Absolute Multiturn Encoder Series Type 9080

11.2001

Operating Instructions

for programmable Absolute Multiturn Hollow Shaft/Shaft Encoder

Field bus connection

english

Fritz Kübler GmbH
Postfach 3440
78050 VS-Schwenningen

Phone 0049 (0)7720-3903-0
Fax +49-7720-21564

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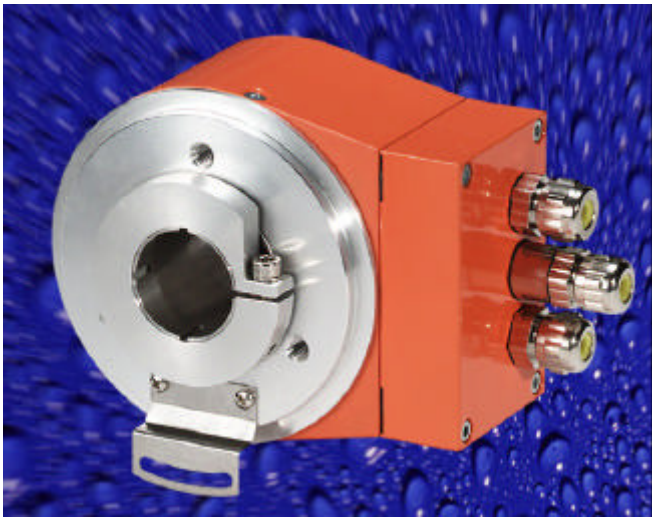
Summary

Project

The chapter Project contains information that is required when starting the design of control systems using Absolute Encoders 9080.
This information ranges from indications about the available encoder versions up to the maximum system extension of a **Profibus** line.



Assembly/Disassembly

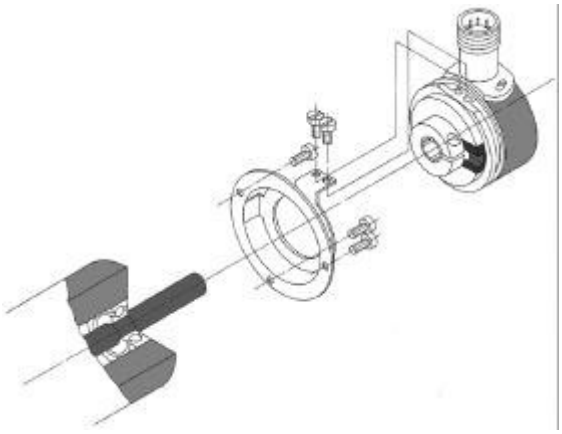
Mounting possibilities for encoders:
Mounting with a pin and the location slot (Hollow shaft encoders)

A standard cylindrical pin ∅ 4 mm according to DIN 7, mounted on the machine, is introduced in the location slot provided on the encoder in order to prevent the rotation of the encoder due to torque, e. g. when the drive starts rotating, and to compensate radial and axial moves, e. g. due to the play of the drive. The cylindrical pin is a part of the mounting set, Art. No.

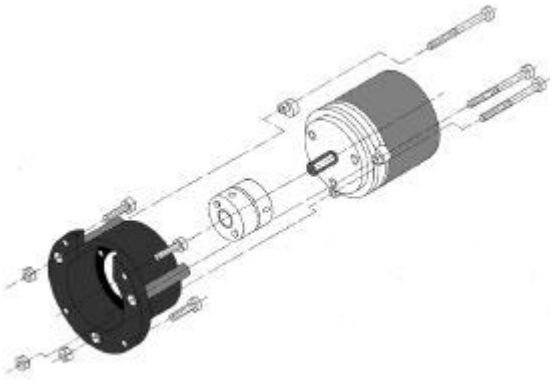
Mounting with a long location slot (Hollow shaft encoders)
The long location slot is also a part of the mounting set.

Adhere to the safety instructions on the instruction sheet of the encoder!

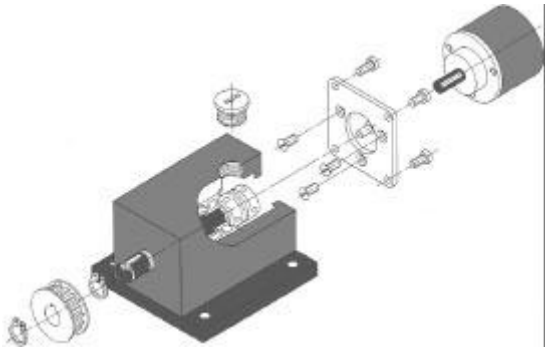
Mounting with the stator coupling (Hollow shaft encoders)
Stator coupling: Kübler Art. No.: 8.0010.1601.0000
This is the optimal mounting type, even though it is the most expansive.



Mounting with an assembly bell+coupling (Mainly shaft encoders)
This mounting ensures thermic and electric insulation of the drive and the encoder. Art. No. 8.0000.4500.XXXX



Mounting with a bearing box (Shaft encoders)
This mounting is to be used mainly when axial and radial shaft loads are likely to appear, that exceed the values indicated in the specifications sheet of the encoder.
Art. No. 8.0010.8200.0004



PROFIBUS-DP basics

This description gives informations about the implementation of the PROFIBUS-DP transmission protocol in the slave mode in our devices. It has to be noted that the extent of the functions described may be limited according to the device or to the application. In particular in the case of protocol conversions, less functions are used in general!

1.1 The profile required

The link between the decentralized process course and the central control via the communication system takes place in the lowest hierarchy level on the field 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 upon the dynamic states of the periphery. In addition to the classisc I/O data exchange, the acyclic transmission of parameter, diagnostic and configuration data must be possible, without impeding in a decisive way the real time ability of the bus. This is the only way to ensure a good diagnostic concept and the safe operation .

1.2 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. With this principle, a Master serves in polling operation its assigned slave devices one after the other on the Bus. A data exchange is initiated by a calling telegram and ended by an acknowledgement telegram of 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 correct configuration of the bus system and the univocal assignment of the Slave devices to the Masters is the condition for this kind of operation. PROFIBUS-DP distinguishes two types of Masters. The Class 1 Master carries out the cyclic operating data transmission and supplies the user data. The Class 1 Master can be addressed by a Class 2 Master using certain functions. A direct access to Slaves is not allowed. The functions are limited to support services like e. g. the reading of the diagnostic information of Slaves. A Class 2 Master is thus also understood as a programming or diagnostic device.

1.3 Protective functions

PROFIBUS-DP is equipped with many protective functions. These do not only ensure a safe communication in the rough environment of the decentralized peripheral equipment at the level of the good operation, but also in case of external disturbances or breakdown of bus members.
Wrong parameter setting is recognized directly, by the fact that bus members with wrong parameters are not integrated in the operating data exchange.
The Master records the breakdown of bus members and indicates it to the user by means of a general diagnostic message.
The breakdown of the transmission line is detected by the slave by means of time monitoring and leads to the switching off of the outputs.
EMC disturbances are almost filtered out by means of the difference signal thanks to the particularly interference-proof transmission process according to RS485.
Data transmission errors are recognized thanks to frame and check-sum controls and lead to the repetition of the telegram.

1.4 Start-up

Before a PROFIBUS-DP System can be started up, univocal bus addresses must be assigned to all connected bus members, including the Master system. This is the only way to ensure an univocal addressing on the bus. As an option, the addresses can also be assigned via the bus.

The physical system settings are made using the parameters set of the Master. This set includes, in addition to the bus address of the Master, e. g. the baud rate, the time-out delays and the number of repetitions of the transmission. In addition to the parameters set of the Master, a Slave data set must be saved for each Slave to be activated. A data set contains the parameterizing and configuration data of the Slave and the address indicator for the logical storage of the I/O data.

When the parameter sets are defined, the Master system begins, upon instruction of the user or automatically, to start the Slaves up, one after the other. Already the first diagnostic cycles show which Slave is detected on the bus. Only the Slaves that sent a correct feedback during the diagnostic cycle will be parameterized during the following parameterizing cycles with the corresponding data stored in the Master. In case of correct execution, configuration cycles perform then a comparison 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 for other purposes. To simplify the diagnostics, a general diagnostic field is kept simultaneously, which shows, bit by bit, whether a Slave shows diagnostics data.

General wiring instructions

1. Installation instructions for RS-485

All devices are connected within a bus structure (line). Up to 32 members (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. To ensure a disturbance-free operation, it must be made sure that both bus terminations always remain powered. The bus termination is provided ready-to-activate in the device or in the connector.
In case of more than 32 bus members, repeaters must be inserted, to connect the various bus segments.
The maximum line length depends on the transmission speed, refer to Table 2.
The line length indicated can be increased using repeaters. It is recommended not to connect more than 3 repeaters serially.

Baud rate (kBit/s)	9,6	19,2	93,75	187,5	500	1500	12000
Range/segment	1.200 m	1.200 m	1.200 m	1.000 m	400 m	200 m	100 m

Table 2: Range depending on the transmission speed for A-type cable.

Shielding - yes or no ?

EN 50 170 leaves it up to the user to decide whether to use shieded or unshielded cable. Unshielded cable is allowed in interference-free environments. However, the following reasons argue for the systematic use of shielded cable:

a) An interference-free room in exists at the most inside shielding cabinets. But, as soon as such a cabinet contains also relays, this is not ensured any more.
b) The use of unshielded cables requires additional protective measures against overvoltage at the bus signal inputs.

This is why we recommend, as a principle, the use of shielded cables for the bus lines. This recommendation extends also to the possibly required power supply cables coming from external power sources to the PROFIBUS devices, e. g. for repeaters. Double-shielded lines suit particularly for environments with strong EMC interference. In this case, in order to ensure an optimal protection, the whole surface of the external shielding (plait) and of the internal shielding (film) must be connected at both cable ends by means of an earth clip with the protective earth.

Shielding rules

When using a shielded bus cable, it is recommended to connect the shield on both sides with a low-induction connection to the protective earth. This ensures the most optimal EMC possible. Separated potentials (e. g. in refineries) are an exception: generally, in these plants, earthing is allowed at one end only.
The link between the cable shielding and the protective earth is carried out preferably by means of the metallic cabinet of a device and the screwed plug of the connector. Consider the fact that the derivation via the pin is not an optimal solution. To achieve an optimal EMC, it is better to set the cable shielding free at a suitable location and to connect it with the protective earth (e. g. the metallic cabinet frame) using a low-induction cable link as short as possible. This may be done

e. g. with a shielding location before the bus plug.

Cable specification - A-type cable for PROFIBUS - DP

Surge impedance:	135 to 165 Ohm, for a measurement frequency of 3 to 20 MHz.
Cable capacitance:	< 30 pF per metre
Conductor section:	> 0,34 mm², corresponds to AWG 22
Cable type:	twisted pairs, 1 x 2 or 2 x 2 or 1 x 4 conductors
Loop resistance:	< 110 Ohm per km
Signal damping:	max. 9 dB on the whole length of the line section
Shielding:	Copper plait shielding or plait shielding and film shielding

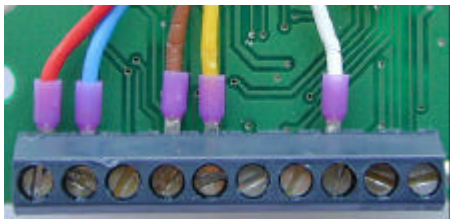
Bus connection

Installation and settings

The 4 hexagon socket screws of the interface section must be opened to perform any setting and to connect the encoder to the **Profibus system** and to the **power supply**.

Then, the connection section may be removed and connected directly on site to the bus system and the power supply. After this, set the device address and the transmission speed and, if required, activate the bus termination, if the encoder is the **last device** in the bus chain. Finally, screw the connection section back onto the encoder section. The encoder is now ready to operate.

The bus connection section can be found after dismounting the connection section and removing the two screws on the printed circuit. The designation **A-Line** and **B-Line** is provided twice; this indicates, that the **PROFIBUS** is **looped internally**. Corresponding terminals to that purpose are already provided on the printed circuit. If the encoder is the **last member on the bus**, the bus termination must be activated.

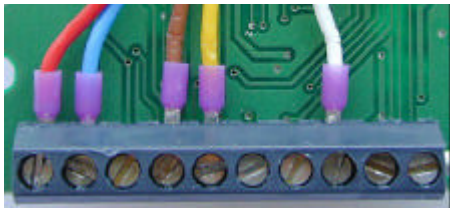


PIN Number	Function
PIN 1	Power supply +10..30 VDC
PIN 2	Power supply GND
PIN 3	**PROFIBUS GND**
PIN 4	**Input PROFIBUS B-Line (PROFIBUS_H)**
PIN 5	**Input PROFIBUS A-Line (PROFIBUS_L)**
PIN 6	**Output PROFIBUS A-Line (PROFIBUS_L)**
PIN 7	**Output PROFIBUS B-Line (PROFIBUS_H)**
PIN 8	**PROFIBUS GND**
PIN 9	Power supply GND
PIN 10	Power supply +10..30 VDC
PIN 11	Cable shielding
PIN 12	Cable shielding

Note:
The two signal lines PROFIBUS_L and PROFIBUS_H shall not be inverted - Please adhere to the above general shielding instructions

The bus connection section can be found after dismounting the connection section and removing the two screws on the printed circuit. The designation **+VDC** and **GND** indicates that the power supply is also **looped internally**. The corresponding terminals to that purpose are provided on the printed circuit.

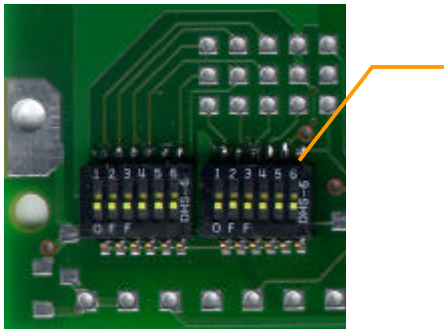
Power supply



PIN Number	Function
PIN 1	**Power supply +10..30 VDC**
PIN 2	**Power supply GND**
PIN 3	PROFIBUS GND
PIN 4	Input PROFIBUS B-Line (PROFIBUS_H)
PIN 5	Input PROFIBUS A-Line (PROFIBUS_L)
PIN 6	Output PROFIBUS A-Line (PROFIBUS_L)
PIN 7	Output PROFIBUS B-Line (PROFIBUS_H)
PIN 8	PROFIBUS GND
PIN 9	**Power supply GND**
PIN 10	**Power supply +10..30 VDC**
PIN 11	Cable shielding
PIN 12	Cable shielding

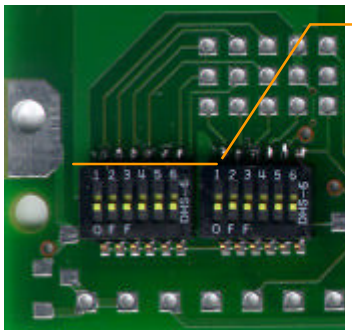
Bus termination

Bus termination On switch S2 (5+6)



In general, the PROFIBUS standard ISO 11898 requires a network topology in the form of a line structure. The line is equipped at both ends with a terminal resistor. It may be necessary to activate this termination if the device must be connected **as the last bus member**. To that purpose, a 220 Ω bus termination resistor is connected **internally** in the encoder, between the lines **PROFIBUS-Low** and **PROFIBUS-High**.

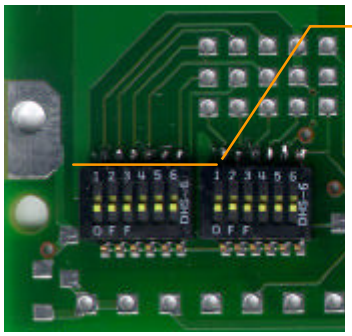
Device address S1 (1-6) + S2 (1)



S1[1-6]+S2[1]

The **node ID** set is read and stored after powering the device, during the initialization of the **PROFIBUS** encoder.
The node ID can be set in the range between **0...126**. It is defined as a binary value. A maximum of **128** node ID's can be assigned to the members of the PROFIBUS bus.

Example: **Address 3**



Switch S1[1-6]+S2[1]

The address **S1(1)** is the least significant bit. When **S1(1+2)** is **on**, the **device address 3** is set.
This is the default setting when delivering the device.

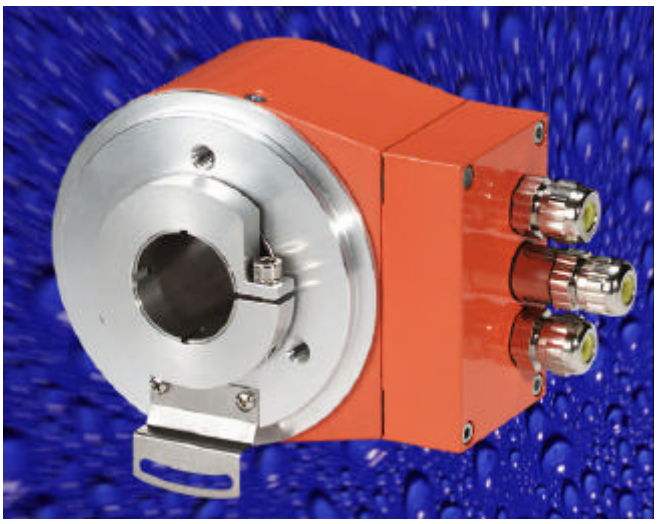
Note:
Each node ID may only be assigned once! Node ID 0 is not allowed and is set to 1 by the software.

PROFIBUS Protocol

ISO/OSI layer 1 and 2
The lower layers according to the OSI model are defined by standard ISO 11898. In addition, the Profibus standard defines the standard for plug-in connectors and supported bit rates.

Layer 7 (Protocol layer)

For the higher layers (layer 7), an organisation of several encoder manufacturers and the PNO **developed a device profile and declared it to be a standard**. PROFIBUS is made up of a profiles family, based on a communications section and several specific device sections.



Profibus LED Status:

red LED

on Device not configured

off Device configuration taken into account, data exchange available

green LED

on Device power supply ok

off No power supply

PROFIBUS implementation

Ident Number

Each DP Slave and each **Class 1 DP Master** must have an ident number **(9080HEX)**. It is required in oder to allow a Master to identify without significant protocol overhead the types of the devices connected. The Master compares the ident number of the connected DP devices with the ident numbers stored in the project data defined by the project tool. The operating data transfer only starts when the correct device types, with the correct station addresses, are connected to the bus. This allows a high safety level against project mistakes.

PROFIBUS pre-settings

Kübler-specific pre-settings

Transmission rate setting

The transmission rate of the device is set by **software** and is normally assigned by the Master system. All modules within a PROFIBUS network must be set to the same transmission rate.

Node address setting

The DIL switch allows changing the node address (node ID) of the encoder. This node ID can have values between 1..127.
The default node ID of the device is set to 3.

1. Device profile for encoders
2. Class 1 imperative for all DP encoders

Function	Octet No.	Data Type Name
Data_Exchange	1-4	Unsigned 32Position Value (input)
Data_Exchange	1-4	Unsigned 32Preset Value (output)
RD_inp	1-4	Unsigned 32Position Value
Slave_Diag	7	Octet String External Diagnose 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 32Singleturn Resolution
Slave_Diag	15,16	Unsigned 16Number of Revolution
Set_prm	9	Octet String Operating Parameters

3. Class 2 Optional functionality

Function	Octet No.	Data Type Name
Slave_Diag	17	Octet String Addtitional 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 32Operting Time
Slave_Diag	32-35	Signed 32 Offset Value
Slave_Diag	36-39	Signed 32 Manufacturer Offset Value
Slave_Diag	40-43	Unsigned 32Measuring Units per Revolution
Slave_Diag	44-47	Unsigned 32Total measuring range in measuring units
Slave_Diag	48-57	ASCII String Serial Number
Set_prm	10-13	Unsigned 32Measuring Units per revolution
Set_prm	14-17	Unsigned 32Total measuring range in measuring units

Technical data

Mechanical features:

Execution:	round, with radial mounting surface for the interface
External diameter:	max. **90** mm
Total length:	max. **60** mm
Hollow shaft internal diameter:	up to **28** mm
Speed:	min. 1500 RPM (for IP 65)
Protection acc. to EN60529:	IP65
Operating temperature range:	min. -20° C to +70° C
extended:	-40° C to +105° C
Shock resistance acc. to DIN-IEC 68-2-27:	1000 $^{m}/_{s^2}$, 6 ms
Vibration resistance acc. to DIN-IEC 68-2-6:	100 $^{m}/_{s^2}$, 10...2000Hz
Connection type:	7 mm **PG System** for BUS and power supply

Electrical features:

Encoder interface:	
Bus interface:	**PROFIBUS 2.0B Standard**
	PROFIBUS device protocol
Resolution:	**25 Bits Multiturn**
13 Bits Singleturn	
Supply voltage:	10-30 VDC
Protocols:	**PROFIBUS**
Profile for Encoder	
Accessories:	CD-Rom with Manual and GSD file