.1 Basic settings" on page 14)
  - Operational parameters set-up (see section "7.2 Operational parameters" on page 16)
- Teach operation (see section "5.3 Teach operation" on page 10)

5.1 Normal display state

NOTE
You can only change over to other operation states while the unit is in the normal display state.

Change over to	Key operation
Basic set-up	Keep **ENTER** and **SET** down simultaneously for 3 seconds
Operational parameter set-up	Keep **ENTER** down for 3 seconds
Teach operation	Keep **CMD** down for 3 seconds

The **CMD** key is only used to execute the Teach procedure with linearisation. For more details please refer to sections "9.1 Linearisation" and "9.2 Manual input or „teaching" of the interpolation points" on page 35.

5.2 Selection and setting of parameters

5.2.1 Selecting a parameter

The **ENTER** key will scroll through the menu. The **SET** key allows to select the corresponding item and change the setting or the numeric value. After this, the selection can be saved by pressing the **ENTER** key again, which automatically changes over to the next menu item.

5.2.2 Changing parameter settings

With numerical entries, at first the lowest digit will blink. When keeping the **SET** key continuously down, the highlighted digit will scroll in a continuous loop from 0 to 9 and again from 0 to 9; and so on. After releasing the **SET** key, the actual value will remain and the next digit will be highlighted (blink). This procedure allows setting all digits to the desired values. After the most significant digit has been set, the low order digit will blink again and you can make corrections if necessary.
With signed parameters, the high order digit will scroll from "0" to "9" (positive) followed by "-" and "-1" (negative).

5.2.3 Saving settings

To save the actual setting, press the **ENTER** key, which will also automatically scroll forward the menu.

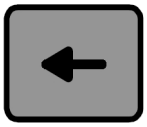
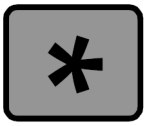
NOTE
At any time the unit changes from programming mode to normal display operation, when you keep the **ENTER** key down again for 3 seconds at least.

5.2.4 Time-out function

A "time-out" function will automatically terminate every menu level, when for a break period of 10 seconds no key has been pressed. In this case, all changes which have not been confirmed by **ENTER** yet would remain unconsidered.

5.3 Teach operation

NOTE
The time-out function remains disabled during all Teach operations.

Key	Function
	**ENTER** will terminate or abort any Teach operation in progress
	**SET** function is fully similar to normal set-up operation
	**CMD** will save the display value in the register and change over to the next interpolation point

For further details on the Teach procedure see section "9.2 Manual input or „teaching" of the interpolation points" on page 37.

5.4 Setting all registers to "Default" values

At any time you can return all settings to the factory default values.

WARNING
This action will reset all parameters to factory default values and your own settings will be lost. You will have to repeat your individual set-up procedure.
Factory default values are shown in the subsequent parameter tables (see section "Parameters list" on page 39).

To reset the unit to default values:

- switch power off;
- press the **ENTER** key on the front;
- keep **ENTER** down while you power up again.

5.5 Code locking of the keypad

When the code locking of the keypad has been switched on (see on page 15), any key access first results as follows:

To access the menu you must press the following key sequence:

within 10 seconds, otherwise the unit will automatically return to the normal display mode.

6 Operator menu

The menu provides one section with "Basic Parameters" (see section "7.1 Basic settings" on page 14)and another section with "Operational Parameters" (see section "7.2 Operational parameters" on page 16). On the display you will only find those parameters which have been enabled by basic settings. E.g. when the Linearisation function has been disabled in the basic set-up, the associated linearisation parameters will also not appear in the parameter menu.
All parameters, as good as possible, are designated by text fragments. Even though the possibilities of forming texts are very limited with a 7-segment display, this method has proved to be most suitable for simplification of the programming procedure.
The subsequent table shows the general structure of the menu.
Detailed descriptions of all parameters will follow in section "7 - Set-up procedure" on page 14.

6.1 Overview of basic parameters

LD250	LD251	LD252	LD253
SSI-Mode	SSI-Mode	SSI-Mode	SSI-Mode
SSI-Bits	SSI-Bits	SSI-Bits	SSI-Bits
SSI-Format	SSI-Format	SSI-Format	SSI-Format
SSI-Baud Rate	SSI-Baud Rate	SSI-Baud Rate	SSI-Baud Rate
SSI-Test	SSI-Test	SSI-Test	SSI-Test
Characteristics	Characteristics	Characteristics	Characteristics
Brightness	Brightness	Brightness	Brightness
Code	Code	Code	Code
Linearisation mode	Linearisation mode	Linearisation mode	Linearisation mode
	Analogue characteristics	Preselection mode 1	Serial unit number
	Analogue offset	Preselection mode 2	Serial format
	Analogue gain	Hysteresis 1	Serial baud rate
		Hysteresis 2	

6.2 Overview of operational parameters

LD250	LD251	LD252	LD253
		Preselection 1	
		Preselection 2	
M-Factor	M-Factor	M-Factor	M-Factor
D-Factor	D-Factor	D-Factor	D-Factor
P-Factor	P-Factor	P-Factor	P-Factor
Decimal point	Decimal point	Decimal point	Decimal point
Display	Display	Display	Display
Hi_Bit (MSB)	Hi_Bit (MSB)	Hi_Bit (MSB)	Hi_Bit (MSB)
Lo_Bit (LSB)	Lo_Bit (LSB)	Lo_Bit (LSB)	Lo_Bit (LSB)
Direction	Direction	Direction	Direction
Error	Error	Error	Error
Error_Polarity	Error_Polarity	Error_Polarity	Error_Polarity
Round Loop	Round Loop	Round Loop	Round Loop
Time	Time	Time	Time
Reset	Reset	Reset	Reset
Zero Position	Zero Position	Zero Position	Zero Position
	Analogue Begin		Ser_Timer
	Analogue End		Ser_Mode
			Ser_Value
P01_X *	P01_X *	P01_X *	P01_X *
P01_Y*	P01_Y*	P01_Y*	P01_Y*
...	...	...	...
P16_X *	P16_X *	P16_X *	P16_X *
P16_Y *	P16_Y *	P16_Y *	P16_Y *

* This only appears if the linearisation function has been enabled in the Basic menu.

7 Set-up procedure

For better understanding the following sections "7.1 Basic settings" and "7.2 Operational parameters" explain settings related to the display only model (LD250). Model-specific settings for analogue output model (LD251), Preselections model (LD252) and Serial Link model (LD253) will be explained separately under sections from "7.3 Model LD251: additional settings for the analogue output" to "7.5 Model LD253: additional settings for the serial interface".

7.1 Basic settings

Customarily these settings have to be carried out one time only upon the very first use of the unit. The basic set-up selects the desired operation mode of the unit, the input characteristics PNP/NPN and the desired brightness of the LED display.

NOTE
To access the Basic Set-up press the **ENTER** and **SET** keys simultaneously for at least 3 seconds.

Menu		Setting range	Default
modE	**SSI-Mode** Setting of Master mode or Slave mode. For details see section "8.1 Master and Slave Operation" on page 27.	MASte SLA	mASte
bitS	**SSI-Bits** Bit length of the SSI string. For more details see section "8.2 Evaluation of encoder bits" on page 28.	08 ... 32	25
Form	**SSI-Format** Setting of the SSI code (Binary or Gray).	bin ... GrAy	bin
bAUd	**SSI-Baud Rate**	0.1 ... 1000.9 kHz	**100.0 kHz**
tESt	**SSI Test** SSI Self test functions. For more details see section "8.5 Testing functions" on page 34.	Cd 11 etc.	
ChAr	**Characteristics *** Switching characteristics of the Reset input. NPN, switch to "-" * PNP, switch to "+"	 nPn PnP	PnP
briGht	**Brightness** Brightness of the 7-segment LED display.	20%, 40%, 60%, 80%, 100%	**100%**

* Please follow the hints given in section "4.3 Control inputs A, B and C" on page 5 carefully.

Menu		Setting range	Default
CodE	**Keypad protection code** (for more details see section "5.5 Code locking of the keypad" on page 11).		no
	Keypad enabled continuously.	no	
	Keypad locked for any access.	All	
	Keypad locked, except for access to preselections 1 and 2 (LD252 only, see section "7.4 Model LD252: additional settings for preselections and switching outputs" on page 21).	P_FrEE	
LinEAr	**Linearisation mode *** For details please refer to sections "9.1 Linearisation" and "9.2 Manual input or „teaching" of the interpolation points" on page 35.		no
	The linearisation is switched off. *	no	
	Linearisation settings for the positive range only (negative values will appear as a mirror).	1-qUA	
	Linearisation over the full numeric range.	4-qUA	

* If "no" is set next to this item, the menu will not display any further linearization parameter.

7.2 Operational parameters

Menu		Setting Range	Default
m FAc	**M-Factor *** Multiplying factor for the SSI value (after consideration of possible bit blanking).	-9.999 ... 9.999	**1.000**
d FAc	**D-Factor *** Dividing factor for the SSI value (after consideration of possible bit blanking).	0.001 ... 9.999	**1.000**
p FAc	**P-Factor *** This signed value will be added to the SSI result (after consideration of possible bit blanking).	-199999 ... 999999	**0**
dPoiA	**Decimal Point** Setting according to the decimal formats shown in the display.	000000 00000.0 ... 0.00000	**00000.0**
diSPLA	**Display** Display mode of the unit: **norm:** regular scaling of the display; **359.59:** angular display format 359° 59' with use of the "Round-Loop" function. For more details see section "8.4.2 "Round-Loop" function" on page 32.	norm 359.59	**Norm**
Hi bit	**Hi Bit **** "Bit Blanking" function: defines the highest bit for evaluation. To evaluate all encoder bits this parameter has to be set to the total number of bits according to setting. For more details see section "8.2 Evaluation of encoder bits" on page 28.	1 ... 32	**25**
Lo bit	**Lo Bit **** "Bit Blanking" function: defines the lowest bit for evaluation. To evaluate all encoder bits this parameter has to be set to "01". For more details see section "8.2 Evaluation of encoder bits" on page 28.	1 ... 31	**1**

* Scaling details are explained in section "8.3 Scaling of the display" on page 29.

** For more details about "Bit Blanking" function see section "8.2 Evaluation of encoder bits" on page 28.

Menu		Setting Range	Default
dir	**Direction** Parameter to negate the SSI value, resulting in a reversal of the direction of the encoder count. **riGht**: increasing values with forward motion. **LEFt**: decreasing values with forward motion.	riGht LEFt	riGht
Error	**Error** (please refer to section "8.6 Error messages" on page 34). Defines the control of presence of an encoder and the location of the error bit in case of error. **00**: No error bit available Control of presence of an encoder is off **01**: No error bit available Control of presence of an encoder is on **>01**: Location of the error bit Control of presence of an encoder is on	0 ... 32	**0**
ErrorP	**Error-Polarity *** Defines the polarity of the error bit in case of error. **0**: Error Bit is Low in case of error **1**: Error bit is High in case of error	0 1	**0**
	When an error occurs, Err-b message is invoked to appear on the display (see section "8.6 Error messages" on page 34). The same function can also be used to monitor the Power Failure Bit of an encoder (mostly called **"PFB"**).		
r-LooP	**Round-Loop** Defines the number of encoder steps per revolution when using the "Round-Loop" function (for further information see section "8.4.2 "Round-Loop" function" on page 32). **0**: Normal display of the encoder data, no "Round-Loop" function. **>0**: Number of steps per "Round-Loop" cycle.	0 ... 999999	**0**
timE	**Time** Sets the update cycle of the display (and of the analogue output or the switching outputs where applicable). The fastest possible update time is 3 msec. or the time period corresponding to one telegram with 4 pause clocks. With "Slave" operation the next update will occur when the unit synchronizes again to the Master pause following to the expiration of the update time.	0.000 ... 1.009 sec	**0.01 sec**

*) Please observe that parameter p FAc will cause an additional displacement of the zero position.

Menu		Setting Range	Default
FE rES	**Reset** A Reset command is available to store the actual SSI position to next register 0-PoS. As a result, the display value will become zero at the actual encoder position and all further operation will refer to this new datum point. The zero position remains memorized also after power-down. **no**: Reset function disabled **Front**: Reset operation performed by means of the front **SET** key **E_tErn**: Reset operation performed by means of the remote Reset input **FR u E**: Reset operation performed by means of both key and remote input	No Front E_tErn Fr u E	no
0-PoS	**Zero Position *** Defines the zero position of the display. When you set this parameter to e.g. "1024", the unit will display zero when the encoder position is 1024. 0-PoS can be set directly via keypad or by means of an external Reset command.	-199999 ... 999999	**0**
P01_X	**Linearisation point 1_X **** X value of the first interpolation point.	-199999 ... 999999	**999999**
P01_Y	**Linearisation point 1_Y **** Y value of the first interpolation point.	-199999 ... 999999	**999999**
	...		
P16_X	**Linearisation point 16_X **** X value of the 16. interpolation point.	-199999 ... 999999	**999999**
P16_Y	**Linearisation point 16_Y **** Y value of the 16. interpolation point.	-199999 ... 999999	**999999**

*) Please observe that parameter **p FAc** will cause an additional displacement of the zero position.

**) Parameters P01_X to P16_Y appear only when the linearisation has been enabled in the basic menu.

For more details about linearisation please refer to section "9.1 Linearisation" on page 35.

7.3 Model LD251: additional settings for the analogue output

The Basic menu provides the following additional settings:

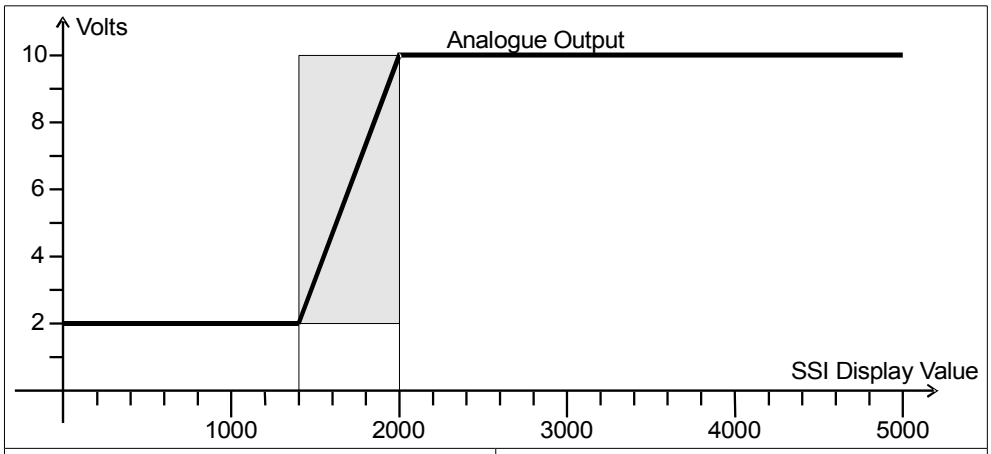
Menu		Setting Range	Default
A-ChAr	**Analogue characteristics** Select one of the following options: +/-10 V (bipolar) 0-10 V (positive output only) 4-20 mA current output 0-20 mA current output With setting +/-10 Volts the polarity of the output voltage will follow the sign in the display.	 - 10_ 10 0_ 10 4_20 0_20	-0_ 10
OFFSEt	**Analogue Offset** Set this parameter to 0 when you expect your analogue signal to start with 0 V (or 0 mA / 4 mA respectively). When another zero definition is desired it can be set via this parameter. Setting of e.g. "5.000" will already produce 5 volts with the output in zero state.	-9,999 ... +9,999	**0**
GAin	**Analogue Gain** It is meant to set the analogue output swing. Setting 10.00 will allow full swing of 10 V or 20 mA, setting 8.00 will reduce the swing to 8 V or 16 mA.	00,00 ... 99,99	**10**

The following Operational parameters provide scaling of the analogue output:

Menu		Setting Range	Default
AnAbEG	**Analogue-Begin** Start value of the analogue conversion range.	-199999 ... 999999	**0**
AnAEnd	**Analogue-End** End value of the analogue conversion range.	-199999 ... 999999	**10000**

By means of the two above parameters any window of the whole display range can be mapped onto the analogue output.

The subsequent example shows how to convert the display range from 1400 to 2000 into an analogue signal of 2 - 10 volts.



A-ChAr = 0 - 10 V	AnAbEG = 1400
OFFSEt = 2.000	AnAEnd = 2000
GAin = 8.00	

NOTE
All settings refer to the scaled values which are shown in the display of the unit and not to the original SSI encoder data.

7.4 Model LD252: additional settings for preselections and switching outputs

The basic set-up menu provides the following additional parameters:

Menu		Default
CHAr 1	**Switching characteristics of output 1**	__r GE
	__r GE **Greater/Equal:** output to switch **statically** "ON" when display value ≥ preselection 1.	
	__r LE **Lower/Equal:** output to switch **statically** "ON" when display value ≤ preselection 1.	
	_n_ GE **Greater/Equal:** output to switch **dynamically** "ON" when display value ≥ preselection 1. (timed pulse output *)	
	_n_ LE **Lower/Equal:** output to switch **dynamically** "ON" when display value ≤ preselection 1. (timed pulse output *)	
CHAr 2	**Switching characteristics of output 2**	__r GE
	__r GE See CHAr 1, referred to preselection 2.	
	__r LE See CHAr 1, referred to preselection 2.	
	_n_ GE See CHAr 1, referred to preselection 2.	
	_n_ LE See CHAr 1, referred to preselection 2.	
	__r 1-2 Output switches **statically** ON when display value ≥ Preselection 1 – Preselection 2 **.	
	_n_ 1-2 Output switches **dynamically** ON when display value ≥ Preselection 1 – Preselection 2 **.	
HYSt 1	**Hysteresis 1:** adjustable hysteresis for output 1. Setting range 0 ... 99999 display units.	0
HYSt 2	**Hysteresis 2:** adjustable hysteresis for output 2. Setting range 0 ... 99999 display units.	0

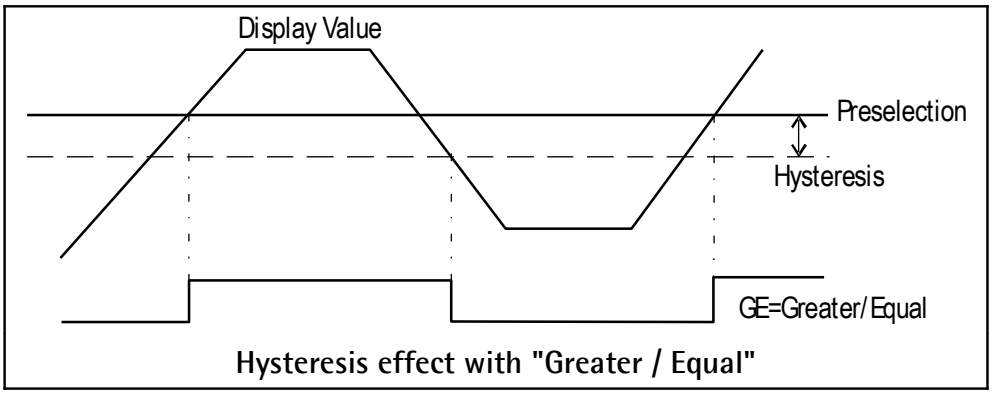
* Timed output pulses have a fixed duration of 500 msec (factory adjustable only).

** Trailing Preset to generate an anticipation signal with a fixed distance to the main signal.

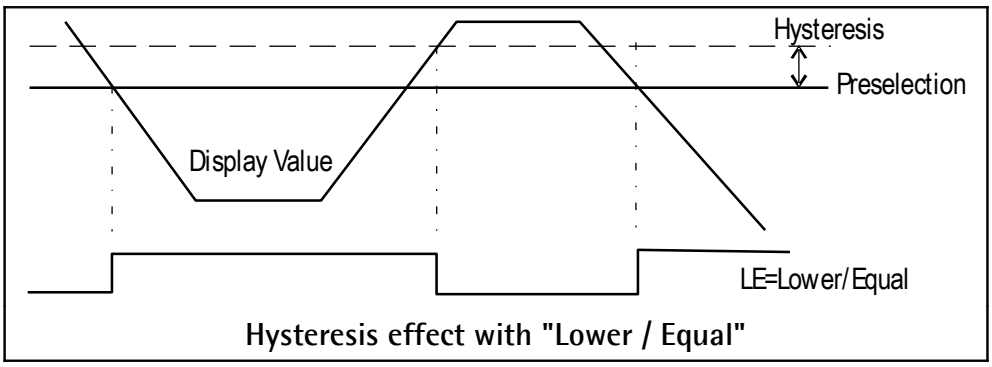
The following operational parameters provide setting of the switching thresholds:

Menu		Setting Range	Default
PrES_1	**Preselection 1**	-199999 ... 999999	**10000**
PrES_2	**Preselection 2**	-199999 ... 999999	**5000**

The working direction of the Hysteresis depends on the setting of the switching characteristics.
With settings **„GE"** or **„LE"** respectively, the following switch points will result:



Hysteresis effect with "Greater / Equal"



Hysteresis effect with "Lower / Equal"

It is possible to check up on the actual switching state of the outputs at any time.
For this, just tap on the **ENTER** key shortly.
The display will then show for the next two seconds one of the following information:

Display	Meaning	
1_2oFF	Both outputs are actually off.	
1_2on	Both outputs are actually on.	
1 on	Output 1 is on.	Output 2 is off.
2on	Output 1 is off.	Output 2 is on.

7.5 Model LD253: additional settings for the serial interface

The basic set-up menu contains the main parameters for configuration of the serial interface.

Menu		Setting Range	Default
S-Un it	**Serial Unit Number** You can assign any address number between 11 and 99 to your unit. The address must <u>not</u> contain a "0" because such numbers are reserved for collective addressing of several units.	0 ... 99	**11**
S-Forn	**Serial data format** The first character indicates the number of Data Bits. The second character specifies the Parity Bit ("even" or "odd" or "none"). The third character indicates the number of Stop Bits.	7 E 1 7 E 2 7 O 1 7 O 2 7 no 1 7 no 2 8 E 1 8 O 1 8 no 1 8 no 2	7 E 1
S-bAUd	**Baud rate** The following baud rates can be selected.	9600 4800 2400 1200 600 19200 38400	9600

The following operational parameters provide setting of the communication profile:

<table>
<tr><th>Menu</th><th>Setting Range</th><th>Default</th></tr>
<tr><td>S-tim</td><td>Serial Timer
Setting 0,000 allows manual activation of a serial data transmission at any time. All other settings specify the cycle time for automatic transmission (provided the S-mod item is set to "Printer-mode" (see the next item and on page 26).

Between two transmission cycles the unit will allow a pause depending on the baud rate. The minimum cycle times for timer transmissions are shown in the table.

<table>
<tr><th>Baud Rate</th><th>Minimum Cycle Time [msec]</th></tr>
<tr><td>600</td><td>384</td></tr>
<tr><td>1200</td><td>192</td></tr>
<tr><td>2400</td><td>96</td></tr>
<tr><td>4800</td><td>48</td></tr>
<tr><td>9600</td><td>24</td></tr>
<tr><td>19200</td><td>12</td></tr>
<tr><td>38400</td><td>6</td></tr>
</table></td><td>0,000
0,010 sec
...
9,999 sec</td><td>0,100 sec</td></tr>
<tr><td>S-mod</td><td>Serial Mode

Operation according to communication profile (see section “7.5.1 PC-Mode” on page 25).
Transmission of string type 1 (see section “7.5.2 Printer-Mode” on page 26).
Transmission of string type 2 (see section “7.5.2 Printer-Mode” on page 26).</td><td>PC
Print 1
Print2</td><td>PC</td></tr>
<tr><td>S-CodE</td><td>Serial Register-Code

Specifies the register code of the data to be transmitted. The most important register codes are:

<table>
<tr><th>Register</th><th>S-Code</th><th>ASCII</th><th>Description</th></tr>
<tr><td>Original SSI value</td><td>111</td><td>; 1</td><td>Direct encoder data</td></tr>
<tr><td>SSI value</td><td>113</td><td>; 3</td><td>Encoder data after Bit Blanking</td></tr>
<tr><td>Display value</td><td>101</td><td>: 1</td><td>Value with full scaling as it appears in the display</td></tr>
</table></td><td>100
...
120</td><td>101</td></tr>
</table>

7.5.1 PC-Mode

Communication with PC mode allows free readout of all parameters and registers of the unit. The subsequent example shows the details of communication for serial readout of the actual display value.

This is the general format of a serial request string:

EOT		AD1	AD2	C1	C2	ENQ

EOT = Control character (Hex 04)
AD1 = Unit address, High Byte
AD2 = Unit address, Low Byte
C1 = Register code, High Byte
C2 = Register code, Low Byte
ENQ = Control character (Hex 05)

Example

Request for the actual display value from unit number 11.

ASCII-Code	EOT	1	1	:	1	ENQ
Hexadecimal	04	31	31	3A	31	05
Binary	0000 0100	0011 0001	0011 0001	0011 1010	0011 0001	0000 0101

Upon correct request the unit will respond as shown on the right. Leading zeros will be suppressed.
BCC represents a block check character generated from an Exclusive-OR of all characters from C1 through ETX (inclusively).

STX	C1	C2	x x x x x x x	ETX	BCC

STX = Control character (Hex 02)
C1 = Register code, High Byte
C2 = Register code, Low Byte
x x x x x = Register data
ETX = Control character (Hex 03)
BCC = Block check character

With incorrect request strings, the unit only responds STX C1 C2 EOT or just NAK.

Provided the actual display value of the unit is "-180" for instance, the full response of the unit will be as shown below:

ASCII	STX	:	1	-	1	8	0	ETX	BCC
Hex	02	3A	31	2D	31	38	30	03	1C
Binary	0000 0010	0011 1010	0011 0001	0010 1101	0011 0001	0011 1000	0011 0000	0000 0011	0001 1100

Again BCC represents the block check character formed from the Exclusive-OR of all characters from C1 through ETX.

7.5.2 Printer-Mode

The Printer mode allows cyclic or manual activation of transmissions of the specified register data. The corresponding register can be specified by means of parameter **S-CodE**.
Another parameter called **S-mod** allows the selection between two different string types:

„S-mod"	Transmission string type
„Print1"	Space | Sign | Data | Line feed | Carriage return | +/- | X X X X X X | LF | CR
„Print2"	Sign | Data | Carriage return +/- | X X X X X X | CR

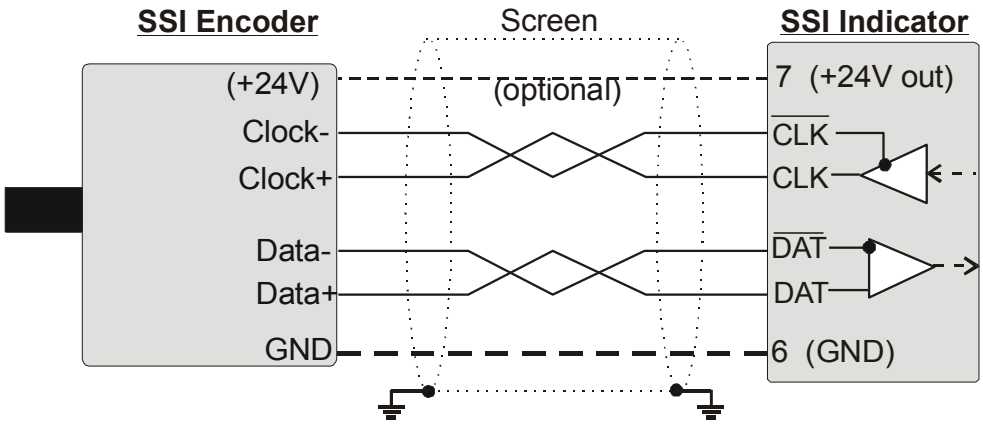
The mode of activation of serial transmissions can be determined as follows:

Cyclic (timed) transmissions	Set the **S-tim** item (see on page 23) to any value ≥ 0.010 sec. Select the desired string type next to parameter **S-mod**. After exiting the menu the timed transmissions will start automatically.
Manual activation of transmissions	Set the **S-tim** item (see on page 23) to 0.000. Select the desired string type by means of parameter **S-mod**. After exiting the menu a transmission can be activated at any time either by shortly pressing the **ENTER** key or by the rising edge of input A.

8 Hints for application

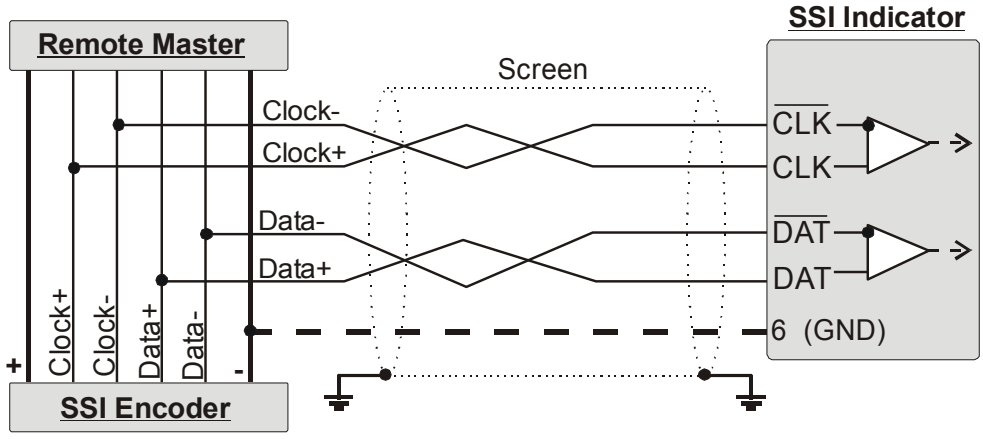
8.1 Master and Slave Operation

Set register **modE** (see section "7.1 Basic settings" on page 14) to position "Master" when the unit should generate the clock signal for the encoder. In this case the clock terminals (CLK) are configured as clock outputs.



SSI Indicator with Master Operation

When your encoder receives its clock from another device already and the unit should only "listen" to the communication, then set register **modE** to **"Slave"**. In this case, both clock terminals (CLK) are configured as inputs.



SSI Indicator with Slave Operation

Set registers **bitS**, **Form** and **bAUd** (section "7.1 Basic settings" on page 14) according to the encoder you use.
You are free to set any baud rate in a range from 0.1 kHz to 1000.0 kHz. However, for technical reasons, in the upper frequency range the unit in "Master" mode can only generate one of the following baud rates accurately:

1000,0 kHz	888,0 kHz	800,0 kHz	727,0 kHz	666,0 kHz
615,0 kHz	571,0 kHz	533,0 kHz	500,0 kHz	470,0 kHz
444,0 kHz	421,0 kHz	400,0 kHz	380,0 kHz	363,0 kHz
347,0 kHz	333,0 kHz	320,0 kHz	307,0 kHz	296,0 kHz
285,0 kHz	275,0 kHz	266,0 kHz	258,0 kHz	250,0 kHz

With Master operation, therefore other settings will result in generation of the next upper or lower value according to above list. With all settings <250.0 kHz the error between set rate and generated rate becomes negligible.

It is mandatory to set the baud rate also with "Slave" operation. In this case, however, the setting is only used to determine the pause time for correct synchronization (pause is detected after 4 clock cycles). The unit automatically synchronizes with every remote clock signal within the specified baud rate range.

8.2 Evaluation of encoder bits

This section is meant to explain the correlation between the basic parameter **bitS** (section "7.1 Basic settings" on page 14) and the operational parameters **Hi bit** and **Lo bit** (see section "7.2 Operational parameters" on page 16). The example below assumes that the encoder has a 16-bit resolution.

NOTE

- Unused bits may be blanked out according to individual need.
- Whenever the number of bits (clock cycles) requested from the SSI Master is higher than the real number of encoder bits, all excessive bits must be blanked by corresponding setting of parameters **Hi bit** and **Lo bit** (see section "7.2 Operational parameters" on page 16).

8.2.1 Basic settings

In general, parameter **bitS** will always be set according to the real resolution of the encoder (i.e. **bitS** = 16 with a 16-bit encoder). In this normal case the SSI telegram will not contain any excessive bits.
With some applications (e.g. with Slave operation) however it may happen that the Master transmits more clock cycles than the number of encoder bits (e.g. 21 clocks with a 16-bit encoder). In such a case the master would always request 21 bits from the encoder, where the encoder responds with 16 usable bits only, followed by 5 waste bits. These 5 excessive bits must be blanked.
All standard SSI telegrams start with the most significant bit (MSB) and close with the least significant bit (LSB). Unusable waste bits (X) will follow at the end of the string. To blank these bits out, in our example we would have to set **Hi bit** to 21 and **Lo bit** to 6 for proper evaluation of the encoder information.

	Hi Bit →															Lo Bit →					
Requested bits (clocks)	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Usable bits (encoder)	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	X	X	X	X	X

8.3 Scaling of the display

Under consideration of the scaling parameters which have been described previously, the final display value of the unit will result from:

$$\text{DISPLAY} = \{\ \text{[Encoder SSI Data]} - \text{[0-Position]}\ \} \times \frac{\text{M-Factor}}{\text{D-Factor}} \pm \text{P-Factor}$$

NOTE

- Encoder SSI data are always positive only. When also negative values should be indicated, this can be achieved by corresponding setting of the parameters **0-PoS** or **P FAc** (see section "7.2 Operational parameters" on page 16).
- The LED display provides 6 decades. For this reason all parameter settings (including **0-PoS**) are also limited to a maximum range of 6 decades. SSI encoders having a resolution of more than 19 bits will however generate SSI data with more than 6 decades. In such a case it can become difficult to set the **0-PoS** value and the other scaling parameters while the mechanical encoder position is in the overflow zone (the unit would insistently display **"overflow"**). To avoid this kind of problem with encoders of more than 19 bits, we recommend to use the "Bit Blanking" function and evaluate 19 bits only (see section "8.2 Evaluation of encoder bits" on page 28).
- If you intend to use the "Round Loop" function later (see **r-LooP** parameter in the section "7.2 Operational parameters" on page 16 and section "8.4.2 "Round-Loop" function" on page 32), it is mandatory to blank all unused bits.
- Remote Reset/Set commands via keyboard or external input will overwrite the current value of parameter **0-PoS** by the actual SSI position of the encoder. Therefore, in the formula above, the content between the brackets { } will become zero and the unit will display the same value as set to parameter **P FAc**. This scaling is also automatically stored to the Flash Prom for full data retention in power-down state.

8.4 Basic modes of operation

8.4.1 Normal SSI display

Normal operation provides calculation of the display value from the SSI encoder data and the settings of the scaling factors. Negative values can be achieved by corresponding setting of the zero position (**0-Pos** item) or by inversion of the direction bit (**dir** item).

To set the unit up without problem, it is advisable to use the following sequence of steps:

- Set all basic registers according to the encoder type you use, as shown in section "7.1 Basic settings" on page 14.
- For better comprehension, use first all initial settings as shown in the list (xxx = according to need).

M-Factor	:	1.000	**Direction**	:	0
D-Factor	:	1.000	**Error**	:	xxx
P-Factor	:	0	**Error P**	:	xxx
Decimal Point	:	000000	**Round-Loop**	:	0
Display	:	0	**Time**	:	xxx
Hi bit	:	see sections 8.2 and 8.3 on page 28 *	**Reset**	:	no
Lo bit	:		**0-Position**	:	0

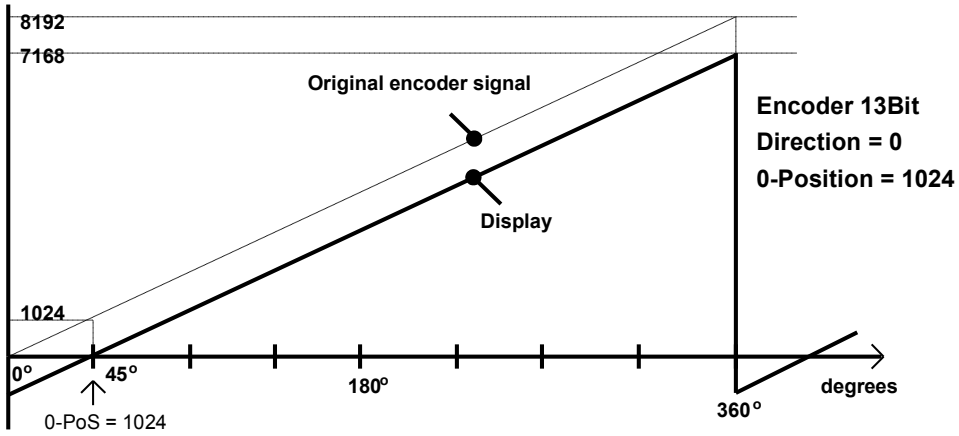
* Please evaluate 19 bits only to avoid overflow.

These settings ensure that the unit displays the pure SSI encoder information at first.

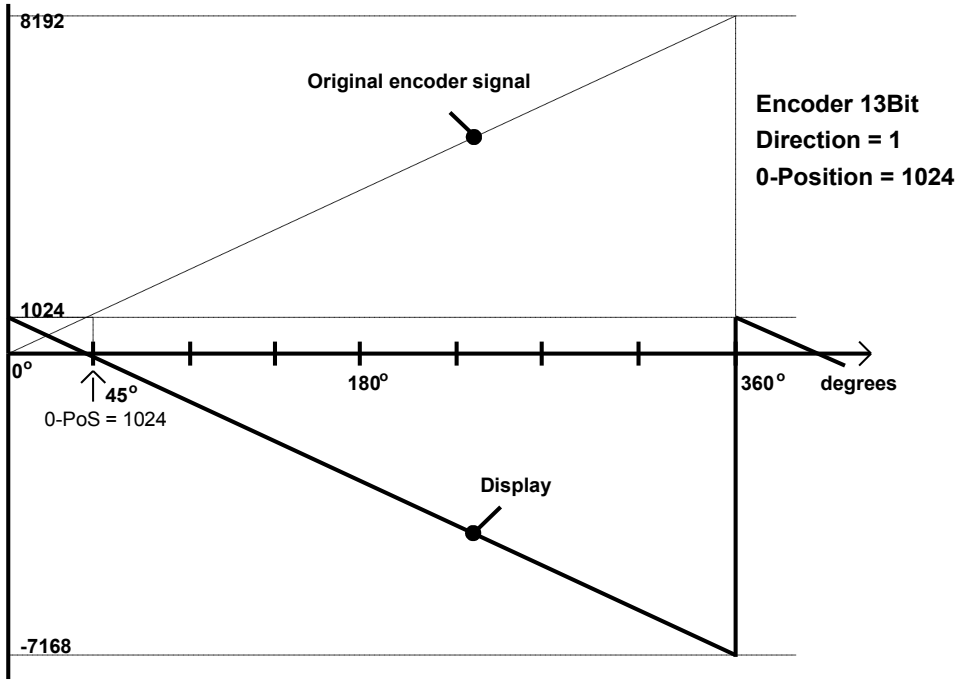
- Move your encoder now from a "lower" position towards a "higher" position according to your own definition of "low" and "high". When also the display changes from lower to higher values, your own definition of directions matches with the encoder definition. If not, change the setting of "Direction" (**dir** item) from "0" to "1" now to receive the desired sense of direction (changes after further parameter settings may cause different results) **.
- Set the desired zero position, either by entering the numeric value to the "0-Position" register (**0-Pos** item) or by using the Reset function as described previously. Your zero definition will divide the range into a positive and a negative zone.
- At this time you are free to set all other registers according to your needs.

The subsequent drawings show the principle of evaluation with use of a 13-bit single-turn encoder, with the direction bit (**dir** item) set to either "0" or to "1" and with the zero position register (**0-Pos** item) set to "1024" **.

** Subject of correct sequence with parameter settings.



Data display with positive counting direction



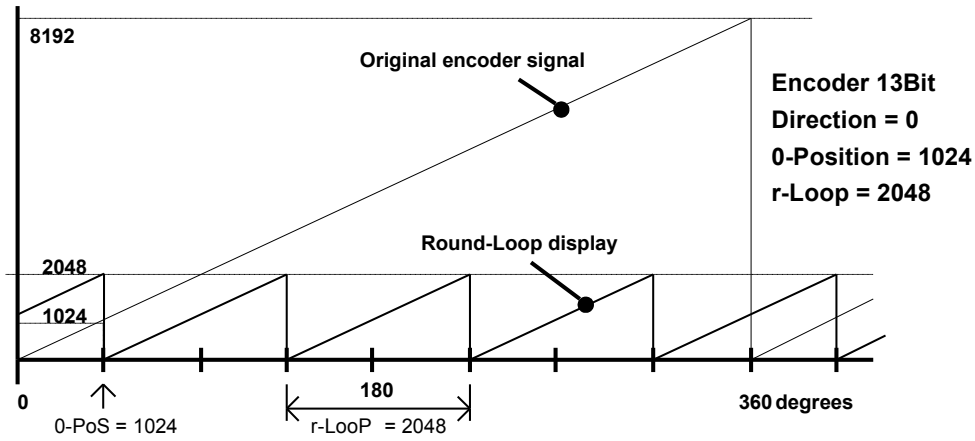
Data display with negative counting direction

8.4.2 "Round-Loop" function

This operational mode is often used with rotating round tables or similar applications, where the absolute encoder information is only used for a limited and repeating range of the encoder (as for instance one revolution of the table, which does not necessarily result in one revolution of the encoder shaft). The "Round-Loop" function never uses any negative display value.
The "Round-Loop" function allows a programmable number of encoder steps to be assigned to one complete 360° rotation of the table. To avoid miscounting when passing the mechanical overflow of the encoder range, the total encoder resolution should be an integer multiple of the number of steps for one loop.
To proceed with set-up operation, please first proceed as explained in section "8.4.1 Normal SSI display" on page 30.
Then set the "Round-Loop" register (**r-LooP** item) to the number of steps corresponding to one revolution of the table. You are free to scale the display to any engineering units desired, by setting the scaling factors correspondingly.

If you like to scale your display with the angular display format 359°59', just change the "Display" register (**diSPLA** item) from "0" to "359,59". This will also automatically disable the general scaling factors.

The subsequent diagram shows the "Round-Loop" function with a 13-bit encoder, assuming that one table revolution corresponds to 2048 encoder steps and the zero position is set to "1024".

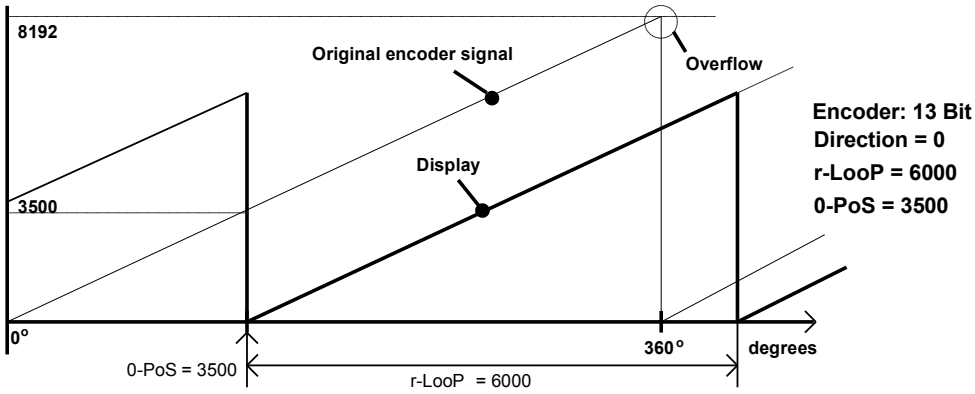


"Round-Loop" operation with 2048 steps / revolution when using a 13-bit encoder

8.4.3 Operation with "Zero-Crossing"

As a special advantage, the "Round-loop" function mode can be used to bypass the mechanical encoder overflow position, because in this mode the unit continues with steady operation, even while the SSI encoder signal passes the mechanical overflow position from maximum value back to zero.
This feature can help to avoid mechanical adjusting of the encoder zero position with many applications, when no other means for the mechanical zero definition is available.

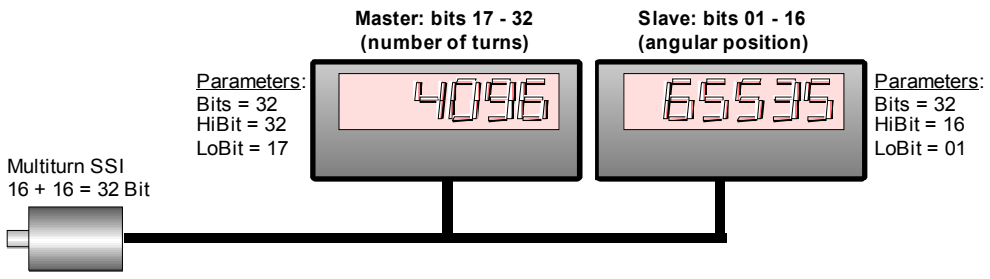
As a general rule, the Reset input will be used to define the zero position. The following picture explains the details of this operation.



Overflow suppression with a 13-bit SSI encoder

8.4.4 Splitting of SSI encoder information into two separate displays

The "Bit Blanking" function also allows to distribute one SSI telegram to two different SSI indicator units. As a typical application the figure below shows how to separate the angular information within one turn and the number of turns in a 16 x 16 multi-turn encoder.



8.5 Testing functions

The test menu can be accessed while programming the basic set up, as shown in section "7.1 Basic settings" on page 14, see tESt item. Most of these tests are for factory use only, but the following tests may be useful also to the user:

Menu	Selection	Text	Description
	Cd 11		**Cd (Clock- and data wiring test)** When the wiring of clock line and data line is ok, the display shows "Cd 11". "Cd 10" message means that the clock line is ok but data wires are false (wrong polarity), while "Cd 01" indicates a problem with the clock lines. In "Master" mode, only data lines are subject to this test.
	Cd 10		
	Cd i0		**Cd (Clock- and data function test)** The next test generates clock and data signals and feeds them directly into the rear terminals. Therefore **please remove the encoder connection**. "Cd i0" informs that clock and data interface are all right. All remaining messages indicate there is a problem with the SSI interface circuit.
	C__		
	d__		
	Cd__		

8.6 Error messages

The unit can detect and display the errors listed below. If you find an error message, please check again the encoder wiring and the settings of all SSI-relevant parameters.

Menu	Description
Err -O	**Overflow** The selected SSI baud rate is too high. Please set a lower baud rate value.
Err -b	**Bit error** The error bit or the power failure bit of the encoder (PFB) are set.
Err -t	**Time-out error** In "Slave" mode, during the last 0.6 seconds (plus wait time setting) the unit did not receive any valid data.
Err -F	**Format error** In "Slave" mode, a telegram having a too short length has been received.
Err-E1	**Missing encoder (1)** Right after power-up the unit detects that all SSI telegrams are empty (all bits = 1).
Err-E2	**Missing encoder (2)** During normal operation the unit detects that regular SSI telegrams are suddenly followed by empty telegrams (all bits = 1).

9 Special functions

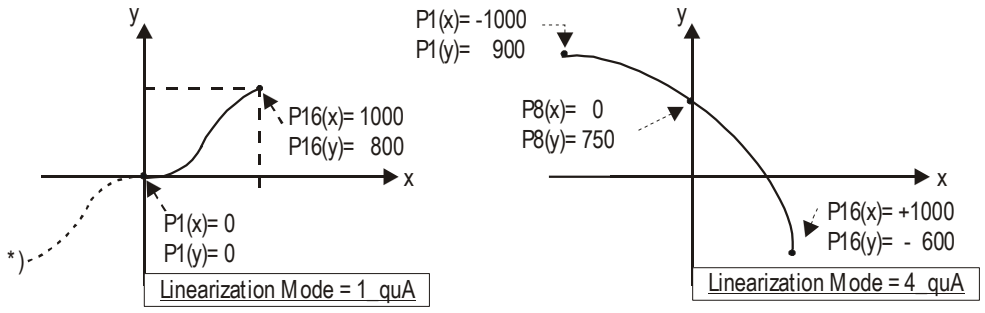
9.1 Linearisation

This function allows a non-linear input signal to be converted into a linear representation or vice versa. 16 interpolation points are available, they can be freely arranged over the whole measuring range at any distance. Between two points the unit will interpolate automatically straight lines.
It is advisable to set several points into areas with strong bending and to use only a few points in areas with little bending. "**Linearisation Mode**" has to be set to either 1-quA or 4-quA (see LinEAr item in section "7.1 Basic settings") to enable the linearisation function (see subsequent drawing).
Parameters P0 1_x to P 16_x select 16 x- coordinates, representing the display values which the unit would normally show in the display. With parameters P0 1_y to P 16_y you can specify which values you would like to display instead of the corresponding _x values.

This means e.g. that the unit will replace the previous P02_x value by the new P02_y value.

NOTE

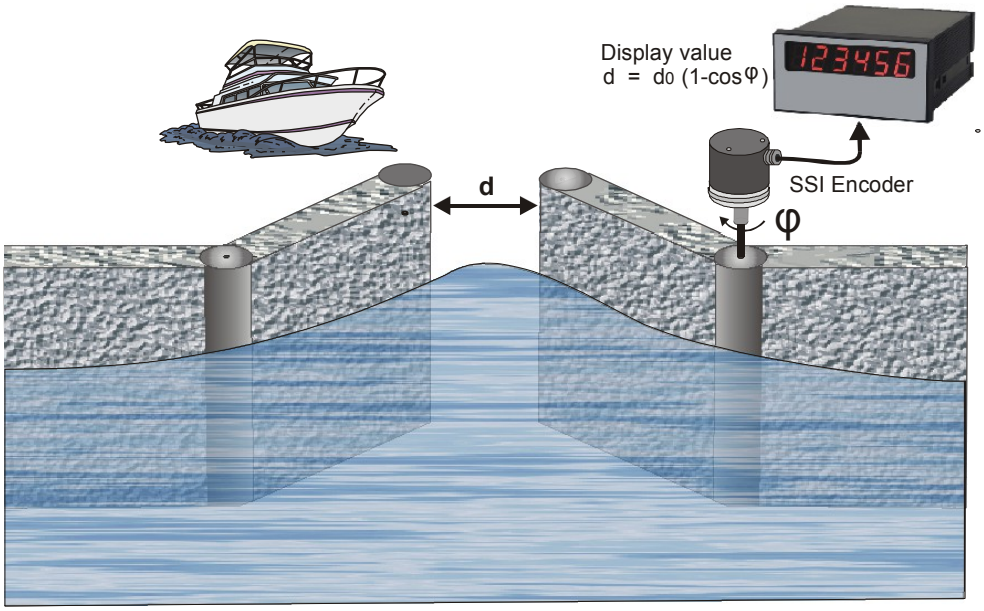
- With respect to the consistency of the linearisation, the x- registers have to use continuously increasing values, e.g. the x- registers must conform to the constraint P0 1_x < P02_x < ... < P 15_x < P 16_x.
- Independently of the selected linearisation mode, the possible setting range of all registers P0 1_x, P0 1_y,..., P 16_x, P 16_y is always -199999 ... 999999.
- With measuring values lower than P0 1_x the display will always show P0 1_y.
- With measuring values higher than P 16_x, the display will always show P 16_y.

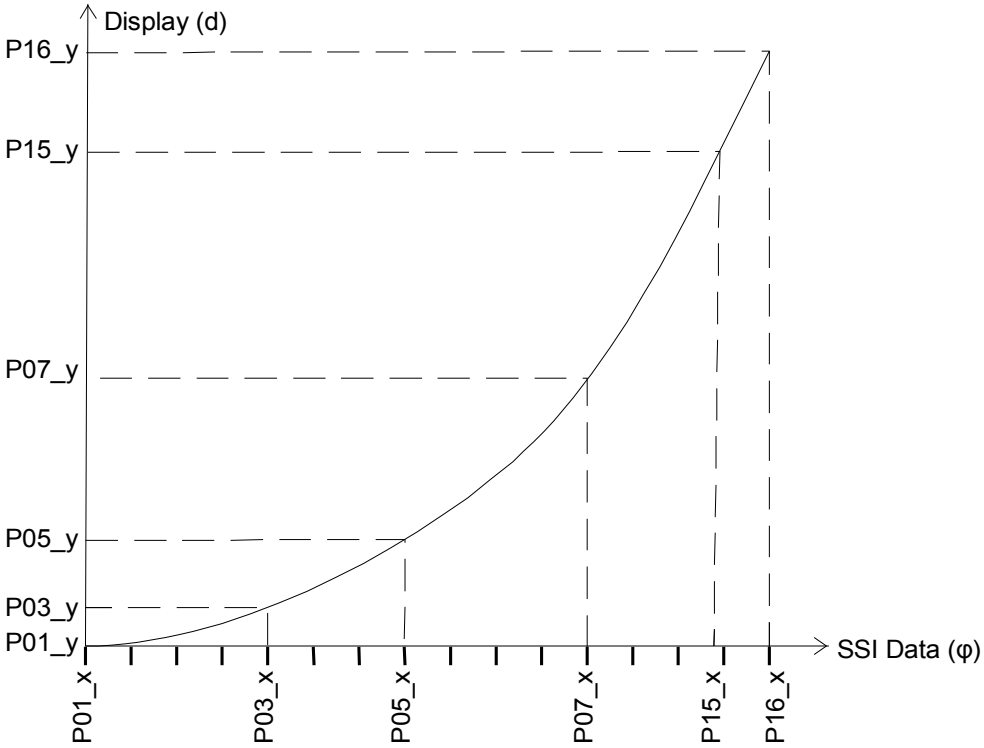


* Mirror of positive range

EXAMPLE

The picture below shows a sluiceway where the gate is controlled by means of a SSI encoder. We would like to display the clearance of the gate "d", but the existing encoder information is proportional to the angular information **φ**.





9.2 Manual input or „teaching" of the interpolation points

Interpolation points to form the linearisation curve can be entered one after each other, using the same procedure as for all other numeric parameters. This means you will have to enter all parameters P01_x to P16_x and P01_y to P16_y manually using the keypad.

WARNING
During manual input of interpolation points the unit will not examine the settings P01_x to P16_x. Therefore the operator is responsible for adherence to the constraint P01_x < P02_x < ... < P15_x < P16_x.

In most cases it should however be much more convenient to use the Teach function.
For this method we have to move the encoder, step by step, from one interpolation point to the next. After each step we enter the desired display value through the keypad.

How to use the "Teach" function

- Please select the desired range of militarization (see section "7.1 Basic settings").
- Hold down the **CMD** key for 3 seconds, until the display shows tEACh. Now the unit has switched over to the Teach mode. To start the teach procedure please press again the **CMD** key within the next 10 seconds. The display will then show P01_X.
- With respect to the consistency required for linearisation, all parameters from P01_x to P16_ y will be overwritten by suitable initial values first. Initial values for P01_x and P01_y are -199999 and all other values will start with 999999.
- Press once more the **CMD** key to display the actual encoder position. Then move the encoder to the first of the desired interpolation points.
- When you read the x-value of your first interpolation point in the display, press **CMD** key again. This will automatically store the actual display value in the P01_x register. For about 1 second you will read P01_y on the display, followed by the same reading again that has been stored previously.
- This display value now can be edited like a regular parameter and you can change it to the desired P01_y value.
- When you read the desired P01_y value in your display, save it by pressing **CMD** key again. This will cause the display to automatically scroll to the next interpolation point P02_x.

- Once we have reached and saved the last interpolation points **P 16_x/y**, the routine will restart with **P0 1_x** again. You are free to double-check your settings once more or to make corrections.
- To finish the Teach procedure, keep **ENTER** key down for about 2 seconds. In the display you will read **StOP** for a short time and then the unit returns to the normal operation. At the same time all linearisation points have been finally saved.

NOTE

- The unit will examine the constraint valid for the x-values of interpolation points. Every interpolation point must be higher than its preceding point. If this constraint is breached, all 6 decimal points will blink automatically as a warning. Pressing the **CMD** key will not store the illegal value, but result in an error text **E.r.r.-.L.0.**.
- To exit the teach mode again, you have the following two possibilities:
  1. Press the **ENTER** key for 2 seconds. On the display you will read **StOP** for a short time and then the unit will switch back to the normal mode.
  2. Just do nothing. After 10 seconds the unit will switch back to the normal mode automatically. In both cases the parameters of linearisation **P0 1_x** to **P 16_y** will not change.

10 Parameters list

10.1 General

Description	Text	Min. value	Max. value	Default value	Positions	Characters	Serial code
SSI-Mode	modE	0	1	0	1	0	00
SSI-Bits	bitS	08	32	25	2	0	01
SSI-Format	Form	0	1	0	1	0	02
SSI-Baudrate	bAUd	0.1	1000.9	100.0	5	1	03
SSI-Test	tESt	0	2	0	1	0	04
NPN / PNP	CHAr	0	1	1	1	0	05
Brightness	briGht	0	4	0	1	0	06
Code locking	Code	0	2	0	1	0	07
M-Factor	mFAc	-9.999	+9.999	1.000	+/- 4	3	08
D-Factor	dFAc	0.001	9.999	1.000	4	3	09
P-Factor	PFAc	-199999	+999999	0	+/- 6	0	10
Decimal point	dPoint	0	5	0	1	0	11
Display	diSPLA	0	1	0	1	0	12
Hi_Bit MSB	Hi_bit	1	32	25	2	0	13
Lo_Bit LSB	Lo_bit	1	31	1	2	0	14
Direction	dir	0	1	0	1	0	15
Error bit	Error	0	32	0	2	0	16
Error polarity	ErrorP	0	1	0	1	0	17
Round-Loop	r-looP	0	999999	0	6	0	18
Wait time	timE	0.000	1.009	0.010	4	3	19
Reset	FErES	0	3	0	1	0	20
Zero position	0-PoS	-199999	+999999	0	+/- 6	0	21

Description	Text	Min. value	Max. value	Default value	Positions	Characters	Serial code
Linear. mode	LinEAr	0	2	0	1	0	D2
Linear. point 1	P0 1_H	-199999	999999	999999	+/-6	0	A0
	P0 1_V	-199999	999999	999999	+/-6	0	A1
Linear. point 2	P02_H	-199999	999999	999999	+/-6	0	A2
	P02_V	-199999	999999	999999	+/-6	0	A3
Linear. point 3	P03_H	-199999	999999	999999	+/-6	0	A4
	P03_V	-199999	999999	999999	+/-6	0	A5
Linear. point 4	P04_H	-199999	999999	999999	+/-6	0	A6
	P04_V	-199999	999999	999999	+/-6	0	A7
Linear. point 5	P05_H	-199999	999999	999999	+/-6	0	A8
	P05_V	-199999	999999	999999	+/-6	0	A9
Linear. point 6	P06_H	-199999	999999	999999	+/-6	0	B0
	P06_V	-199999	999999	999999	+/-6	0	B1
Linear. point 7	P07_H	-199999	999999	999999	+/-6	0	B2
	P07_V	-199999	999999	999999	+/-6	0	B3
Linear. point 8	P08_H	-199999	999999	999999	+/-6	0	B4
	P08_V	-199999	999999	999999	+/-6	0	B5
Linear. Point 9	P09_H	-199999	999999	999999	+/-6	0	B6
	P09_V	-199999	999999	999999	+/-6	0	B7
Linear. Point 10	P 10_H	-199999	999999	999999	+/-6	0	B8
	P 10_V	-199999	999999	999999	+/-6	0	B9
Linear. point 11	P 11_H	-199999	999999	999999	+/-6	0	C0
	P 11_V	-199999	999999	999999	+/-6	0	C1
Linear. point 12	P 12_H	-199999	999999	999999	+/-6	0	C2
	P 12_V	-199999	999999	999999	+/-6	0	C3
Linear. point 13	P 13_H	-199999	999999	999999	+/-6	0	C4
	P 13_V	-199999	999999	999999	+/-6	0	C5
Linear. point 14	P 14_H	-199999	999999	999999	+/-6	0	C6
	P 14_V	-199999	999999	999999	+/-6	0	C7
Linear. point 15	P 15_H	-199999	999999	999999	+/-6	0	C8
	P 15_V	-199999	999999	999999	+/-6	0	C9
Linear. point 16	P 16_H	-199999	999999	999999	+/-6	0	D0
	P 16_V	-199999	999999	999999	+/-6	0	D1

10.2 Analogue output (model LD251)

See section "7.3 Model LD251: additional settings for the analogue output" on page 19

Description	Text	Min. value	Max. value	Default value	Positions	Characters	Serial code
Analogue mode	A-CHAr	0	3	0	1	0	33
Offset	OFFSEt	-9,999	+9,999	0,000	+/- 4	3	34
Gain	GAin	00,00	99,99	10,00	4	2	35
Analogue begin	AnAbEG	-199999	999999	0	+/- 6	0	31
Analogue end	AnAEnd	-199999	999999	100000	+/- 6	0	32

10.3 Preselections (model LD252)

See section "7.4 Model LD252: additional settings for preselections and switching outputs" on page 21

Description	Text	Min. value	Max. value	Default value	Positions	Characters	Serial code
Presel. mode 1	CHAr 1	0	3	0	1	0	29
Presel. mode 2	CHAr 2	0	5	0	1	0	30
Hysteresis 1	HySt 1	0	99999	0	5	0	36
Hysteresis 2	HySt2	0	99999	0	5	0	37
Preselection 1	PrES 1	-199999	+999999	10000	+/- 6	0	27
Preselection 2	PrES 2	-199999	+999999	5000	+/- 6	0	28

10.4 Serial interface (model LD253)

See section "7.5 Model LD253: additional settings for the serial interface" on page 23

Description	Text	Min. value	Max. value	Default value	Positions	Characters	Serial code
Serial address	S-Unit	0	99	11	2	0	90
Serial format	S-Form	0	9	0	1	0	92
Baud rate	S-bAUd	0	6	0	1	0	91
Serial timer	S-tim	10	9999	100	4	3	38
Serial mode	S-mod	0	2	0	1	0	39
Register-code	S-CodE	100	120	101	3	0	40

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Document release	Description
1.0	1st issue

Lika Electronic
Via S. Lorenzo, 25 - 36010 Carrè (VI) - Italy

Tel. +39 0445 806600
Fax +39 0445 806699

Italy: eMail info@lika.it - www.lika.it
World: eMail info@lika.biz - www.lika.biz