Operating Manual

R60730.0002 – Index 3a

SK.1A-1S1D2RS

Universal signal converter: analog (V/mA) - incremental / SSI / RS232 / RS485

Product Features:

- Analog input for voltage, current or potentiometer operation
- Operation as frequency converter/-generator, positional / angular encoder or data logging possible
- Programmable curves with optionally repeating curve cycles
- Frequency output (HTL or TTL level, max. 1 MHz) proportional to the input signal
- Incremental output and SSI interface, for digital expression of linear or angular positions
- Incremental direction signal A, B under control of input signal and parameter settings
- Additional control functions similar to a motorized potentiometer
- USB programming port and serial interface (RS232 / RS485)
- Programmable marker resp. index pulse output (0, /0)
- Power supply 12 to 30 VDC

Version:	Description:
Index 1 (German is the original version)	2018-02
Index 2	2020-12 + OSxx
Index 3a	2021-04 / Additions of MODBUS

Table of Contents

1. Safety Instructions and Responsibility

1.1 General Safety Instructions

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

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

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

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

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

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

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

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

1.2 Use according to the intended purpose

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

Please note that device may only be installed in proper form and used in a technically perfect condition - in accordance to the Technical Specifications (see chapter 8). The device is not suitable for operation in explosion-proof areas or areas which are excluded by the EN 61010-1 standard.

1.3 Installation

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

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

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

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

All selected wires and isolations must be conform to the provided voltage- and temperature-ranges. Further all country- and application-specific standards, which are relevant for structure, form and quality of the wires, must be ensured. Indications about the permissible wire cross-sections for wiring are described in the Technical Specifications (see chapter 8).

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 these 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.

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

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.

2. Introduction

The SK.1A-1S1D2RS is a versatile and competitive signal converter and frequency generator for use with industrial applications in drive and automation technology.

Functional overview:

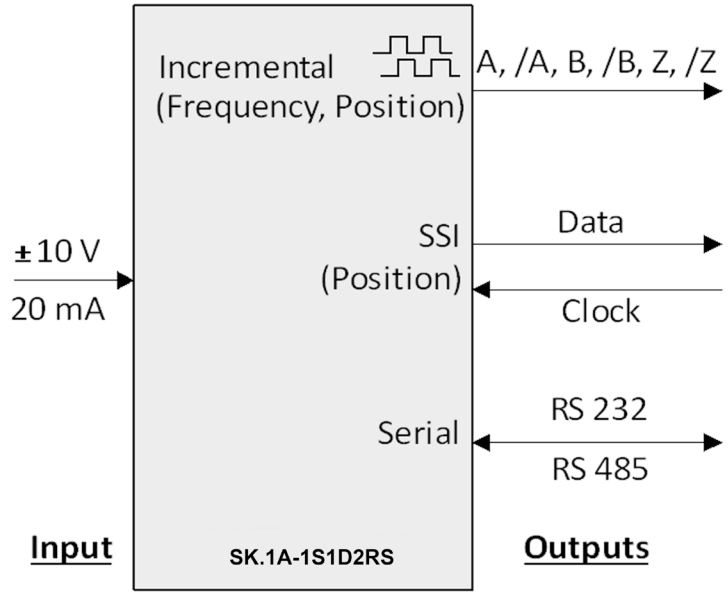


Figure 2-1 Functional overview

The unit accepts analogue input signals (0 - ±10 V, 0 - 20 mA or 4 - 20 mA) for conversion to digital output signals.

Due to an inbuilt reference voltage source it is also easy to connect potentiometers or similar analogue transducer systems to the input of the unit.

The USB communication port is not available with the previous version SK.1A-1S1D2RS.

2.1. Operation as Signal Converter

The conversion output generated from the analogue input is available with following formats:

- **Frequency**
  The unit converts the analogue input into a proportional output frequency with a free programmable range between 0.01 Hz and 1 MHz. A full set of impulse channels A, /A, B, /B, 0, /0 is available and the direction information (A, B, 90°) automatically considers the actual state and course of the analogue input with regard to the related parameter settings. An external voltage connected to terminal [Com+] defines the output voltage level (range 5 - 30 V). Where no remote voltage has been applied (Com+ unconnected), the unit automatically provides a 4 volts output (TTL compatible).
- **Linear or angular position with incremental representation**
  The unit converts the analogue input into a positional or angular information similar to an incremental encoder. This means that e.g. the rotation angle of an analogue potentiometer shaft converts to real incremental encoder information. The unit provides a full set of output channels A, /A, B, /B, 0 /0, and the directional information (A, B, 90°) fully follows the mechanical motion of the potentiometer. The impulse level on the incremental output is determined by the remote voltage applied to terminal [Com+] (range 5 - 30 V). When no external voltage is applied (i.e. terminal Com+ unconnected) the unit automatically generates a 4 volts signal swing (TTL compatible).
- **Linear or angular position with absolute SSI output**
  The unit converts the analogue input into a positional or angular information similar to an absolute encoder with SSI interface. This means that e.g. the rotation angle of an analogue potentiometer shaft converts to real SSI encoder information. Similar to a real SSI encoder the SK.1A-1S1D2RS converter always acts as a “Slave” responding to the clock signal of a remote SSI master unit. All SSI signal levels are in line with the common SSI standard (TTL-differential or RS422 respectively).
- **Serial and USB**
  At any time and with all modes of operation the conversion result of the unit is accessible by PC or PLC, via the serial interface or by the converter’s USB port.

2.2. Operation as Frequency or Position Generator (Motorized Potentiometer Mode)

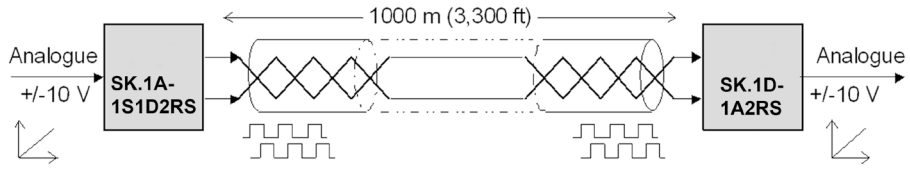
With this mode of operation the unit functions similar to a motorized potentiometer or to a digital positioning axis.

In frequency mode the unit generates a scalable frequency output where the frequency can be adjusted via remote commands „UP“ (increase) and „DOWN“ (decrease). In positioning mode the unit generates quadrature counting impulses in forward or reverse direction, under control of the „UP“ and „DOWN“ commands (virtual positioning axis).

Moreover the unit provides a „Repeat“-Function for cyclic execution of frequency or position curves within programmable limits.

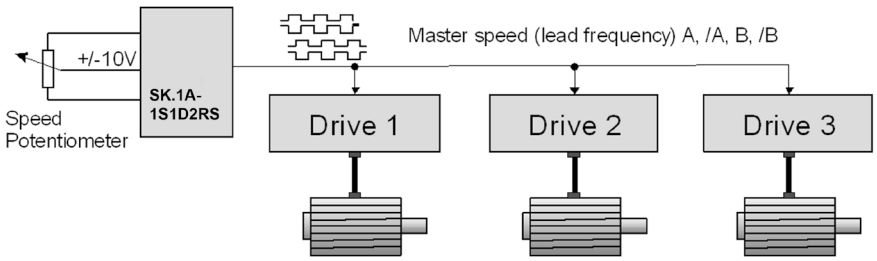
3. Typical Examples of Application

3.1. SK.1A-1S1D2RS as Analogue-to-Frequency Converter or Generator



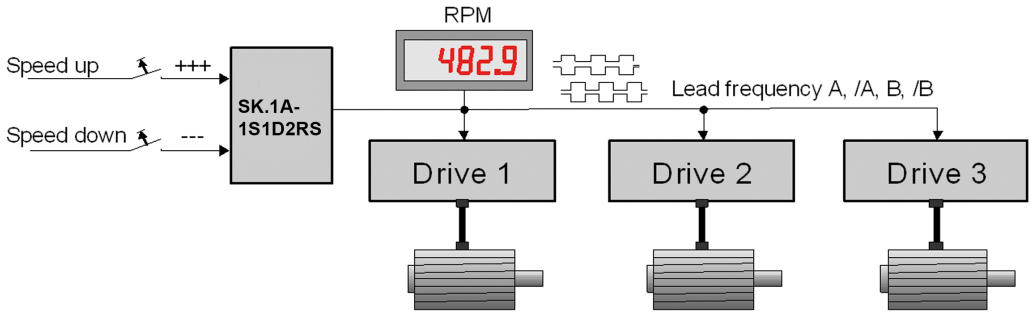
Secure digital transmission of sensitive analogue signals over long distances

Figure 3-1



Generation of a digital set speed reference with use of a simple potentiometer

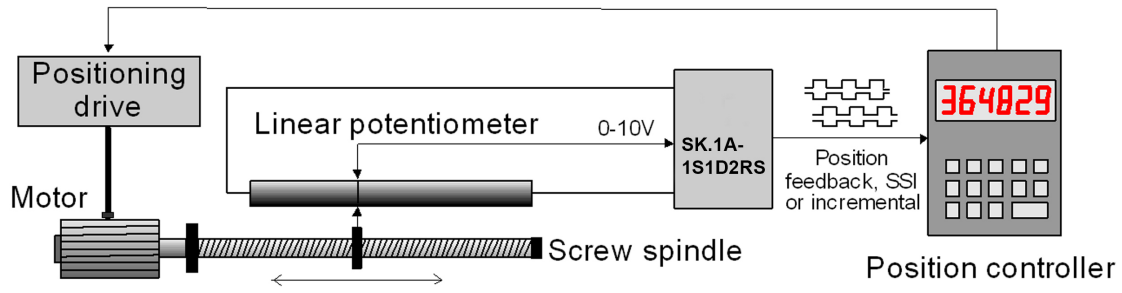
Figure 3-2



Digital RPM setting with a drive network by simple commands „UP“ or „DOWN“

Figure 3-3

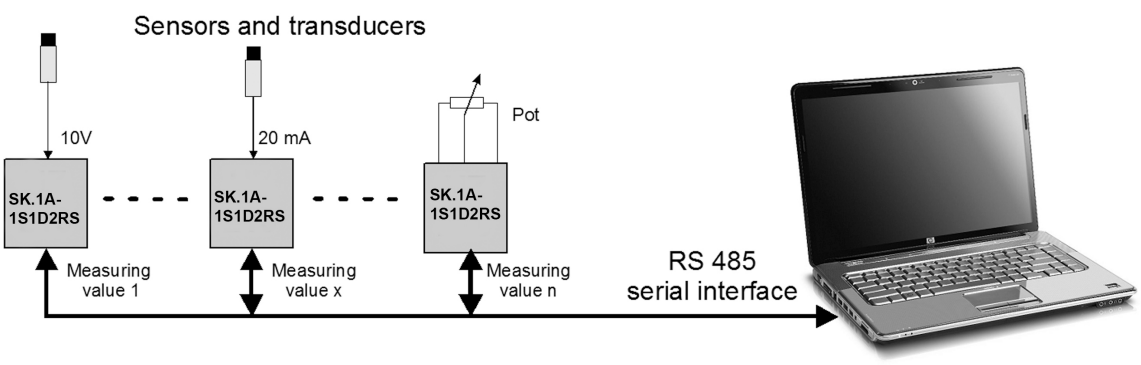
3.2. SK.1A-1S1D2RS as Positional or Angular Encoder with Analogue Input



Operation of a digital position controller with use of an analogue feedback system

Figure 3-4

3.3. SK.1A-1S1D2RS for PC Applications (Data Logging)



Evaluation of several sensor data via RS485 bus and PC

Figure 3-5

4. Connections and Control Elements

For electrical connection the unit provides four plug-in terminal strips **X1**, **X3**, **X4** and **X5**, with mechanical codification against accidental misconnection. The 9-pin Sub-D-connector **X2** and the front USB port provide communication and PC setup of the unit.

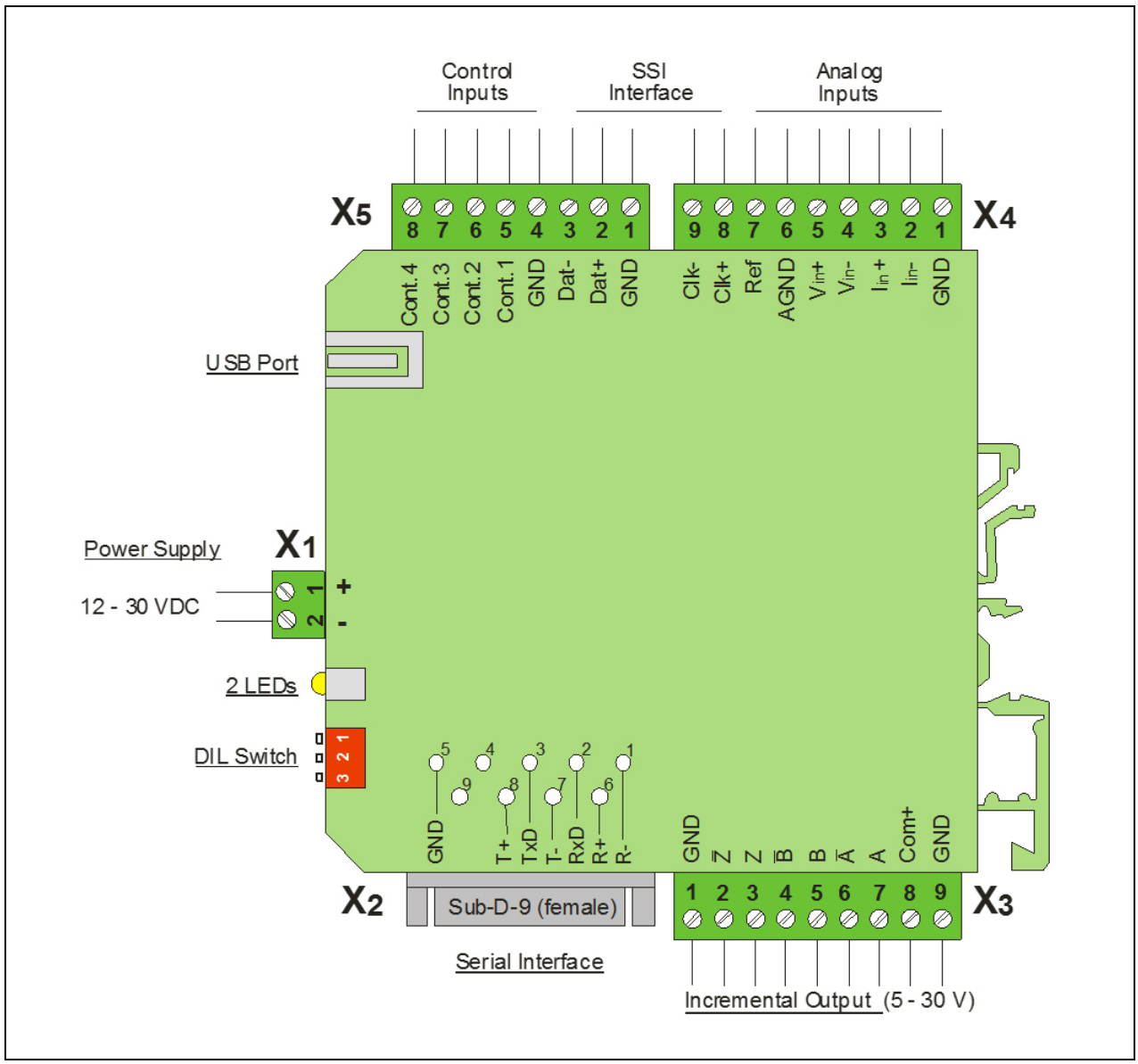


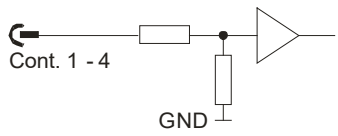
Figure 4-1

4.1. Power Supply

The SK.1A-1S1D2RS converter requires a DC supply from 12 to 30 VDC applied to the screw terminals **X1 [1]** (+) and **X1 [2]** (-) (residual ripple $\leq$ 0.5 V). In idle state the typical consumption is approx. 50 mA (24 VDC input). The green front LED indicates that power is applied to the unit.

4.2. Control Inputs Control1 - Control4

Four control inputs with programmable function are accessible via terminals **X5 [5**, **6**, **7, 8]**. The desired function can be assigned by the parameters [Input Config.] and [Input Function] of the „Command Setting“ menu.[a]
All control inputs are designed as PNP inputs, i.e. a positive voltage must be applied with reference to GND. The switching thresholds are LOW ≤ 3 V and HIGH ≥ 10 V, and the input impedance is about 15 kΩ.



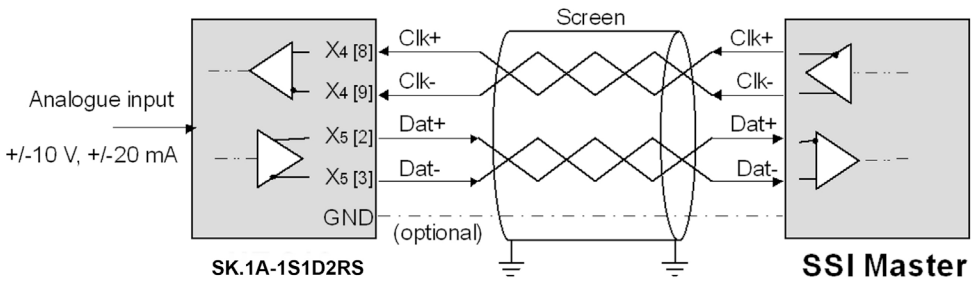
Principal of a control input circuit

Figure 4-2

4.3. The SSI Interface

A synchronous serial interface according to the industrial SSI standard is available on terminal strips **X4** and **X5**, for absolute signal transmission of positions or angles. In SSI operating mode the converter acts exactly like an SSI absolute encoder, i.e. it receives a clock signal from a remote Master via lines **X4 [8]** (Clk+) and **X4 [9]** (Clk-), and it sends the corresponding data via lines **X5 [2]** (Dat+) and **X5 [3]** (Dat-).

Please note that the unit will not provide any internal termination resistors. [b]



Connection of the SSI interface to a remote SSI Master (position controller, PLC or similar)

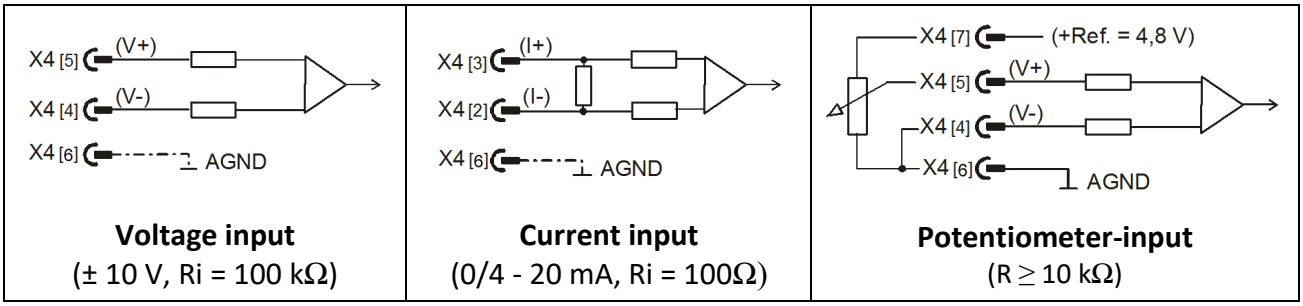
Figure 4-3

[a] See chapter 5.5

[b] For recommendations about screening and signal termination please refer to the document “General Rules for Wiring, Screening and Earthing” available under the Support section of our website.

4.4. Analogue Inputs

The differential inputs on the input side of the converter accept standard voltages (± 10 V), standard currents (0/4 - 20 mA) and also potentiometer connection. The drawings below explain the principle of the input circuits with each of the input connection modes. There should be a GND reference of the analog signal on at least one of the sides, otherwise the analog signal can float with respect to GND. To avoid this, V- or I- can then be connected to AGND, for example.



Voltage input (± 10 V, Ri = 100 kΩ)	**Current input** (0/4 - 20 mA, Ri = 100Ω)	**Potentiometer-input** (R ≥ 10 kΩ)

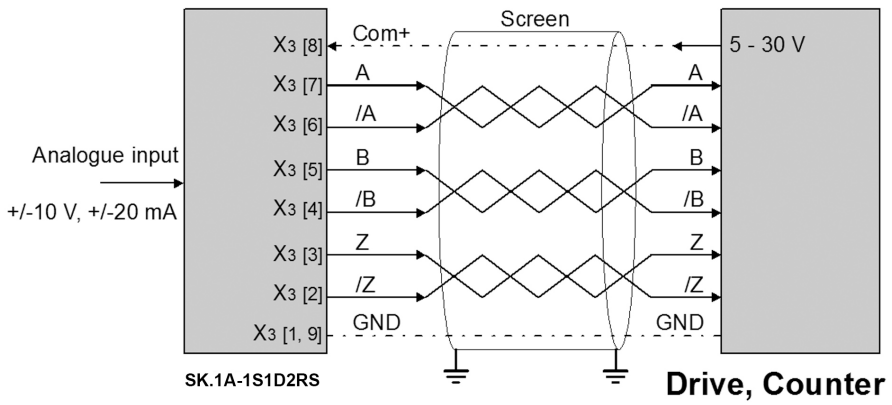
Figure 4-4

4.5. Incremental Outputs

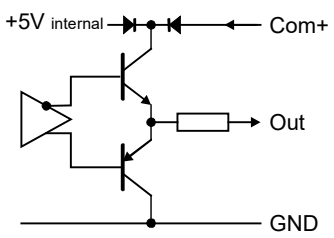
A complete set of incremental channels A, /A, B, /B, 0 and /0 is available for incremental representation of the analogue input signal. Inverted channels are for optional use and may remain unconnected if not needed (e.g. for transmission at a 24 volts impulse level with use of channels A and B only). Likewise also the marker pulse outputs 0 and /0 may remain open when the application does not provide zero pulse evaluation.

Dependent on the respective Mode of Operation of the converter the incremental output signals represent either a frequency proportional to the analogue input signal (i.e. straight analogue-to-frequency conversion), or a linear or angular position (i.e. for applications with analogue linear scales or analogue angular transducers).

All output lines are equipped with push-pull drivers (short-circuit-proof) and the output swing (signal level) results from the remote voltage applied to terminal **X3 [8].** Upon non-connection of this terminal the unit automatically generates a 4 volts TTL-compatible output.



Connection of the incremental output to a target unit *)
(e.g. drive, counter, position controller etc.)



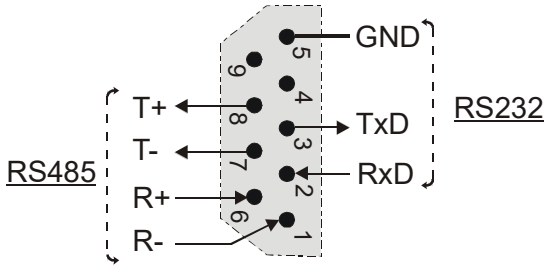
Output circuit
(principle)

Figure 4-5

*) For recommendations about screening and signal termination please refer to the document "General Rules for Wiring, Screening and Earthing" available under the Support section of our website.

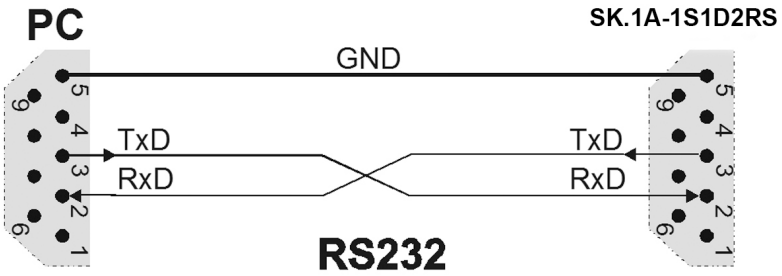
4.6. The Serial Interface

Both, a serial RS232 interface and a RS485 interface are available on the unit; however, the converter can only communicate by one or by the other interface, but not by both at a time. Serial communication allows readout of internal measuring and conversion results and is also required for setup and commissioning of the unit.via PC.



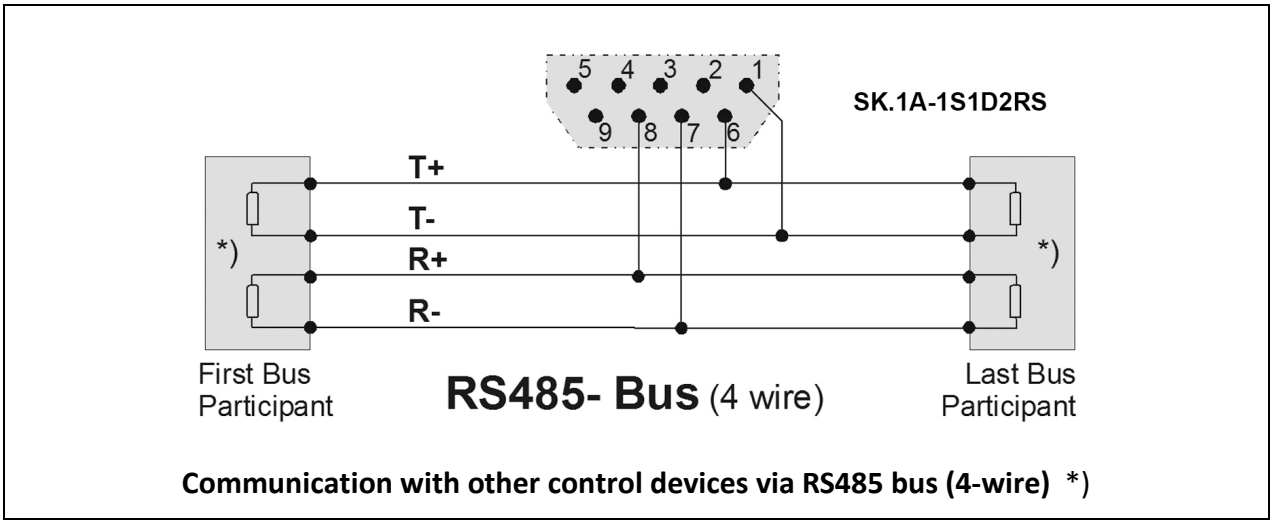
Pin assignment of the serial connector

Figure 4-6



Connection of a PC to the RS232 interface**)

Figure 4-7



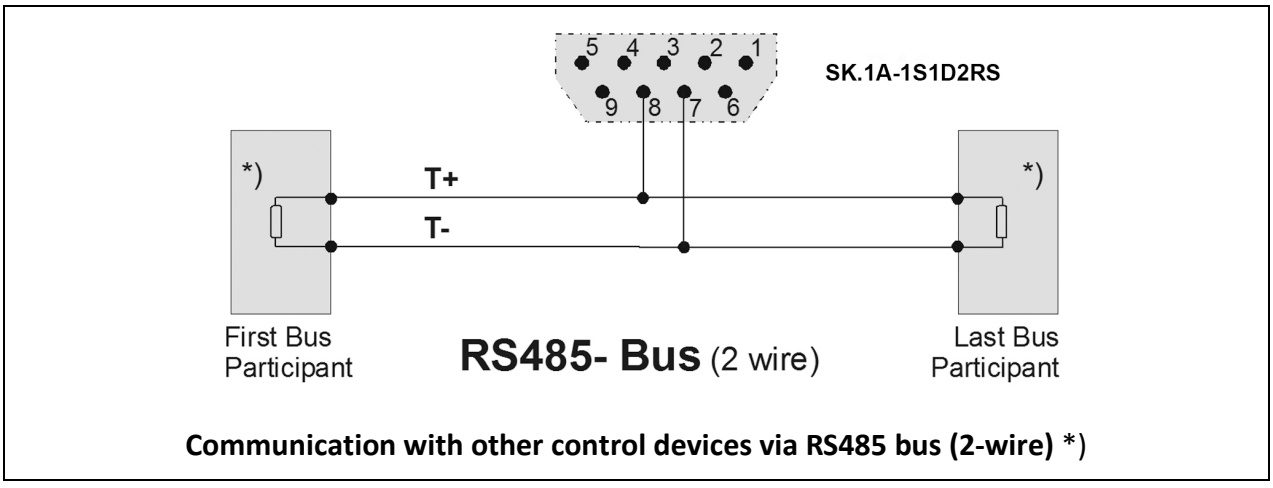
Communication with other control devices via RS485 bus (4-wire) *)

Figure 4-8

*) For recommendations about screening and signal termination please refer to the document "General Rules for Wiring, Screening and Earthing" available under the Support section of our website.

**) Please connect only pins 2, 3 and 5 as shown. Connection of the other pins (e.g. by using a fully occupied 9-conductor cable) will cause problems with communication.

Where both, RS232 and RS485 interface are in use, you can communicate by the one or by the other, but <u>not</u> by both interfaces at the same time.



Communication with other control devices via RS485 bus (2-wire) *)

Figure 4-9

*) For recommendations about screening and signal termination please refer to the document "General Rules for Wiring, Screening and Earthing" available under the Support section of our website

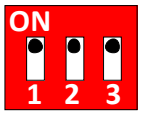
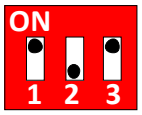
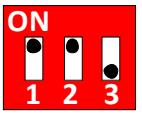
4.7. The USB Communication Port

For connection of the converter to a PC via USB a connection cable with “type A” connectors on both sides is required (A-A-cable, available in Electronic Shops or from Kuebler).

Special hints for operation of the USB port can be found in chapter 7.

4.8. The Front DIL Switch and the Front LEDs

The 3-pin DIL switch located on the front side provides the following settings:

		
Normal Operation For normal operation of the converter all positions of the switch must be ON at any time.	**Reload Default Settings** Upon next power-up all parameters will be overwritten by the factory default values.	**Programming-Mode** For factory use only, e.g.to download a new firmware version to the unit

DIL switch settings are read once upon power up of the unit only. It is therefore important to cycle the power supply after any change of DIL switch settings, in order to activate the corresponding function.

The green LED on the front indicates that DC power is applied to the unit. The yellow LED remains OFF first after powering the unit up, then turns on after initialization of the processor, to indicate that the converter is ready for operation.

5. Parameter Settings OSxx

For setting of parameters and commissioning a PC with Operator Software OSxx is required. Please connect your PC to the unit via USB cable (see 4.7 and 7) or by serial link (see 4.6). The link to the free download can be found on the homepage www.kuebler.com.
After starting the OSxx software the following screen will appear:

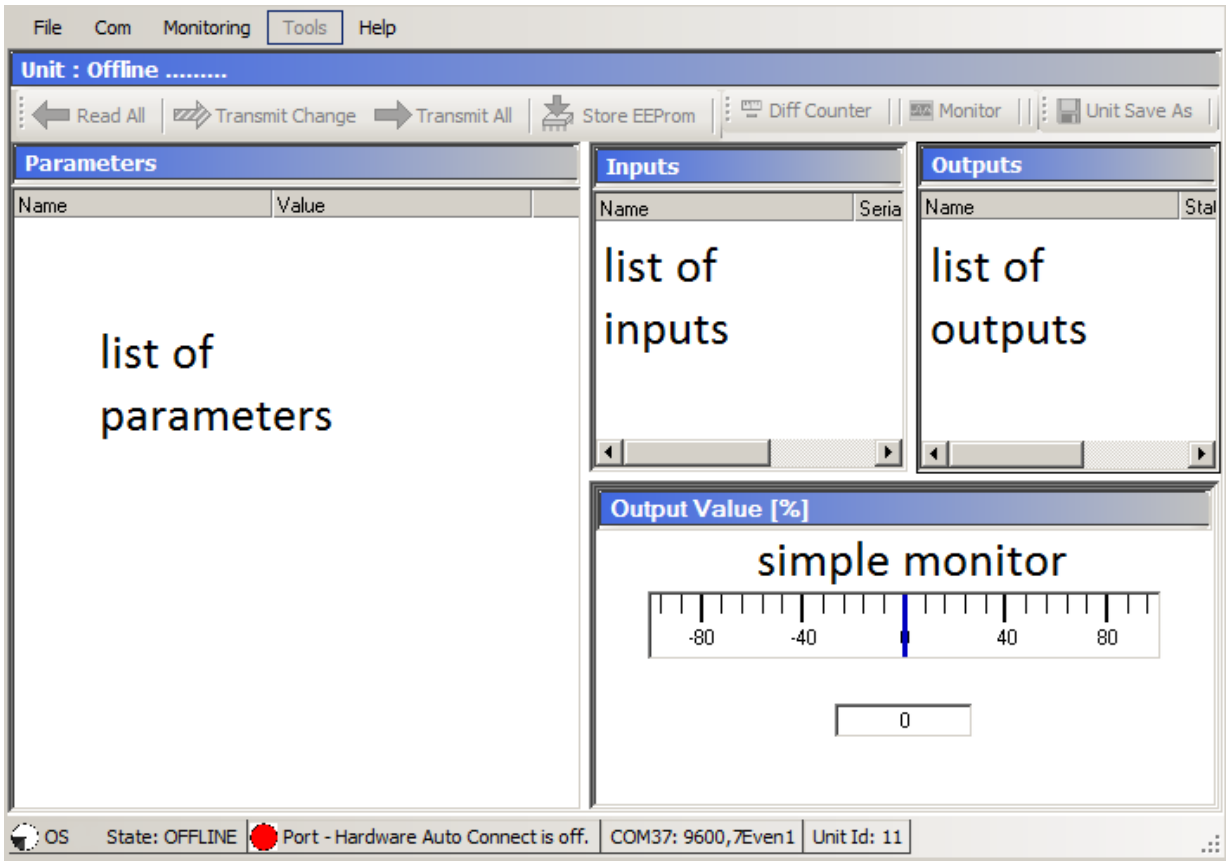


Figure 5-1

If "OFFLINE" is shown in the top line, please click on "Com" to adapt the serial setting of your PC to the converter.

The parameter field allows to read and to edit all unit parameters according to need. The subsequent parameter tables explain the function and setting of each parameter in detail.
The tables also inform about the factory default settings and the serial access codes of all parameters.

- **It is possible to operate both, the serial interface and the USB port simultaneously.**
- **Special hints for serial communication can be found in chapter 6.**
- **Special hints for USB communication and for simultaneous operation of both communication ports can be found in chapter 7.**

5.1. General Settings

No.	Parameter Description	Range	Default	Ser.
001	**Operational Mode:** **0:** Analogue input => Frequency (incremental output) **1:** Analogue input => Position (incremental output) [a] **2:** Analogue input => Position (incremental output) [a] **3:** Analogue input => Position (SSI interface)	0, 1, 2, 3	0	LECOM A0 MODBUS **L**00/(**H**02)
002	**Special Mode:** **0:** standard operation as a signal converter **1:** Function as „Motorized Potentiometer“ (frequency and position generator, keys „UP“ and „DOWN“) **2:** Repeat-Function (cyclic course of frequency or position curves)	0, 1, 2	0	LECOM A1 MODBUS **L**04/(**H**06)
003	**Linear Mode:** Programmable Linearization [b] **0:** Linearization OFF **1:** Linearization in the positive range only (negative input values appear as a mirror of positive values) **2:** Full range linearization of positive and negative inputs	0, 1, 2	0	LECOM A2 MODBUS **L**08/(**H**0A)
004	**0-Pulse:** Number of increments between 2 marker pulses When this parameter is set to a value “n”, the converter generates an index output pulse after every “n” encoder impulses	5 - 60 000	10	LECOM A3 MODBUS **L**0C/(**H**0E)
005	**HW-0-Reference:** Hardware Reference for marker pulse Parameter to define the function of control input [Cont1] **0:** Free function assignment to [Cont1] Parameter 032 [Input 1 Function] assigns the function to the control input [Cont1] **1:** a static HIGH signal on input [Cont1] will reset the marker pulse counter to zero (re-initialization) [c] **2:** a rising edge on input [Cont1] will reset the marker pulse counter to zero (re-initialization) [c] **3:** a falling edge on input [Cont1] will reset the marker pulse counter to zero (re-initialization) [c]	0, 1, 2, 3	0	LECOM A4 MODBUS **L**10/(**H**12)
006	**Time up:** Ramp time for UP commands (increase output with motorized potentiometer and repeat functions)	0,001 - 99,999 sec	1,000	LECOM A5 MODBUS **L**14/**H**16
007	**Time down:** Ramp time for DOWN commands (decrease output with motorized potentiometer and repeat functions)	0,001 - 99,999 sec	1,000	LECOM A6 MODBUS **L**18/**H**1A
008	**Reserved**, no function			
009	**Reserved**, no function			

[a] Mode 1 uses a fixed time raster of 100 µsec. causing a possible minimum output frequency of 10 kHz.
Mode 2 uses variable input sampling and therefore can also generate frequencies lower than 10 kHz with slow changes of the input position

[b] See chapter 5.8

[c] Input „Cont1“ is now reserved for this function only and no more available for other assignments, i.e. it is mandatory to set parameter [Input1 Function] to “0”.

5.2. Analogue Settings (Analogue Input)

No.	Parameter Description	Range	Default	Ser.
010	**Analogue Mode:** Input characteristics **0:** Input signal = voltage (±10 V) **1:** Input signal = current (0/4 - 20 mA)	0, 1	0	LECOM A9 MODBUS **L**24/(**H**26)
011	**Analogue Low Value:** Beginning of the analogue range	± 10 000 mV	-10 000	LECOM B0 MODBUS **L**28/**H**2A
012	**Analogue High Value:** End of the analogue range	± 10 000 mV	+10 000	LECOM B1 MODBUS **L**2C/**H**2E
013	**Analogue Set Value:** Preset value for the analogue input *)	± 10 000 mV	0	LECOM B2 MODBUS **L**30/**H**34
014	**Analogue Filter:** Filter function for the analogue input (used for smoothing of unstable analogue input signals) **00:** Filter OFF (immediate response) **01:**Filter LOW, fast response (T ca. 50 µsec) --- **05:**Filter MEDIUM. medium response (T ca. 800 µsec) --- **12:**Filter HIGH, very slow response (T ca. 100 msec)	0 - 12	0	LECOM B3 MODBUS **L**34/(**H**36)
015	**Analogue Slew Rate:** Limitation of the dynamic slope of analogue input signals to a maximum value according to setting	0 - 1,0000 V/µsec	0	LECOM B4 MODBUS **L**38/(**H**3A)
016	**Analogue Band:** Dead band for signal changes The output will only respond to changes of the analogue input if they are greater than the dead band setting	0 - 100 mV	0	LECOM B5 MODBUS **L**3C/(**H**3E)
017	**Analogue Polarity:** positive or negative frequencies **0:** The direction information A/B (90°) will change according to input signal and parameter setting **1:** All impulse outputs are in forward direction only (A always leading B), no reverse frequencies (This setting is not relevant with „Operational Mode = 3“, SSI)	0, 1	0	LECOM B6 MODBUS **L**40/(**H**42)
018	**Reserved**, no function			

5.3. SSI Setting (SSI Data Transmission)

No.	Parameter Description	Range	Default	Ser.
019	**SSI Low Value:** Beginning of the SSI output value where the analogue input equals to „Analogue Low Value“	Range	Default	Ser.
020	**SSI High Value:** End of the SSI output value where the analogue input equals to „Analogue High Value“	1 - 33554431 (25 Bit)	0	LECOM B8 MODBUS **L**48/**H**4A
021	**SSI Format:** Coding of the SSI signal **0:** Output data is Gray coded **1:** Output data is binary coded	1 - 33554431 (25 Bit)	8191 (13 Bit)	LECOM B9 MODBUS **L**4C/**H**4E
022	**SSI Baud Rate:** SSI transmission speed	0, 1	0	LECOM C0 MODBUS **L**50/(**H**52)
023	**SSI Bit:** Resolution, total length of one SSI telegram	0,001 - 1,000 MHz	0,100	LECOM C1 MODBUS **L**54/**H**56
024	**Reserved**, no function	10 - 25 Bit	25	LECOM C2 MODBUS **L**58/(**H**5A)

*) see parameter no. 032 [Input1 Function]

5.4. Encoder Setting (Incremental Output)

No.	Parameter Description	Range	Default	Ser.
025	**POS Low Value:** Beginning of the position count where the analogue input equals to „Analogue Low Value“	±100 000 000 (increments)	0	LECOM C4 MODBUS **L**60/**H**62
026	**POS High Value:** End of the position count where the analogue input equals to „Analogue High Value“	±100 000 000 (increments)	10 000	LECOM C5 MODBUS **L**64/**H**66
027	**FRE Low Value:** Start value of the frequency where the analogue input equals to „Analogue Low Value“	± 1 000 000.00 (Hz)	-1000.00	LECOM C6 MODBUS **L**68/**H**68
028	**FRE High Value:** End value of the frequency where the analogue input equals to „Analogue High Value“	± 1 000 000.00 (Hz)	+1000.00	LECOM C7 MODBUS **L**6C/**H**6E
029	**Reserved**, no function			
030	**Reserved**, no function			

5.5. Command Setting (Control Inputs)

No.	Parameter Description	Range	Default	Ser.
031	**Input 1 Config:** Switching characteristics of input „Cont1“ **0:** Function active with static LOW level **1:** Function active with static HIGH level	0, 1	0	LECOM D0 MODBUS **L**78/(**H**7A)
032	**Input 1 Function:** Function of input „Cont 1“ **0: no function assigned** **1: Function „Set“**. Forces the analogue input temporary to the fixed value according to the setting of [Analogue Set Value] (see parameter no. 013) **2: Function „Inhibit“.** Disables temporary all changing at the analog input and freeze the last value **3: Function „DOWN“.** Down-function (decrease value) with motorized potentiometer applications **4: Funktion „UP“.** Up-function (increase value) with motorized potentiometer applications **5: Function „Z-Reference“.** Assigns a static Reset function for the marker impulse counter *) **6: Function „Print“.** The input will trigger a serial transmission of the specified measuring value.	0 - 6	0	LECOM D1 MODBUS **L**7C/(**H**7E)
033	**Input 2 Config:** see „Input 1 Config“	0, 1	0	LECOM D2 MODBUS **L**80/(**H**82)
034	**Input 2 Function:** see „Input 1 Function“	0 - 6	0	LECOM D3 MODBUS **L**84/(**H**86)

035	**Input 3 Config:**	see „Input 1 Config“	0, 1	0	LECOM D4 MODBUS **L**8C/(**H**8A)
036	**Input 3 Function:**	see „Input 1 Function“	0 - 6	0	LECOM D5 MODBUS **L**90/(**H**92)
037	**Input 4 Config:**	see „Input 1 Config“	0, 1	0	LECOM D6 MODBUS **L**94/(**H**96)
038	**Input 4 Function:**	see „Input 1 Function“	0 - 6	0	LECOM D7 MODBUS **L**98/(**H**98)
039	**Reserved**, no function				
040	**Reserved**, no function				

*) Function only suitable for slow and purely static Reset (e.g. for index referencing in standstill). For dynamic requirements please refer to parameter 005 [HW-0-Reference].

5.6. Serial Setting (RS232/RS485 Interface)

No.	Parameter Description	Range	Default	Ser.
041	**Unit Number** (serial device address)	11 … 99	11	LECOM 90 MODBUS **L**A4/(**H**A6)
042	**Serial Baud Rate** (communication speed) (only for LECOM, do not describe for MODBUS) **0 =** 9600 Bauds **1 =** 4800 Bauds **2 =** 2400 Bauds **3 =** 1200 Bauds **4 =** 600 Bauds **5 =** 19 200 Bauds **6 =** 38 400 Bauds **7=** 56 000 Bauds **8=** 57 600 Bauds **9=** 76 800 Bauds **10=** 115 200 Bauds	0 - 10	0	LECOM 91
043	**Serial Format** (byte format of serial data) (only for LECOM, do not describe for MODBUS) **0 =** 7 Data, Parity even, 1 Stop **1 =** 7 Data, Parity even, 2 Stop **2 =** 7 Data, Parity odd, 1 Stop **3 =** 7 Data, Parity odd, 2 Stop **4 =** 7 Data, no Parity, 1 Stop **5 =** 7 Data, no Parity, 2 Stop **6 =** 8 Data, Parity even, 1 Stop **7 =** 8 Data, Parity odd, 1 Stop **8 =** 8 Data, no Parity, 1 Stop **9 =** 8 Data, no Parity, 2 Stop	0 … 9	0	LECOM 92
044	**Serial Protocol** (transmit protocol with Printer-Mode *) **0 =** Transmission = Unit No. – Data, LF, CR **1 =** Transmission = Data, LF, CR	0 … 1	0	LECOM E0
045	**Serial Timer** (setting for timed transmissions (sec.) *)	0.000 … 9.999	0	LECOM E1 MODBUS **L**B4/(**H**B6)
046	**Register Code** (serial register code of the transmit value *)	0 … 19	16	LECOM E2 MODBUS **L**B8/(**H**BA)
047	**Serial Mode** (Protocol selection) 0 = LECOM Protocol 1 = MODBUS RTU,8 Daten, Parity Even, 1 Stop 2 = MODBUS RTU,8 Daten, Parity Odd, 1 Stop 3 = MODBUS RTU,8 Daten, No Parity, 2 Stop	0 … 3	0	LECOM E3 MODBUS **L**BC/(**H**BE)
048	**MB Address** (MODBUS Adresse)	1 … 247	1	LECOM E4 MODBUS **L**C0/(**H**C2)
049	**Reserved**, no function			

*) More information about serial operation of the unit can be found in chapter 6.

5.7. Linearization Setting

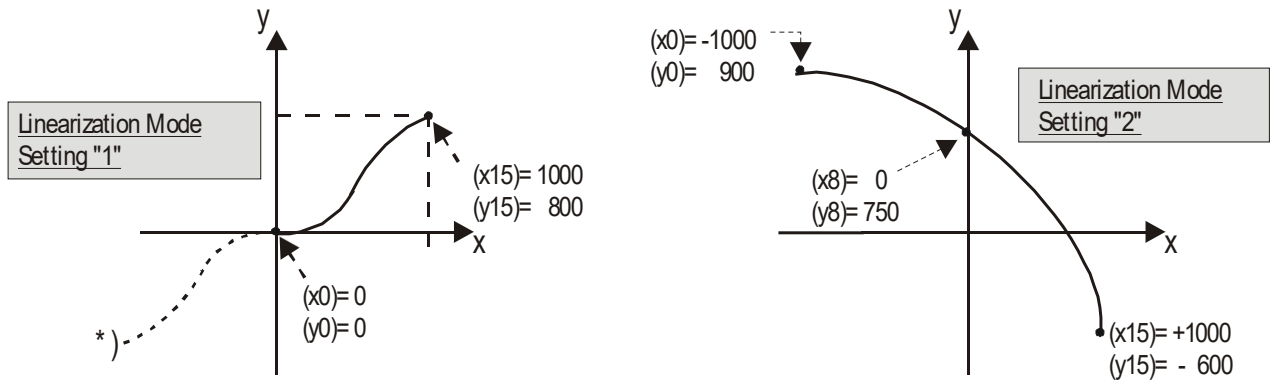
No.	Linearization Table	Range	Default	Ser.
050	First interpolation point (x0, original value)	-10 000 … +10 000	0	MODBUS **L**C8/**H**CA
051	First interpolation point (y0 as substitution for x0)			…
052	Second interpolation point (x1, original value)			…
053	Second interpolation point (y1 as substitution for x1)			…
	etc. ---->			…
080	Last interpolation point (x15, original value)			LECOM H7 MODBUS **L**144/**H**146
081	Last interpolation point (y15 as substitution for x15)			MODBUS **L**C8/**H**CA

5.8. MB-CRC-Calculator

No.	Parameter	Range	Default	Ser.
082	**MB CRC Reset**: Reset of the CRC Calulator. If MB CRC Reset = 0 is set, the CRC Calculator in the monitor field (variable <7) is set to XXXXFFFF. If MB CRC Reset = 1 is set, the CRC value is recalculated with every MB byte.	0…1	0	LECOM 00 MODBUS **L**148/(**H**14A)
083	**MB CRC Byte:** CRC Calc. via input bytes Into this memory cell the MB bytes can be transferred one after the other and then the CRC checksum can be read out in the monitor field (variable <7). For the MB command 0x07 0x11 the checksum is to be determined. - MB CRC Reset = 0, MB Byte = 7dec + Transmit change -> Variable <7 = 0xXXXX FFFF (Reset) - MB CRC Reset = 1, MB Byte = 7dec + Transmit change -> Variable <7 = 0xXXXX 82FE - MB Byte = 17dec + Transmit change -> Variable <7 = 0xXXXX 8CC3 Now the command can be composed -> 07 11 C3 8C Note that with MODBUS the LByte is sent first and then the HByte for the CRC, therefore it must be swapped.	0 … 255	0	LECOM 01 MODBUS **L**14C/(**H**14E)
084	**Reserve**, Without function			

5.9. Hints for Use of the Linearization Function

The drawings below explain the difference between the settings
„Linear Mode“ = 1 and „Linear Mode“ = 2:



- **The x-values are to determine which originally measured input value should be substituted by another value**
- **The corresponding y value defines a new value for replacement of the previous x value** (e.g. the value x3 will be modified into y3)
- **Values between two interpolation points will be reproduced by straight lines (linear interpolation)**
- **x-registers must use continuously increasing settings, i.e. P0(x) must have the lowest and P15(x) must have the highest setting**
- **Independent of all other settings the acceptable range for x values and y values is always from -10 000 to +10 000.**
- **For measuring values outside of the defined linearization range, please note:**
  - if a measuring value is lower than x0, the linearization result will always be y0.
  - if a measuring value is higher than x15, the linearization result will always be y15.

Figure 5-2

6. Hints for Serial Communication

Serial communication is intended to be used for

- **Setup and programming of the unit by PC with operator software OSxx**
- **Automatic and cyclic transmission of converter data to a PC or PLC or data logger (Printer Mode)**
- **Communication via communication protocol LECOM**
- **Communication via communication protocol MODBUS**

This chapter describes the most essential communication functions only.

6.1. Automatic and Cyclic Data Transmission

Set any cycle time unequal to zero to parameter [Serial Timer]. Set the serial access code of the register you would like to transmit to parameter [Register Code]. In theory you could transmit any of all available internal register values by serial link, however in the current case only the following register makes really sense:

Parameter „Register Code“	Code internal	Value for transmission
16	**LECOM ; 6**	Analogue input value, scaled in mV
16	**MODBUS L1064**	Analogue input value, scaled in mV

Depending on the setting of parameter [Serial Protocol] the unit transmits one of the following two strings (xxxx = Converter Data, LF = Line Feed [hex. 0A], CR = Carriage Return [hex 0D])
(Leading zeros will not be transmitted)

	(Unit No.)										
Serial Protocol = 0 :	**1**	**1**	**+/-**	**X**	**X**	**X**	**X**	**X**	**X**	**LF**	**CR**
Serial Protocol = 1 :			**+/-**	**X**	**X**	**X**	**X**	**X**	**X**	**LF**	**CR**

6.2. Communication Protocol LECOM

When communicating with the unit via LECOM protocol, you have full read/write access to all internal parameters, states and actual values. The LECOM protocol uses the DRIVECOM standard according to DIN ISO 1745. The serial access codes of all parameters can be found in the parameter description (see chapter 5).

To request data from the unit, the following request string must be sent:

EOT		**AD1**	**AD2**	**C1**	**C2**	**ENQ**
EOT = control character (Hex 04) AD1 = unit address, High Byte AD2 = unit address, Low Byte C1 = register code to read, High Byte C2 = register code to read, Low Byte ENQ = control character (Hex 05)						

The table below shows how to request the actual analogue input data (register code ;6) from a converter with the serial unit number 11:

ASCII-Code:	EOT	1	1	;	6	ENQ
Hexadecimal:	04	31	31	3B	36	05
Binary:	0000 0100	0011 0001	0011 0001	0011 1011	0011 0100	0000 0101

Upon correct receipt of the request string the unit will respond:

STX	C1	C2	x x x x x x	ETX	BCC
STX = control character (Hex 02) C1 = register code to read, High Byte C2 = register code to read, Low Byte xxxxx = data (measuring value) ETX = control character (Hex 03) BCC = block check character					

Leading zeros will not be transmitted. The block check character BCC is composed by an EXCLUSIVE-OR function of all characters from C1 up to and including ETX.

To write parameter data to the unit the following data string must be sent:

EOT	AD1	AD2	STX	C1	C2	x x x x x x	ETX	BCC
EOT = control character (Hex 04) AD1 = unit address, High Byte AD2 = unit address, Low Byte STX = control character (Hex 02) C1 = register code to write data, High Byte C2 = register code to write data, Low Byte xxxxx = data, new parameter value ETX = control character (Hex 03) BCC = Block check character								

Upon correct receipt the unit will respond by ACK, otherwise by NAK.
Every new parameter sent will first wait in a buffer memory, without affecting the function. This feature enables the user, during normal converter operation, to prepare a complete new parameter set in the background.
To activate transmitted parameters you must write the numeric value “1” to the [Activate Data] register. This immediately activates all changed settings at the same time.
Where you like the new parameters to remain valid also after the next power up of the unit, you still have to write the numeric value “1” to the [Store EEProm] register. This will store all new data to the EEProm of the unit. Otherwise, after power down the unit would return with the previous parameter settings.

Function	**Code**
Activate Data	67
Store EEProm	68

Both commands provide dynamic operation, i.e. it is enough to just send "1" to the corresponding location. After execution the command will reset to zero automatically.

Example: send [Activate Data] to the converter with unit number 11:

ASCII	EOT	1	1	STX	6	7	1	ETX	BCC
Hex	04	31	31	02	36	37	31	03	33

6.3. MODBUS communication protocol

If you communicate with the device via the MODBUS protocol, you have full read and write access to all internal parameters, states and actual values. The counter uses the MODBUS RTU protocol. The serial access codes for all parameters of the device are given in the parameter descriptions in section 5. With the help of the USB access the parameter Serial Mode can be changed from LECOM to MODBUS. The Serial Baud Rate parameter refers to both protocols. The parameter MB Address can be used to set the MODBUS device address. The settings 1..247 are permitted here. Attention: For MODBUS the checksum sequence L/H is thus just the opposite of the data.

The SK.1A-1S1D2RS supports the Reading Holding Register function (R, FCT = 03), the Report Slave ID function (R, FCT = 11) and the Preset Single Register function (W, FCT = 06).

To request data from the device, the following request string must be sent:

ADR	**FCT**	**STH**	**STL**	**CRH**	**CRL**	**CRCL**	**CRCH**
	ADR = MB address (parameter) FCT = function (Hex 03) STH = start address, High Byte STL = start address, Low Byte CRH = number of registers High Byte CRL = number of registers, Low Byte CRCL = checksum CRC16, Low Byte CRCH = checksum CRC16, High Byte						

For example, if the parameter Z-Pulse (MODBUS ST = 00 0C (hex), 32 Bit = 2 Word -> MODBUS CR = 00 02) is to be read out from a device with device address 07, the detailed request string is as follows:

Designation:	ADR	FCT	STH	STL	CRH	CRL	CRCL	CRCH
Hexadecimal:	07	03	00	0C	00	02	04	6E
Binary:	0000 0111	0000 0011	0000 0000	0000 1100	0000 0000	0000 0010	0000 0100	0110 1110

If the request is correct, the response of the device is:

ADR	FCT	CB	DATA	CRCL	CRCH
ADR = MB address (parameter) FCT = function (Hex 03) CB = number of bytes, here 4 Bytes DATA = data, 4 bytes (32 Bit) CRCx = check sum CRC16					

Designation:	ADR	FCT	CB	DATA	CRCL	CRCH
Hexadecimal:	07	03	04	00 00 00 0A	1C	34
Binary:	0000 0111	0000 0011	0000 0100		0001 1100	0011 0100

The read data corresponds to a setting value of the parameter Z pulse of 10.

- The Reading Holding Registers function supports 2 word (32-bit) accesses to the direct parameter addresses (0x0, 0x4, 0x8, 0xC..).
- The Reading Holding Register function also supports more than 2 word accesses to the direct parameter addresses (0x0, 0x4, 0x8, 0xC..) for range readout.

To describe a parameter, the following string must be sent:

ADR	**FCT**	**REH**	**REL**	**DAH**	**DAL**	**CRCL**	**CRCH**
	ADR = MB address (parameter) FCT = function (Hex 06) REH = register address, High Byte REL = register address, Low Byte DAH = data High Byte DAL = data Low Byte CRCL = check sum CRC16, Low Byte CRCH = check sum CRC16, High Byte						

For example, if the parameter SSI High Value (MODBUS ST = 00 4E, 004C (hex), MODBUS DA = 00 04, 00 02) is to be written in a device with device address 07, then the detailed request string for the High Word Register is:

Designation:	ADR	FCT	REH	REL	DAH	DAL	CRCL	CRCH
Hexadecimal:	07	06	00	4E	00	04	E8	78
Binary:	0000 0111	0000 0011	0000 0000	0100 1110	0000 0000	0000 0100	1110 1000	0111 1000

If the request is correct, the response of the device is:

ADR	FCT	REG	DATA	CRCL	CRCH
ADR = MB address (parameter) FCT = function (Hex 06) REG = register adress DATA = data CRCx = check sum CRC16					

Designation:	ADR	FCT	REG	DATA	CRCL	CRCH
Hexadecimal:	07	06	00 4E	00 04	E8	78
Binary:	0000 0111	0000 0110			1110 1000	0111 1000

String for writing the low word register:

Designation:	ADR	FCT	REH	REL	DAH	DAL	CRCL	CRCH
Hexadecimal:	07	06	00	4C	00	02	C9	BA
Binary:	0000 0111	0000 0011	0000 0000	0100 0110	0000 0000	0000 0010	0110 1001	1011 1010

The written data corresponds to a setting value of the parameter SSI High Value of 262146. (00 04 00 02 hex). The newly sent parameter is first temporarily stored in the device without affecting the function. Thus it is possible to prepare several new parameters in the background while the device function is running.

If the transmitted parameters are to be activated, an "Activate Data" must be sent to the device. If the transmitted parameters are to be activated, an "Activate Data" must be sent to the device. This activates all changed parameters at the same time.

To execute an "Activate Data", the following string must be sent:

Designation:	ADR	FCT	REH	REL	DAH	DAL	CRCL	CRCH
Hexadecimal:	07	06	FF	FE	00	01	19	88
Binary:	0000 0111	0000 0011	1111 1111	1111 1110	0000 0000	0000 0001	0001 1001	1000 1000

It is important to ensure, that a range violation of the parameter results in it not being transferred to the buffer. The permissible parameter ranges can be taken from the parameter description and are defined for the parameter SSI High Value from 1 to 33554431.

If the new parameters are to remain permanently stored even after the power supply is switched off, a "Store EEProm" must also be sent to the device. Thus all new data are also stored in the EEProm of the device. Otherwise, the device returns to the original parameter set after a new switch-on.

To execute a "Store EEProm", the following string must be sent:

Designation:	ADR	FCT	REH	REL	DAH	DAL	CRCL	CRCH
Hexadecimal:	07	06	FF	FE	00	02	34	49
Binary:	0000 0111	0000 0011	1111 1111	1111 1110	0000 0000	0000 0010	0011 0100	0100 1001

For negative parameter values such as -10000, the value must be divided into two 16-bit values and transmitted with two write accesses. (-10000 dec = FFFF D8F0 hex).
An ID can be requested to identify the device:

To request an ID, the following string must be sent:

Designation:	ADR	FCT	CRCL	CRCH
Hexadecimal:	07	11	C3	8C
Binary:	0000 0111	0001 0001	1100 0011	1000 1100

If the request is correct, the response of the device is:

Designation:	ADR	FCT	BYTE	RUN	DATA	CRCL	CRCH
Hexadecimal:	07	11	12	FF	83 75 46 49 65 45 49 83 49 68 50 82 83	E4	D7
Binary:	0000 0111	0001 0000	0001 0020	1111 1111		1110 0100	1101 0111

83 75 46 49 65 45 49 83 49 68 50 82 83 corresponds in ASCII format : SK.1A-1S1D2RS
Here the unit header, which is also visible in the OS, is shown. It identifies the device (SK.1A-1S1D2RS) with software version (03A), as well as the special number if available.

Division of the memory range:

Memory address (dec)	MODBUS-FCT	R-Access	Read / Write	Note
0…335 0…332 (32 Bit)	03 (R) 06 (W)	2-124 Words 1 Word	R/W	Parameter range
1000..1127 1000..1124 (32 Bit)	03 (R)	2-64 Words	Read only	Variable range
FFFE (hex, 16 Bit)	06 (W)	1 Word	Write only	Command range

7. Hints for Operation of the USB Port

The following notes only apply to the Windows 7.0, 8.0 and 8.1 operating systems.
Windows 10 automatically detects the USB interface of the device.

Before using the USB interface, the OSxx software must be installed on the PC. The software is available for download on the "Support" page of the Kübler website www.kuebler.com.

- When two OS Operator Software programs are running at the same time (one via USB and the other via serial), the indicator box **Dual OS** of the **OUTPUTS** column will be ON
  (this indication responds with a short delay).
- In the **Inputs** field both columns, **Serial** and **Bus** will now be active**.**
  Column **Serial** indicates all commands released by the PC actually in use, and column **Bus** indicates all commands released by the other (remote) OS Software. At any time column **Extern** indicates the switching state of the hardware command inputs of the unit.
- It is possible to disable parameter settings and changes coming from the other (remote) OS software. This can be achieved by setting the command **Overwrite Buffer** to ON. When switched ON, the commands „Activate Data“ and „Store EEProm“ of the second communication channel will be suppressed. This is to ensure that parameter settings can happen only by the PC currently used, and no undesirable modifications will get in from the other (remote) communication port.
- **Whenever two PC's run the OS software simultaneously, it is important to never enter the Test menu from any of the two sides.**

Open the device manager: Start ➔Control Panel ➔ Device Manager

Connect the device. Depending on the current configuration of the operation system a submenu “**Other devices**” is added.
If the operation system tries to download the device driver software via windows update, abort this by clicking ”Skip optaining driver software from Windows Update”.

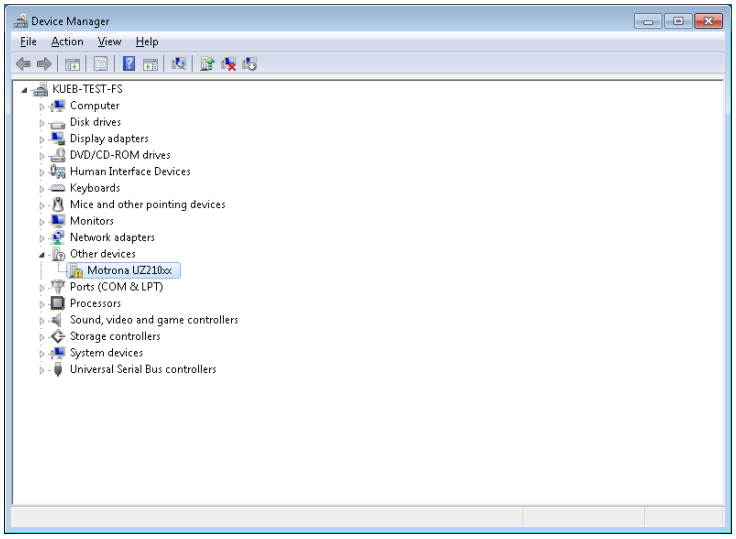


Figure 7-1 Driver installation: device manager

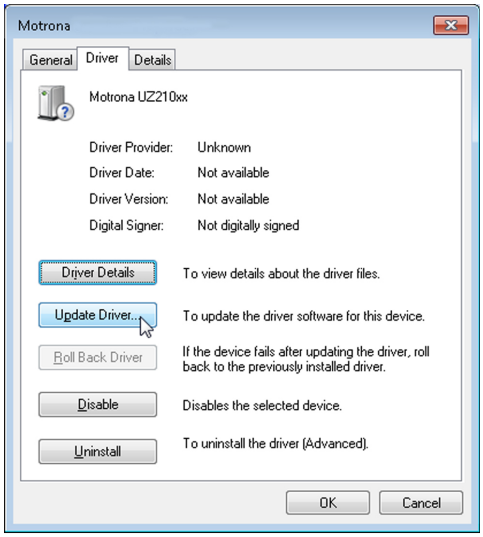


Figure 7-2 Driver installation Pop-up "Update Driver Software…"

Then select "**Browse my computer for driver software"** in the windows dialog "Update Driver Software".

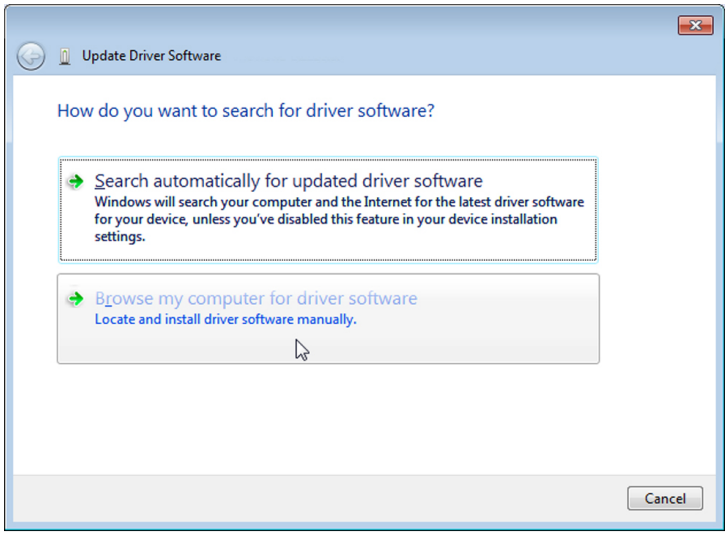


Figure 7-3 Selection window " Browse my computer for driver software"

Select the path where the drivers are installed. The drivers are located under the installation path of the OSxx. This is: "…\Osxx\Data\Drivers". Select: "Next"

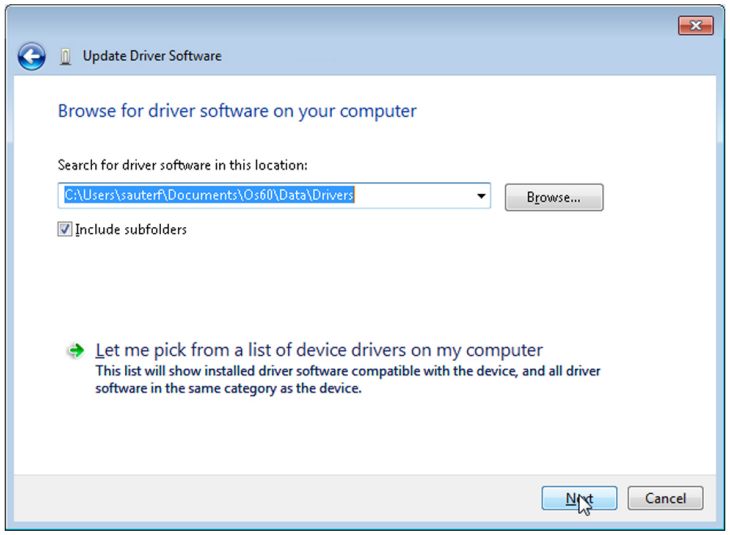


Figure 7-4 Update driver software

A new window "**Windows Security**" appears.

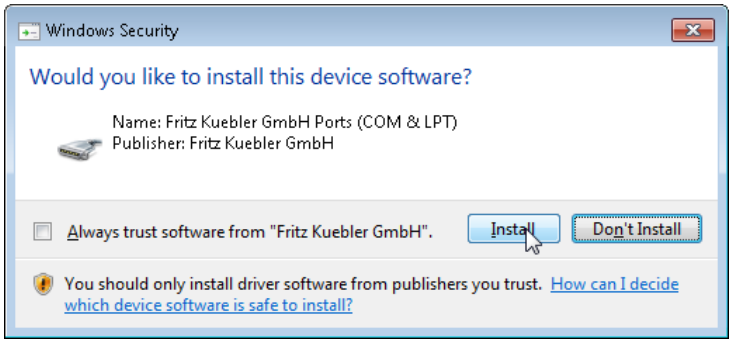


Figure 7-5 Driver Installation: Security Message

Clicking on "**Install**" starts the installation.

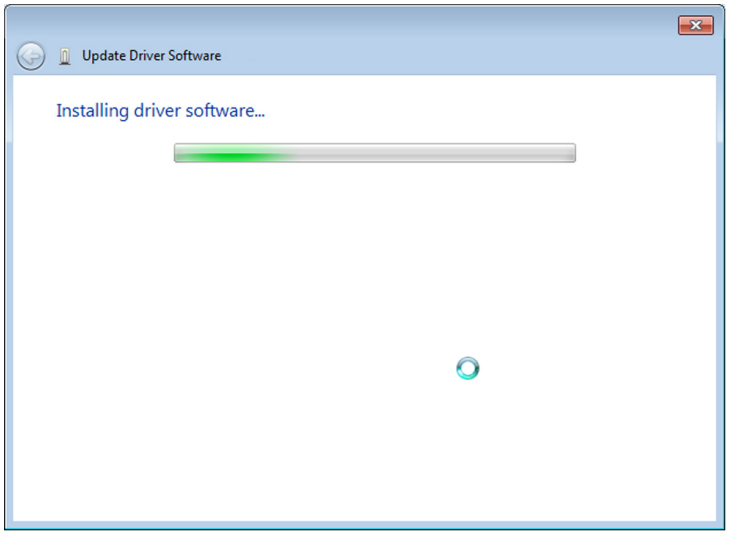


Figure 7-6 Driver installation: Update driver software

When the installation of the device driver is completed, click the “**Close**” button to finish the installation procedure.

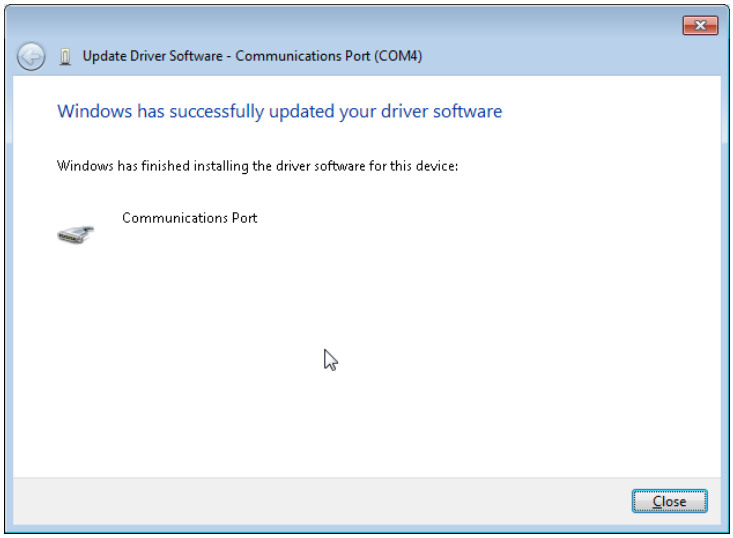


Figure 7-7 Driver installation: Installation completed

8. Technical Specifications

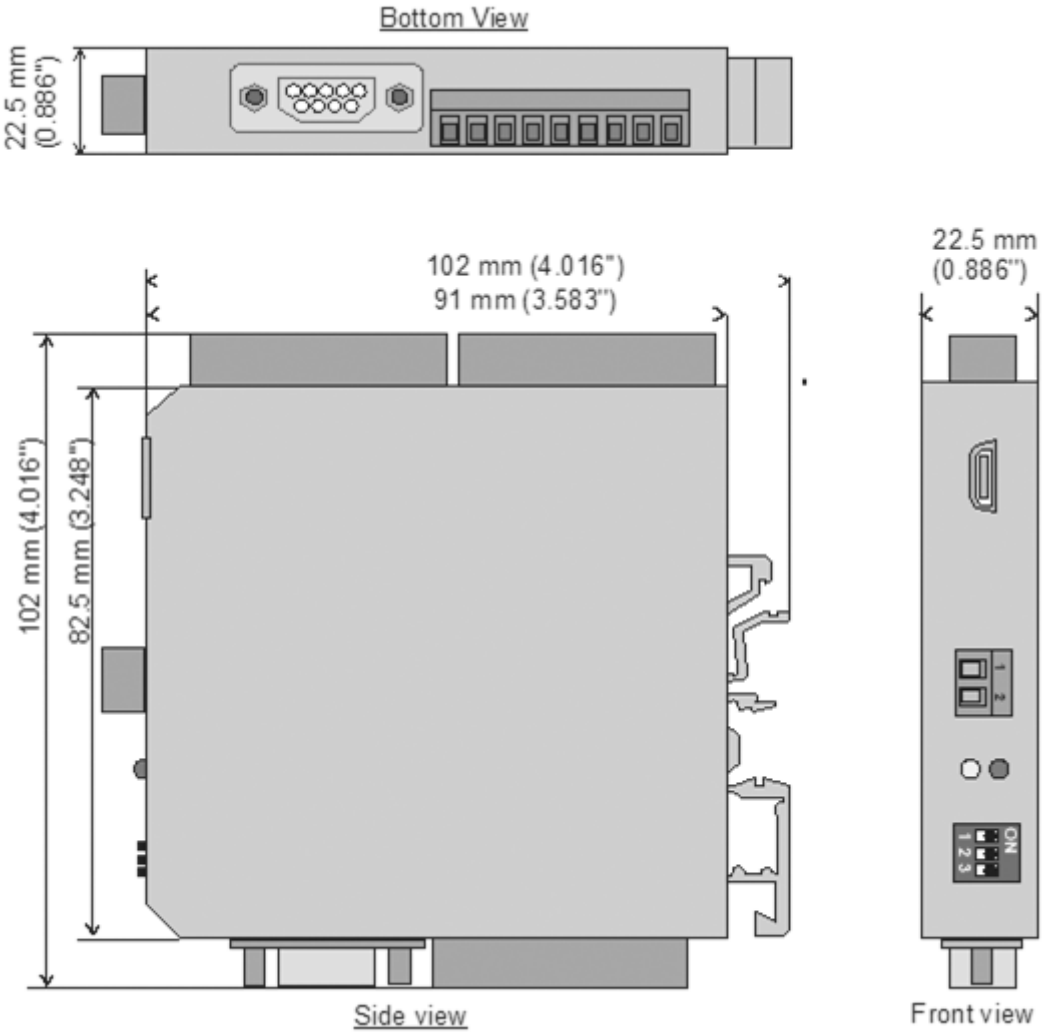
Power supply:	Input voltage:	12 … 30 VDC
	Protection circuit:	reverse polarity protection
	Ripple:	≤ 10 % at 24 VDC
	Consumption:	approx. 50 mA (unloaded)
	Connections:	screw terminal, 1.5 mm² / AWG 16
Analog input:	Voltage input:	-10 … +10 V / 0 … 10 V
	Internal resistance:	Ri ≈ 120 kOhm
	Current input:	0 … 20 mA / 4 … 20 mA
	Internal resistance:	Ri ≈ 100 Ohm
	Resolution:	14 bit (± 13 bit)
	Accuracy:	0.1 %
	Update-time:	100 µs (in accordance to 10000 measuring values per
	max. Input frequency:	second)
	VREF for external potentiometer:	1 kHz (with 10 sampling points)
	Internal VREF resistance:	approx. 4.8 V (+/- 0.1%)
	Connections:	Ri ≈ 240 Ohm
		screw terminal, 1.5 mm² / AWG 16
Control inputs:	Number of inputs:	4
	Characteristic:	PNP, active high
	Signal levels:	HTL: LOW = 0 … 3 V, HIGH = 10 … 30 V
	Internal resistance:	Ri ≈ 1.5 kOhm
	Input current:	approx. 2 mA
	Minimum pulse time:	1 msec (5 µs at Cont.1 when [HW-0-Reference] ≠ 0)
	Connections:	screw terminal, 1.5 mm² / AWG 16
Incremental output:	Signal levels:	HTL: 5 … 30 V (depends from the external supply)
		or TTL / RS422: 4 V (no external supply necessary)
	Channels:	A, /A, B, /B, 0, /0
	Frequency range:	0.01 Hz … 1 MHz
	Output current:	max. 30 mA (per channel)
	Output circuit:	push-pull
	Reaction time:	< 260 µs
	Fastest position change possibility:	1 increment / µs
	Protection circuit:	short circuit proof
	Connections:	screw terminal, 1.5 mm² / AWG 16
SSI interface:	Function:	simulates an SSI absolute encoder
	Standard:	according to the SSI standard, 10 … 25 bit, binary or Gray
		(supports only single transmission but not multiple-
	Clock (input):	transmission)
	Data (output):	TTL-differential / RS485 [Clk+], [Clk-]
	Termination resistors:	TTL-differential / RS485 [Dat+], [Dat-]
	SSI baud rate:	internally not provided
	Connections:	max. 1 MHz
		screw terminal, 1.5 mm² / AWG 16
Serial interface:	Format:	RS232 or RS485 (2- or 4-wire)
	Baud rates:	600, 1200, 2400, 9600 (Default), 19200,
		38400, 56000, 57600, 76800 and 115200
	Connections:	SUB-D connector (female), 9-pin
USB interface:	Version:	USB 2.0
	Driver:	kuebler_vcom.inf (download on www.kuebler.com)
	Connections:	by USB-Port, connector type „A

Continuation "Technical Specifications"

Housing:	Material: Mounting: Dimensions (w x h x d): Protection class: Weight:	plastic 35 mm top hat rail (according to EN 60715) 22.5 x 102 x 102 mm IP20 approx. 100 g
Temperature range:	Operation: Storage:	0 °C … +45 °C / +32 … +113 °F (not condensing) -25 °C … +70 °C / -13 … +158 °F (not condensing)
Conformity & standards:	EMC 2014/30/EU: RoHS (II) 2011/65/EU RoHS (III) 2015/863:	EN 61326-1: 2013 for industrial location EN 55011: 2017 / CISPR11: 2017 Class A EN IEC 63000: 2018

9. Dimensions

Dimensions in mm [inch]



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