Operating Manual

safety - control - motion - interface

IP251

Universal SSI / RS232 signal converter for operation with absolute SSI sensors and encoders

Product Features:

- Converts SSI data as well as serial data to parallel binary, Gray oder BCD data format
- Linearization facilities by freely programmable in-/output curves
- Additional facilities like bit-blanking, round-loop-operation etc.
- Parallel output 25 bits (push-pull, short circuit proof)
- RS232 interface for serial readout of the sensor data
- SSI: Master or Slave operation
- 18 to 30 VDC power supply

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Version:	Description:
IP25101a/ HK/AF/ Apr-03	Original Version
IP25101b/ AF/HK/ Aug.03	Correction DIL-switch position 7 ON/OFF. "Parallel Mode" 3,4,5 and "Parallel Value" for direct serial access to the parallel output
IP25101c/ PP/Nov. 12	Added chapter 7.5
IP25102a/ kk/nw/Sept. 13	Added Printermode
Ip251_02b_oi/Dez-15/ag	„RS485" removed from parameter table. Legal Notices added. New design and chapter for "Safety Instructions". "Technical specifications" actualized. Smaller corrections and modulations

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1. Safety Instructions and Responsibility

1.1. General Safety Instructions

This operation manual is a significant component of the unit and includes important rules and hints about the installation, function and usage. Non-observance can result in damage and/or impairment of the functions to the unit or the machine or even in injury to persons using the equipment!

Please read the following instructions carefully before operating the device and observe all safety and warning instructions! Keep the manual for later use.

A pertinent qualification of the respective staff is a fundamental requirement in order to use these manual. The unit must be installed, connected and put into operation by a qualified electrician.

Liability exclusion: The manufacturer is not liable for personal injury and/or damage to property and for consequential damage, due to incorrect handling, installation and operation. Further claims, due to errors in the operation manual as well as misinterpretations are excluded from liability.

In addition the manufacturer reserve the right to modify the hardware, software or operation manual at any time and without prior notice. Therefore, there might be minor differences between the unit and the descriptions in operation manual.

The raiser respectively positioner is exclusively responsible for the safety of the system and equipment where the unit will be integrated.

During installation or maintenance all general and also all country- and application-specific safety rules and standards must be observed.

If the device is used in processes, where a failure or faulty operation could damage the system or injure persons, appropriate precautions to avoid such consequences must be taken.

1.2. Use according to the intended purpose

The unit is intended exclusively for use in industrial machines, constructions and systems. Non-conforming usage does not correspond to the provisions and lies within the sole responsibility of the user. The manufacturer is not liable for damages which has arisen through unsuitable and improper use.

Please note that device may only be installed in proper form and used in a technically perfect condition - in accordance to the Technical Specifications (see chapter 9). The device is not suitable for operation in explosion-proof areas or areas which are excluded by the EN 61010-1 standard.

1.3. Installation

The device is only allowed to be installed and operated within the permissible temperature range. Please ensure an adequate ventilation and avoid all direct contact between the device and hot or aggressive gases and liquids.

Before installation or maintenance, the unit must be disconnected from all voltage-sources. Further it must be ensured that no danger can arise by touching the disconnected voltage-sources.

Devices which are supplied by AC-voltages, must be connected exclusively by switches, respectively circuit-breakers with the low voltage network. The switch or circuit-breaker must be placed as near as possible to the device and further indicated as separator.

Incoming as well as outgoing wires and wires for extra low voltages (ELV) must be separated from dangerous electrical cables (SELV circuits) by using a double resp. increased isolation.

All selected wires and isolations must be conform to the provided voltage- and temperature-ranges. Further all country- and application-specific standards, which are relevant for structure, form and quality of the wires, must be ensured. Indications about the permissible wire cross-sections for wiring are described in the Technical Specifications (see chapter 9).

Before first start-up it must be ensured that all connections and wires are firmly seated and secured in the screw terminals. All (inclusively unused) terminals must be fastened by turning the relevant screws clockwise up to the stop.

Overvoltages at the connections must be limited to values in accordance to the overvoltage category II.

For placement, wiring, environmental conditions as well as shielding and earthing/grounding of the supply lines the general standards of industrial automation industry and the specific shielding instructions of the manufacturer are valid. Please find all respective hints and rules on www.motrona.com/download.html --> "[General EMC Rules for Wiring, Screening and Earthing]".

1.4. Cleaning, Maintenance and Service Notes

To clean the front of the unit please use only a slightly damp (not wet!), soft cloth. For the rear no cleaning is necessary. For an unscheduled, individual cleaning of the rear the maintenance staff or assembler is self-responsible.

During normal operation no maintenance is necessary. In case of unexpected problems, failures or malfunctions the device must be shipped for back to the manufacturer for checking, adjustment and reparation (if necessary). Unauthorized opening and repairing can have negative effects or failures to the protection-measures of the unit.

2. Introduction

IP251 represents a small and low-cost, but highly performing converter for industrial applications, where the information of a sensor or encoder with SSI interface needs to be converted to a parallel signal or a serial RS232 data format. Also it is possible to convert serial RS232 data to a parallel format.

The unit has been designed as a compact module with 12 screw terminals, a 9-position and a 25-position SUB-D connector (female). The housing is suitable for simple and quick snap-on mounting on a top hat rail (according to the EN 60715 standard).

2.1. Applicable encoders and sensors:

Single-turn or multi-turn absolute encoders and all similar sensors using a standard SSI interface (6 to 25 bits of resolution with binary or Gray code). The unit can operate in either

- Master mode (clock signal generated by the IP251 unit), or in
- Slave mode (clock signal generated by a remote device)

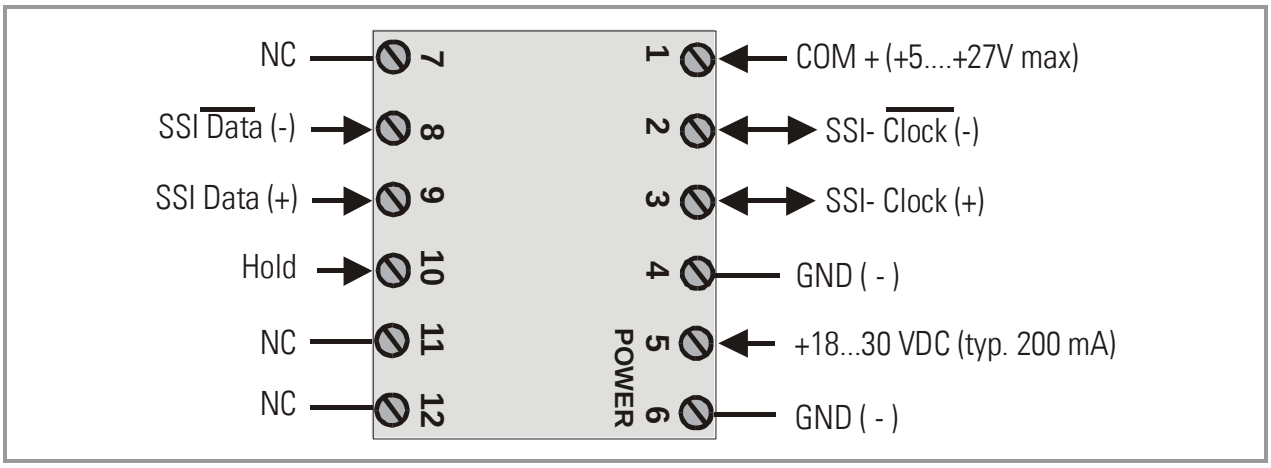
2.2. Remark about the encoder resolution:

The unit provides settings for the standard resolutions of 13 bits, 21 bits and 25 bits. In general, for sensors with other resolutions you can use the next higher setting (i.e. set the unit to 21 bits with a sensor of 16 bits).

Depending on brand and specification of the encoder, in some cases it may be necessary to blank out the surplus bits by using the bit blanking function described later. In general however, the unit should work perfectly also without special bit blanking.

3. Terminal Assignment

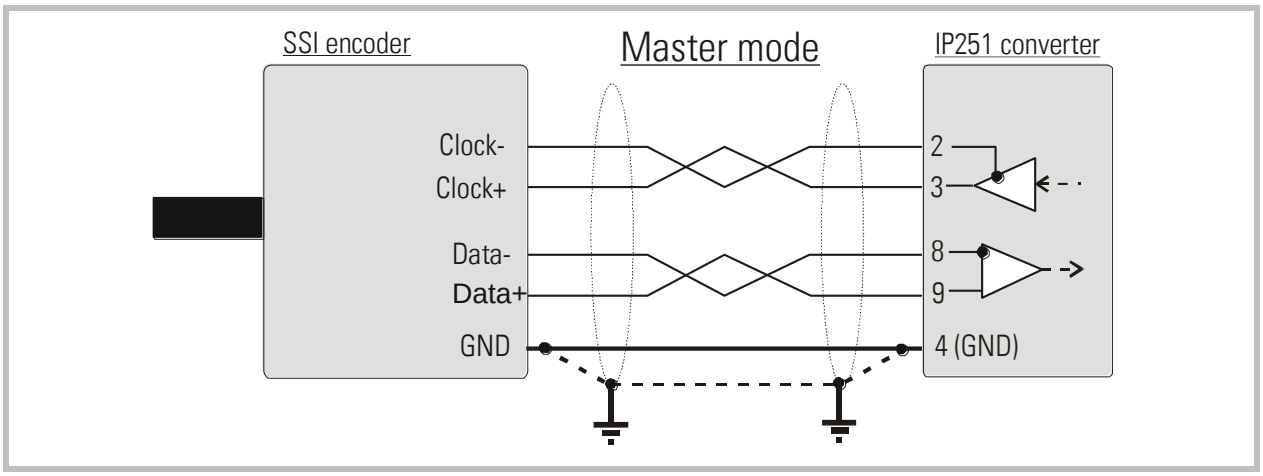
The subsequent diagram shows the assignment of the screw terminals. GND terminals 4 and 6 are connected internally. Depending on input voltage and load of the auxiliary voltage output, the total power consumption of the unit is about 200 mA.



We recommend to connect the Minus wire of the power supply to earth potential.

4. Connections

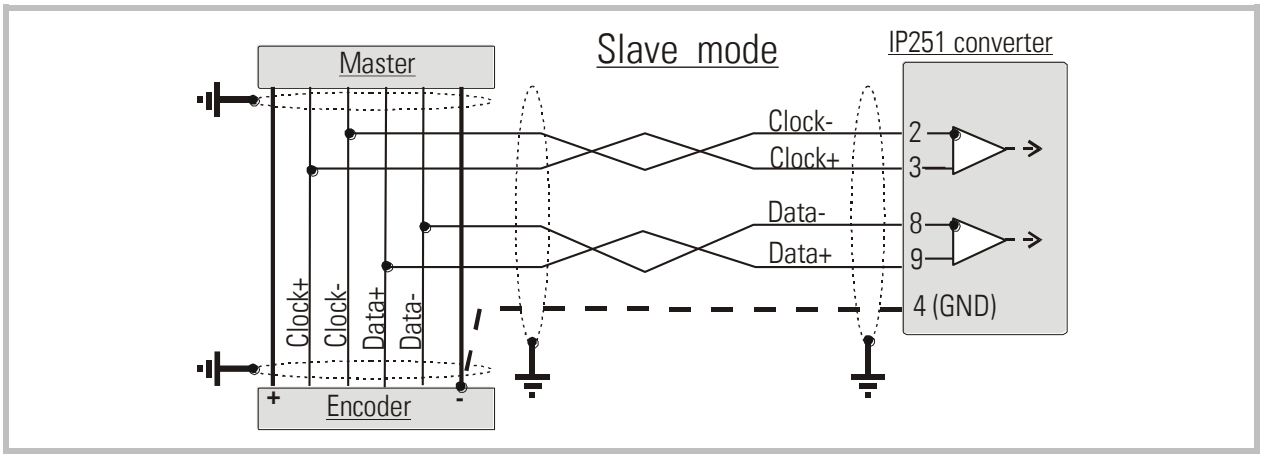
4.1. SSI encoder, Master operation



We recommend to connect the screen to GND and earth potential on both sites.

4.2. SSI encoder, Slave operation

With this mode, the IP251 converter operates in parallel to another unit, acting as a „listener" to the existing data communication. Quite according to need, the common potential of the master can be connected to terminal 4 (GND), or remain open for fully differential operation.



4.3. Hold input

A HIGH signal to this input freezes the parallel output data.

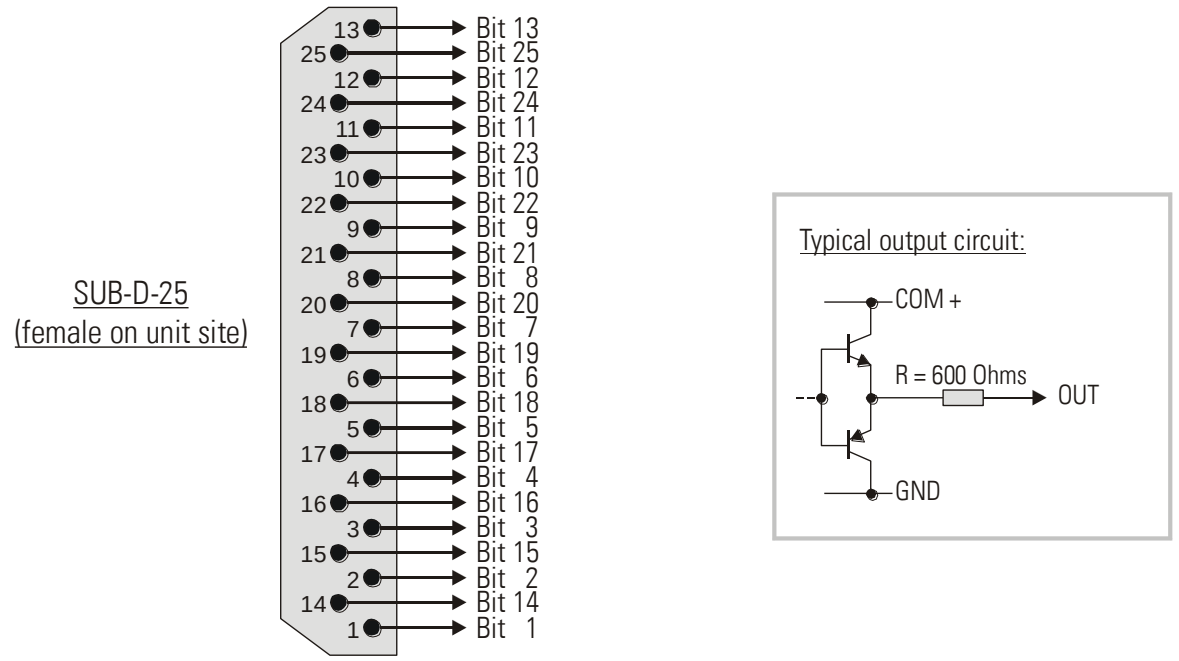
The Hold function becomes active 500 µs after the rising edge of the signal and remains active for the duration of the signal. With PC setup, the polarity of the signal can be inverted (Falling edge, active low, see register "Hold polarity").

The Hold input provides PNP/HTL characteristics (LOW = open or 0 … 3 V, HIGH =10 … 30 V)

4.4. Parallel outputs

The unit provides 25 push-pull outputs which are short-circuit proof. The separate common output voltage for the outputs must be applied to screw terminal 1 (COM+). The maximum voltage to COM+ should not exceed +27 V, otherwise no continuous short-circuit proof of the outputs can be guaranteed.

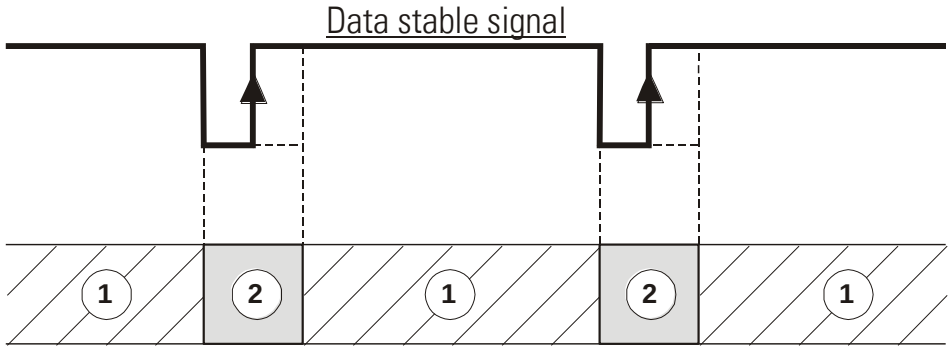
The voltage drop between COM+ and an output in HIGH state is approx. 1 V (unloaded).



4.5. "Data stable" output

The output for bit 25 can be configured as a "Data-stable" signal by means of the DIL-switch. In this case a LOW state indicates that parallel output data are stable and will not change. The rising edge of the signal still guarantees stable data and can be used for remote Latch of the parallel data.

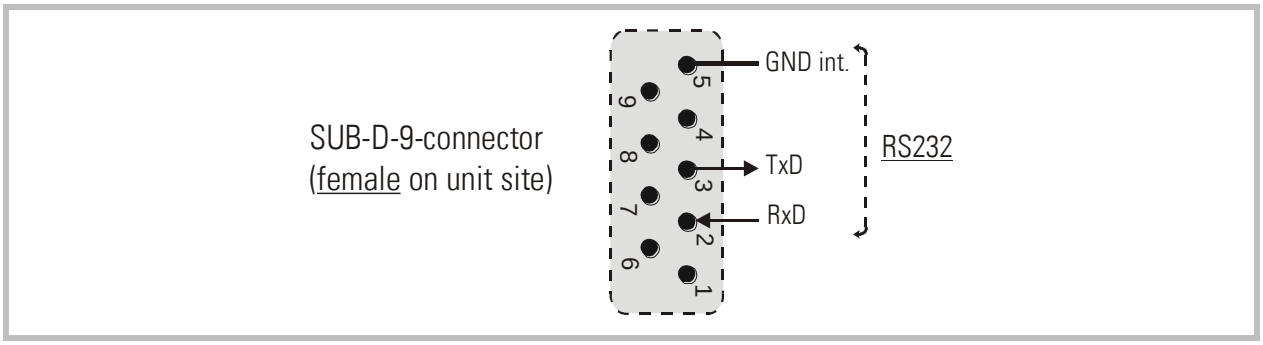
The LOW duration of the signal is at least 1/3 of the SSI Wait Time setting.

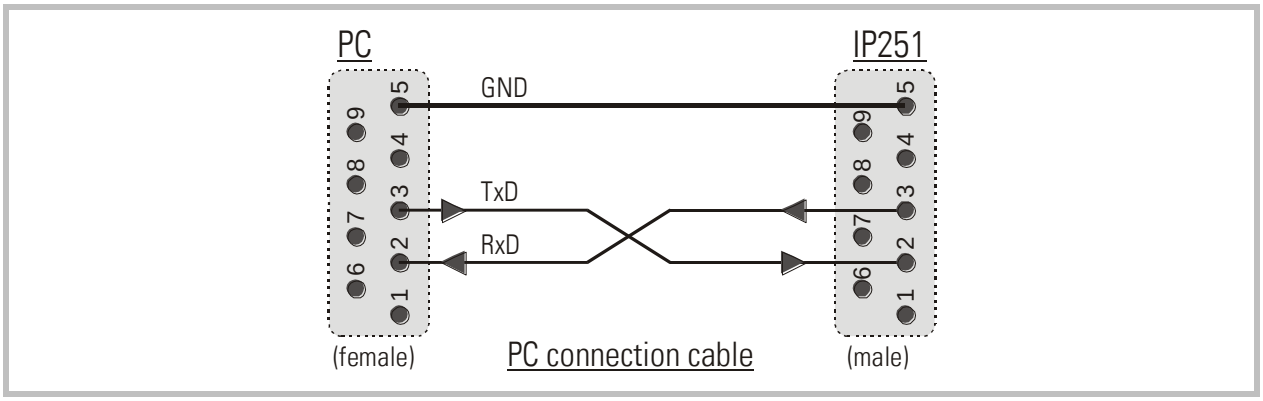


Zone 1: Parallel output data subject to change
Zone 2: Parallel output data are stable

4.6. Serial interface

For PC setup and for serial readout of the encoder position, a serial RS232 interface is available. The serial interface allows to operate and setup the unit as well as readout the encoder position by a PC or Notebook.

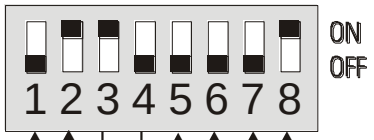




5. DIL Switch Settings

The DIL switch located on the top site of the unit provides encoder settings and customer-specific settings of the desired operation modes.

Changes of switch settings will become active only after the next power-up cycle!



Set Default:
OFF: Unit loads default settings with every power-up cycle
ON : No loading of default settings upon power-up.

Update Mode
OFF: Update of parallel output after every SSI telegram
ON: Update of parallel output in a fixed preset time pattern

Pin 25 Function:
OFF: Pin 25 indicates that output data is stable (LOW)
ON : Pin 25 is a normal data output (bit 25 or error bit)

SSI Code
OFF: Gray Code
ON: Binary Code

SSI Resolution:
3 OFF, 4 OFF : not valid
3 ON, 4 OFF : 25 bit encoder
3 OFF, 4 ON : 21 bit encoder
3 ON, 4 ON : 13 bit encoder

SSI Mode:
OFF : Slave Operation
ON : Master Operation

Pin 25 Function:
OFF : Pin 25 = Error bit output
ON : Pin 25 = normal data output (bit 25)

The switch settings shown in the example are suitable for Master operation of a 25 bit SSI encoder with Gray coded output. The parallel output operates with equidistant update times and pin 25 is used to indicate valid and stable output data.

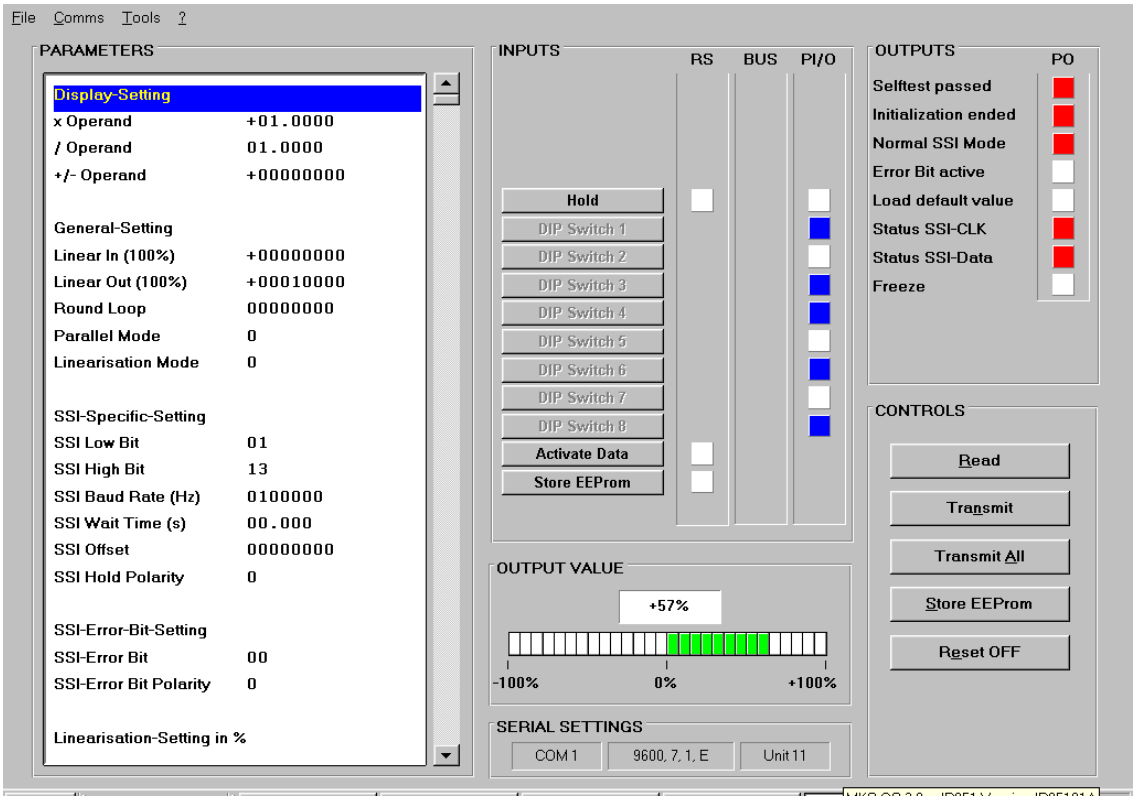
6. Extended Functions with PC Setup

For normal use with **standard applications**, the unit is ready to work after correct wiring and setting of the DIL switches. In this case, **the subsequent sections are not relevant.**

With use of a PC however, you have full access to useful complementary functions and tests as shown subsequently. For this you will need the PC operator software OS3.x which is available for free download from

www.motrona.com

Connect your PC to the converter, using a serial RS232 cable like shown in section 4.6. of this manual. Then run the OS3.x software and you will see the following screen:



In case your text and color fields remain empty and the headline says „OFFLINE“, you must verify your serial settings. To do this, select „Comms“ from the menu bar.

Ex factory, all motrona units use the following serial standard settings:

Unit No. 11, Baud rate 9600, 1 start/ 7 data/ parity even/ 1 stop bit

If the serial settings of the unit should be unknown, you can run the „SCAN“ function from the „TOOLS“ menu to find out.

6.1. Self-Test

On your PC screen, in the "Outputs" field, you find several indicator boxes.
When the "Self-test passed" box lights red, this indicates that the unit has correctly initialized and is ready to work. The fields "Status SSI-CLK" and "Status SSI-Data" indicate that the clock and data lines work correctly (red color = o.k.) *)

You may observe that these boxes blink, because of the update cycle of your PC. However, you should see "red" predominantly with correct operation of the lines.

6.2. Output value

When the encoder position is changing, this window must show increasing or decreasing encoder values. Where the color bar or the percentage display are jumping or hunting, please check once more for correct setting of the DIL switch.

6.3. Hold key

This soft key operates in parallel to the hardware input terminal 10 and allows freezing the parallel output from the PC screen. Indicator boxes in the RS column indicate that the Hold function is active, either by software or by hardware command.

*) Testing the clock lines is primarily useful with Slave operation. Though the test works also in Master mode, the result says only that the internal generation of the clock works fine. However, in Master mode, this test cannot indicate faulty clock drivers or bad wiring of the clock lines

7. Parameters

7.1. Scaling of serial readout data

You can read out the actual SSI position of the encoder at any time from the serial link. For setting of communication parameters (baud rate etc.) you need a PC.

IP251 uses the DRIVECOM communication standard according to ISO 1745. Details about this protocol can be found in the file Serpro1a.doc,
(available for Download from www.motrona.com)

The serial access code for the actual encoder position is „ :8 "
(ASCII characters for colon and 8)

Serial data be re-scaled by using the parameters xOperand, /Operand and +/-Operand :

$$\text{Serial Readout} = \left[\text{SSI encoder data} \times \frac{\text{xOperand}}{\text{/Operand}} \right] + \text{+/-Operand}$$

There operands affect only serial readout of encoder data but not the parallel data output.
With the settings

xOperand	=	1.0000,
/Operand	=	1.0000
+/-Operand	=	0.0000

the serial readout value equals to the SSI encoder value.

7.2. Scaling of parallel output data

7.2.1. If you like to convert the SSI encoder data to the parallel output straight 1:1

- Linearisation Mode = 0
- Round Loop = 0
- Parallel Mode = 0 (binary output)
  = 1 (Gray coded output)
  = 2 (BCD output)
- Parallel Inv. = 0 (Log 1 = „HIGH", normal output polarity)
  = 1 (Log 1 = „LOW", inverted output polarity)

The settings of the Linearization registers are not important in this case.

7.2.2. If you like to convert the SSI encoder data to the parallel output with a different scaling:

Example: encoder 16 Bit = 65536 steps to be converted to a range of 0 - 10 000 on the parallel output

- Linearisation Mode = 1
- Round Loop = 0
- Parallel Mode = 0 (binary output)
  = 1 (Gray output)
  = 2 (BCD output)
- Parallel Inv. = 0 (Log 1 = „HIGH“, normal output polarity)
  = 1 (Log 1 = „LOW“, inverted output polarity)
- Linear In (100%) = 65 536
  Linear Out (100%) = 10 000
- P1 (x) = 000.0 %
  P1 (y) = 000.0 %
  P2 (x) = 100.0 %
  P2 (y) = 100.0 %

7.2.3. If you like to transform the SSI encoder data to a curve on the parallel output site (Linearization)

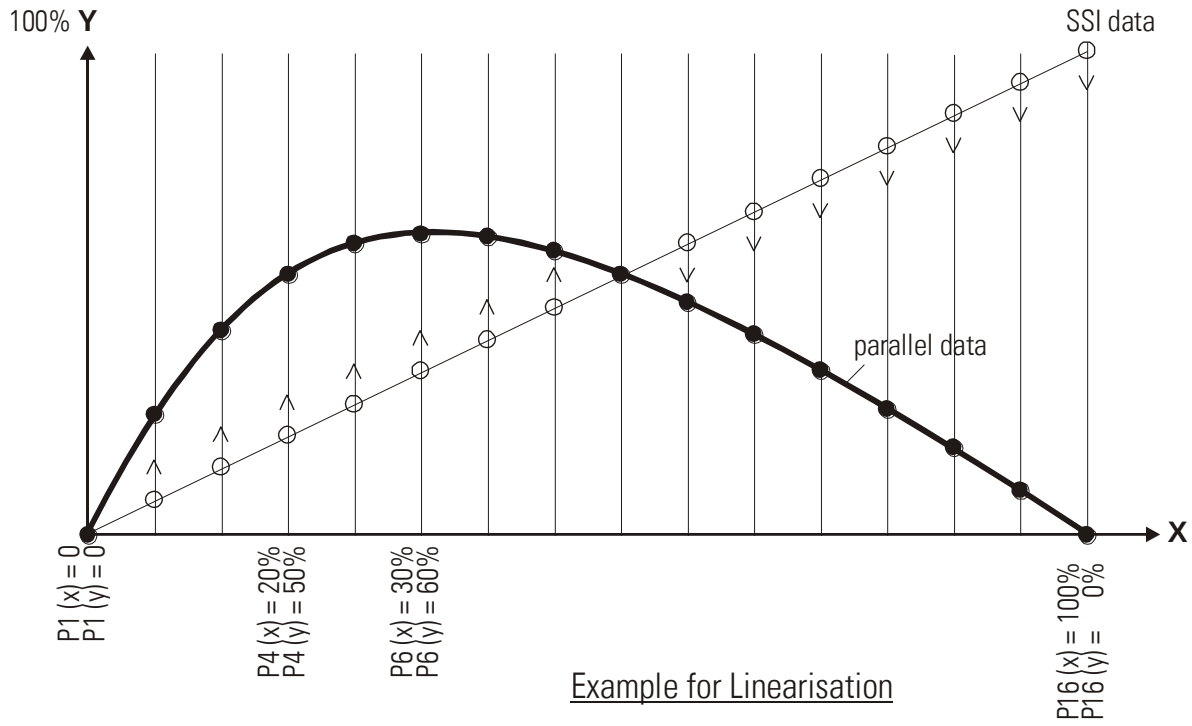
Example: encoder 16 Bit = 65536 steps to be transformed to a programmable curve.

- Linearisation Mode = 1
- Round Loop = 0
- Parallel Mode = 0 (binary output)
  = 1 (Gray output)
  = 2 (BCD output)
- Parallel Inv. = 0 (Log 1 = „HIGH“, normal output polarity)
  = 1 (Log 1 = „LOW“, inverted output polarity)

- Use registers **P1(x)** to **P16(x)** to specify the coordinates on the x-axis. These are the original SSI data generated by the sensor. These settings are in % of full scale
- Now enter the attached values to registers **P1(y)** to **P16(y)**. These are the values that the parallel output will generate instead of the x- values *)

*) Example:. P2(y) will substitute P2(x) etc.

- x-registers must follow continuously increasing settings, i.e. P1(x) must receive the lowest setting and P16(x) must receive the highest setting
- All entries use a percent format of xx.xxx% full scale. Setting 0.000% means zero output and setting 100.000% means full scale encoder output
- With Linearization Mode set to 1, it is a must to set P1(x) to 0% and P16(x) to 100%. Linearization is defined in the positive range only and the negative range will be a mirror image of the positive range with reference to zero.
- With Linearisation Mode set to 2, it is a must to set P1(x) to –100% and P16(x) to +100%. This enables the user to set curves which are not symmetric to the zero position



Example for Linearisation

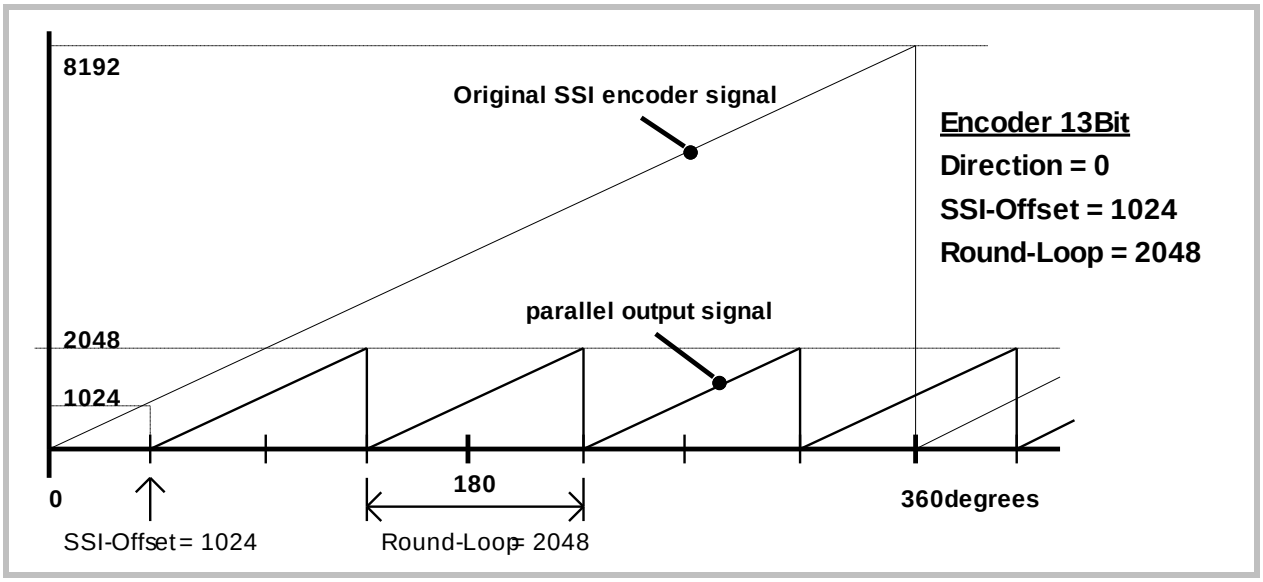
7.3. Ring counter, parameter "Round Loop":

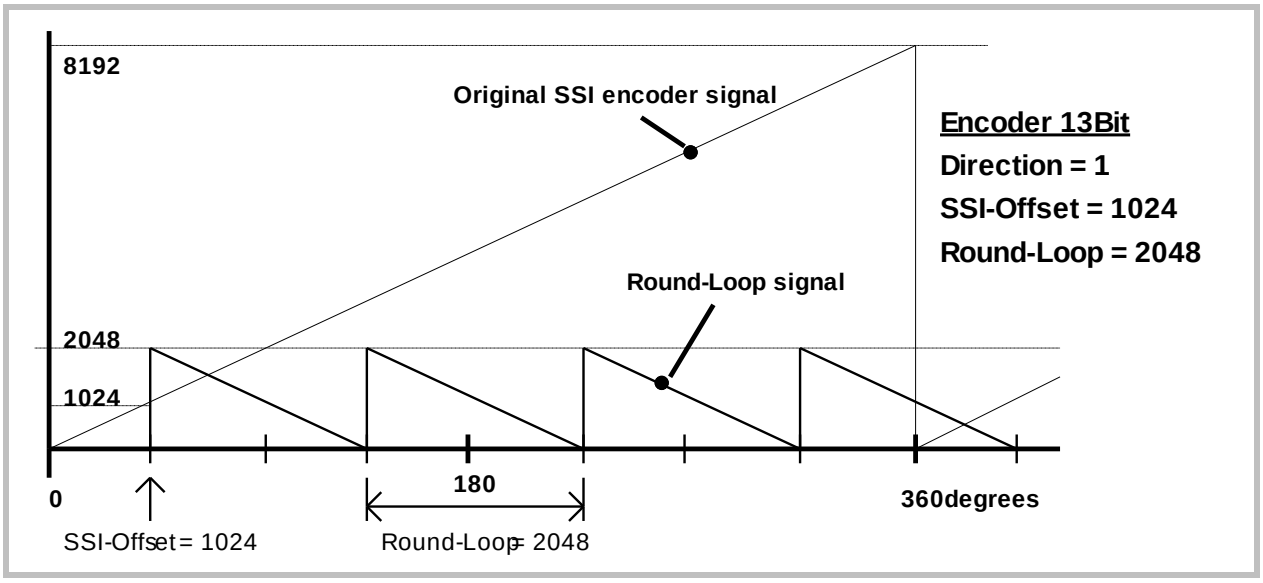
In general, this setting should be 00000. Any other setting will substitute the real encoder position by a repeating cycle count.

Example: when the Round Loop register is set to 2048, the internal position register will only count in a range between 0 and 2047. When we underpass zero with reverse direction, again 2047 will appear. When we exceed 2047 with forward direction, we will restart at 0 again.

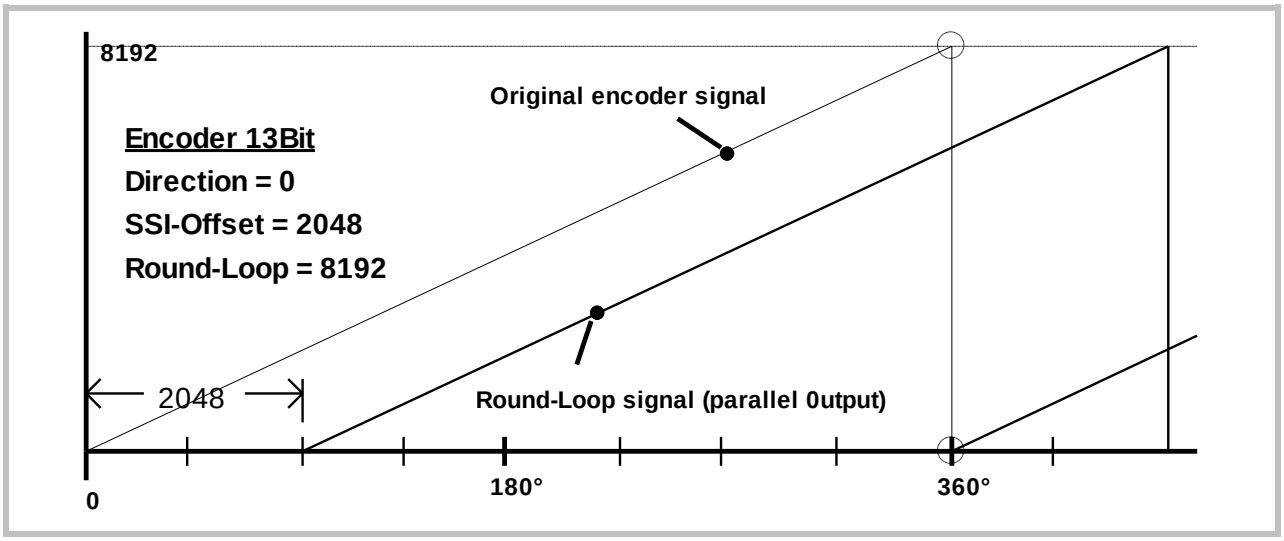
The zero position of the round-loop counter can be set by register “SSI-Offset” which allows settings between 0 and the Round-Loop value. Register “Direction” allows to set the counting direction of the round loop counter (0 = up, 1 = down).

The following drawings explain the coherence between original SSI encoder data, Round-Loop setting, SSI-Offset and Direction register.





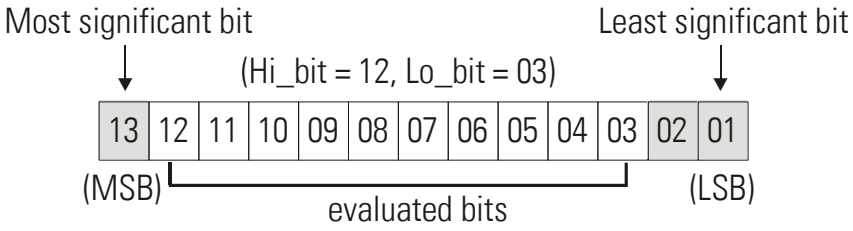
The Round-Loop function is also suitable to suppress the encoder overflow, if you do not like to change the mechanical situation. As shown in the subsequent picture, you need to set the Round-Loop register to the full encoder resolution and then shift the zero transition by setting the SSI Offset correspondingly.



- With each change of the Round-Loop parameter, the offset value must be re-entered.
- With use of the Round-Loop function it is also possible to change the counting direction of the encoder, by appropriate setting the direction bit.

7.4. More parameters:

Parameter	Description		
Parallel Mode:	Sets the code of the parallel output and the input source of the converter.		
	Parallel Mode :	Parallel output	Data source
	0	Binary format	SSI encoder
	1	Gray format	
	2	BCD format	
	3	Binary format	Serial RS 232 interface
	4	Gray format	
	5	BCD format	
Linearisation Mode:	Sets the mode of linearization. 0: Linearisation off, all linearization registers are irrelevant. 1: Linearisation in a range of 0 – 100% 2: Linearisation over full range –100% to +100% See example under section 7.2.3 „Linearisation"		

Parameter	Description
SSI Low Bit:	Defines the lowest bit (LSB) for evaluation when the bit blanking function is used. Must be set to "01" for full evaluation of the encoder range.
SSI High Bit:	Defines the highest bit (MSB) for evaluation when the bit blanking function is used. Must be set to the total number of encoder bits for full evaluation of the encoder range. The following example uses a 13 bit encoder where High Bit is set to 12 and Low Bit is set to 03, resulting in evaluation of bits 03 to 12 and blanking of positions 01, 02 and 13 

Bit blanking results in a different evaluation of the encoder information, and you should be fully aware of what happens with the resolution and the number of registered turns when you use this function. The subsequent example uses a 13 bit single-turn encoder to explain different result with blanking on one bit:

- Without blanking, a 13 bit encoder would provide a 0 ... 8191 information with a 0 ... 360° turn of the encoder shaft.
  This assumes setting of "High Bit = 13" and "Low Bit = 01".
  It is easy to understand that there are two different ways how to use only 12 of the 13 bits available:
- When we set High Bit to 12 while Low Bit remains 01, we have blanked the high order bit. The result corresponds to an encoder providing information 0 ... 4095 while we turn from 0 ... 180°, and again the same 0 ... 4095 information while we turn from 180° to 360°. The resolution remains unchanged with respect to the number of steps per revolution.
- We can also leave High Bit to 13 and set Low Bit to 02 instead. This means blanking the low order bit. As a result, within one turn of 0 ... 360°, we receive the encoder information 0 ... 4095 one time only, but the total number of steps per revolution has been halved.

Parameter	Description
SSI Baud Rate:	Sets the communication speed of the SSI interface with SSI encoders. Setting range: 100 Hz to 1MHz. You are free to set any desired frequency between 0.1 kHz and 1000.0 kHz. For technical reasons however, in the upper frequency range with Master operation, the unit will only generate one of the following frequencies accurately: 1 000.0 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.

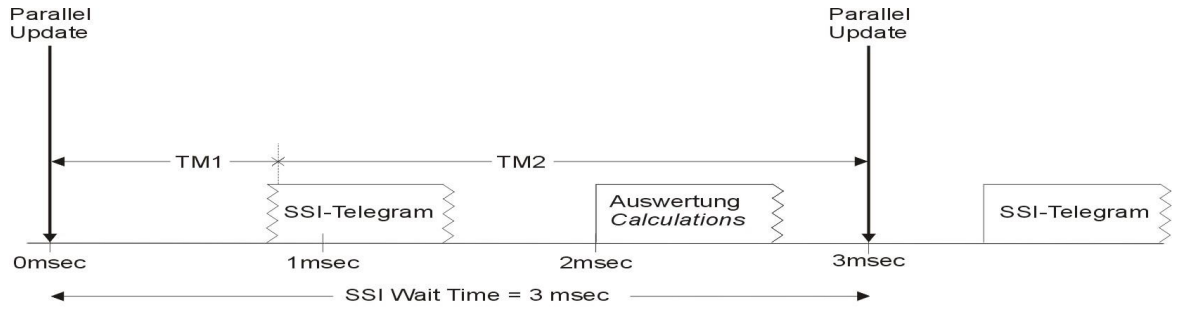
It is mandatory to set the Baud rate also with Slave operation.

In this case, however, the setting serves only to determine the pause time for correct synchronizations (pause is detected after 4 clock cycles). The unit automatically synchronizes with every remote clock signal within the specified Baud rate range.

SSI Wait Time:	This register sets the waiting time between two SSI telegrams in a range from 0.001 to 10.000 s. In normal operation, due to processor cycle times, the real time may vary by 512 µs. with respect to the preset time. The fastest sequence possible is 1.3 ms at a setting of 0.000. With Slave operation mode, the distance of the SSI protocols depends on the remote Master and the SSI Wait Time specifies the distance of evaluation data strings. Setting to 100 ms results in evaluation of one telegram only every 100 ms, even though the Master may have transmitted many telegrams more. Especially with applications of closed-loop control loops, it may be of advantage to have **equidistant updating of** the output (DIL switch 7 = OFF). This is possible with Master mode only and the Wait Time setting (must be >0) directly corresponds to the time pattern of updates.

The subsequent drawing explains the timing with use of equidistant update mode with a SSI Wait Time setting of 3 ms.

With equidistant operation mode, the SSI wait time setting is limited to maximum 90 ms.



- The shortest possible time for equidistant updating is 2 ms, due to internal processing times (SSI Wait Time set to 0.001). While your PC is communicating with the unit, it is even 5 ms.
- The time marks TM1 and TM2 shown in above diagram can be displayed with the Monitor function of the PC operator software. It is easy to understand that the sum of both times must be equal to the Wait Time setting, otherwise you must increase the Baud rate or choose a longer update cycle. (The serial access codes are :3 for TM1 and :5 for TM2)
- In critical cases you can reduce the internal processing times of the unit, by omitting the conversion of serial RS232 encoder data. For this, just set parameter "/Operand" to 00000

Parameter	Description
SSI Offset:	Defines the electrical zero position of the encoder with respect to the mechanical zero position. When the Round-Loop function is not active (Round-Loop = 0), the SSI Offset is subtracted from the SSI position reading, which can also cause negative results. When the Round-Loop is active, SSI Offset displaces the mechanical zero position, but always with only positive results.
SSI Hold Polarity	Sets the polarity of the Hold signal on terminal 10 (active high or active low) **0 : Hold = High,** **1 : Hold = Low,**

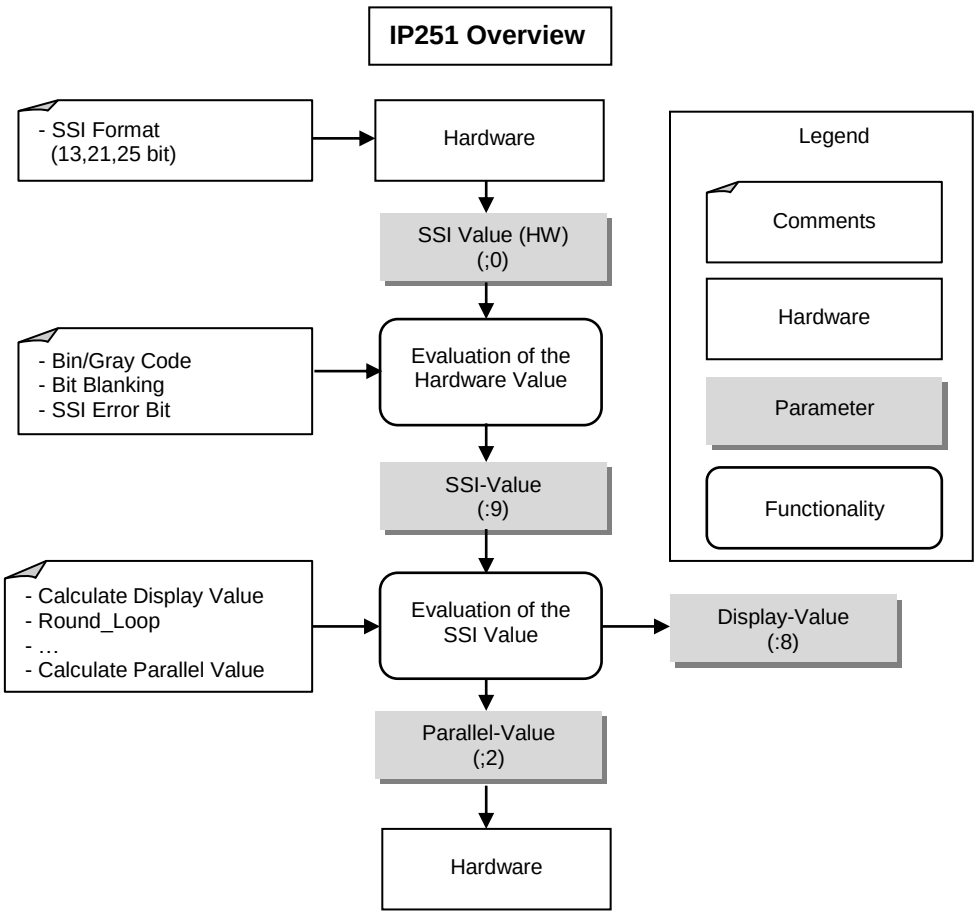
SSI Error Bit:	Defines the position of the error bit (if available with the encoder in use). 00: no error bit available 13: bit 13 represents the error bit 25: bit 25 represents the error bit etc. Errors indicated by the encoder can be read out via serial code ;9 (semicolon nine, error indication = 2000hex). In case of an error, the "Error Bit active" box on the PC screen appears red. It is also possible to use pin 25 of the parallel output for error indication (see DIL switch settings).
SSI Error Bit Polarity:	Defines the polarity of the Error Bit 0: Bit is LOW in case of error 1: Bit is HIGH in case of error
P01 (x), P01 (y) etc:	Linearisation registers (see section 7.2.3)
Direction:	This parameter changes the internal direction of counting (0 or 1), provided the unit operates in Round Loop mode.
Parallel Inv:	When you change this register from 0 to 1, the data on the parallel output will be inverted.
Parallel Value:	The numerical value of this parameter appears directly at the parallel output, provided the register „Parallel Mode" has been set to a value greater than 2 before. The serial access code of Parallel Value is "48" and the setting can be changed at any time via serial link This function may be useful for testing of function and wiring of the parallel output.

7.5. Parameters for RS232 settings

<table>
<tr><th>Parameter</th><th>Description</th></tr>
<tr><td>Unit Number :</td><td>Any address numbers between 11 and 99 * can be chosen
(Factory setting = 11).

* Please note: The address must <u>not</u> contain a “0“ because these numbers are reserved for collective addressing.</td></tr>
<tr><td>Serial Baud Rate:</td><td>
<table>
<tr><th>Setting</th><th>Baud-Rate</th></tr>
<tr><td>0*</td><td>9600</td></tr>
<tr><td>1</td><td>4800</td></tr>
<tr><td>2</td><td>2400</td></tr>
<tr><td>3</td><td>1200</td></tr>
<tr><td>4</td><td>600</td></tr>
<tr><td>5</td><td>19 200</td></tr>
<tr><td>6</td><td>38 400</td></tr>
<tr><td colspan="2">* = Factory setting</td></tr>
</table>
</td></tr>
<tr><td>Serial Format:</td><td>
<table>
<tr><th>Setting</th><th>Data bits</th><th>Parity</th><th>Stop bits</th></tr>
<tr><td>0</td><td>7</td><td>even</td><td>1</td></tr>
<tr><td>1</td><td>7</td><td>even</td><td>2</td></tr>
<tr><td>2</td><td>7</td><td>odd</td><td>1</td></tr>
<tr><td>3</td><td>7</td><td>odd</td><td>2</td></tr>
<tr><td>4</td><td>7</td><td>none</td><td>1</td></tr>
<tr><td>5</td><td>7</td><td>none</td><td>2</td></tr>
<tr><td>6</td><td>8</td><td>even</td><td>1</td></tr>
<tr><td>7</td><td>8</td><td>odd</td><td>1</td></tr>
<tr><td>8</td><td>8</td><td>none</td><td>1</td></tr>
<tr><td>9</td><td>8</td><td>none</td><td>2</td></tr>
<tr><td colspan="4">* = Factory setting</td></tr>
</table>
</td></tr>
<tr><td>Serial Protocol:</td><td>Determines the sequence of characters sent, when you use the serial output for cyclic data transmission under timer control (xxxxxxx is the measuring value transmitted). The length of the transmitted value is dependent on its current value.

Both print formats are shown in the following table:
<table>
<tr><td></td><td colspan="2">Unit No.</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Serial Protocol = 0*:</td><td>1</td><td>1</td><td>+/-</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>LF</td><td>CR</td></tr>
<tr><td>Serial Protocol = 1 :</td><td></td><td></td><td>+/-</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>X</td><td>LF</td><td>CR</td></tr>
<tr><td colspan="12">* = Factory setting</td></tr>
</table>
</td></tr>
</table>

Parameter	Description
Serial Timer:	This register determines the cycle time in seconds for cyclic transmission when the Printer Mode is switched on. Range 0.001 to 99.999 seconds. With setting "0" all cyclic transmission is switched off and the unit will only send data upon request (PC mode *).
Serial Value:	Sets the code of the register of which the content should be sent with cyclic transmission. Setting range 00** – 09 (corresponds to register codes :0 to :9) and 10 - 19 (corresponds to register codes ;0 to ;9). For clarification of register codes see the following figure. The most important register codes are: **Register** / **ASCII** SSI Value (HW) ;0 SSI Value :9 Display Value :8 Parallel Value ;2  ** = Factory Setting

*) see next page…

*) The serial port of the unit can operate in either “PC mode“ or “Printer mode“.

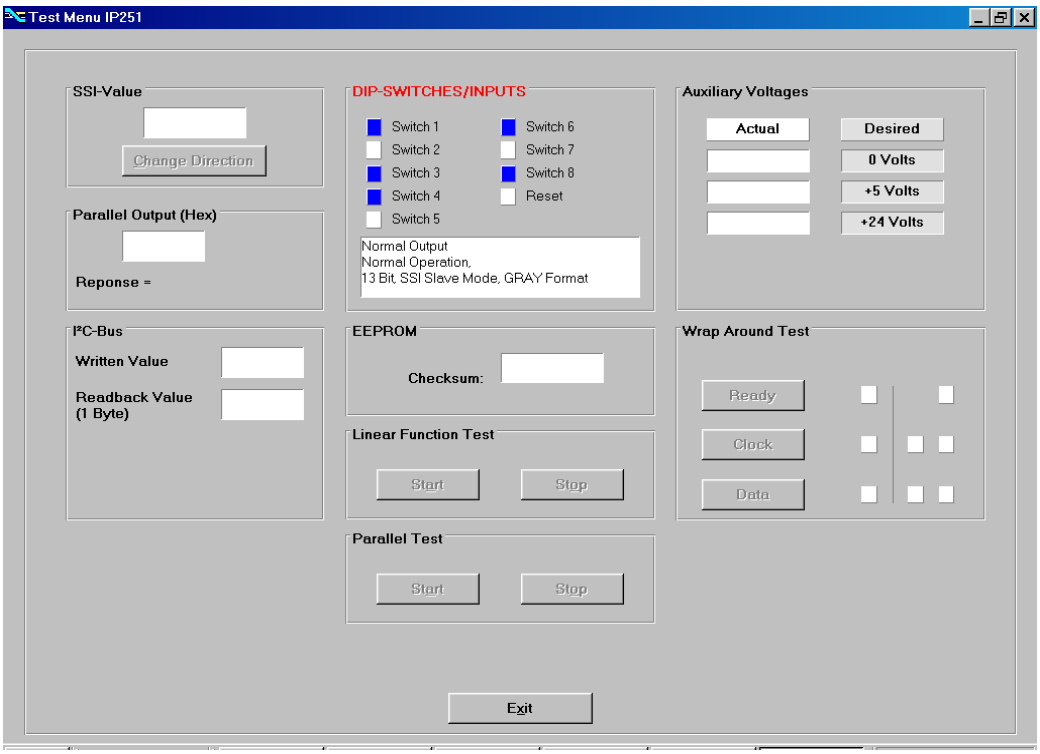
With PC mode, the unit receives a request string and responds with a corresponding data string. For details of the protocol see separate description “SERPRO“.

With Printer mode, the unit sends data without any request and under Timer control as described subsequently. As soon as the unit receives a character, it automatically switches over to PC Mode and operates according to protocol. When for a period of 20 sec. no character has been received, the unit switches automatically back to “Printer Mode“ and starts cyclic data transmission again.

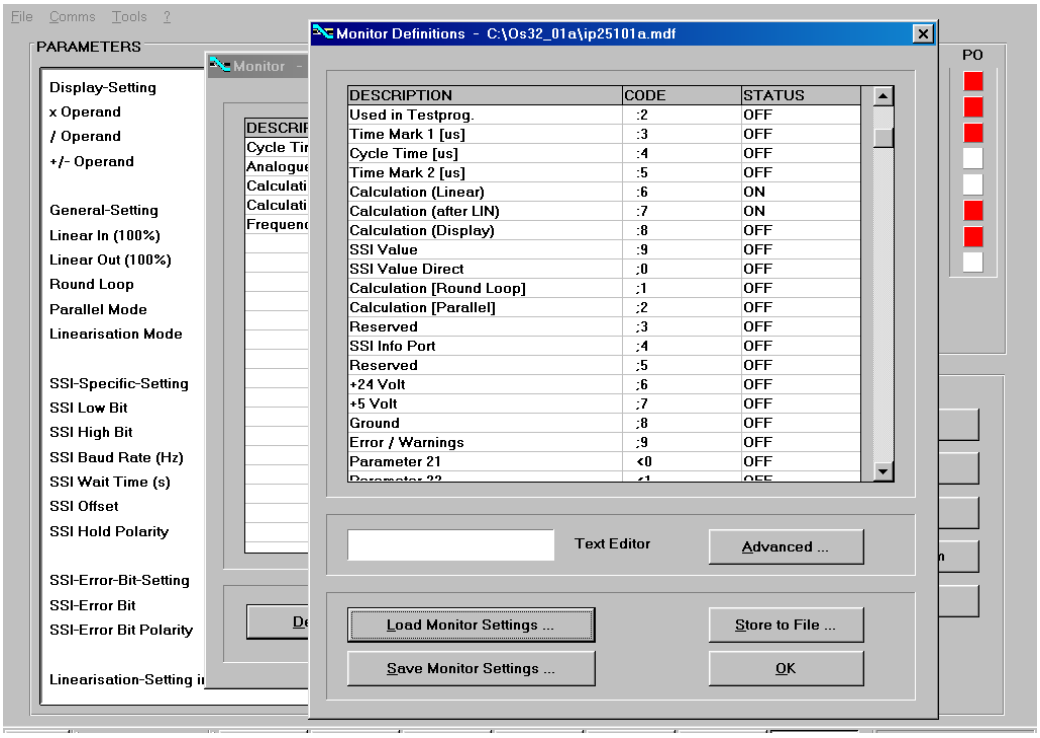
8. Test Functions

When you select TEST from the TOOLS menu, you are able to verify the following data, by clicking to the corresponding field:

Actual encoder position, DIL switch settings, Internal supply voltages, Parallel output state



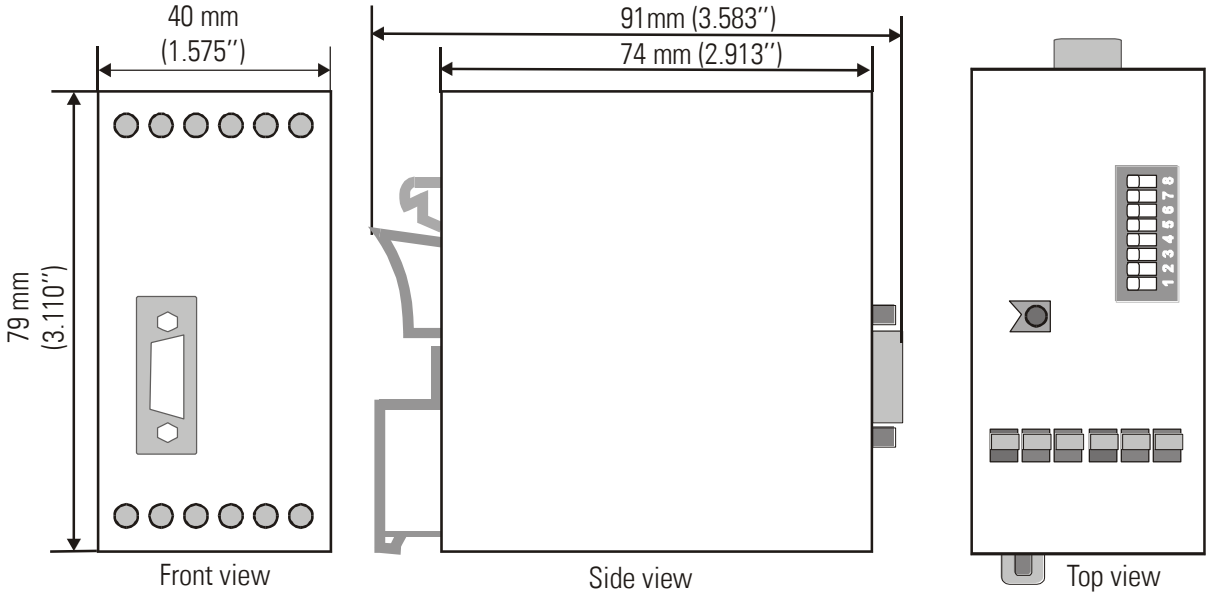
Additionally, the following registers can be recorded by using the monitor function:



9. Technical Specifications

Power supply:	Input voltage:	18 … 30 VDC
	Protection circuit:	reverse polarity protection
	Ripple:	≤ 10 % at 24 VDC
	Consumption:	approx. 200 mA
	Connections:	screw terminals, 1.5 mm² / AWG 16
Encoders / sensors:	Usable types:	absolute encoders (single-turn, multi-turn or comparable)
	Interface:	SSI (6 … 25 Bit binary- or Gray code)
	Encoder supply:	external input necessary (voltage depends on the used encoder type)
SSI input:	Input format:	TTL differential, RS422-standard
	Frequency range:	100 Hz … 1 MHz
	Standard resolutions:	13, 21 or 25 Bit (selectable)
	SSI interval time:	min. 4 x clock
	Operational modes:	master or slave (selectable)
	Connections:	screw terminals, 1.5 mm² / AWG 16
Control input:	Input logic	PNP, active high / low (reversible via PC)
	Signal levels:	LOW: 0 … 3 V, HIGH: 10 … 30 V
	Function:	hold
	Signal delay time:	approx. 500 µs
	Internal resistance:	Ri ≈ 5 kOhm
	Connections:	screw terminals, 1.5 mm² / AWG 16
Parallel output:	Output format:	Binary, Gray or BCD
	Resolution:	25 bit
	Signal levels:	0 … 35 V * (external input at COM+ required)
	Output current:	max. 20 mA (at 24 V)
	Internal resistance:	Ri ≈ 600 Ohm
	Protection circuit:	*) short circuit proof up to max. 27 V
	Connections:	COM+: screw terminals, 1.5 mm² / AWG 16 outputs: 25-pin SUB-D connector (female)
Serial interface:	Format:	RS232 or RS485 (selectable)
	Baud rate (selectable):	600, 1200, 2400, 4800, 9600 (default), 19200, 38400 Baud
	Operation modes:	PC or printer mode
	Connections:	9-pin SUB-D connector (female)
Housing:	Material:	plastic
	Mounting:	35 mm top hat rail (according to EN 60715)
	Dimensions (w x h x d):	40 x 79 x 91 mm / 1.5748 x 3.1102 x 3.5827 inch
	Protection class:	IP20
	Weight:	approx. 190 g
Ambient temperature:	Operation:	0 °C … +45 °C / +32 … +113 °F (not condensing)
	Storage:	-25 °C … +70 °C / -13 … +158 °F (not condensing)
Failure rate:	MTBF in years:	65.6 a (long-term usage at 60 °C / 140 °F)
Conformity & standards:	EMC 2004/108/EC:	EN 61000-6-2, EN 61000-6-3, EN 61000-6-4
	Guideline 2011/65/EU:	RoHS-conform

10. Dimensions



11. Parameter List, Default Settings

Parameter	Min. value	Max. value	Default	Pos.	Char.	Ser. Code
X Operand	-10.0000	+10.0000	1.0000	+/- 6	4	00
/ Operand	0	10.0000	1.0000	6	4	01
+/- Operand	-99999999	99999999	0	+/- 8	0	02
Linear In	-99999999	+99999999	0	+/- 8	0	03
Linear Out	-99999999	+99999999	10000	+/- 8	0	04
Round Loop	0	99999999	0	8	0	05
Parallel Mode	0	2	0	1	0	06
Linearisation Mode	0	2	0	1	0	07
SSI Low Bit	0	25	1	2	0	08
SSI High Bit	1	25	25	2	0	09
SSI Baudrate	100	1000000	100000	7	0	10
SSI Wait Time	0	10.000	0	5	3	11
SSI Offset	0	99999999	0	8	0	12
SSI Hold Polarity	0	1	0	1	0	13
SSI Error Bit	0	25	0	2	0	14
SSI Error Bit Polarity	0	1	0	1	0	15
P1(x)	-100.000	+100.000	100000	+/- 6	3	A0
P1(y)…..	-100.000	+100.000	100000	+/- 6	3	A1
P16(x)	-100.000	+100.000	100000	+/- 6	3	D0
P16(y)	-100.000	+100.000	100000	+/- 6	3	D1
Direction	0	1	0	1	0	46
Parallel Inv	0	1	1	1	0	47
Parallel Value	-999 999	33554431	+/-8	5	0	48
Unit Number	0	99	11	2	0	90
Serial Baud Rate	0	6	0	1	0	91
Serial Format	0	9	0	1	0	92
Serial Protocol	0	1	0	1	0	30
Serial Timer	0	99.999	0	5	3	31
Serial Value	0	19	0	2	0	32