Manual
Signal converter IMX

Frequency SSI absolute value Start-Stop Pulse counter	→	Analog (current / voltage) Serial (RS232 / RS485)

Product features:

- Multifunctional unit with several operating modes for incremental encoders or SSI absolute encoders
- For incremental encoders:
  Operating modes as frequency converter or position transducer (pulse counter)
  Universal incremental inputs (HTL/TTL/RS422) for NPN/PNP/NAMUR encoders and sensors
  Functions such as linkages (eg. A+B), scaling, filters, start-up bridging, …
  Input frequencies up to 1 MHz
- For SSI absolute encoders:
  Master or Slave operation with clock frequencies up to 1 MHz
  For single turn and multi turn encoders with SSI formats from 10 … 32 Bit
  Functions such as bit suppression, round-loop function, scaling, …
- For absolute and magnetostrictive position encoder with Start-Stop-Interface:
  Operating modes for master or slave, for position, angle and speed measurement
- 16 bit analog output, configurable for voltage or current operation
- USB interface and RS232/RS485-interface for configuration and serial readout
- Extremely short conversion times
- Linearization with 24 control points
- Auxiliary voltage output 5 and 24VDC for encoder supply
- Numerous connection options via 6 control inputs and 6 control outputs
- Compact rail housing to EN60715

Version:	Description:
April 19	First Version
August 19	New added: chapter "Compatibility Hint"
November 19	Extension of QR-code and of new filter functions at Mode Frequency
December 19	Revised Version
Januar 20	Extension by start-stop-interface
April 2020	New connection diagram in chapter 4, failure rate added
August 2020	New USB interface at X7

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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 <u>observe all safety and warning instructions!</u> 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 reserves 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 have 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). 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.

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.

1.4.   EMC Guidelines

All motrona devices are designed to provide high protection against electromagnetic interference. Nevertheless you must minimize the influence of electromagnetic noise to the device and all connected cables.

Therefore the following measures are mandatory for a successful installation and operation:
- **Use shielded cables for all signal and control input and output lines.**
- **Cables for digital controls (digital I/O, relay outputs) must not exceed a length of 30 m and are allowed for in building operation only**
- Use shield connection clamps to connect the cable shields properly to earth
- The wiring of the common ground lines must be star-shaped and common ground must be connected to earth at only one single point
- The device should be mounted in a metal enclosure with sufficient distance to sources of electromagnetic noise.
- Run signal and control cables apart from power lines and other cables emitting electromagnetic noise.

1.5.   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.

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2. Introduction

The device is designed as a signal converter with control inputs and outputs. Its extensive functions make it universally applicable.

2.1. Operating Mode

Basically all functions have to be configured in the parameter menu. The device can be used in the following operating modes:

- Operation as frequency converter for incremental input signals (replaces FU252)
- Operation as position transducer / counter for incremental input signals (replaces ZU252)
- Operation as absolute value converter for signals of a start-stop interface
- Operation as absolute value converter for SSI signals (replaces IV251)

2.2. Function diagram

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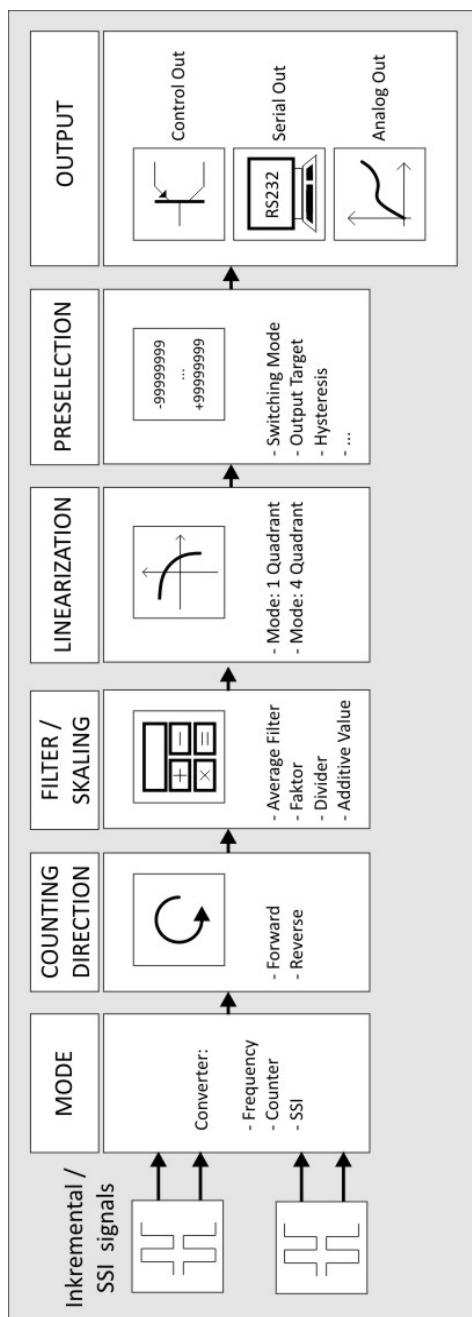
2.3. Power – LED / Error messages

The device has a green LED on its front foil. This lights up permanently as soon as the supply voltage of the device has been applied. If an error occurs, the LED flashes at 1 Hz.
The analog output is also controlled with 0 V or 0/4 mA. If the error no longer exists, the LED automatically lights up again permanently and the analogue output responds to the current result.
The exact error can be read out via the serial interface via the user interface (OS).
(→ Variable: Error_Status, Code: "; 3")

The individual error codes are explained below:

Errorcode: (Error_Status)	Error identification:	Error description:
0x00000001	Maximum Value	Measured value is greater than 99999999
0x00000002	Minimum Value	Measured value is less than -99999999
0x00000004	SSI Encoder Error	SSI error bit set
0x00000008	Encoder Fault	For internal test purposes only!
0x00000010	Frequency (Input A) out of range	Maximum or minimum permissible input frequency at input A has been exceeded or fallen below with the exponential filter setting used.
0x00000020	Frequency (Input B) out of range	Maximum or minimum permissible input frequency at input B has been exceeded or fallen below with the exponential filter setting used.
0x00000040	Start/Stop Encoder Error	No "start" and no "stop" pulse detected between two "init" pulses. (only for PV210) Check sensor connections!
0x00000080	Position Encoder Outside the Limit	No "start" and no "stop" pulse detected between two "init" pulses. (only for PV210) Possible cause: No position sensor or position sensor outside the limits.

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3. Electrical Connections

The terminal screws should be tightened with a slotted screwdriver (blade width 2mm).
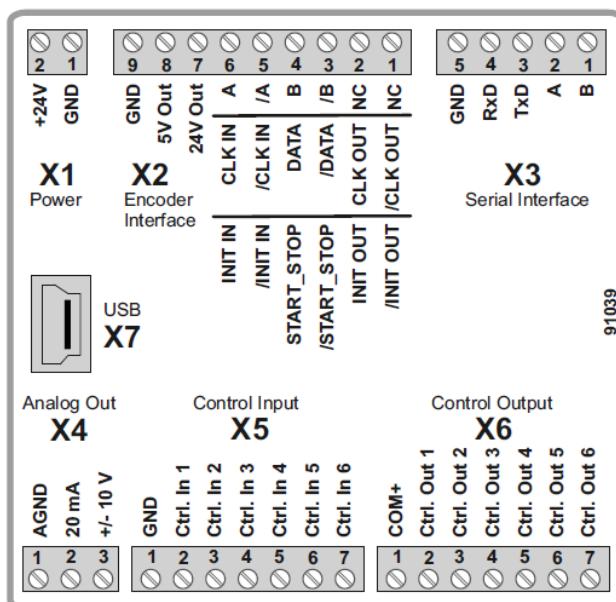
3.1.   DC Power Supply (X1)

The unit accepts DC supply from 18 to 30 V at the terminals X1 1 and 2. The power consumption depends on the level of the supply voltage with aprox. 50 mA and the additional current required at the Auxiliary Voltage Output.

All GND terminals are internally interconnected.

3.2.   Auxiliary voltage output (X2)

Two auxiliary voltages (24 VDC and 5 VDC) are available as encoder / sensor supply at terminal X2 pins 7, 8 and 9. The 24 VDC output voltage depends on the device supply (see technical data).

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3.3. Incremental encoder input (X2)

Terminal X2 pins 3, 4, 5 and 6 provide a connection for various incremental signals.

RS422
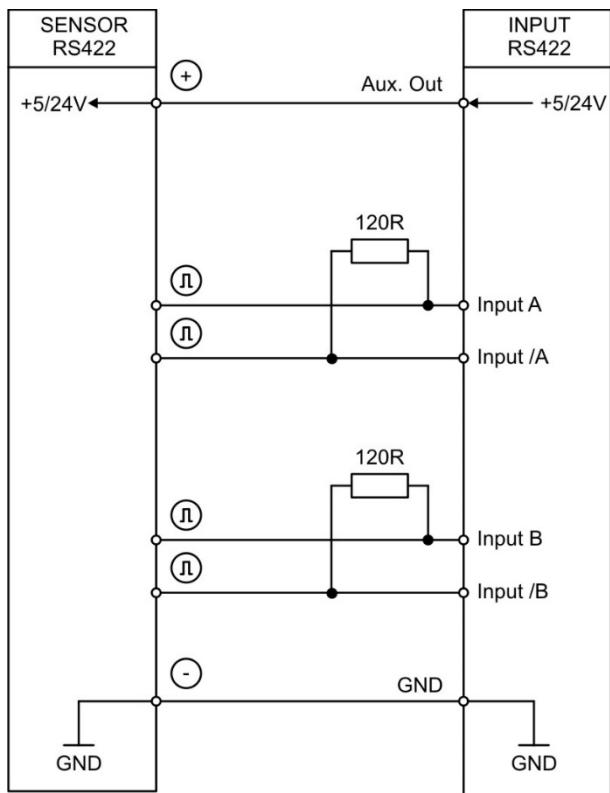
HTL DIFFERENTIAL

HTL PNP

HTL NPN

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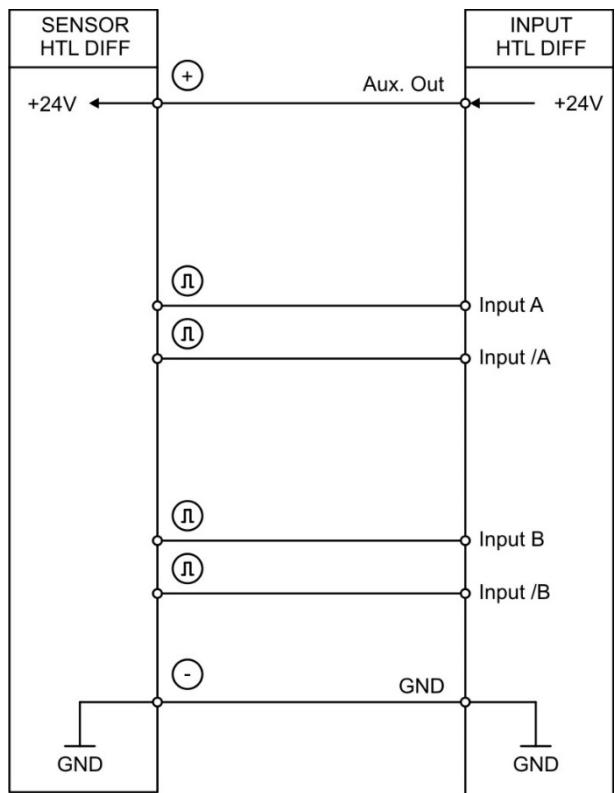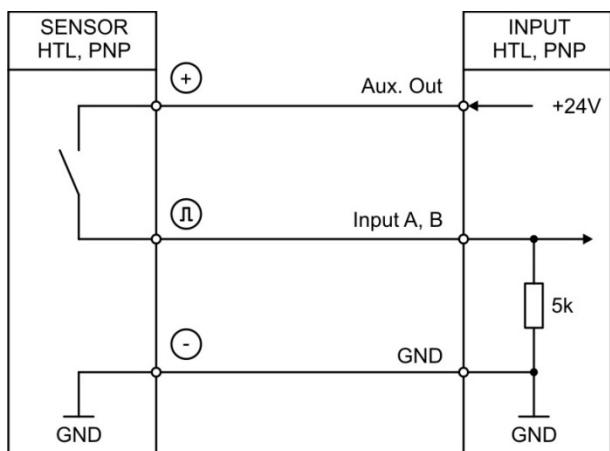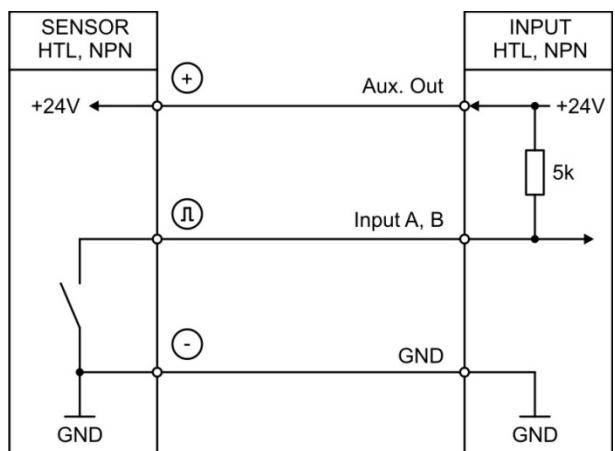
Continuation „**Incremental encoder input (X2)**":
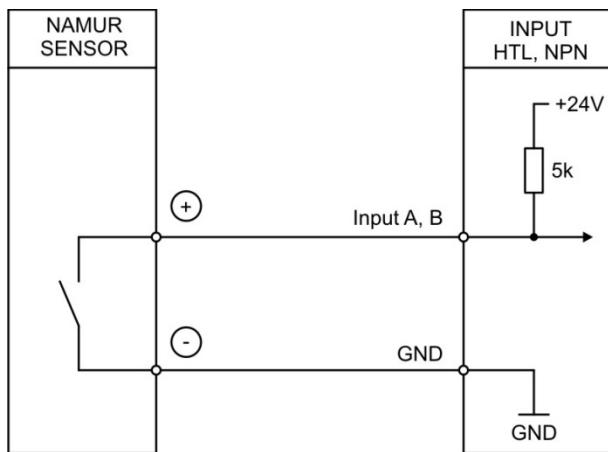
HTL NPN (NAMUR)   **TTL (PNP)**
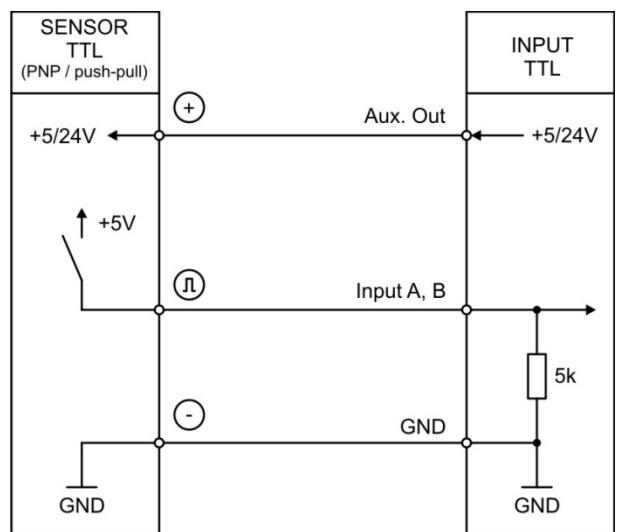
Unconnected PNP inputs are always "LOW" and unconnected NPN inputs are always "HIGH".
All inputs are designed to receive impulses from electrical impulse sources.

Notice for mechanical switching contacts:
When exceptionally mechanical contacts are used, please connect an external capacitor between GND (-)
and the corresponding input (+). A capacity of 10 µF will reduce the input frequency to
20 Hz and miscounting due to contact bouncing will be eliminated.

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3.4. SSI-Absolute encoder input (X2)

At terminal X2 pin 1, 2, 3, 4 the SSI connection for the MODE MASTER is available.
At terminal X2 pin 3, 4, 5, 6 the SSI connection for the MODE SLAVE is available.

Connection for **MODE Master**:

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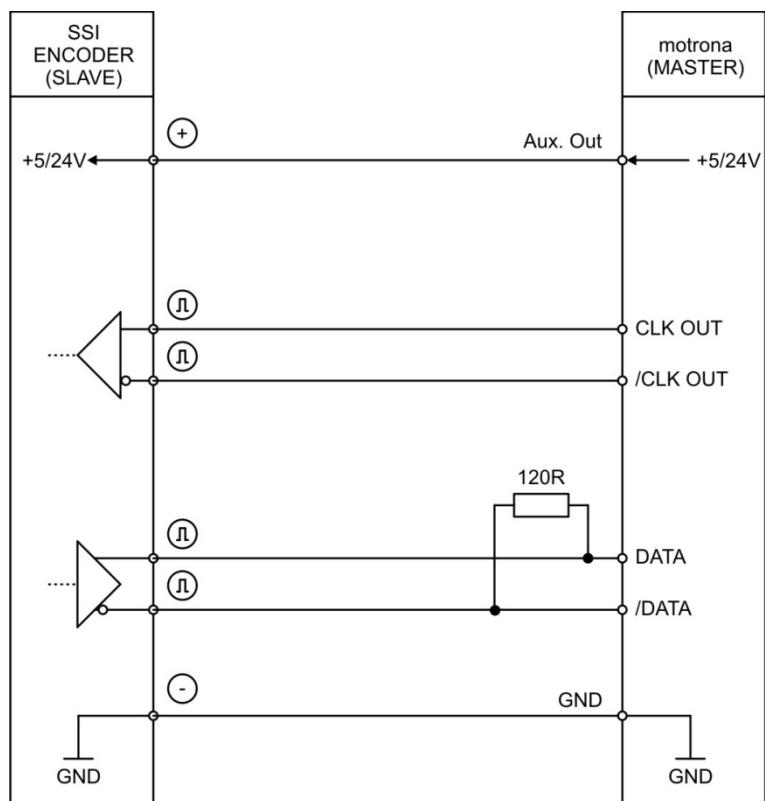
Continuation „**SSI-Absolute encoder input (X2)**":

Connection for **MODE Slave**:

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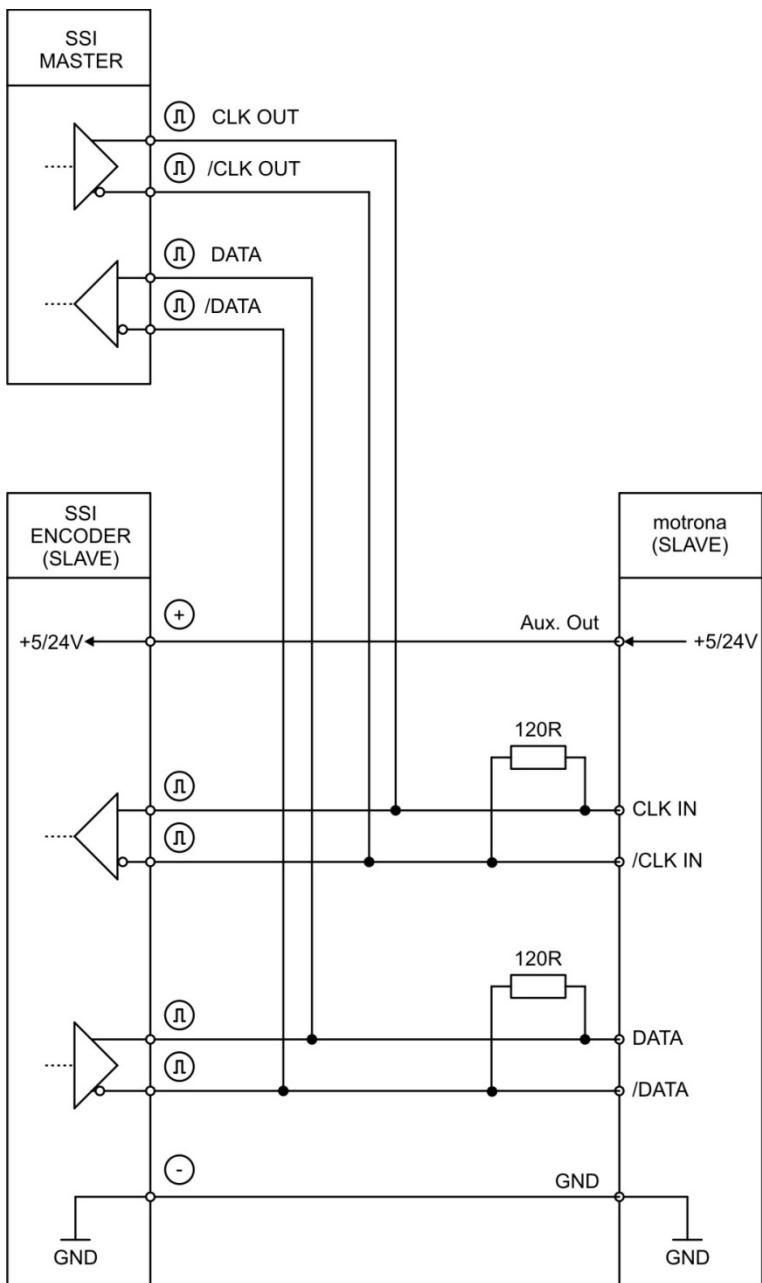
3.5. Start-stop encoder inputs (X2)

At terminal X2 - Pin 1+2 the RS422 connection for the init pulse in "MODE MASTER" is available. (Device generates Init pulse itself!).
At terminal X2 - Pin 5+6 the RS422 connection for the init pulse in "MODE SLAVE" is available. (Init pulse is generated by an external device!).
At terminal X2 - Pin 3 + 4 the RS422 connection for the Sart-Stop pulse is available.

Connection of the RS422 signals:
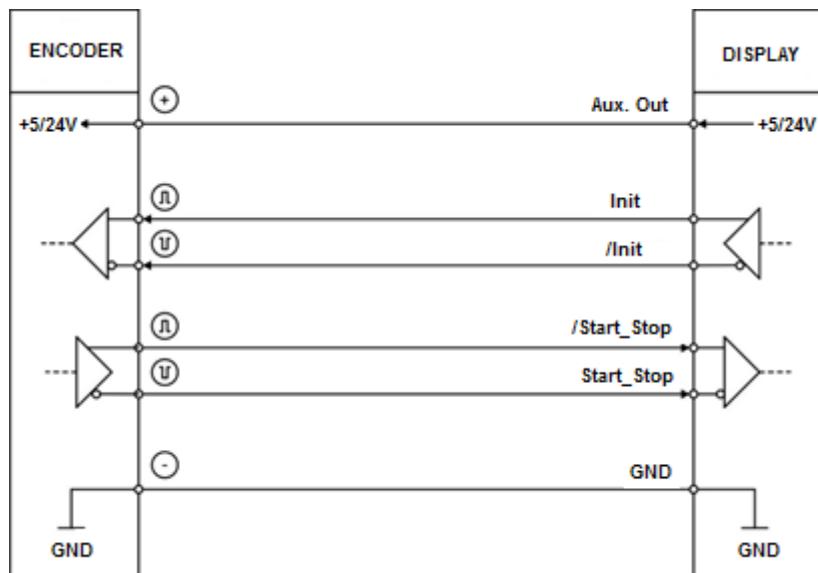
DPI measurement operation

In the "MODE MASTER", the init pulse is sent to the position sensor on the init line at regular intervals (SAMPLING TIME (ms)), whose rising edge triggers a measurement.
The pulse width of the init pulse can be set by means of the "INIT PULSE TIME (µs)" parameter.

T_{Init} :	1…9 µs (adjustable)
T_{Start}:	~3…5 µs
T_{Stop}:	~3…5 µs

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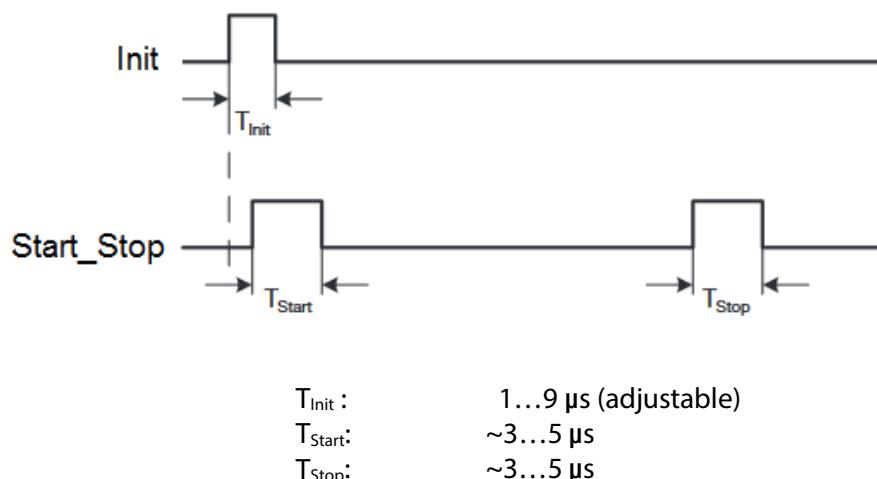
3.6. Control Inputs (X5)

At terminal X5 pins 2,3,4,5,6 and 7 there are six control inputs with HTL PNP characteristic available.
Control Input 1 (Ctrl. In 1) to Control Input 5 (Ctrl. In 5) are freely configurable in the COMMAND MENU and are used for functions to be triggered externally. eg. for releasing the latching, resetting the measurement result or for teaching the preset values or the analog output.
Control input 6 (Ctrl. In 6) is used exclusively for resetting the device parameters to the "default" values.
Thus, it is not freely configurable.

> **Note: With an HTL pulse (rising edge) on Ctrl. In 6, the device is reset to the factory settings.**

Wiring of the **control inputs**:
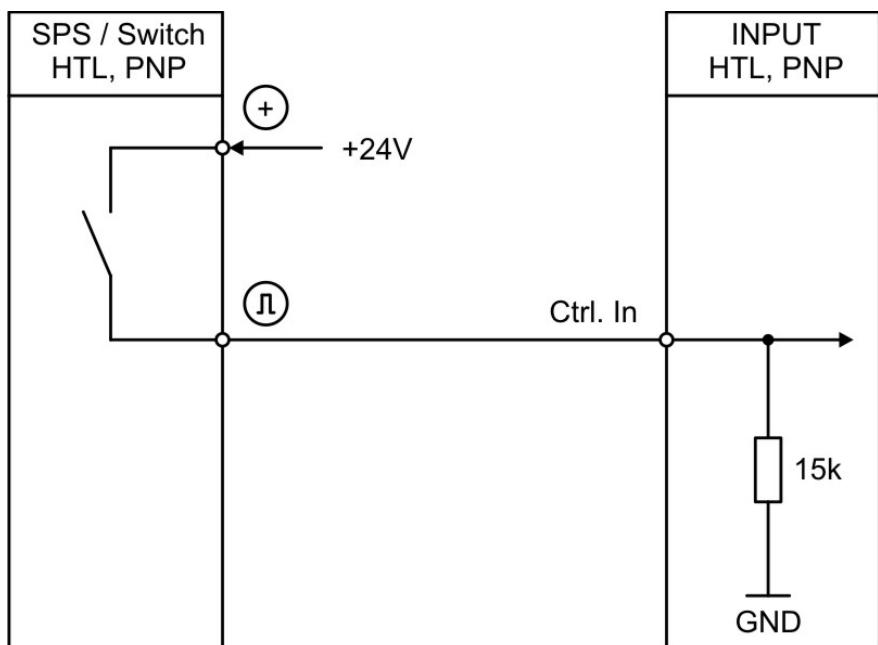
Unconnected control inputs are always "LOW".
All inputs are designed to receive impulses from an electronic impulse source.

Notice for mechanical switching contacts:
When exceptionally mechanical contacts are used, please connect an external capacitor between GND (-) and the corresponding input (+). A capacity of 10 µF will reduce the input frequency to
20 Hz and miscounting due to contact bouncing will be eliminated.

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3.7.   Analog output (X4)

A 16 bit analog output is available at terminal X4 pin 1, 2 and 3.
This output can be configured and scaled in the ANALOG MENU.

The following configuration is possible:

•	Voltage output:	-10 … +10 V
•	Current output:	0 … 20 mA
•	Current output:	4 … 20 mA

The analog output is proportional to the display value and is referenced to potential AGND.
AGND and GND are internally interconnected.

> **Important:**
> **A parallel operation with voltage and current output at the analog output
> is <u>not</u> allowed.**

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3.8.   Serial interface (X3)

A serial interface (RS232 or RS485) is available at terminal X3.
This interface can be configured in the SERIAL MENU.

The serial interface RS232 or RS485 can be used:
- for easy setup and commissioning of the units
- to modify settings and parameters during operation
- to read out internal states and actual measuring values by PC or PLC

The following drawing shows the connection to a PC by using a standard Sub-D-9 connector:

Connection of the **RS232** interface:
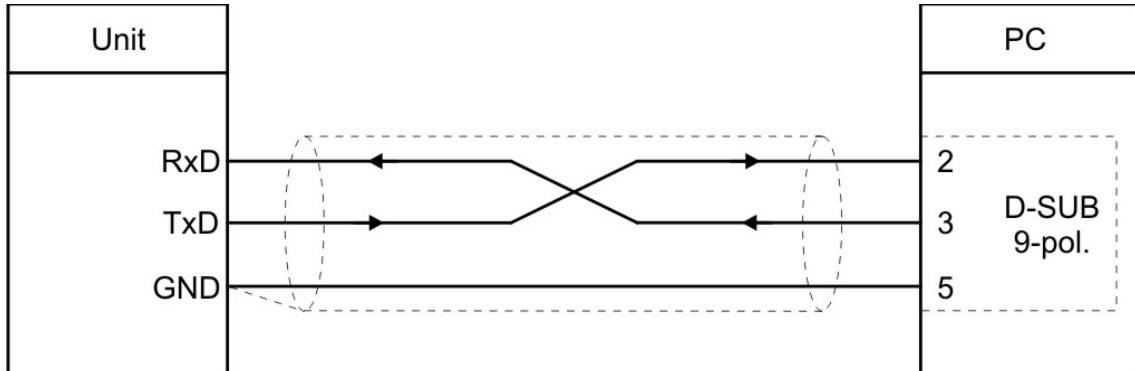
Connection of the **RS485-**interface:
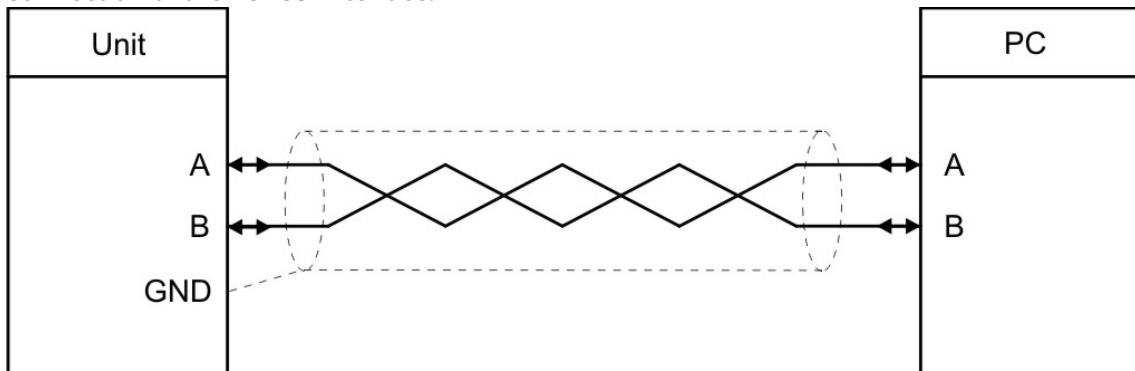
> ☞   **Important: Parallel operation of RS232 and RS485 is <u>not</u> allowed!**

3.9.   USB interface (X7)

A serial USB interface (mini USB) is available at X7.

The USB interface can be used as follows:
- For parameterization of the device during commissioning
- To change parameters during operation
- For reading out actual values via PC

> ☞   **The serial USB communication is done with a baud rate of "*115200 Baud*" and a serial data format of "*8none1*" and cannot be changed by the user!**

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3.10. Control outputs (X6)

Six control outputs are available at terminal X6 pin 2, 3, 4, 5, 6 and 7.
Switching conditions can be set in the PRESELECTION MENU. The output Ctrl. Out1 – 6 are fast PNP outputs with a switching capability of 5 – 30 Volt / 200 mA per channel.

The switching voltage of the outputs must be applied to input terminal X6 pin 1 (COM+).
In case of switching inductive loads it is advisable to use external filtering of the coils.

Wiring of the **control-outputs**:

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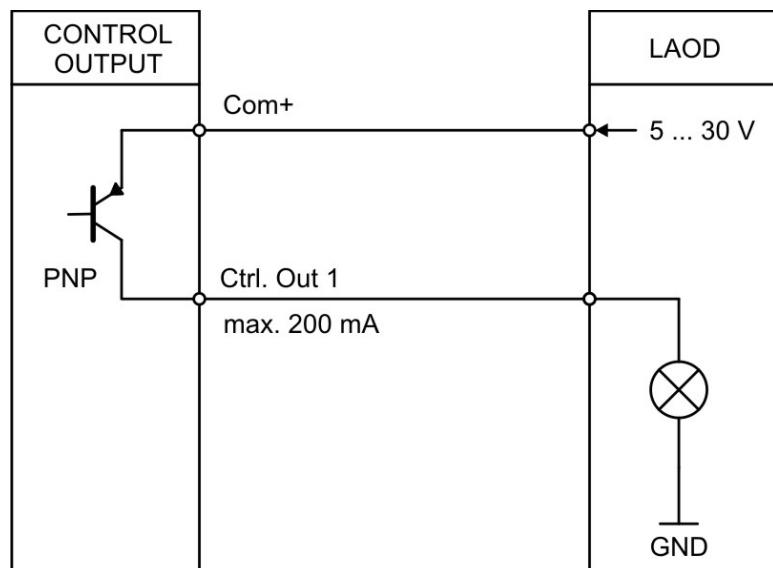
4. Parameter / Overview-Menu Structure

The parameterization of the device is realized via the serial interface with a PC and the operating software OS. The link to the free download can be found on page 2.
This section provides an overview of the menus and their parameters. The menu names are printed bold and the associated parameters are listed under the menu name.

Menu / Parameter

GENERAL MENU
MODE
ENCODER PROPERTIES
ENCODER DIRECTION
FACTOR
DIVIDER
ADDITIVE VALUE
LINEARIZATION MODE
BACKUP MEMORY
FACTORY SETTINGS

MODE FREQUENCY
FREQUENCY MODE
FREQUENCY BASE
SAMPLING TIME 1 (S)
WAIT TIME 1(S)
STANDSTILL TIME 1 (S)
AVERAGE FILTER 1
SAMPLING TIME 2 (S)
WAIT TIME 2(S)
AVERAGE FILTER 2

MODE COUNTER
COUNT MODE
FACTOR A
SET VALUE A
FACTOR B
SET VALUE B
ROUND LOOP VALUE

Menu / Parameter

MODE SSI
SSI MODE
ENCODER RESOLUTION
DATA FORMAT
BAUD RATE
SSI ZERO
HIGH BIT
LOW BIT
SSI OFFSET
ROUND LOOP VALUE
SAMPLING TIME (S)
ERROR BIT
ERROR POLARITY

MODE START/STOP
INIT MODE
SAMPLING TIME (ms)
INIT PULSE TIME (µs)
VELOCITY (m/s)
OPERATIONAL MODE
OFFSET
CIRCUMFERENCE (mm)
ROUND LOOP VALUE
AVERAGE FILTER - POSITION
STANDSTILL TIME (s)
AVERAGE FILTER - SPEED

PRESELECTION VALUES
PRESELECTION 1
PRESELECTION 2
PRESELECTION 3
PRESELECTION 4
PRESELECTION 5
PRESELECTION 6

Continuation „**Parameter / menu structure**":

Menu / Parameter

PRESELECTION 1 MENU
MODE 1
HYSTERESIS 1
PULSE TIME 1 (S)
OUTPUT TARGET 1
OUTPUT POLARITY 1
OUTPUT LOCK 1
START UP DELAY 1 (S)

PRESELECTION 2 MENU
MODE 2
HYSTERESIS 2
PULSE TIME 2 (S)
OUTPUT TARGET 2
OUTPUT POLARITY 2
OUTPUT LOCK 2
START UP DELAY 2 (S)

PRESELECTION 3 MENU
MODE 3
HYSTERESIS 3
PULSE TIME 3 (S)
OUTPUT TARGET 3
OUTPUT POLARITY 3
OUTPUT LOCK 3
START UP DELAY 3 (S)

PRESELECTION 4 MENU
MODE 4
HYSTERESIS 4
PULSE TIME 4 (S)
OUTPUT TARGET 4
OUTPUT POLARITY 4 (S)
OUTPUT LOCK 4
START UP DELAY 4 (S)

PRESELECTION 5 MENU
MODE 5
HYSTERESIS 5
PULSE TIME 5 (S)
OUTPUT TARGET 5
OUTPUT POLARITY 5
OUTPUT LOCK 5
START UP DELAY 5 (S)

Menu / Parameter

PRESELECTION 6 MENU
MODE 6
HYSTERESIS 6
PULSE TIME 6 (S)
OUTPUT TARGET 6
OUTPUT POLARITY 6
OUTPUT LOCK 6
START UP DELAY 6 (S)

SERIAL MENU
UNIT NUMBER
SERIAL BAUD RATE
SERIAL FORMAT
SERIAL INIT
SERIAL PROTOCOL
SERIAL TIMER (S)
SERIAL VALUE
MODBUS

ANALOG MENU
ANALOG FORMAT
ANALOG START
ANALOG END
ANALOG GAIN (%)
ANALOG OFFSET (%)

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Continuation „**Parameter / menu structure**":

Menu / Parameter

COMMAND MENU
INPUT 1 ACTION
INPUT 1 CONFIG
INPUT 2 ACTION
INPUT 2 CONFIG
INPUT 3 ACTION
INPUT 3 CONFIG
INPUT 4 ACTION
INPUT 4 CONFIG
INPUT 5 ACTION
INPUT 5 CONFIG
INPUT 6 ACTION (FACTORY SETTINGS)
INPUT 6 CONFIG (RISING EDGE)

LINEARISATION MENU
P1(X)
P1(Y)
P2(X)
P2(Y)
…
…
P23(X)
P23(Y)
P24(X)
P24(Y)

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4.1. General Menu

MODE
This parameter specifies the selected measuring function.

0	NOT DEFINED	Operating mode: Not defined, modulation and measurement results are zero
1	FREQUENCY	Operating mode: Frequency converter, incremental signals (replaces FU252)
2	COUNTER	Operating mode: Counter, incremental signals (replaces ZU252)
3	SSI	Operating mode: Absolute value converter, SSI signals (replaces IV251)
4	START / STOP	Operating mode: Start / Stop – interface converter

ENCODER PROPERTIES
This parameter determines the characteristics of the incremental input.
(Note: Only relevant for MODE: "FREQUENCY" and MODE: "COUNTER"!)

0	RS422	RS422
1	HTL DIFFERENTIAL	HTL differential
2	HTL PNP	PNP (switch to +)
3	HTL NPN	NPN (switch to -))
4	TTL PNP	TTL PNP (switch to +)

ENCODER DIRECTION
This parameter reverses the counting or traversing direction.

0	FORWARD	Forward
1	REVERSE	Reverse

FACTOR
This parameter defines the factor with which the measurement result is multiplied.

	-99999999	Smallest value
	1	Default value
	99999999	Highest value

DIVIDER
This parameter defines the divisor with which the measurement result is divided.

	-99999999	Smallest value
	1	Default value
	99999999	Highest value

ADDITIVE VALUE
This parameter defines an additive constant, which is added to the measurement result.

	-99999999	Smallest value
	0	Default value
	99999999	Highest value

Continuation „**General Menu**":

LINEARIZATION MODE		
This parameter defines the linearization function. Observe notes in the appendix!		
0	**OFF**	No linearization
1	**1 QUADRANT**	Linearization in the 1. quadrant
2	**4 QUADRANT**	Linearization in all 4 quadrants

BACK UP MEMORY		
(Note: Only relevant for MODE: "COUNTER"!)		
0	**NO**	No back up memory –up by power failure
1	**YES**	Back up memory is active. Saves the actual value of the counter readings in case of power failure and switched on mode "Counter".

FACTORY SETTINGS		
0	**NO**	No default values are loaded
1	**YES**	Load default values of all parameters (grey marked default values)

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4.2.   Mode Frequency

In this menu the operation is defined as a frequency converter (incremental signals). Depending on the selected operating mode, only channel A or both channels (channel A and channel B) are active.

FREQUENCY MODE
This parameter determines which frequency measurement mode is desired.

0	A ONLY	Single-channel frequency measurement (only for channel A)
1	RATIO	Frequency ratio of both channels (channel B / channel A). <u>Note:</u> Interpretation of the result with 4 decimal places in the format +/- x.xxxx
2	PERCENT	Percent deviation from channel B to channel A. <u>Note:</u> Interpretation of the result with 2 decimal places in the format +/- xxx.xx %
3	A + B	Frequency addition of both channels (channel A + channel B)
4	A - B	Frequency subtraction of both channels (channel A - channel B)
5	A/B x 90°	Frequency measurement with A / B x 90 ° signal. (Forward / reverse direction of rotation detection)

FREQUENCY BASE
Setting the desired basis for the frequency measurement (resolution).

	0	1 Hz (Interpretation of the result in the format: xxxxxxxx Hz)
	1	1/10 Hz (Interpretation of the result in the format: xxxxxxx.x Hz)
	2	1/100 Hz (Interpretation of the result in the format: xxxxxx.xx Hz)
	3	1/1000 Hz (Interpretation of the result in the format: xxxxx.xxx Hz)

SAMPLING TIME 1 (S)
The set value corresponds to the minimum measuring time (for channel A) in seconds.
The sampling time serves as a filter at irregular frequencies.
This parameter directly influences the reaction time of the device.

	0,001	Shortest Sampling time
	0,1	Default value
	9,999	Longest Sampling time

$$f = \frac{6}{T}$$

Sampling Time (Setting)

T = Real Sampling Time

Continuation „**Mode Frequency**":

WAIT TIME 1 (S)		
This parameter defines the period time of the lowest frequency, accordingly the time between two rising signal edges on channel A detecting frequency 0 Hz. Frequencies with a period time higher than the set "WAIT TIME 1" will be detected as frequency = 0 Hz.		

	0,01	Frequency = 0 Hz, for frequencies below 100 Hz
	1,00	Default value
	79,99	Frequency = 0 Hz, for frequencies below 0,01 Hz

STANDSTILL TIME 1 (S)		
This parameter defines the time setting for standstill definition. A time of xx.xx seconds after detection "Frequency = 0 Hz " at channel A the unit signals "standstill" and reactivates the start-up-delays. Stand still detection can be set in PRESELECTION MENU.		

	0,01	Shortest time in seconds
	...	
	99,99	Largest time in seconds

Continuation „**Mode Frequency**":

AVERAGE FILTER 1

Selectable averaging or filter function for unstable frequencies at input A for smoothing the analog signal. At settings 5 to 16, the device uses an exponential function.
The time constant T (63%) corresponds to the sampling cycles.

For example: If SAMPLING TIME = 0,1 s and AVERAGE FILTER = Exponential filter, T (63 %) = 2x SAMPLING TIME, after 0,2 seconds, 63% of the step size are reached.

	0	No average value will be created (quick reaction to every change)
	1	2 numbers of floating average cycles
	2	4 numbers of floating average cycles
	3	8 numbers of floating average cycles
	4	16 numbers of floating average cycles
	5	Exponential filter, T (63 %) = 2x SAMPLING TIME
	6	Exponential filter, T (63 %) = 4x SAMPLING TIME
	7	Exponential filter, T (63 %) = 8x SAMPLING TIME
	8	Exponential filter, T (63 %) = 16x SAMPLING TIME
	9	Exponential filter, T (63 %) = 32x SAMPLING TIME
	10	Exponential filter, T (63 %) = 64x SAMPLING TIME
	11	Exponential filter, T (63 %) = 128x SAMPLING TIME
	12	Exponential filter, T (63 %) = 256x SAMPLING TIME
	13	Exponential filter, T (63 %) = 512x SAMPLING TIME
	14	Exponential filter, T (63 %) = 1024x SAMPLING TIME
	15	Exponential filter, T (63 %) = 2048x SAMPLING TIME
	16	Exponential filter, T (63 %) = 4096x SAMPLING TIME (very slow reaction)

Notice:

When using the exponential filter, the maximum permissible frequencies at the input must not be exceeded due to an otherwise following data type overflow! If the frequency is nevertheless exceeded, the frequency is replaced by the maximum permissible value (with corresponding setting) for further calculation and an error is output. The LED flashes and the analogue output consequently controls 0 V or 0/4 mA.
The maximum allowable frequencies are listed below for the associated settings.

		FREQUENCY BASE			
		[0] - 1 Hz	**[1]** - 1/10 Hz	**[2]** - 1/100 Hz	**[3]** - 1/1000 Hz
AVERAGE FILTER 1+2	**[5]** - 2x	1.073.741.823 Hz	107.374.182,3 Hz	10.737.418,23 Hz	1.073.741,823 Hz
	[6] - 4x	536.870.911 Hz	53.687.091,1 Hz	5.368.709,11 Hz	536.870,911 Hz
	[7] - 8x	268.435.455 Hz	26.843.545,5 Hz	2.684.354,55 Hz	268.435,455 Hz
	[8] - 16x	134.217.727 Hz	13.421.772,7 Hz	1.342.177,27 Hz	134.217,727 Hz
	[9] - 32x	67.108.863 Hz	6.710.886,3 Hz	671.088,63 Hz	67.108,863 Hz
	[10] - 64x	33.554.431 Hz	3.355.443,1 Hz	335.544,31 Hz	33.554,431 Hz
	[11] - 128x	16.777.215 Hz	1.677.721,5 Hz	167.772,15 Hz	16.777,215 Hz
	[12] - 256x	8.388.607 Hz	838.860,7 Hz	83.886,07 Hz	8.388,607 Hz
	[13] - 512x	4.194.303 Hz	419.430,3 Hz	41.943,03 Hz	4.194,303 Hz

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[14] - 1024x	2.097.151 Hz	209.715,1 Hz	20.971,51 Hz	2.097,151 Hz
[15] - 2048x	1.048.575 Hz	104.857,5 Hz	10.485,75 Hz	1.048,575 Hz
[16] - 4096x	524.287 Hz	52.428,7 Hz	5.242,87 Hz	524,287 Hz

Continuation „**Mode Frequency**":

<table>
<tr><td colspan="3">SAMPLING TIME 2 (S)
The set value corresponds to the minimum measuring time (for channel B) in seconds.
The sampling time serves as a filter at irregular frequencies.
This parameter directly influences the reaction time of the device</td></tr>
<tr><td></td><td>0,001</td><td>Shortest Sampling time</td></tr>
<tr><td></td><td>0,1</td><td>Default value</td></tr>
<tr><td></td><td>9,999</td><td>Longest Sampling time</td></tr>
<tr><td></td><td colspan="2">

$$f = \frac{6}{T}$$

</td></tr>
</table>
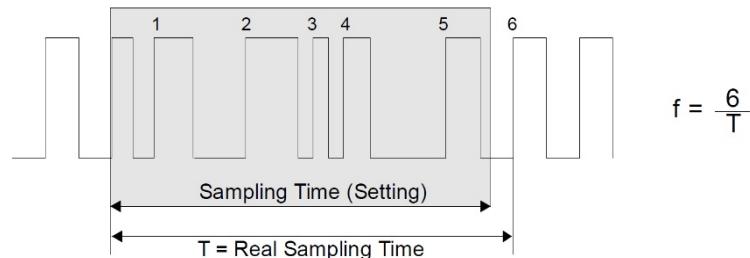
<table>
<tr><td colspan="3">WAIT TIME 2 (S)
This parameter defines the period time of the lowest frequency, accordingly the time between two rising signal edges on channel B detecting frequency 0 Hz. Frequencies with a period time higher than the set "WAIT TIME 2" will be detected as frequency = 0 Hz.</td></tr>
<tr><td></td><td>0,01</td><td>Frequency = 0 Hz, for frequencies below 100 Hz</td></tr>
<tr><td></td><td>1,00</td><td>Default value</td></tr>
<tr><td></td><td>79,99</td><td>Frequency = 0 Hz, for frequencies below 0,01 Hz</td></tr>
<tr><td></td><td colspan="2">

</td></tr>
</table>
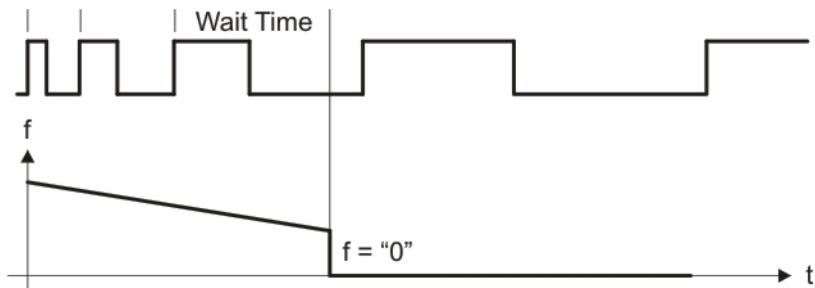
Continuation „**Mode Frequency**":

AVERAGE FILTER 2
Selectable averaging or filter function for unstable frequencies at input A for smoothing the analog signal. At settings 5 to 16, the device uses an exponential function.
The time constant T (63%) corresponds to the sampling cycles.

For example: If SAMPLING TIME = 0,1 s and AVERAGE FILTER = Exponential filter, T (63 %) = 2x SAMPLING TIME, after 0,2 seconds, 63% of the step size are reached.

		0	No average value will be created (quick reaction to every change)
		1	2 numbers of floating average cycles
		2	4 numbers of floating average cycles
		3	8 numbers of floating average cycles
		4	16 numbers of floating average cycles
		5	Exponential filter, T (63 %) = 2x SAMPLING TIME
		6	Exponential filter, T (63 %) = 4x SAMPLING TIME
		7	Exponential filter, T (63 %) = 8x SAMPLING TIME
		8	Exponential filter, T (63 %) = 16x SAMPLING TIME
		9	Exponential filter, T (63 %) = 32x SAMPLING TIME
		10	Exponential filter, T (63 %) = 64x SAMPLING TIME
		11	Exponential filter, T (63 %) = 128x SAMPLING TIME
		12	Exponential filter, T (63 %) = 256x SAMPLING TIME
		13	Exponential filter, T (63 %) = 512x SAMPLING TIME
		14	Exponential filter, T (63 %) = 1024x SAMPLING TIME
		15	Exponential filter, T (63 %) = 2048x SAMPLING TIME
		16	Exponential filter, T (63 %) = 4096x SAMPLING TIME (very slow reaction)

Notice:
When using the exponential filter, the maximum permissible frequencies at the input must not be exceeded due to an otherwise following data type overflow! If the frequency is nevertheless exceeded, the frequency is replaced by the maximum permissible value (with corresponding setting) for further calculation and an error is output. The LED flashes and the analogue output consequently controls 0 V or 0/4 mA.
The maximum permissible frequencies have already been listed in parameter AVERAGE FILTER 1 and can be taken there.

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4.3. **Mode Counter**

In this menu, the operation is defined as a position transducer for incremental signals (pulse, sum, difference, up or down counter). Input A and B are active.

COUNT MODE
This parameter defines the counter operation.

0	**A SINGLE**	Input A is a counting input. Input B defines the counting direction: „LOW" = forward „HIGH" = reverse	
1	**A + B**	Sum counter: Impulses at A + Impulses at B	
2	**A - B**	Differential counter: Impulses at A – impulses at B	
3	**A/B 90 x1**	Quadrature counter: Impulses A, B with edge counting x1	
4	**A/B 90 x2**	Quadrature counter: Impulses A, B with edge counting x2	
5	**A/B 90 x4**	Quadrature counter: Impulses A, B with edge counting x4	

FACTOR A
Scaling factor for input A.

For example: A setting of factor 1.23456 and 100000 input pulses will result in a value of 123456 for input A.

0,00001	Smallest value
1	Default value
99,99999	Highest value

SET VALUE A
With a "RESET / SET COUNTER A" command (via control input), the counter of input A is set to this value.

-99999999	Smallest value
0	Default value
+99999999	Highest value

FACTOR B
Scaling factor for input B.

For example: A setting of factor 1.23456 and 100000 input pulses will result in a value of 123456 for input B.

0,00001	Smallest value
1	Default value
99,99999	Highest value

SET VALUE B
With a "RESET / SET COUNTER B" command (via control input), the counter of input B is set to this value.

-99999999	Smallest value
0	Default value
+99999999	Highest value

ROUND LOOP VALUE
Defines the number of encoder steps if a round-loop function is desired.
(Only for COUNT MODE: A SINGLE and A / B x 90)

0	Round-loop function is turned off.

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	...	
	99999999	Number of steps for the round-loop function.

4.4.   Mode SSI

In this menu the operation is defined as absolute value converter (SSI signals).

SSI MODE
SSI Setting of the operating mode: Maser or Slave
Depending on the SSI MODE, different terminals must be used for the SSI CLK!
(Mode Master: Terminal X2 - Pin 1 and 2 / Mode Slave: Terminal X2 - Pin 5 and 6)

0	**MASTER**	Master-Mode: Clock for SSI encoder comes from the device
1	**SLAVE**	Slave-Mode: Clock for SSI encoder comes from the external master.

ENCODER RESOLUTION
Resolution of the SSI encoder (total number of bits)

10	Smallest value
25	Default value
32	Highest value

DATA FORMAT
Setting the SSI code (binary or gray)

0	**GRAY CODE**	SSI-Code Gray
1	**BINARY CODE**	SSI-Code Binär

BAUD RATE
Clock frequency of SSI telegrams

0	**2 MHZ**	N.A.
1	**1.5 MHZ**	N.A.
2	**1 MHZ**	Clock frequency 1 MHz
3	**500 KHZ**	Clock frequency 500 kHz
4	**250 KHZ**	Clock frequency 250 kHz
5	**100 KHZ**	Clock frequency 100 kHz

SSI ZERO
In the case of a "ZERO POSITION" command (via control input), the current SSI position of the encoder is transferred to the "SSI ZERO" parameter and the actual encoder zero point is shifted accordingly. (Encoder zero offset)

0	Smallest value
...	
999999999	Highest value

HIGH BIT (for bit blanking)
Defines the highest evaluated bit (MSB) for bit blanking.
If all bits should be evaluated, HIGH BIT must be set to the given total number of bit.

01	Smallest value
25	Default value
32	Highest value

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Continuation „**Mode SSI**":

LOW BIT (for bit blanking) Defines the lowest evaluated bit (MSB) for bit blanking. If all bits should be evaluated, LOW BIT must be set to 01.		
	01	Smallest value
	...	
	32	Highest value

SSI OFFSET In the case of a „RESET/SET VALUE" command (via control input or PC user interface) the not yet scaled, currently acquired position value (after bit suppression and possibly performed encoder zero offset) is transferred to the "SSI OFFSET" parameter and the display zeroed. From the new display zero point, you can now move in positive and negative direction, depending on the direction of rotation. (Display offset)		
	0	Smallest value
	...	
	999999999	Highest value

ROUND LOOP VALUE Defines the number of encoder steps when a round-loop function is desired.		
	0	Round-loop function is turned off.
	...	
	99999999	Number of steps for the round-loop function.

SAMPLING TIME (S) Determines the read cycle for the SSI signal in the Master MODE.		
	0.001	Minimum measurement time in seconds
	0.010	Default value
	9.999	Maximum measurement time in seconds

ERROR BIT Defines the encoder monitoring and the error bit		
	0	No error bit available. Review on connected sensor is turned off.
	...	
	32	Position of the error bits to be evaluated Review on connected sensor is turned on.

ERROR POLARITY Defined the polarity of the error bit in the case of an error		
	0	Bit is low in the case of an error
	1	Bit is high in the case of an error

Note: SSI value processing see appendix (chapter 6.5 and 6.6)

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4.5.   Mode Start/Stop

This menu defines the operating as Start / Stop – interface converter.

INIT MODE		
Operating mode: Master or Slave Depending on the selected INIT MODE, different terminals must be used for the Init pulse! (Mode Master: terminal X2 – Pin 1 and 2 / Mode Slave: terminal X2 – Pin 5 and 6)		
0	**MASTER**	Master-operation: Init pulse is generated by the device.
1	**SLAVE**	Slave-operation: Init pulse comes from an external master.

SAMPLING TIME (ms)		
Period duration between two init pulses (in milliseconds). Corresponds to the time after a new measurement is started and directly affects the reaction time of the device.		
	00.200	Minimum measurement time
	04.000	Default value
	16.000	Maximum measurement time

INIT PULSE TIME (µs)		
This parameter defines the pulse width of the Init pulse (in microseconds).		
	1	Smallest value
	2	Default value
	9	Highest value

VELOCITY (m/s)		
Waveguide velocity of the encoder (in m/s).		
	0001.00	Smallest value
	2800.00	Default value
	9999.99	Highest value

OPERATIONAL MODE		
This parameter determines which measurement type the device should run.		
0	**POSITION**	Distance measurement
1	**ANGLE**	Angle measurement
2	**SPEED**	Speed measurement
	Note: For further information regarding the different "OPERATIONAL MODES" and interpretation of the respective measurement results see appendix! (Chapter 6.7)	

OFFSET		
In the case of a "Reset/Set Value" command (via control input or PC user interface) the current position of the encoder is transferred to the "OFFSET" parameter in a non-volatile manner. (zero offset!)		
	-99999999	Smallest value
	0	Default value
	99999999	Highest value

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Continuation „**Mode Start/Stop**":

CIRCUMFERENCE (mm)		
Setting the reference size (in "mm") for an angle measurement.		
The distance covered (e.g. circumference) at which the subsequent output value (ROUND LOOP VALUE) is to be generated must be set here.		
(Note: Only for OPERATIONAL MODE: "ANGLE")		
	00000.001	Smallest value
	01000.000	Default value
	99999.999	Highest value

ROUND LOOP VALUE		
Setting of the desired measured value to be generated when the previous reference value ("CIRCUMFERENCE") is reached.		
(Note: Only for OPERATIONAL MODE: "ANGLE")		
	1	Smallest value
	360	Default value
	99999999	Highest value

AVERAGE FILTER – POSITION (filter for average value)		
The average value can be switched to avoid position fluctuations.		
	0	No average value
	1	Flowing mean value with 2 cycles
	2	Flowing average value with 4 cycles
	3	Flowing average value with 8 cycles
	4	Flowing mean value with 16 cycles

STANDSTILL TIME (s)		
This parameter defines the time for standstill definition. If standstill is detected, standstill is signalled after xx,xx seconds and the start-up suppression is reactivated.		
A standstill monitoring can be set in the PRESELECTION MENU.		
	0,01	Shortest delay time in seconds
	…	
	99,99	Longest delay time in seconds

AVERAGE FILTER – SPEED (filter for average value)		
The average value can be switched to avoid velocity fluctuations.		
	0	No average value
	1	Flowing mean value with 2 cycles
	2	Flowing average value with 4 cycles
	3	Flowing average value with 8 cycles
	4	Flowing mean value with 16 cycles

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4.6.   **Preselection Values**

This menu is used to set the preselection values of the switching points. The switching points always refer to the scaled measurement result "Measurement Result"!

PRESELECTION 1
Preselection / switching point 1

	-99999999	Smallest value
	1000	Default value
	+99999999	Highest value

PRESELECTION 2
Preselection / switching point 2

	-99999999	Smallest value
	2000	Default value
	+99999999	Highest value

PRESELECTION 3
Preselection / switching point 3

	-99999999	Smallest value
	3000	Default value
	+99999999	Highest value

PRESELECTION 4
Preselection / switching point 4

	-99999999	Smallest value
	4000	Default value
	+99999999	Highest value

PRESELECTION 5
Preselection / switching point 5

	-99999999	Smallest value
	5000	Default value
	+99999999	Highest value

PRESELECTION 6
Preselection / switching point 6

	-99999999	Smallest value
	6000	Default value
	+99999999	Highest value

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4.7. Preselection 1 Menu

MODE 1 Switching conditions for preselection 1. Output switches under the following conditions:			
	0	**|RESULT|>=|PRES|**	Absolute value of the display value is greater or equal absolute value of PRESELECTION 1 With HYSTERESIS 1 not equal 0 the following switching condition is applied: Display value >= PRESELECTION 1 → ON, Display value < PRESELECTION 1 – HYSTERESIS 1 →OFF
	1	**|RESULT|<=|PRES|**	Absolute value of the display value is less or equal absolute value of PRESELECTION 1 (start-up suppression (START UP DELAY) is advisable) With HYSTERESIS 1 not equal 0 the following switching condition is applied: Display value <= PRESELECTION 1 → ON, Display value > PRESELECTION 1 + HYSTERESIS 1 →OFF
	2	**|RESULT|=|PRES|**	Absolute value of the display value is equal absolute value of PRESELECTION 1 A range (Preselection +/- ½ Hysteresis) can be defined and monitored in conjunction with the hysteresis. With HYSTERESIS 1 not equal 0 the following switching condition is applied: Display value > PRESELECTION 1 + ½ HYSTERESIS 1 → OFF, Display value < PRESELECTION 1 - ½ HYSTERESIS 1 → OFF
	3	**RESULT>=PRES**	Display value is greater or equal PRESELECTION 1, e.g. overspeed With HYSTERESIS 1 not equal 0 the following switching condition is applied: Display value >= PRESELECTION 1 → ON, Display value < PRESELECTION 1 – HYSTERESIS 1 →OFF
	4	**RESULT<=PRES**	Display value is less or equal PRESELECTION 1, e.g. underspeed (start-up suppression (START UP DELAY) is advisable) With HYSTERESIS 1 not equal 0 the following switching condition is applied: Display value <= PRESELECTION 1 → ON, Display value > PRESELECTION 1 + HYSTERESIS 1 →OFF
	5	**RESULT=PRES**	Display value is equal PRESELECTION 1. A range (Preselection +/- ½ Hysteresis) can be defined and monitored in conjunction with the hysteresis. With HYSTERESIS 1 not equal 0 the following switching condition is applied: Display value > PRESELECTION 1 + ½ HYSTERESIS 1 → OFF, Display value < PRESELECTION 1 - ½ HYSTERESIS 1 → OFF
	6	**RESULT=0**	Display value is zero (Standstill after STANDSTILL TIME 1(s)), e. g. standstill monitoring. (Only in MODE: "START/STOP" + OPERATIONAL MODE: "SPEED" and in MODE: "FREQUENCY").
	7	**RES>=PRES-TRAIL**	Trailing PRESELECTION 1: Display value is greater or equal PRESELECTION 1 – PRESELECTION 4 → ON, PRESELECTION 4 is the trailing value from PRESELECTION 1
	8	**ERROR SET**	Error message for device errors.

Continuation „**Preselection 1 Menu**":

HYSTERESIS 1	
This parameter defines the switching hysteresis of the switch-off point for preselection 1	
0	No switching hysteresis
...	
99999	Switching hysteresis of 99999

PULSE TIME 1 (S)	
Duration of output pulse for the switching condition of preselection 1	
0,000	No output pulse (static signal)
...	
60,000	Pulse duration of 60 seconds

OUTPUT TARGET 1
Assignment of an output for the switching condition of preselection 1.
If more than one switching condition is assigned to one output, the output is set when at least one switching condition is true

0	**NO**	No assignment
1	**CTRL OUT 1**	Switching condition assigned to "Ctrl. Out 1"
2	**CTRL OUT 2**	Switching condition assigned to "Ctrl. Out 2"
3	**CTRL OUT 3**	Switching condition assigned to "Ctrl. Out 3"
4	**CTRL OUT 4**	Switching condition assigned to "Ctrl. Out 4"
5	**CTRL OUT 5**	Switching condition assigned to "Ctrl. Out 5"
6	**CTRL OUT 6**	Switching condition assigned to "Ctrl. Out 6"

OUTPUT POLARITY 1
Polarity for the switching condition of preselection 1

0	**ACTIVE HIGH**	Switching condition is true → Active „HIGH"
1	**ACTIVE LOW**	Switching condition is true → Active „LOW"

OUTPUT LOCK 1
Latch for the switching condition of preselection 1

0	**NO**	No latch for preselection
1	**YES**	Latch for preselection (command LOCK RELEASE will clear latch)

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Continuation „**Preselection 1 Menu**":

START UP DELAY 1 (S)	
Start-up suppression for the switching condition of preselection 1. Time to start the monitoring function. This adjustment is only valid for the switching condition |RESULT|<=|PRES| or RESULT<=PRES and only for MODE „FREQUENCY" – Channel A or MODE: „START/STOP" + OPERATIONAL MODE: „SPEED". START UP DELAY is set to this parameter, when the frequency is detected as 0 Hz (or at a velocity of 0 m/s). The monitoring function remains deactivated until the set time has elapsed. With a setting "60.000", the automatic start override is activated. The monitoring function remains deactivated until the preset value / switching point is exceeded for the first time.	

	0.000	No start-up suppression
	...	
	59.999	Start-up suppression in seconds
	60.000	Automatic start-up suppression

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4.8. Preselection 2 Menu

MODE 2
Switching conditions for preselection 2., see chapter PRESELECTION 1 MENU (except the trailing value)

			See chapter PRESELECTION 1 MENU
6		**RES>=PRES-TRAIL**	Trailing PRESELECTION 2: Display value is greater or equal PRESELECTION 2 – PRESELECTION 5 → ON, PRESELECTION 5 is the trailing value from PRESELECTION 2

HYSTERESIS 2
This parameter defines the switching hysteresis of the switch-off point for preselection 2.
See chapter PRESELECTION 1 MENU.

PULSE TIME 2 (S)
Duration of output pulse for the switching condition of preselection 2.
See chapter PRESELECTION 1 MENU..

OUTPUT TARGET 2
Assignment of an output for the switching condition of preselection 2.
See chapter PRESELECTION 1 MENU.

0	**NO**	No assignment
1	**CTRL OUT 1**	Switching condition assigned to "Ctrl. Out 1"
2	**CTRL OUT 2**	Switching condition assigned to "Ctrl. Out 2"
3	**CTRL OUT 3**	Switching condition assigned to "Ctrl. Out 3"
4	**CTRL OUT 4**	Switching condition assigned to "Ctrl. Out 4"
5	**CTRL OUT 5**	Switching condition assigned to "Ctrl. Out 5"
6	**CTRL OUT 6**	Switching condition assigned to "Ctrl. Out 6"

OUTPUT POLARITY 2
Polarity for the switching condition of preselection 2.
See chapter PRESELECTION 1 MENU.

OUTPUT LOCK 2
Latch for the switching condition of preselection 2.
See chapter PRESELECTION 1 MENU.

START UP DELAY 2 (S)
Start-up suppression for the switching condition of preselection 2.
See chapter PRESELECTION 1 MENU.

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4.9.   Preselection 3 Menu

MODE 3 Switching conditions for preselection 3. see chapter PRESELECTION 1 MENU (except the trailing value).			
			See chapter PRESELECTION 1 MENU
	6	**RES>=PRES-TRAIL**	Trailing PRESELECTION 3: Display value is greater or equal PRESELECTION 3 – PRESELECTION 6 → ON, PRESELECTION 6 is the trailing value from PRESELECTION 3

HYSTERESIS 3
This parameter defines the switching hysteresis of the switch-off point for preselection 3.
See chapter PRESELECTION 1 MENU.

PULSE TIME 3 (S)
Duration of output pulse for the switching condition of preselection 3.
See chapter PRESELECTION 1 MENU.

OUTPUT TARGET 3
Assignment of an output for the switching condition of preselection 3.
See chapter PRESELECTION 1 MENU.

0	**NO**	No assignment
1	**CTRL OUT 1**	Switching condition assigned to "Ctrl. Out 1"
2	**CTRL OUT 2**	Switching condition assigned to "Ctrl. Out 2"
3	**CTRL OUT 3**	Switching condition assigned to "Ctrl. Out 3"
4	**CTRL OUT 4**	Switching condition assigned to "Ctrl. Out 4"
5	**CTRL OUT 5**	Switching condition assigned to "Ctrl. Out 5"
6	**CTRL OUT 6**	Switching condition assigned to "Ctrl. Out 6"

OUTPUT POLARITY 3
Polarity for the switching condition of preselection 3.
See chapter PRESELECTION 1 MENU.

OUTPUT LOCK 3
Latch for the switching condition of preselection 3.
See chapter PRESELECTION 1 MENU.

START UP DELAY 3 (S)
Start-up suppression for the switching condition of preselection 3.
See chapter PRESELECTION 1 MENU.

4.10.   **Preselection 4 Menu**

MODE 4
Switching conditions for preselection 4. see chapter PRESELECTION 1 MENU (except the trailing value)

			See chapter PRESELECTION 1 MENU
	6	**RES>=PRES-TRAIL**	Trailing PRESELECTION 4: Display value is greater or equal PRESELECTION 4 – PRESELECTION 1 → ON, PRESELECTION 1 is the trailing value from PRESELECTION 4

HYSTERESIS 4
This parameter defines the switching hysteresis of the switch-off point for preselection 4.
See chapter PRESELECTION 1 MENU.

PULSE TIME 4 (S)
Duration of output pulse for the switching condition of preselection 4.
See chapter PRESELECTION 1 MENU.

OUTPUT TARGET 4
Assignment of an output for the switching condition of preselection 4.
See chapter PRESELECTION 1 MENU.

0	**NO**	No assignment
1	**CTRL OUT 1**	Switching condition assigned to "Ctrl. Out 1"
2	**CTRL OUT 2**	Switching condition assigned to "Ctrl. Out 2"
3	**CTRL OUT 3**	Switching condition assigned to "Ctrl. Out 3"
4	**CTRL OUT 4**	Switching condition assigned to "Ctrl. Out 4"
5	**CTRL OUT 5**	Switching condition assigned to "Ctrl. Out 5"
6	**CTRL OUT 6**	Switching condition assigned to "Ctrl. Out 6"

OUTPUT POLARITY 4
Polarity for the switching condition of preselection 4.
See chapter PRESELECTION 1 MENU.

OUTPUT LOCK 4
Latch for the switching condition of preselection 4.
See chapter PRESELECTION 1 MENU.

START UP DELAY 4 (S)
Start-up suppression for the switching condition of preselection 4.
See chapter PRESELECTION 1 MENU.

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4.11. **Preselection 5 Menu**

MODE 5 Switching conditions for preselection 5. see chapter PRESELECTION 1 MENU (except the trailing value)			
			See chapter PRESELECTION 1 MENU
	6	**RES>=PRES-TRAIL**	Trailing PRESELECTION 5: Display value is greater or equal PRESELECTION 5 – PRESELECTION 2 → ON, PRESELECTION 2 is the trailing value from PRESELECTION 5

HYSTERESIS 5 This parameter defines the switching hysteresis of the switch-off point for preselection 5. See chapter PRESELECTION 1 MENU.

PULSE TIME 5 (S) Duration of output pulse for the switching condition of preselection 5. See chapter PRESELECTION 1 MENU.

OUTPUT TARGET 5
Assignment of an output for the switching condition of preselection 5.
See chapter PRESELECTION 1 MENU.

0	**NO**	No assignment
1	**CTRL OUT 1**	Switching condition assigned to "Ctrl. Out 1"
2	**CTRL OUT 2**	Switching condition assigned to "Ctrl. Out 2"
3	**CTRL OUT 3**	Switching condition assigned to "Ctrl. Out 3"
4	**CTRL OUT 4**	Switching condition assigned to "Ctrl. Out 4"
5	**CTRL OUT 5**	Switching condition assigned to "Ctrl. Out 5"
6	**CTRL OUT 6**	Switching condition assigned to "Ctrl. Out 6"

OUTPUT POLARITY 5 Polarity for the switching condition of preselection 5. See chapter PRESELECTION 1 MENU.

OUTPUT LOCK 5 Latch for the switching condition of preselection 5. See chapter PRESELECTION 1 MENU.

START UP DELAY 5 (S) Start-up suppression for the switching condition of preselection 5. See chapter PRESELECTION 1 MENU.

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4.12.   **Preselection 6 Menu**

<table>
<tr><td colspan="4">MODE 6
Switching conditions for preselection 6. see chapter PRESELECTION 1 MENU (except the trailing value)</td></tr>
<tr><td></td><td></td><td></td><td>See chapter PRESELECTION 1 MENU</td></tr>
<tr><td></td><td>6</td><td>RES>=PRES-TRAIL</td><td>Trailing PRESELECTION 6:
Display value is greater or equal PRESELECTION 6 – PRESELECTION 3 → ON,
PRESELECTION 3 is the trailing value from PRESELECTION 6</td></tr>
</table>

<table>
<tr><td>HYSTERESIS 6
This parameter defines the switching hysteresis of the switch-off point for preselection 6.
See chapter PRESELECTION 1 MENU.</td></tr>
</table>

<table>
<tr><td>PULSE TIME 6 (S)
Duration of output pulse for the switching condition of preselection 6.
See chapter PRESELECTION 1 MENU.</td></tr>
</table>

<table>
<tr><td colspan="3">OUTPUT TARGET 6
Assignment of an output for the switching condition of preselection 6.
See chapter PRESELECTION 1 MENU.</td></tr>
<tr><td>0</td><td>NO</td><td>No assignment</td></tr>
<tr><td>1</td><td>CTRL OUT 1</td><td>Switching condition assigned to "Ctrl. Out 1"</td></tr>
<tr><td>2</td><td>CTRL OUT 2</td><td>Switching condition assigned to "Ctrl. Out 2"</td></tr>
<tr><td>3</td><td>CTRL OUT 3</td><td>Switching condition assigned to "Ctrl. Out 3"</td></tr>
<tr><td>4</td><td>CTRL OUT 4</td><td>Switching condition assigned to "Ctrl. Out 4"</td></tr>
<tr><td>5</td><td>CTRL OUT 5</td><td>Switching condition assigned to "Ctrl. Out 5"</td></tr>
<tr><td>6</td><td>CTRL OUT 6</td><td>Switching condition assigned to "Ctrl. Out 6"</td></tr>
</table>

<table>
<tr><td>OUTPUT POLARITY 6
Polarity for the switching condition of preselection 6.
See chapter PRESELECTION 1 MENU.</td></tr>
</table>

<table>
<tr><td>OUTPUT LOCK 6
Latch for the switching condition of preselection 6.
See chapter PRESELECTION 1 MENU.</td></tr>
</table>

<table>
<tr><td>START UP DELAY 6 (S)
Start-up suppression for the switching condition of preselection 6.
See chapter PRESELECTION 1 MENU.</td></tr>
</table>

4.13. Serial Menu

This menu defines the basic settings of serial interface.

UNIT NUMBER		
This parameter defines serial device addresses. The addresses between 11 and 99 can be assigned to the devices. Addresses with zero are not allowed, there are used as broadcast addresses.		
11	Smallest address	
...		
99	Highest address	

SERIAL BAUD RATE		
This parameter defines the serial baud rate.		
0	**9600**	9600 baud
1	**19200**	19200 baud
2	**38400**	38400 baud

SERIAL FORMAT				
This parameter defines the bit data format.				
0	**7-EVEN-1**	7 data	Parity even	1 Stop
1	**7-EVEN-2**	7 data	Parity even	2 Stops
2	**7-ODD-1**	7 data	Parity odd	1 Stop
3	**7-ODD-2**	7 data	Parity odd	2 Stops
4	**7-NONE-1**	7 data	no Parity	1 Stop
5	**7-NONE-2**	7 data	no Parity	2 Stops
6	**8-EVEN-1**	8 data	Parity even	1 Stop
7	**8-ODD-1**	8 data	Parity odd	1 Stop
8	**8-NONE-1**	8 data	no Parity	1 Stop
9	**8-NONE-2**	8 data	no Parity	2 Stops

SERIAL INIT		
This parameter defines the baud rate for the initialization to the user interface OS. With settings larger than 9600 the initialization time can be reduced.		
0	**NO**	Initialization with 9600 baud. Then the device operates with the value selected by the user.
1	**YES**	Initialization with the baud rate set by SERIAL BAUD RATE. Then the device operates with the value selected by the user.

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Continuation „**Serial Menu**":

SERIAL PROTOCOL		
Determines the sequence of characters send, when using the serial output for cyclic data transmission under time control (xxxxxxx = value SERIAL VALUE). Setting „1" removes the unit address from the string which allows a slight faster transmission cycle.		

0	Transmission report = Unit Nr., +/-, data, LF, CR
	<table><tr><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>X</td><td>LF</td><td>CR</td></tr></table>
1	Transmission report = +/-, data, LF, CR
	<table><tr><td>+/-</td><td>X</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></table>

SERIAL TIMER (S)		
This register determines the cycle time in seconds for cycling transmission of SERIAL VALUE when using the serial output. (On a serial request, the cycling transmission is stopped for 20 s)		
0,000	All cyclic transmission is switched off. The unit will send data upon a serial request or with command SERIAL PRINT.
…	
60,000	Cycle time in seconds.

SERIAL VALUE
This parameter defines the value to be transmitted.

Einstellung	Code	Bedeutung
0	:0	Measurement_Result (Result after linking, scaling, filter, etc.)
1	:1	Analog_Out_Voltage (Analog output modulation (in mV))
2	:2	Frequency (measured frequency - channel A without scaling)
3	:3	Frequency_2 (measured frequency - channel B without scaling)
4	:4	Counter (total count after linking without scaling, filters, etc.)
5	:5	Counter_A (counter reading - channel A)
6	:6	Counter_B (counter reading - channel B)
7	:7	SSI_Data (read + possibly converted binary SSI value)
8	:8	SSI_Calc_Result (SSI value incl. SSI zero and SSI offset without scaling, filters, etc.)
9	:9	Minimum_Value (Minimum value of Measurement_Result)
10	;0	Maximum_Value (Maximum value of Measurement_Result)
11	;1	Analog_Out_Current (Analog output modulation (in yA))
12	;2	Analog_Out_Percentage (Percentage analog output level) (Measurement result in xxx.x %)
13	;3	Error Status (Reading the error code)
14	;4	SSI Read Value (readed, unconverted SSI value)
15	;5	SSI Loop Value (SSI value after round loop calculation)
16	;6	Actual Speed ()
17	;7	Actual Position (Start Stop: position [in µm] with offset without scaling)
18	;8	Actual Angle (Start Stop: e.g. angle with offset without scaling)

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	19	;9	Raw Position (Start Stop: position [in µm] without Offset and without scaling))

Continuation „**Serial Menu**":

MODBUS		
This parameter enables the Modbus protocol and determines the Modbus address.		
For details of the Modbus communication please refer to the additional manual Modbus_RTU		
	0	Modbus disabled Serial interface is using Lecom protocol (Motrona-default protocol)
	1 … 247	Modbus enabled: Serial interface is using Modbus RTU protocol The set value is the Modbus address of the device.

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4.14. **Analog Menu**

This menu defines the basic settings of the analog output. The analog output always refers to the scaled "Measurement Result"!

ANALOG FORMAT

This parameter defines the output characteristics. The analogue output is proportional to the display value.

With setting ANALOG FORMAT (-10 … +10 V) in MODE COUNTER the polarity of the analog output depends on the polarity of the display value.

0	**-10…10V**	-10 … +10 V
1	**0…20MA**	0 … 20 mA
2	**4…20MA**	4 … 20 mA

ANALOG START

This parameter defines the start value of the analog conversion. This start value is corresponding to the display value for an analog output of 0 V or 0/4 mA.

-99999999	Smallest end value
0	Default Wert
+99999999	Highest end value

ANALOG END

This parameter defines the end value of the analog conversion. This end value is corresponding to the display value for an analog output of (+/-) 10 V or 20mA.

-99999999	Smallest end value
10000	Default Wert
+99999999	Highest end value

ANALOG GAIN (%)

This parameter specifies the maximum conversion of the analog output in %.

e. g. 102.00 corresponds to a conversion of 10.2 V or 20.4 mA, when the ANALOG END value is reached.
e. g. 95.00 corresponds to a conversion of 9.5 V or 18 mA, when the ANALOG END value is reached.

0,00	Smallest gain
100,00	Default value
110,00	Highest gain

ANALOG OFFSET (%)

This parameter defines the zero offset of the analog output.

z. B. 0.20 result in an offset of 0.02 V or 0.04 mA at ANALOG START value

-99,99	Smallest offset
0	Default value
+99,00	Highest offset

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4.15. Command Menu

INPUT 1 ACTION (function Input 1)

This parameter defines the function of the input "Ctrl. In 1".

(s) =   static switching (level evaluation), INPUT CONFIG must be set to active LOW / HIGH

(d) =   dynamic switching (edge evaluation) ,INPUT CONFIG must be set to RISING/FALLING EDGE

0	NO	No function	
1	RESET/SET VALUE	**Mode "SSI":** Transfer of the currently detected position value (after bit suppression and possibly performed encoder zero offset shift) into the parameter "SSI offset" (display offset) **Mode "Counter":** Reset / set of both counter values (channel A and B) to the set values in SET VALUE A u. B **Mode "Start/Stop":** Power-failure-proof stored transfer of the current position or angle measurement to the "Offset" parameter.	(d) (s)
2	FREEZE	Freezing of the current measurement result	(s)
3	TEACH ANALOG START	Transfer of the current measurement result in the parameter "Analog Start"	(d)
4	TEACH ANALOG END	Transfer of the current measurement result in the parameter "Analog End"	(d)
5	TEACH PRESELECTION 1	Transfer of the current measurement result into the parameter "Preselection 1"	(d)
6	TEACH PRESELECTION 2	Transfer of the current measurement result into the parameter "Preselection 2"	(d)
7	TEACH PRESELECTION 3	Transfer of the current measurement result into the parameter "Preselection 3"	(d)
8	TEACH PRESELECTION 4	Transfer of the current measurement result into the parameter "Preselection 4"	(d)
9	TEACH PRESELECTION 5	Transfer of the current measurement result into the parameter "Preselection 5"	(d)
10	TEACH PRESELECTION 6	Transfer of the current measurement result into the parameter "Preselection 6"	(d)
11	RESET MIN/MAX	Reset the minimum / maximum value	(d) (s)
12	LOCK RELEASE	Release latching of all outputs	(d)
13	SERIAL PRINT	Sending of serial data, see parameter SERIAL VALUE	(d)
14	ACTIVATE DATA	N.A.	
15	STORE DATA	N.A.	
16	TESTPROGRAM	N.A.	
17	CLEAR LOOP TIME	Reset of the maximum "Loop Time"	(d)
18	RESET/SET COUNTER A	**Mode "Counter":** Reset / set the counter value of channel A to the set value in SET VALUE A	(d) (s)
19	RESET/SET COUNTER B	**Mode "Counter":** Reset / set the counter value of channel B to the set value in SET VALUE B	(d) (s)
20	LOCK COUNTER A	**Mode "Counter":** Counter (channel A) is locked and does not count any further pulses as long as this command is present.	(s)
21	LOCK COUNTER B	**Mode "Counter":** Counter (channel B) is locked and does not count any further pulses as long as this command is present.	(s)

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22	**ZERO POSITION**	**Mode "SSI":** Transfer of the current SSI position in the parameter "SSI-Zero" (encoder zero offset)	(d) (s)
23	**FACTORY SETTINGS**	Device is reset to factory settings	(d)

Continuation „**Command Menu**":

INPUT 1 CONFIG
This parameter defines the switching characteristics of the input "Ctrl. In 1".

0	**ACTIVE LOW**	Active at „LOW" (static)
1	**ACTIVE HIGH**	Active at „HIGH" (static)
2	**RISING EDGE**	Activate at rising edge
3	**FALLING EDGE**	Activate at falling edge

INPUT 2 ACTION
This parameter defines the control function of the input "Ctrl. In 2".
See parameter INPUT 1 ACTION.

INPUT 2 CONFIG
This parameter defines the switching characteristics of the input "Ctrl. In 2".
See parameter INPUT 1 CONFIG.

INPUT 3 ACTION
This parameter defines the function of the input "Ctrl. In 3".
See parameter INPUT 1 ACTION.

INPUT 3 CONFIG
This parameter defines the switching characteristics of the input "Ctrl. In 3".
See parameter INPUT 1 CONFIG.

INPUT 4 ACTION
This parameter defines the function of the input "Ctrl. In 4".
See parameter INPUT 1 ACTION.

INPUT 4 CONFIG
This parameter defines the switching characteristics of the input "Ctrl. In 4".
See parameter INPUT 1 CONFIG.

INPUT 5 ACTION
This parameter defines the function of the input "Ctrl. In 5".
See parameter INPUT 1 ACTION.

INPUT 5 CONFIG
This parameter defines the switching characteristics of the input "Ctrl. In 5".
See parameter INPUT 1 CONFIG.

INPUT 6 ACTION (FACTORY SETTINGS)
This parameter is permanently preset to "Factory Settings" and can not be changed.

INPUT 6 CONFIG (RISING EDGE)
This parameter is permanently preset to "Rising Edge" and can not be changed.

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4.16.   **Linearization Menu**

The linearization function is defined in this menu. The linearization function always refers to the scaled "Measurement Result"!

Linearization description and examples are shown in the appendix.

P1(X) … P24(X)		
X-coordinate of the linearization point. This is the value that the device would generate without linearization depending on the input signal.		
	-99999999	Smallest X-coordinate
	0	Default value
	+99999999	Largest X-coordinate

P1(Y) … P24(Y)		
Y-coordinate of the linearization point. This is the value that the device should generate instead of the x coordinate. e.g. P2 (X) is replaced by P2 (Y).		
	-99999999	Smallest X-coordinate
	0	Default value
	+99999999	Largest X-coordinate

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5. Appendix

5.1. Data readout via serial interface

All codes shown in the parameter SERIAL VALUE are available for serial readout by PC or PLC. The communication of the device is based on the Drivecom protocol according to ISO 1745 or the Modbus RTU protocol. All protocol details can be found in the chapter "Modbus RTU Interface" in this manual.

To request for a data transmission you must send the following request string to the converter:

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)

The following example shows the request string for readout of the actual input frequency of a monitor (Code=1) from a unit with unit address 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

After a correct request, the unit will respond:

STX	C1	C2	xxxxx	ETX	BCC

STX = control character (Hex 02)
C1 = register code, High Byte
C2 = register code, Low Byte
xxxxx = readout data
ETX = control character (Hex 03)
BCC = block check character

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5.2.   **Modbus RTU Interface**

The Modbus interface of the touchMatrix series is a standard Modbus RTU Slave and provides the following Modbus functions:

- Read Coils
- Write Single Coil
- Read Holding Registers
- Write Multiple Registers
- Diagnosis

For the operation of the interface module and the understanding of this manual basic knowledge in Modbus RTU communication is presupposed.

5.2.1.   **Parameter setting**

Required parameter settings in "Serial menu":

UNIT NUMMER
Not valid for Modbus communication
(For setting of Modbus address see parameter "MODBUS")

SERIAL BAUD RATE
This parameter defines the serial baud rate

0	**9600**	9600 baud
1	**19200**	19200 baud
2	**38400**	38400 baud

SERIAL FORMAT
This parameter defines the bit data format.

0	7-EVEN-1	
1	7-EVEN-2	
2	7-ODD-1	Do not use with Modbus protocol
3	7-ODD-2	
4	7-NONE-1	
5	7-NONE-2	
6	**8-EVEN-1**	8 data bits Parity even 1 stop bit
7	**8-ODD-1**	8 data bits Parity odd 1 stop bit
8	8-NONE-1	Do not use with Modbus protocol
9	**8-NONE-2**	8 data bits no Parity 2 stop bits

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Continuation "**Parameter setting**":

SERIAL INIT
Not valid for Modbus communication

SERIAL PROTOCOL
Not valid for Modbus communication

SERIAL TIMER (S)
Not valid for Modbus communication

SERIAL VALUE
Not valid for Modbus communication

MODBUS
This parameter enables the Modbus protocol and determines the Modbus address.

	0	Do not use for Modbus protocol (Modbus disabled)
	1 … 247	Modbus enabled: Serial interface is using Modbus RTU protocol The number set here determines the Modbus node address.

5.2.2. Read Holding Registers and Write Multiple Registers

With the functions "Read Holding Registers" and "Write Multiple Registers" it is possible to access all registers of the device.

All variables (actual data) and status registers are mapped to Modbus Holding Registers.
However, as all registers of the device are 32 bit registers but Modbus Holding registers are only 16 bit registers, each register of the device requires two Holding registers.
(For this reason the use of Modbus function "Write Single Register" is not possible.)

It is only possible to access to one single register of the touchMATRIX device by each read or write operation, therefore the "Quantity (or number) of registers" in the Modbus request must always be 2.

Access to parameters
Holding Register 0x0000 / 0x0001 hex and following allow access to the device parameters.

The holding register numbers for a certain parameter can be calculated by the parameter # that can be found in the parameter table in the touchMatrix device manual:
Holding Register low = (parameter #) x 2
Holding Register high = (parameter #) x 2 + 1

Example:
Access to parameter # 51 "PRESELECTION 1" by Holding Register 0x0066 and 0x0067 hex.

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Continuation "**Read Holding Registers und Write Multiple Registers**"**:**

Access to actual data
Holding Register 0x1000 / 0x1001 hex and following allow access to variables of the device (actual data registers):

    Holding Register 0x1000 / 0x1001 hex → Actual data with serial Code ":0" (Display value)
    Holding Register 0x1002 / 0x1003 hex → Actual data with serial Code ":1"
    Holding Register 0x1004 / 0x1005 hex → Actual data with serial Code ":2"
    Holding Register 0x1006 / 0x1007 hex → Actual data with serial Code ":3"
    etc.

Access to status registers
Holding Register 0x2000 / 0x2001 hex and following allow access to status registers of the device:

    Holding Register 0x2000 / 0x2001 hex → Output Status (Ctrl. Out status, read only)
    Holding Register 0x2002 / 0x2003 hex → Serial Commands
    Holding Register 0x2004 / 0x2005 hex → External Command (Ctrl. In status, read only)
    Holding Register 0x2006 / 0x2007 hex → All Commands (read only)

5.2.3. **Read Coils and Write Single Coil**

With the functions "Read Coils" and "Write Single Coil" it is possible to read and set/reset single commands:

Coil number	Serial code of command	Command	
0	54	RESET/SET	Transfer of the currently detected position value into the parameter "Offset" Setting Counter A and Counter B to "Set Value"
1	55	FREEZE DISPLAY	Freezing of the current measurement result
2	56	TEACH ANALOG START	Transfer of the current measurement result in the parameter "Analog Start"
3	57	TEACH ANALOG END	Transfer of the current measurement result in the parameter "Analog End"
4	58	TEACH PRESELECTION 1	Transfer of the current measurement result into the parameter "Preselection 1"
5	59	TEACH PRESELECTION 2	Transfer of the current measurement result into the parameter "Preselection 2"
6	60	TEACH PRESELECTION 3	Transfer of the current measurement result into the parameter "Preselection 3"
7	61	TEACH PRESELECTION 4	Transfer of the current measurement result into the parameter "Preselection 4"
8	62	TEACH PRESELECTION 5	Transfer of the current measurement result into the parameter "Preselection 5"
9	63	TEACH PRESELECTION 6	Transfer of the current measurement result into the parameter "Preselection 6"
10	64	RESET MIN/MAX	Reset the minimum / maximum value
11	65	LOCK RELEASE	Release latching of all outputs

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Continuation "**Read Coils and Write Single Coil**"

12	66	SERIAL PRINT (do not use with Modbus)	Sending of serial data, see parameter SERIAL VALUE
13	67	ACTIVATE DATA (not required with Modbus)	The data is activated.
14	68	STORE DATA	Store to EEPROM
15	69	TESTPROGRAM (do not use with Modbus)	Testprogram (do not use with Modbus)

5.2.4. Diagnose

The device supports the diagnostics subfunction 00 "Return Query Data". Other diagnostics functions are not available.

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5.3. Parameter / serial codes

#	Menü	Name	Code	Min	Max	Default
0	GENERAL MENU	MODE	00	0	4	0
1	GENERAL MENU	ENCODER PROPERTIES	01	0	4	0
2	GENERAL MENU	ENCODER DIRECTION	02	0	1	0
3	GENERAL MENU	FACTOR	03	-99999999	99999999	1
4	GENERAL MENU	DIVIDER	04	-99999999	99999999	1
5	GENERAL MENU	ADDITIVE VALUE	05	-99999999	99999999	0
6	GENERAL MENU	LINEARIZATION MODE	06	0	2	0
7	GENERAL MENU	BACKUP MEMORY	07	0	1	1
8	GENERAL MENU	FACTORY SETTINGS	08	0	1	0
9	GENERAL MENU	__	09	0	0	0
10	GENERAL MENU	__	10	0	0	0
11	MODE FREQUENCY	FREQUENCY MODE	11	0	5	0
12	MODE FREQUENCY	FREQUENCY BASE	12	0	3	2
13	MODE FREQUENCY	SAMPLING TIME 1 (S)	13	1	9999	100
14	MODE FREQUENCY	WAIT TIME 1 (S)	14	1	7999	100
15	MODE FREQUENCY	STANDSTILL TIME 1 (S)	15	1	9999	1
16	MODE FREQUENCY	AVERAGE FILTER 1	16	0	16	0
17	MODE FREQUENCY	SAMPLING TIME 2 (S)	17	1	9999	100
18	MODE FREQUENCY	WAIT TIME 2 (S)	18	1	7999	100
19	MODE FREQUENCY	AVERAGE FILTER 2	19	0	16	0
20	MODE FREQUENCY	__	20	0	0	0
21	MODE FREQUENCY	__	21	0	0	0
22	MODE COUNTER	COUNT MODE	22	0	5	3
23	MODE COUNTER	FACTOR A	23	1	9999999	100000
24	MODE COUNTER	SET VALUE A	24	-99999999	99999999	0
25	MODE COUNTER	FACTOR B	25	1	9999999	100000
26	MODE COUNTER	SET VALUE B	26	-99999999	99999999	0
27	MODE COUNTER	ROUND LOOP VALUE	27	0	99999999	0
28	MODE COUNTER	__	28	0	0	0
29	MODE COUNTER	__	29	0	0	0
30	MODE SSI	SSI MODE	30	0	1	0
31	MODE SSI	ENCODER RESOLUTION	31	10	32	25
21	MODE SSI	DATA FORMAT	32	0	1	0
33	MODE SSI	BAUD RATE	33	0	5	2
34	MODE SSI	SSI ZERO	34	0	999999999	0
35	MODE SSI	HIGH BIT	35	1	32	25

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#	Menu	Name	Code	Min	Max	Default
36	MODE SSI	LOW BIT	36	1	32	1
37	MODE SSI	SSI OFFSET	37	0	999999999	0
38	MODE SSI	ROUND LOOP VALUE	38	0	99999999	0
39	MODE SSI	SAMPLING TIME (S)	39	1	9999	10
40	MODE SSI	ERROR BIT	40	0	32	0
41	MODE SSI	ERROR POLARITY	41	0	1	0
42	MODE SSI	__	42	0	0	0
43	MODE SSI	__	43	0	0	0

Continuation "**Parameter / serial codes**":

#	Menu	Name	Code	Min	Max	Default
44	MODE START/STOP	INIT MODE	44	0	1	0
45	MODE START/STOP	SAMPLING TIME (ms)	45	200	16000	4000
46	MODE START/STOP	INIT PULSE TIME (ys)	46	1	9	2
47	MODE START/STOP	VELOCITY (m/s)	47	100	999999	280000
48	MODE START/STOP	OPERATIONAL MODE	48	0	2	0
49	MODE START/STOP	OFFSET	49	-99999999	999999999	0
50	MODE START/STOP	CIRCUMFERENCE (mm)	50	1	999999999	100000
51	MODE START/STOP	ROUND LOOP VALUE	51	1	999999999	360
52	MODE START/STOP	AVERAGE FILTER - POSITION	52	0	4	0
53	MODE START/STOP	STANDSTILL TIME (s)	53	1	9999	1
54	MODE START/STOP	AVERAGE FILTER - SPEED	U0	0	4	0
55	MODE START/STOP	__	U1	0	0	0
56	MODE START/STOP	__	U2	0	0	0
57	PRESELECTION VALUES	PRESELECTION 1	A0	-99999999	999999999	1000
58	PRESELECTION VALUES	PRESELECTION 2	A1	-99999999	999999999	2000
59	PRESELECTION VALUES	PRESELECTION 3	A2	-99999999	999999999	3000
60	PRESELECTION VALUES	PRESELECTION 4	A3	-99999999	999999999	4000
61	PRESELECTION VALUES	PRESELECTION 5	A4	-99999999	999999999	5000
62	PRESELECTION VALUES	PRESELECTION 6	A5	-99999999	999999999	6000
63	PRESELECTION 1 MENU	MODE 1	A6	0	8	0
64	PRESELECTION 1 MENU	HYSTERESIS 1	A7	0	99999	0

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65	PRESELECTION 1 MENU	PULSE TIME 1 (S)	A8	0	60000	0
66	PRESELECTION 1 MENU	OUTPUT TARGET 1	A9	0	6	1
67	PRESELECTION 1 MENU	OUTPUT POLARITY 1	B0	0	1	0
68	PRESELECTION 1 MENU	OUTPUT LOCK 1	B1	0	1	0
69	PRESELECTION 1 MENU	START UP DELAY 1 (S)	B2	0	60000	0
70	PRESELECTION 1 MENU	__	B3	0	0	0
71	PRESELECTION 1 MENU	__	B4	0	0	0
72	PRESELECTION 1 MENU	__	B5	0	0	0
73	PRESELECTION 1 MENU	__	B6	0	0	0
74	PRESELECTION 2 MENU	MODE 2	B7	0	8	0
75	PRESELECTION 2 MENU	HYSTERESIS 2	B8	0	99999	0
76	PRESELECTION 2 MENU	PULSE TIME 2 (S)	B9	0	60000	0
77	PRESELECTION 2 MENU	OUTPUT TARGET 2	C0	0	6	2
78	PRESELECTION 2 MENU	OUTPUT POLARITY 2	C1	0	1	0
79	PRESELECTION 2 MENU	OUTPUT LOCK 2	C2	0	1	0
80	PRESELECTION 2 MENU	START UP DELAY 2 (S)	C3	0	60000	0
81	PRESELECTION 2 MENU	__	C4	0	0	0
82	PRESELECTION 2 MENU	__	C5	0	0	0
83	PRESELECTION 2 MENU	__	C6	0	0	0
84	PRESELECTION 2 MENU	__	C7	0	0	0
85	PRESELECTION 3 MENU	MODE 3	C8	0	8	0
86	PRESELECTION 3 MENU	HYSTERESIS 3	C9	0	99999	0
87	PRESELECTION 3 MENU	PULSE TIME 3 (S)	D0	0	60000	0

Continuation "**Parameter / serial codes**":

#	Menu	Name	Code	Min	Max	Default
88	PRESELECTION 3 MENU	OUTPUT TARGET 3	D1	0	6	3

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89	PRESELECTION 3 MENU	OUTPUT POLARITY 3	D2	0	1	0
90	PRESELECTION 3 MENU	OUTPUT LOCK 3	D3	0	1	0
91	PRESELECTION 3 MENU	START UP DELAY 3 (S)	D4	0	60000	0
92	PRESELECTION 3 MENU	__	D5	0	0	0
93	PRESELECTION 3 MENU	__	D6	0	0	0
94	PRESELECTION 3 MENU	__	D7	0	0	0
95	PRESELECTION 3 MENU	__	D8	0	0	0
96	PRESELECTION 4 MENU	MODE 4	D9	0	8	0
97	PRESELECTION 4 MENU	HYSTERESIS 4	E0	0	99999	0
98	PRESELECTION 4 MENU	PULSE TIME 4 (S)	E1	0	60000	0
99	PRESELECTION 4 MENU	OUTPUT TARGET 4	E2	0	6	4
100	PRESELECTION 4 MENU	OUTPUT POLARITY 4	E3	0	1	0
101	PRESELECTION 4 MENU	OUTPUT LOCK 4	E4	0	1	0
102	PRESELECTION 4 MENU	START UP DELAY 4 (S)	E5	0	60000	0
103	PRESELECTION 4 MENU	__	E6	0	0	0
104	PRESELECTION 4 MENU	__	E7	0	0	0
105	PRESELECTION 4 MENU	__	E8	0	0	0
106	PRESELECTION 4 MENU	__	E9	0	0	0
107	PRESELECTION 5 MENU	MODE 5	F0	0	8	0
108	PRESELECTION 5 MENU	HYSTERESIS 5	F1	0	99999	0
109	PRESELECTION 5 MENU	PULSE TIME 5 (S)	F2	0	60000	0
110	PRESELECTION 5 MENU	OUTPUT TARGET 5	F3	0	6	5
111	PRESELECTION 5 MENU	OUTPUT POLARITY 5	F4	0	1	0
112	PRESELECTION 5 MENU	OUTPUT LOCK 5	F5	0	1	0
113	PRESELECTION 5 MENU	START UP DELAY 5 (S)	F6	0	60000	0

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#	Menu	Name	Code	Min	Max	Default
114	PRESELECTION 5 MENU	__	F7	0	0	0
115	PRESELECTION 5 MENU	__	F8	0	0	0
116	PRESELECTION 5 MENU	__	F9	0	0	0
117	PRESELECTION 5 MENU	__	G0	0	0	0
118	PRESELECTION 6 MENU	MODE 6	G1	0	8	0
119	PRESELECTION 6 MENU	HYSTERESIS 6	G2	0	99999	0
120	PRESELECTION 6 MENU	PULSE TIME 6 (S)	G3	0	60000	0
121	PRESELECTION 6 MENU	OUTPUT TARGET 6	G4	0	6	6
122	PRESELECTION 6 MENU	OUTPUT POLARITY 6	G5	0	1	0
123	PRESELECTION 6 MENU	OUTPUT LOCK 6	G6	0	1	0
124	PRESELECTION 6 MENU	START UP DELAY 6 (S)	G7	0	60000	0
125	PRESELECTION 6 MENU	__	G8	0	0	0
126	PRESELECTION 6 MENU	__	G9	0	0	0
127	PRESELECTION 6 MENU	__	H0	0	0	0
128	PRESELECTION 6 MENU	__	H1	0	0	0
129	SERIAL MENU	UNIT NUMBER	90	11	99	11
130	SERIAL MENU	SERIAL BAUD RATE	91	0	2	0
131	SERIAL MENU	SERIAL FORMAT	92	0	9	0
132	SERIAL MENU	SERIAL INIT	9~	0	1	0
133	SERIAL MENU	SERIAL PROTOCOL	H2	0	1	0

Continuation "**Parameter / serial codes**":

#	Menu	Name	Code	Min	Max	Default
134	SERIAL MENU	SERIAL TIMER (S)	H3	0	60000	0
135	SERIAL MENU	SERIAL VALUE	H4	0	19	0
136	SERIAL MENU	MODBUS	H5	0	247	0
137	SERIAL MENU	__	H6	0	0	0
138	SERIAL MENU	__	H7	0	0	0
139	ANALOG MENU	ANALOG FORMAT	H8	0	2	0
140	ANALOG MENU	ANALOG START	H9	-99999999	99999999	0
141	ANALOG MENU	ANALOG END	I0	-99999999	99999999	10000
142	ANALOG MENU	ANALOG GAIN %	I1	0	11000	10000
143	ANALOG MENU	ANALOG OFFSET %	I2	-9999	9999	0

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144	COMMAND MENU	INPUT 1 ACTION	I3	0	23	0
145	COMMAND MENU	INPUT 1 CONFIG.	I4	0	3	2
146	COMMAND MENU	INPUT 2 ACTION	I5	0	23	0
147	COMMAND MENU	INPUT 2 CONFIG.	I6	0	3	2
148	COMMAND MENU	INPUT 3 ACTION	I7	0	23	0
149	COMMAND MENU	INPUT 3 CONFIG.	I8	0	3	2
150	COMMAND MENU	INPUT 4 ACTION	I9	0	22	0
151	COMMAND MENU	INPUT 4 CONFIG.	J0	0	3	2
152	COMMAND MENU	INPUT 5 ACTION	J1	0	22	0
153	COMMAND MENU	INPUT 5 CONFIG.	J2	0	3	2
154	COMMAND MENU	INPUT 6 ACTION (FACTORY SETTINGS)	J3	22	22	22
155	COMMAND MENU	INPUT 6 CONFIG. (RISING EDGE)	J4	2	2	2
156	COMMAND MENU	__	J5	0	0	0
157	COMMAND MENU	__	J6	0	0	0
158	COMMAND MENU	__	J7	0	0	0
159	COMMAND MENU	__	J8	0	0	0
160	COMMAND MENU	__	J9	0	0	0
161	COMMAND MENU	__	K0	0	0	0
162	LINEARIZATION MENU	P1(X)	K1	-99999999	99999999	0
163	LINEARIZATION MENU	P1(Y)	K2	-99999999	99999999	0
164	LINEARIZATION MENU	P2(X)	K3	-99999999	99999999	0
165	LINEARIZATION MENU	P2(Y)	K4	-99999999	99999999	0
166	LINEARIZATION MENU	P3(X)	K5	-99999999	99999999	0
167	LINEARIZATION MENU	P3(Y)	K6	-99999999	99999999	0
168	LINEARIZATION MENU	P4(X)	K7	-99999999	99999999	0
169	LINEARIZATION MENU	P4(Y)	K8	-99999999	99999999	0
170	LINEARIZATION MENU	P5(X)	K9	-99999999	99999999	0
171	LINEARIZATION MENU	P5(Y)	L0	-99999999	99999999	0
172	LINEARIZATION MENU	P6(X)	L1	-99999999	99999999	0
173	LINEARIZATION MENU	P6(Y)	L2	-99999999	99999999	0
174	LINEARIZATION MENU	P7(X)	L3	-99999999	99999999	0
175	LINEARIZATION MENU	P7(Y)	L4	-99999999	99999999	0
176	LINEARIZATION MENU	P8(X)	L5	-99999999	99999999	0

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#	Menu	Name	Code	Min	Max	Default
177	LINEARIZATION MENU	P8(Y)	L6	-99999999	99999999	0

Continuation "**Parameter / serial codes**":

#	Menu	Name	Code	Min	Max	Default
178	LINEARIZATION MENU	P9(X)	L7	-99999999	99999999	0
179	LINEARIZATION MENU	P9(Y)	L8	-99999999	99999999	0
180	LINEARIZATION MENU	P10(X)	L9	-99999999	99999999	0
181	LINEARIZATION MENU	P10(Y)	M0	-99999999	99999999	0
182	LINEARIZATION MENU	P11(X)	M1	-99999999	99999999	0
183	LINEARIZATION MENU	P11(Y)	M2	-99999999	99999999	0
184	LINEARIZATION MENU	P12(X)	M3	-99999999	99999999	0
185	LINEARIZATION MENU	P12(Y)	M4	-99999999	99999999	0
186	LINEARIZATION MENU	P13(X)	M5	-99999999	99999999	0
187	LINEARIZATION MENU	P13(Y)	M6	-99999999	99999999	0
188	LINEARIZATION MENU	P14(X)	M7	-99999999	99999999	0
189	LINEARIZATION MENU	P14(Y)	M8	-99999999	99999999	0
190	LINEARIZATION MENU	P15(X)	M9	-99999999	99999999	0
191	LINEARIZATION MENU	P15(Y)	N0	-99999999	99999999	0
192	LINEARIZATION MENU	P16(X)	N1	-99999999	99999999	0
193	LINEARIZATION MENU	P16(Y)	N2	-99999999	99999999	0
194	LINEARIZATION MENU	P17(X)	N3	-99999999	99999999	0
195	LINEARIZATION MENU	P17(Y)	N4	-99999999	99999999	0
196	LINEARIZATION MENU	P18(X)	N5	-99999999	99999999	0
197	LINEARIZATION MENU	P18(Y)	N6	-99999999	99999999	0
198	LINEARIZATION MENU	P19(X)	N7	-99999999	99999999	0
199	LINEARIZATION MENU	P19(Y)	N8	-99999999	99999999	0

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200	LINEARIZATION MENU	P20(X)	N9	-99999999	99999999	0
201	LINEARIZATION MENU	P20(Y)	O0	-99999999	99999999	0
202	LINEARIZATION MENU	P21(X)	O1	-99999999	99999999	0
203	LINEARIZATION MENU	P21(Y)	O2	-99999999	99999999	0
204	LINEARIZATION MENU	P22(X)	O3	-99999999	99999999	0
205	LINEARIZATION MENU	P22(Y)	O4	-99999999	99999999	0
206	LINEARIZATION MENU	P23(X)	O5	-99999999	99999999	0
207	LINEARIZATION MENU	P23(Y)	O6	-99999999	99999999	0
208	LINEARIZATION MENU	P24(X)	O7	-99999999	99999999	0
209	LINEARIZATION MENU	P24(Y)	O8	-99999999	99999999	0

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Serial codes of commands:

Serial Code	Command
54	RESET/SET
55	FREEZE DISPLAY
56	TEACH ANALOG START
57	TEACH ANALOG END
58	TEACH PRESELECTION 1
59	TEACH PRESELECTION 2
60	TEACH PRESELECTION 3
61	TEACH PRESELECTION 4
62	TEACH PRESELECTION 5
63	TEACH PRESELECTION 6
64	RESET MIN/MAX
65	LOCK RELEASE
66	SERIAL PRINT
67	ACTIVATE DATA
68	STORE DATA
69	TESTPROGRAM

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5.4. **Linearization**

The linearization function of this unit allows converting a linear input signal into a non-linear developing (or vice versa). There are 24 programmable x/y coordinates available, which can be set in any desired distance over the full conversion range. Between two coordinates, the unit uses linear interpolation. Therefore it is advisable to use more coordinates in a range with strong curves and only a few coordinates where the curvature is less.

5.
To specify an individual linearization curve, the parameter LINEARISAZATION MODE must be set to either 1 QUADRANT or 4 QUADRANT (see following diagram).

6.
The parameters P1(X) to P24(X) are used to specify the coordinates on the x-axis. These are the measuring values that the unit normally would generate according to the actual input signal.

7.
Now enter the attached values to parameter P1(Y) to P24(Y). These are the values that the unit will generate instead of the x- values, i.e. P5(Y) replaces P5(X) etc.

The X-Coordinates must use continuously increasing settings, i.e. P1(X) must have the lowest and P24(X) must have the highest setting. If the measured value is bigger than the last defined X-value, the corresponding Y-value is displayed.
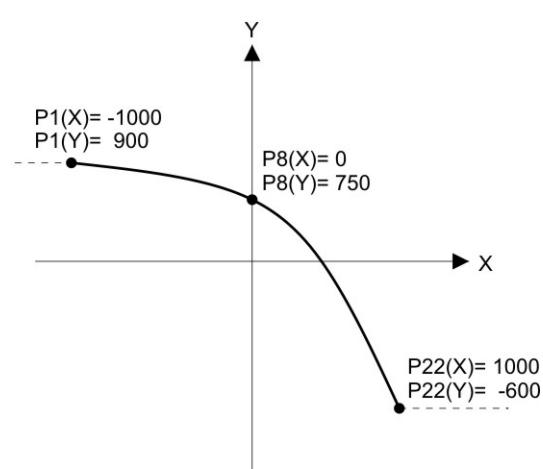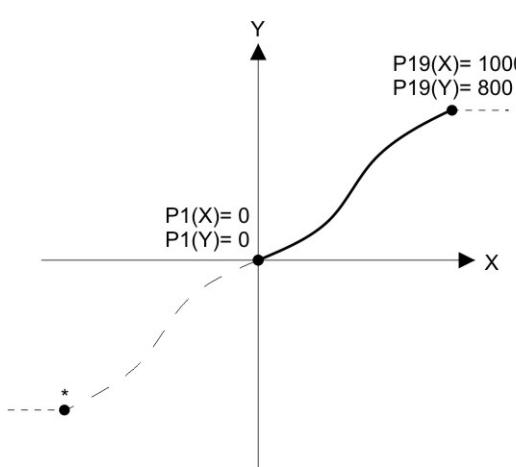
Example: Linearization Mode: 1 Quadrant
* Linearization is point symmetric to 1. Quadrant

Example: Linearization Mode: 4 Quadrant

Mode: 1 Quadrant:
P1(X) must be set to zero. Linearization is only defined in the positive range and the negative range will be mirrored symmetric to central point.

Mode: 4 Quadrant:
P1(X) can also be set to a negative value. If the measured value is smaller than P1(X), P1(Y) is displayed.

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Application Example:
The picture below shows a watergate where the opening is picked up by means of an incremental encoder. We would like to display the clearance of the gate "d", but the existing encoder information is proportional to the angular information φ.

Display value
$$d = d_0 (1-\cos\varphi)$$

Incremental Encoder

φ

d

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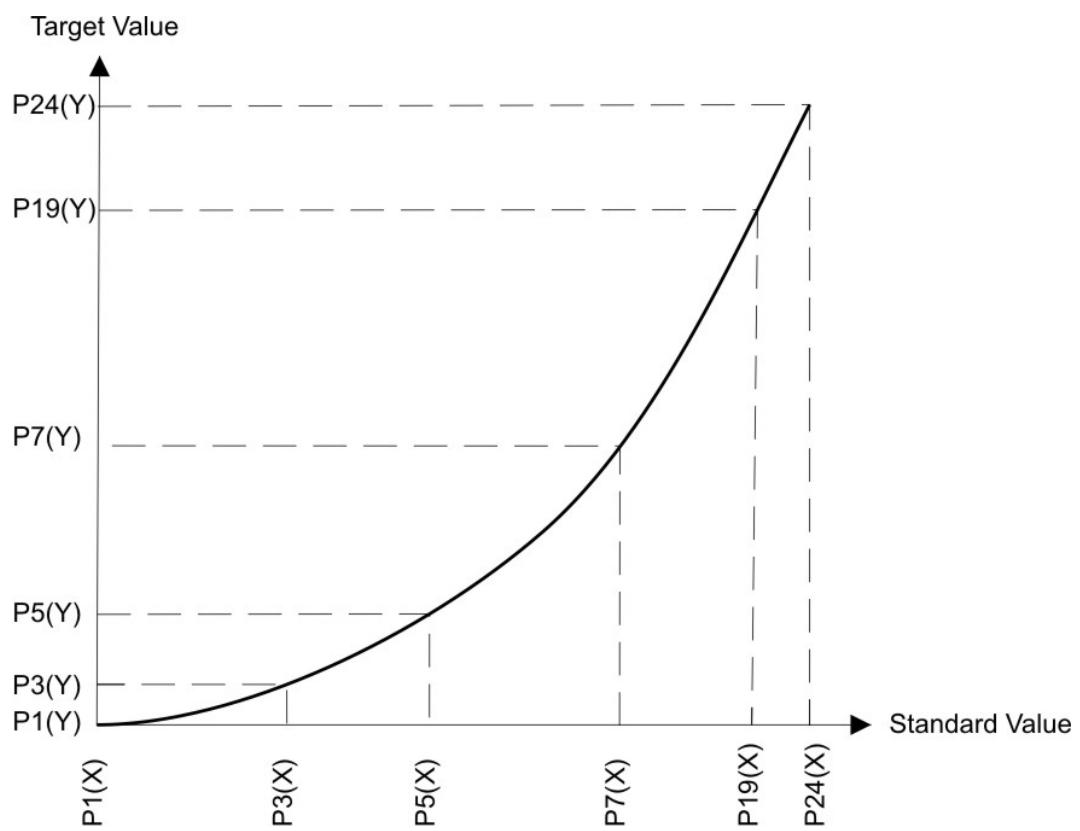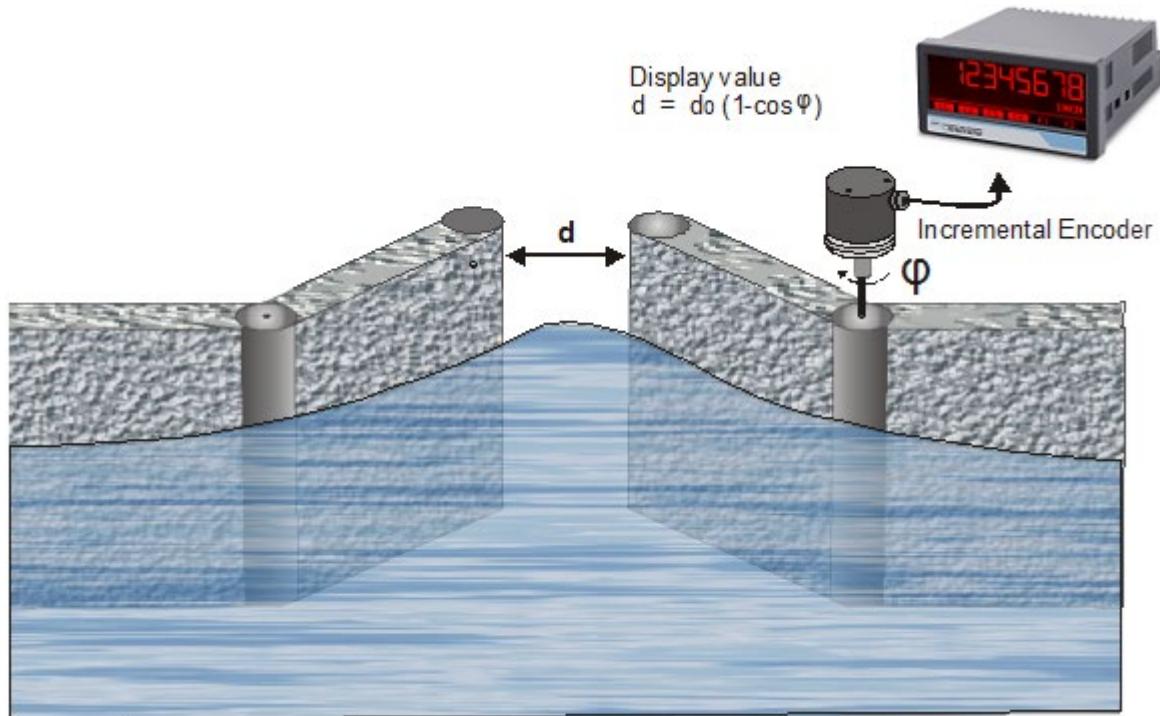
5.5. Reading SSI-Value

The received data is always filled to 32 bit data length.

| Weight	Bit	Value
1	1	u
2	2	u
4	3	u
8	4	u
16	5	u
32	6	u
64	7	u
128	8	u
256	9	u
512	10	u
1024	11	u
2048	12	u
4096	13	u
8192	14	u
16384	15	u
32768	16	u
65536	17	u
131072	18	u
262144	19	u
524288	20	u
1048576	21	u
2097152	22	u
4194304	23	u
8388608	24	u
16777216	25	u
33554432	26	0
67108864	27	0
134217728	28	0
268435456	29	0
536870912	30	0
1073741824	31	0
2147483648	32	0

BAUD RATE „500 kHz"

Clock

Fill to 32

MODE „Master"

Data „0"

ENCODER RESOLUTION „25"

Clk

Data

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5.6. Internal processing and calculation of SSI data

Checking the error bit:

ERROR POLARITY
ERROR BIT
„25"

Data Conversion:
Gray Code →binary

„gray"
DATA FORMAT

Data splitting:
Bit per revolution and number of revolutions

„12"
BITS PER REVOLUTION

REVOLUTIONS

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Considering SSI Zero position:

"0"
SSI ZERO

$w = (u - v)$

$Mask = (2^{SSI\ Bits}-1)$

$x = (w\ \&\ Mask)$

Checking the direction of rotation:

"0"
DIRECTION

Evaluation of the bit blanking:

"18"
HIGH BIT

"4"
LOW BIT

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Considering SSI Offset:	„0" **SSI OFFSET** 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 y y y y y y y y y y y y y y y y $z = (x - y)$ 32 31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 z z z z z z z z z z z z z z z z z z z z z z z z z z z z z z z z
Calculation Display Value:	$$\boxed{z} \times \frac{\text{FACTOR} \, \text{"1"}}{\text{DIVIDER} \, \text{"1"}} + \text{ADDITIVE VALUE} \, \text{"0"} =$$

5.7. Operating modes / OP modes of the Start/Stop interface

The device supports the following operating modes:

- <u>MASTER</u>
    - The Init pulse for the connected encoder is generated by the device.
    - The two Init connections (INIT OUT, /INIT OUT) are configured as outputs in this case.

- <u>SLAVE</u>
    - The Init pulse for the encoder is generated by an external device.
    - The two Init connections (ext. INIT IN, ext. /INIT IN) are configured as inputs in this case.

The desired operating mode can be selected in the "General Menu" using the "INIT MODE" parameter.

The device can also be operated in the following three "Operational Modes". The desired measurement function (distance measurement, angle measurement or velocity measurement) can be selected from among by means of the "OPERATIONAL MODE" parameter.

- **POSITION** (distance measurement)

The current position of the position encoder is determined on the basis of a run-time measurement consisting of a start and stop pulse and can be converted into another unit, if desired, using the existing scaling parameters (Factor, Divider and Additive Value) (e.g. for serial readout of the position value in a desired unit).

Interpretation of the measurement result during distance measurement:

The default setting of the scaling parameters ("FACTOR = 1", "DIVIDER = 1" and ADDITIVE VALUE = 0") corresponds to a position measurement result in micrometers (μm).
For example, to get a position in "inch" with three fictitious decimal places, the parameter "FACTOR" must be set to "10", the parameter "DIVIDER" to "254" and the parameter "ADDITIVE VALUE" to "0".

- **ANGLE** (angle measurement)

For angle measurement, the desired position or angle output value per rotation can be specified by means of parameter "ROUND LOOP VALUE". This output value is generated as soon as the distance covered (e.g. circumference), which is set as the reference value in the parameter "CIRCUMFERENCE (in mm)", is reached. Afterwards the output value starts again at 0 until the covered distance is reached again. (Round Loop Function!)
Using existing scaling parameters (Factor, Divider and Additive Value), this output value can be rescaled if desired.

Interpretation of the measurement result during angle measurement:

The default setting ("CIRCUMFERENCE (mm) = 100.000" and "ROUND LOOP VALUE = 360", as well as "FACTOR = 1", "DIVIDER = 1" and "ADDITIVE VALUE = 0") corresponds to an angle output or position output of "0...360" (e.g.: degrees) every 100.000 mm.
Continuation "**Operating modes / OP modes of the Start/Stop interface**"

- **SPEED** (speed measurement)

The speed is recorded and can be converted again into another unit using existing scaling parameters (Factor, Divider and Additive Value), if desired.

Interpretation of the measurement result during speed measurement:

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The default setting ("FACTOR = 1", "DIVIDER = 1" and "ADDITIVE VALUE = 0") corresponds to a velocity output in meters per second [m/s].

> **The analog output, the setpoints of the transistor outputs and the linearization function always refer to the scaled measuring result of the selected operational mode!**

5.8.   **Dimensions**

102 mm   (4.02 ")

91 mm   (3.58 ")

102 mm   (4.02 ")

83 mm   (3.27 ")

23 mm

(0.9 ")

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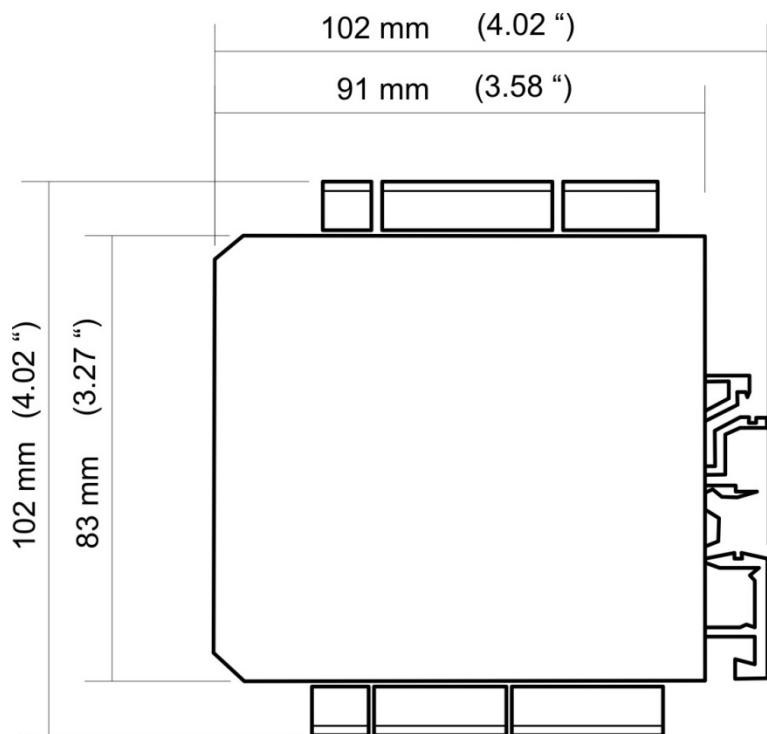
5.9. Technical Specifications:

Technical Specifications		
Connections:	Connector type:	screw terminal, 1.5 mm² / AWG 16
Power supply (DC)::	Input voltage: Protection circuit: Consumption: Fuse protection:	18 … 30 VDC reverse polarity protection approx. 50 mA (unloaded) extern: T 0.5 A
Encoder supply:	Output voltage: Output current:	5 VDC and 24 VDC (approx.1 V lower than the power supply) max. 250 mA
Incremental-inputs:	Number of inputs: Configuration:: RS422: HTL differential TTL/ HTL PNP / NPN: Load: Frequency measurement accuracy:	A, /A, B, /B RS422, TTL, HTL differential, HTL PNP or HTL NPN max. 1 MHz (RS422 differential signal > 0,5 V) max. 500 kHz (HTL differential signal > 2 V) max. 250 kHz max. 6 mA / Ri > 5 kOhm / 10 pFv +/- 50 ppm, +/-1 Digit
SSI interface:	Number (channels): Configuration: Format: Frequency: Resolution: Load:	Clock, /Clock, Data, /Data Master or Slave Binary or Gray code max. 1 MHz 10 … 32 Bit Max. 3 mA / Ri > 10 kOhm / 10 pF
Start/Stop-interface:	RS422 input: RS422 output: Pulse width Init-pulse: Frequency Init-pulse: Clock frequency time measurement:: Resolution:	1 x (Start_Stop, /Start_Stop); 1x (ext. Init_In, ext. /Init_In) 1 x (Init_Out, /Init_Out) 1…9 µs (adjustable) 62,5 Hz - 5000 Hz (adjustable) 48 MHz Depending on the waveguide velocity of the encoder. (e.g. 0,059mm / step at v = 2850 m/s)
Control inputs:	Number of inputs: Format: Frequency: Load:	6 HTL, PNP (10 … 30 V) max. 10 kHz max. 2 mA / Ri > 15 kOhm / 470 pF
Analog-output:	Configuration: Voltage output: Current output: Resolution: Accuracy: Reaction time:	current or voltage operation -10…+10 V (max. 2mA) 0/4 … 20 mA (burden: max. 270 Ohm) 16 Bit ± 0,1 % 0℃ … +45℃ ± 0,15 % -20℃ … 0℃ und +45℃ … +60℃ < 1 ms
Control-Outputs:	Number of outputs: Format / level: Output current: Reaction time:	6 5 … 30 V (depends on the Com+ voltage), PNP max. 200 mA < 1 ms
Serial interface:	Format: Baudrate:	RS232 oder RS485 9600, 19200 oder 38400 baud
USB interface:	Mini-USB:	115200 Baud, Data Format 8 none 1
Display:	LED:	green status LED
Housing:	Material: Mounting: Dimensions (w x h x d): Protection class: Weight:	Plastic housing 35 mm DIN rail (EN 60715) 23 x 102 x 102 mm IP20 approx. 100 g
Ambient temperature:	Operation: Storage:	-20℃ … +60℃ (not condensing -25℃ … +75℃ (not condensing)
Failure rate:	MTBF in years:	59,1 a (Continuous operation at 60 ° C)
Conformity and standards:	EMC 2014/30/EU:	EN 61326-1: 2013 for industrial location EN 55011: 2017 / CISPR11: 2017 Class A

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	RoHS (II) 2011/65/EU
	RoHS (III) 2015/863: EN IEC 63000: 2018