R60711.0002

Manual

Sendix 7058 / 7078 / 7158 / 7178
Absolute Singleturn Encoder

Sendix 7068 / 7088 / 7168 / 7188
Absolute Multiturn Encoder

pulses for automation

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List of abbreviations

Abbreviation	Term
SSA	Set Slave Address
CW	Clockwise
CCW	Counter clockwise
PNO	ProfiNet Nutzer Organisation

1. Technical details and characteristics

1.1 PROFIBUS-DP basics

This description provides information concerning the implementation of the PROFIBUS-DP transmission protocol in the slave mode in our devices. It should be noted that the extent of the functions described might be limited according to the device or application. With protocol conversions in particular, as a rule fewer functions are used!

1.2 The profile required

The link between the decentralized process operation and the central control via the communication system takes place in the lowest hierarchy level on the filed or process bus. At this level, the main requirements are a simple protocol operation and short data transmission times for the communication. This ensures the fastest system reaction time to the dynamic states of the peripherals. In addition to the classic data exchange, the acyclic transmission of parameter, diagnostic and configuration data must be possible, without radically impeding the real-time capability of the bus. This is the only way to guarantee the achievement of good diagnostics and safe operation.

1.3 Characteristics

The main task of PROFIBUS-DP is the cyclic transmission of the process data from the control system to the peripheral equipment and vice versa. The access procedure uses the Master-Slave principle. Here in the polling operation a Master communicates with its assigned slave devices one after the other on the bus. A data exchange is initiated by a request telegram and ended by an acknowledgement telegram from the Slave concerned. So, each Slave only becomes active after a call from the Master. This avoids a simultaneous bus access. The hybrid access procedure of PROFIBUS allows a combined operation of several bus masters and even a mixed operation of PROFIBUS-DP and PROFIBUS-FMS within a bus section. However the pre-requisition for this is the correct configuration of the bus system and the unambiguous assignment of the Slave devices to the Masters. PROFIBUS-DP distinguishes two types of Master. The Class 1 Master carries out the cyclic transmission of the operating data and supplies the user data. The Class 1 Master can be addressed by a Class 2 Master using certain functions.

NOTICE	**Direct access to the Slaves is not permitted.** The functions are limited to support services such as reading the diagnostic information of the slaves. A Class 2 Master is thus also understood as a programming or diagnostic device

1.4 Protective functions

PROFIBUS-DP is equipped with many protective functions. These ensure safe fault-free communication not only in the harsh environment of the decentralized peripheral equipment, but also in the case of external interference or the failure of one or more stations. Wrong parameter settings are recognized directly, in that stations having the wrong parameters are not integrated in the operating data exchange.

The Master records the failure of any station and indicates this to the user by means of a general diagnostic message. Any breakdown in the transmission path is detected by the Slave by means of time monitoring and leads to the outputs being switched off.

EMV disturbances are virtually filtered out by means of the difference signal, thanks to the particularly noise-immune RS485 transmission system.

Data transmission errors are recognized thanks to frame and check-sum controls and lead to the retransmission of the telegram.

2. Electrical installation

2.1 Installation instructions for RS-485

All devices are connected within a bus structure (line). Up to 32 stations (Master or Slaves) can be linked together in one segment. The bus is terminated at the beginning and at the end of each segment by an active bus termination (termination resistors). To ensure disturbance-free operation both bus terminations must always remain powered. The bus termination is provided ready-to-activate in the device of in the connector. When there are more than 32 stations on the bus, repeaters must be inserted to connect the individual bus segments.

2.2 Node Attachment

The nodes are attached to the LAN cables via bus connectors or cable leads, bus terminals or RS-485 repeaters.

2.3 Cable Termination

Each bus segment must be terminated at both ends with its characteristic impedance. This cable terminator is integrated in the S-485 repeaters, the bus terminals, the ILM and the bus connectors and can be activated if required. Before the cable terminator can be activated, the component must be supplied with power. With the bus terminals and the bus connectors, this power is supplied by the connected DTE, whereas the RS-485 repeater, the ILM, and the terminator have their own power supply. The RS-485 transmission technique allows the attachment of a maximum of 32devices (DTEs and repeaters) per bus segment. The maximum permitted cable length of a segment depends on the transmission rate and the LAN cable used.

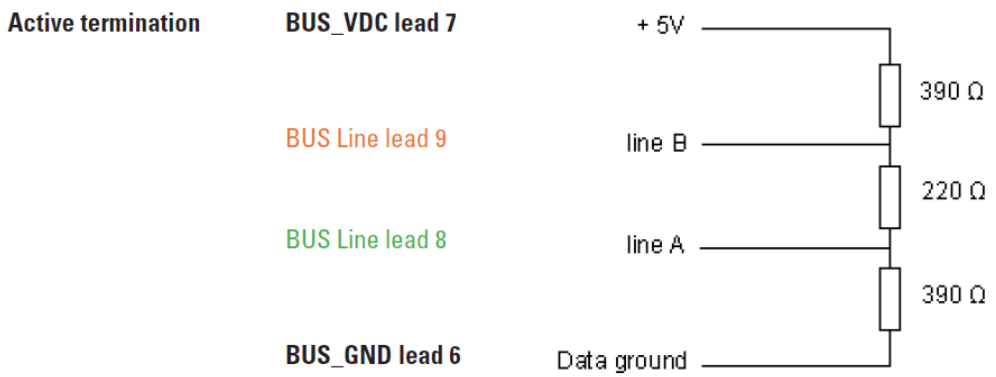
2.4 Bus Termination

If the device represents the final station on the bus, then the looped-through Profibus must actively terminated at both ends with a bus termination resistor between A and B. At **closed housings** it is necessary to order with termination adjusted the right way, otherwise it is mandatory to adapt an external resistor. For a good signal transmission it is necessary to terminate PROFIBUS segments by a bus termination. For PROFIBUS RS 485 a bus termination consists of a combination of three resistors.

Connect the Termination resistors to lead **8 and 9 (BUS_A) and (BUS_B)** and for the active power lines to **lead 6 and 7**.

Type:								mA							
Series -Nr.						VDC									
SIG.	0V	+V		**BUS -A**	**BUS-B**	BUS_ GND	BUS_ VDC	BUS -A	BUS-B						
Lead nr.	**1**	**2**		**4**	**5**	6	7	8	9						PH
Ex	**II 2G Ex d II C T6 PTB 09 ATEX 1106 X** **II 2D EX tD A21 IP6X T85°C CE 0102**									Working temperature -40°...+60°C					

Figure 1



3. Grounding and equipotential bonding

Effective grounding and equipotential bonding are very important for the interference immunity of PROFIBUS networks. Grounding and bonding is thus primarily to ensure correct functioning of PROFIBUS, and not for safety reasons. Proper grounding of the cable shield ensures that electrostatic interference is reduced, so minimizing pickup. Equipotential bonding ensures that the ground or earth potential is the same across the network. This, in turn, prevents ground currents flowing through the PROFIBUS cable shield. The following information provides general guidance for the installation of grounding and equipotential bonding.

At the PROFIBUS station

Connect the PROFIBUS cable shield to the equipotential bonding at every PROFIBUS station.

The PROFIBUS connector, where used, provides connection for the cable shield. However, this requires a properly made the shield connection in the connector.

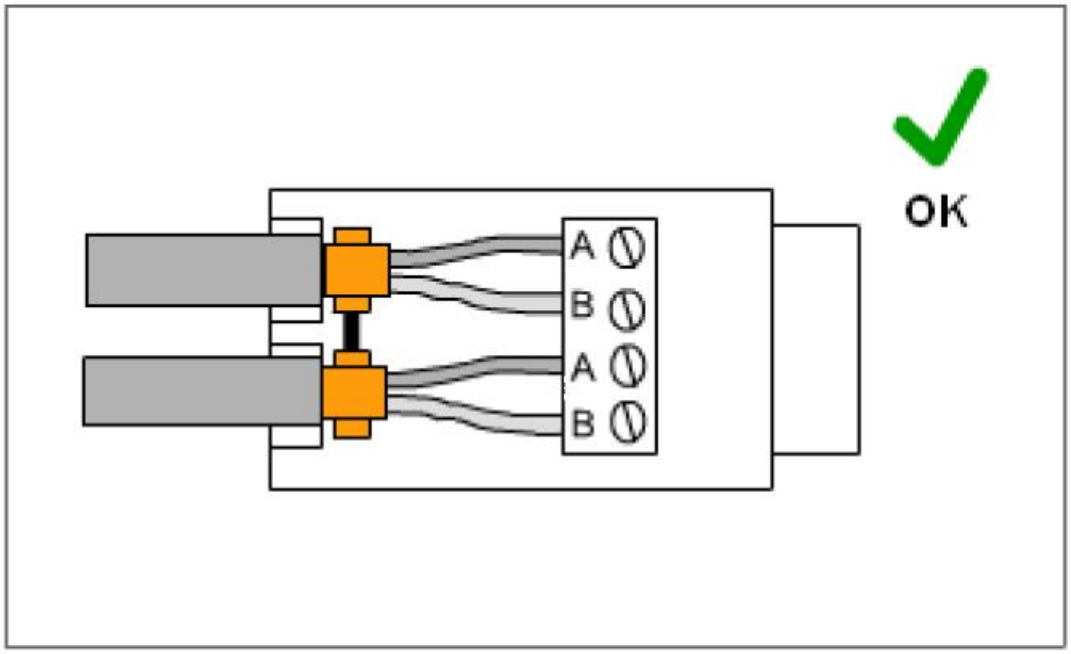


Figure 2

4. Quick Start Guide - Default settings on delivery

Before a PROFIBUS-DP system can be started up, unique bus addresses must be assigned to all connected stations, including the Master system. This is the only way to ensure unambiguous addressing on the bus. The station addresses should be assigned via the bus at first.

The physical system settings are made using the parameter set of the Master. In addition to the bus address of the Master, this set includes, for example, the baud rate, the time-out delays and the number of repetitions of the transmission. Along with the Master parameter set, a Slave data set must be saved for each Slave to be activated. A data set contains the parameter assignment and configuration data of the Slave and the address indicator for the logical storage of the I/O data. If the parameter sets are present, then either at the request of the user or automatically the Master system begins to start the Slaves up, one after the other. The first so-called diagnostic cycles are able to show, which slave is present on the bus. Only those Slaves, which sent a correct feedback during the diagnostic cycle, will subsequently be parameterized in the parameter cycles with the corresponding data stored in the Master. If this has been correctly carried out, then configuration cycles follow, during which a comparison is made between the required configuration data stored in the Master and the actual configuration data of the Slave. After the last diagnostic cycle, each Slave for which no error was detected during the comparison is ready for operation.

Each of these Slaves is then integrated automatically by the Master in the operating data transfer. For diagnostic purposes, the Master provides a diagnostic buffer for each Slave, which can be read by the user for other purposes. To simplify the diagnostics, a general diagnostic field is kept simultaneously, which shows bitwise whether a Slave has diagnostic data ready or not.

On delivery the following parameters have been factory set.

Description	Setting	Switch
Baud rate	automatic	Not available
Node address	125	***At closed housings the switch is set to the preorded node address or to 0xFF for "set station address" with software**
Termination	OFF	**Switch setting off**

Index (hex)	Name	Standard value
	Encoder Profile	
Set-prm 9	Operating Parameter	Bit 3 Scaling on
		Class 2 on/CW
Set_prm 10-13	Measuring Units per Revolution	**8192 (13 Bit)**
Set_prm 14-17	Total Measuring Range	**33554432 (25 Bit)**

Figure 3

If errors have occurred during programming of the objects and if these parameters have been saved in the EEPROM, it will not be possible to address the encoder next time it is switched on; this error can be cleared only by means of a general **Reset** of the encoder.

5. Characteristics of ProfiBus

5.1 PNO-Ident-Number

The Sendix Absolute Singleturn/Multiturn Encoder has the **PNO-Ident-Number 5868** (Hex). This number is registered at the PNO (Profibus User Organization) as an unique identification. The according GSD-Files are named as follows:

- **Multiturn Series 7068,7088 KUEB7068.GSD**
- **Singleturn Series 7058,7078 KUEB7058.GSD**

5.2 Start phase of the encoder on the PROFIBUS

When the encoder starts up it is in the 'Baud-Search' state. Once the baud rate has been recognized, it switches to the WAIT_PRM state and waits for the parameter data from the DP-Master. The parameterisation occurs automatically when the DP-Master starts up. The following parameters are transmitted to the encoder: count direction and the measuring length in steps (for more details, see the Encoder Profile from the PNO). When the correct parameter data have been successfully transferred, the encoder switches to the WAIT_CFG state. The PROFIBUS Master then sends a configuration byte to determine the number of inputs/outputs. If the configuration byte is correct, the encoder switches to the state **DATA_EXCHANGE**.

5.3 Configuration and Parameterisation

The parameterisation, i.e. the transfer of the parameters for count direction, encoder resolution etc., normally occurs within the configuration programme for the PROFIBUS Master used. To do this, the type file or GSD (device file) should be copied to the respective directory for type or GSD files. With some programmes such as COM PROFIBUS or STEP7 Manager, an update of the internal device list (hardware catalogue) must be carried out within the software. For more information about integrating field devices, please refer to the documentation for the software you are using. The two steps described below are normally necessary for integrating and parameterising the encoder in a Master system.

5.4 Configuration

For configuration purposes, i.e. to input the length and type of the I/O on the PROFIBUS, the configuration programme normally provides an input mask (screen), in which – independently of the desired configuration – the identifier has normally already been set as a default, so that only the I/O addresses remain to be entered. Depending on the required configuration that is desired, the encoder allocates a varying number of input and output words on the PROFIBUS.

The following parameters described are also dependent on the required configuration. The GSD device file **(e.g. KUEB7068.GSD)** contains five required configurations for PNO Class1 and 2, each with 16- and 32 Bit resolution.

6. Device Profile V1.1

This profile describes a manufacturer-independent and mandatory determination of the interface for encoders. It is defined in the protocol, which Profibus functions are used as well as how they are to be used. This standard permits an open manufacturer-independent bus system.

The device profile is divided into two object classes:

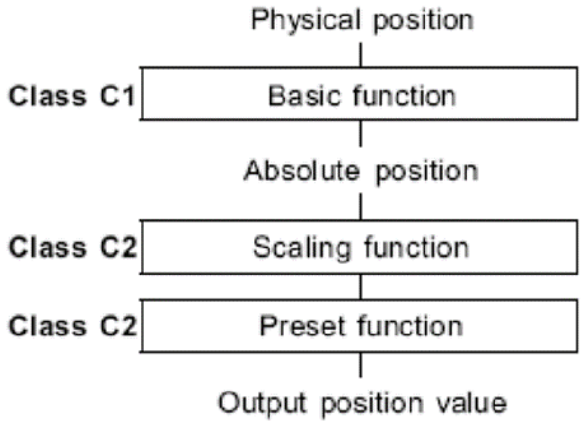


Figure 4

- Class C1 describes all the basic functions, which the encoder should contain.
- Class C2 contains a number of extended functions, which must either be supported by encoders of this class (Mandatory) or which are optional. Class C2 devices thus contain all the C1 and C2 mandatory functions, as well as additional manufacturer-dependent optional functions. An address area is also defined in the profile, which can be reserved for a manufacturer's own proprietary special functions.

Configuration

The configuration programme normally provides an input mask (screen) for parameterisation purposes, i.e. for entering the data for resolution, count direction etc. The individual modules are listed below:

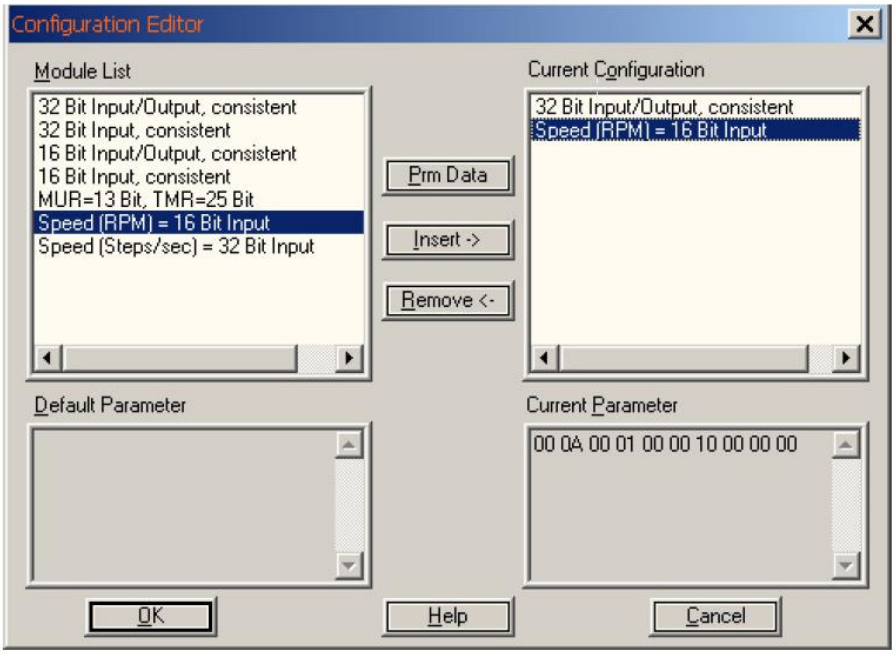


Figure 5

Configurations available for the regular operation of the encoder:

- 32 Bit Input/Output, consistent
- 32 Bit Input, consistent
- 16 Bit Input/Output, consistent
- 16 Bit Input, consistent
- MUR=13 Bit and TMR=25 Bit (32 Bit Input/Output, consistent)
- all can combined with Speed (RPM) 16 Bit consistent or Speed (Units/s) 32 Bit consistent

7. Encoder Profile 3062 V1.1

Class 2 32-Bit resolution, Input/Output consistent:

The encoder uses 2 input words and 2 output words, which are each consistently transmitted over the bus.

Class 2 32-Bit resolution, Input consistent:

The encoder uses 2 input words, which are each consistently transmitted over the bus.

Class 1 16-Bit resolution, Input/Output consistent:

The encoder uses 1 input word and 1 output word, which are each consistently transmitted over the bus.

Class 1 16-Bit resolution, Input consistent:

The encoder uses 1 input word, which is consistently transmitted over the bus.

Combination with:

Class 2 32-Bit resolution, Input consistent Speed in (units/s) or

Class 2 16-Bit resolution, Input consistent Speed in (rpm)

The encoder uses max. 2 input words, which are each consistently transmitted over the bus.

Default setting Scaling on, 25 Bit total resolution

Class 2 32-Bit resolution MUR=13Bit,TMR=25Bit:

7.1 Preset setting

In the mode ‘Class 2’ the encoder can be adjusted over the PROFIBUS to any position value in the value range of 27 Bit or 15 Bit. This occurs by **setting the most significant bit (MSB) of the output data** (2^31 for configuration Class 2 - 32 Bit or 2^15 for configuration Class 2 - 16 Bit).

The **Preset Value** that is transmitted in the data bytes 0 - 3 is accepted as the position value with the rising edge of Bit 32 (=Bit 7 of data byte 3). The encoder then continues counting from this position. A new adjustment is then only possible after the control bit has been reset. There is no acknowledgment of this action via the inputs.

7.2 Speed values

All modules can be combined with the configuration of an additional Speed value. The **input words** are increased to a maximum length of 8 Bytes (64 Bit) depending on the configuration of the speed value. The Speed value is signed and depends on the count direction.

Positive values in CW, negative in CCW direction.

Format is in “Big Endian”:

Input word		Input word			
Byte 0	Byte 1	Byte 2	Byte 3	Format	Max.
		0	0	RPM	0
		17	70	RPM	6000
		E8	90	RPM	-6000
00	63	FF	9C	Units/s	6553500
FF	9C	00	64	Units/s	-6553500

Figure 6

Speed limits:

Singleturn Encoder:	**600 rpm**	higher speed shows ffffh as value
Multiturn encoder:	**12000 rpm**	higher speed shows ffffh as value

7.3 Extended Diagnostics

Device profile for encoders

Class 1 Mandatory for all DP encoders			
Function	**Octet N°**	**Data Type**	**Name**
Data_Exchange	1-4	Unsigned 32	Position Value (input)
Data_Exchange	1-4	Unsigned 32	Preset Value (output)
Data_Exchange	1-4	Unsigned 32	Speed Value (input) (units/s)
Data_Exchange	1-4	Unsigned 16	Speed Value (input) (rpm)
RD_inp	1-4	Unsigned 32	Position Value
RD_inp	1-4	Unsigned 32	Speed Value
Slave_Diag	7	Octet String	External Diagnostic Header
Slave_Diag	8	Octet String	Alarms
Slave_Diag	9	Octet String	Operating Status
Slave_Diag	10	Octet String	Encoder Type
Slave_Diag	11-14	Unsigned 32	Singleturn Resolution
Slave_Diag	15,16	Unsigned 16	Number of Revolution
Set_prm	9	Octet String	Operating Parameters

Figure 7

Class 2 Optional Functionality			
Function	**Octet N°**	**Data Type**	**Name**
Slave_Diag	17	Octet String	Additional Alarms
Slave_Diag	18,19	Octet String	Supported Alarms
Slave_Diag	20,21	Octet String	Warnings
Slave_Diag	22,23	Octet String	Supported Warnings
Slave_Diag	24,25	Octet String	Profile Version
Slave_Diag	26,27	Octet String	Software Version
Slave_Diag	28-31	Unsigned 32	Operating Time
Slave_Diag	32-35	Signed 32	Offset Value
Slave_Diag	36-39	Signed 32	Manufacturer Offset Value
Slave_Diag	40-43	Unsigned 32	Measuring Units per Revolution
Slave_Diag	44-47	Unsigned 32	Total measuring range in meausring units
Slave_Diag	48-57	ASCII String	Serial Number
Set_prm	10-13	Unsigned 32	Measuring Units per Revolution
Set_prm	14-17	Unsigned 32	Total measuring range in measuring units

Figure 8

8. Set Slave Adress (SSA)

The Service Access Point **"SAP 55 Set_Slave_Address"** can only be carried out with a **Class2 Master** in the Profibus startup sequence. Default settings after a Power-on is **the address 125 (0x7D) for SSA_Support.**

SAP (Decimal)	SERVICE
Default 0	Cyclical Data Exchange (Write_Read_Data)
54	Master-to-Master SAP (M-M Communication)
55	Change Station Address (Set_Slave_Add)
56	Read Inputs (Rd_Inp)
57	Read Outputs (Rd_Outp)
58	Control Commands to a DP Slave (Global_Control)
59	Read Configuration Data (Get_Cfg)
60	Read Diagnostic Data (Slave_Diagnosis)
61	Send Parameterization Data (Set_Prm)
62	Check Configuration Data (Chk_Cfg)

Figure 9

Note: SAP55 is optional and may be disabled if the slave doesn't provide non-volatile storage memory for the station address.

Only **valid addresses** will be stored in a non-volatile memory and are active by now.

The **Node number 0** is reserved and must not be used by any node. The resulting node numbers lie in the range **1...7Dh** hexadecimal

(1...125 decimal).

9. Profibus connection Cable leads output

9.1 Supply voltage (Power supply)

Connect the Supply voltage to the **lead 1 and 2 (0V) and (+ VDC).**

Type:								mA							
Series -Nr.						VDC									
SIG.	0V	+V		BUS -A	BUS-B	BUS_ GND	BUS_ VDC	BUS -A	BUS-B						⍰
Lead nr.	**1**	**2**		4	5	6	7	8	9						PH
Ex	**II 2G Ex d II C T6 PTB 09 ATEX 1106 X** **II 2D EX tD A21 IP6X T85°C CE 0102**								Working temperature -40°...+60°C						

Figure 10

9.2 Profibus lines A and B

Connect the Profibus Input-lines to lead **4 and 5 (BUS_A) and (BUS_B)** and for outgoing lines to **lead 8 and 9.**

Type:								mA							
Series -Nr.						VDC									
SIG.	0V	+V		**BUS -A**	**BUS-B**	BUS_ GND	BUS_ VDC	**BUS -A**	**BUS-B**						⍰
Lead nr.	1	2		4	5	6	7	8	9						PH
Ex	**II 2G Ex d II C T6 PTB 09 ATEX 1106 X** **II 2D EX tD A21 IP6X T85°C CE 0102**								Working temperature -40°...+60°C						

Figure 11

10. Parameterisation

In order to carry out a general parameterisation of the device, it is necessary first to select a **module** from the GSD file **(KUEB7068.GSD)**.

Example:

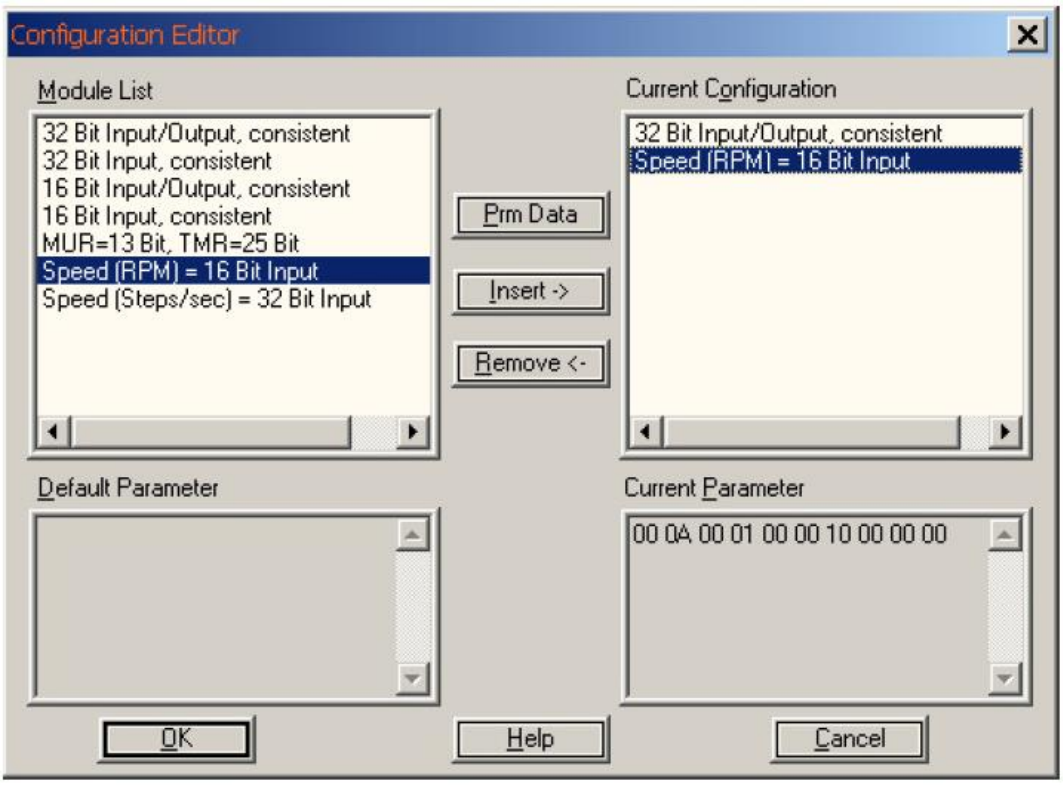


Figure 12

With the parameter telegram (except for the 25-Bit configuration) the following can be defined:

- **Code Sequence (Octet 9, Bit 0)**
  - 0 = clockwise
  - 1 = counter clockwise
- **Class 2 functionality (Octet 9, Bit 1)**
  - 0 = no
  - 1 = yes
- **Scaling enabled (Octet 9, Bit 3)**
  - 0 = no
  - **1 = yes**
- **Scaling type (Octet 9, Bit 7)**
  - 0 = Standard (MUR + TMR)
  - 1 = Alternative (NDR + TMR)
- **Scaling parameter MUR or NDR (Octets 10-13)**
  - MUR = Measuring Units per Revolution
  - NDR = Number of Distinguished Revolutions
- **Scaling parameter TMR (Octets 14-17)**
  - **TMR = Total Measuring Range**

11. Scaling

With Standard Scaling, scaling will be done as follows:

- With MUR and TMR
- One revolution is equivalent exactly to MUR = TMR values

Positionscaled = ((Positionunscaled / Singleturn-resolution) * MUR) % TMR

With Alternative Scaling, scaling will be done as follows:

- With NDR and TMR
- NDR revolutions are equivalent exactly to the TMR values

Positionscaled = ((Positionunscaled / (NDR * Singleturn-resolution)) * TMR) % TMR

1. **Code sequence CW**

   Possible settings:

   Increasing clockwise (0) (CW)

   Increasing counter-clockwise (1) (CCW)

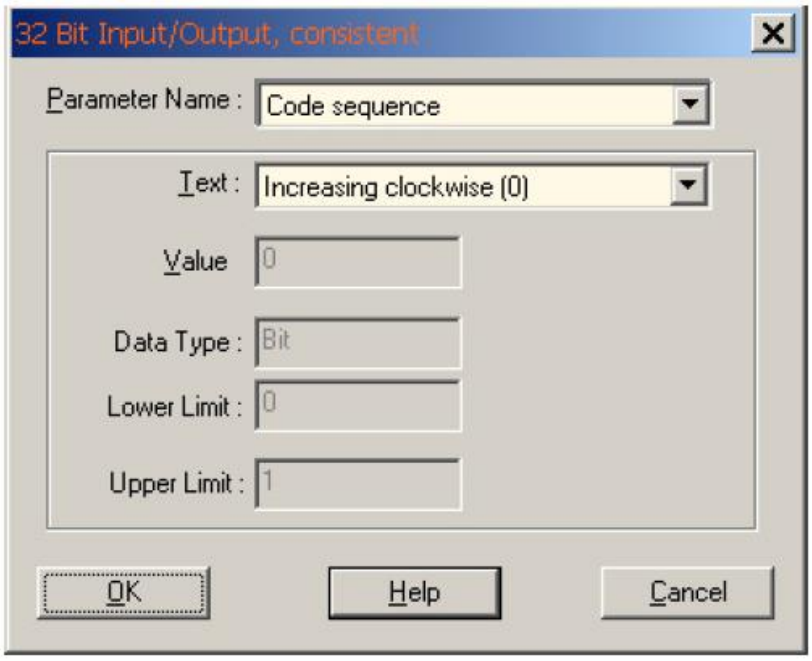


Figure 13

2. Class 2 functionality on

Class 2 must be turned on when scaling is active.

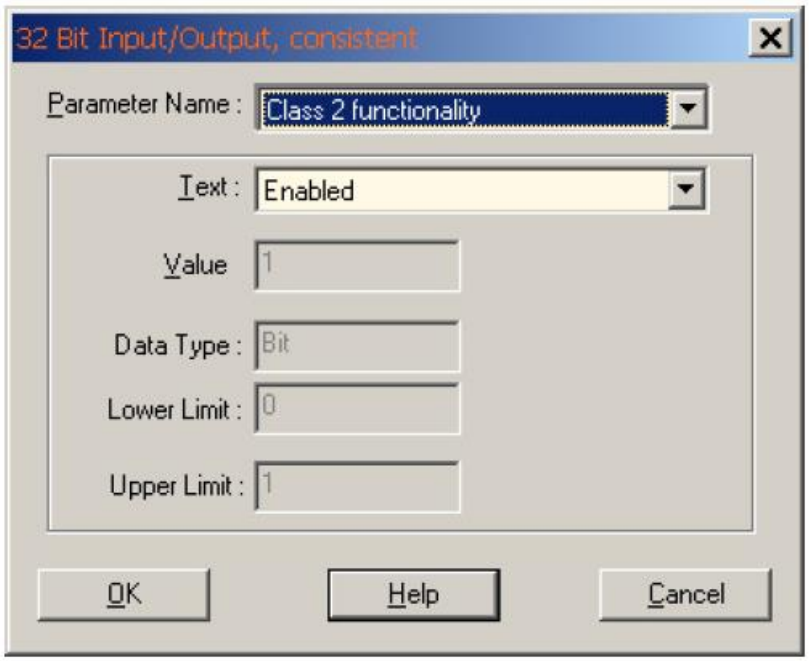


Figure 14

3. Scaling function control on

When scaling is turned on – Position depends on the values MUR and TMR.

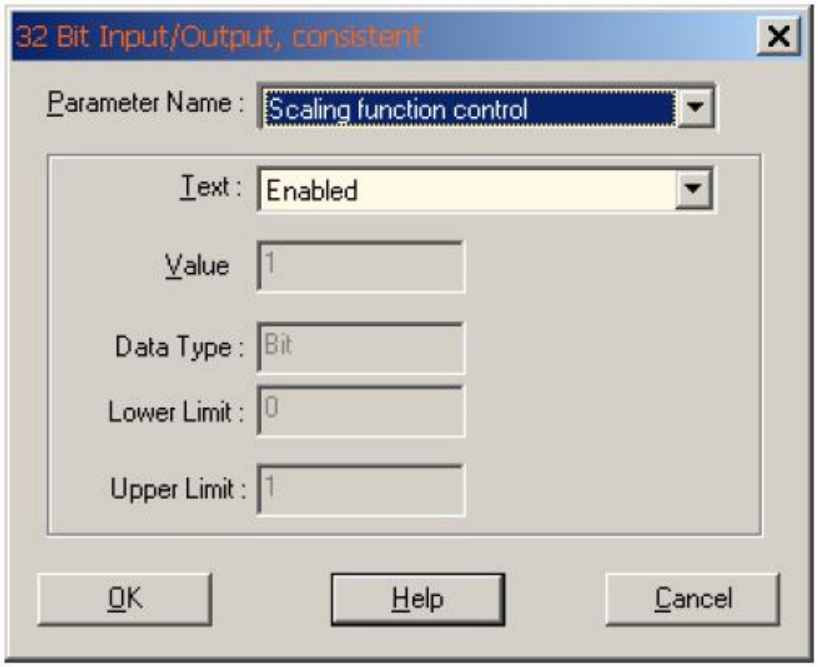


Figure 15

4. Scaling type MUR + TMR

Scaling type (MUR + TMR)

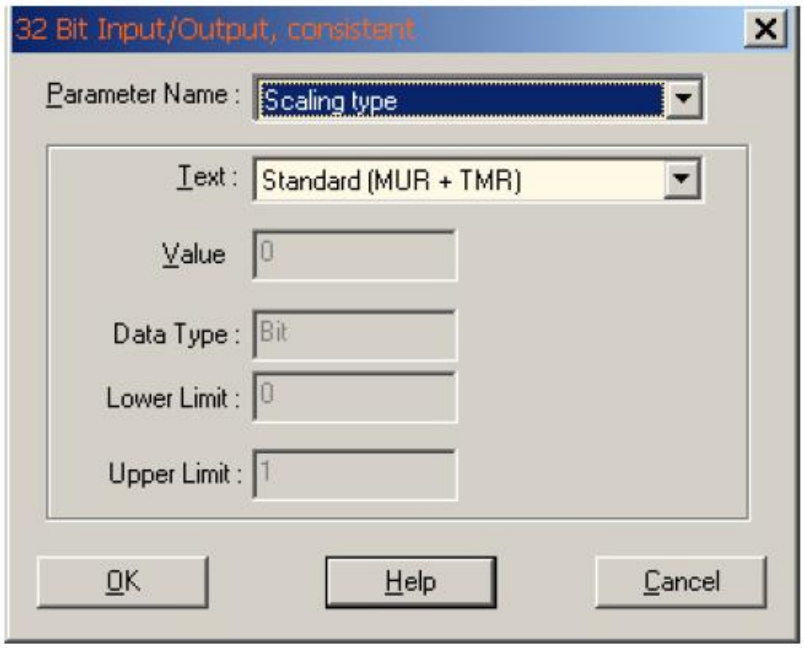


Figure 16

5. Value for Resolution per Revolution MUR

Example: 3600 Steps per revolution

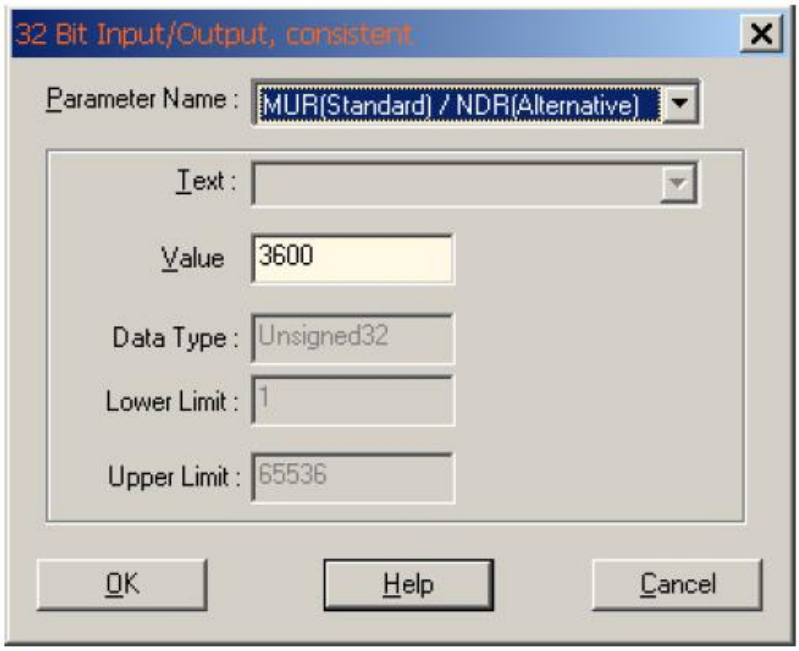


Figure 17

6. Value for total Resolution

Example: Value for total resolution 36000

Position range: 0…36000

Revolutions 10

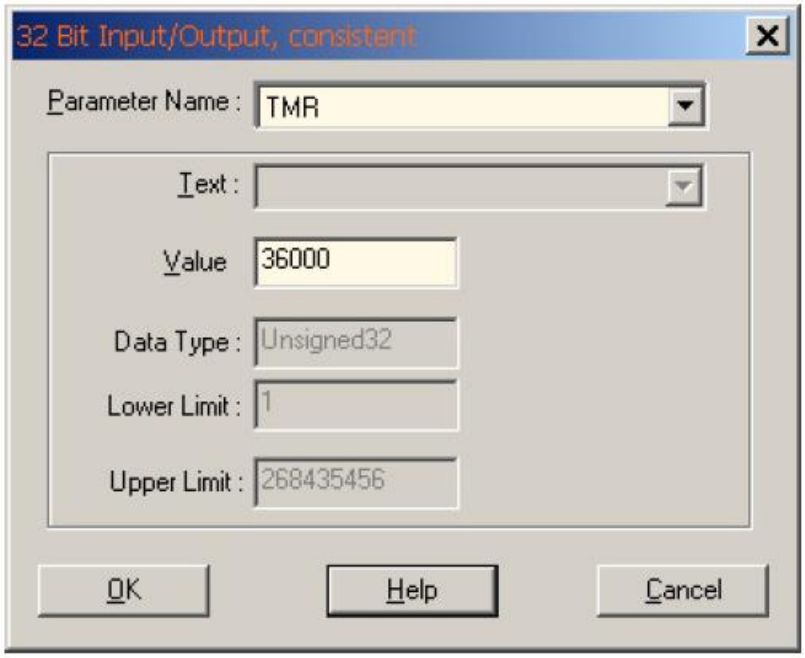


Figure 18

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