SCANCON Industrial Encoders

SCH88BEX

Technical Manual

Encoder Version 2PB

Scancon Encoders Huginsvej 8 3400 Hillerød Denmark
Tel. +45 48 17 27 02 www.scancon.dk

Table of Contents

1 Introduction

The **SCH88BEX** Encoder is an Ex-proof, Absolute Multiturn Encoder designed primarily for use in oilfield applications where reliability is critical but can also be used for other applications that require a rugged and reliable Ex-proof Absolute Encoder.

The **SCH88BEX** features a large through-bore hollow shaft that can be easily mounted on shafts of various sizes. It is the only large through-bore Ex-proof Profibus encoder on the market that has ATEX, IECEx, Class I Div.1, and AEx certifications.

Specifically designed for the Oil Industry, this rugged encoder incorporates features such as a 30 mm through hollow bore, a removable end cap for easy onsite cable replacement, and both manual and Profibus interface options for setting the Profibus device address. The **SCH88BEX** is the Ex-proof Profibus encoder of choice for oilfield applications.

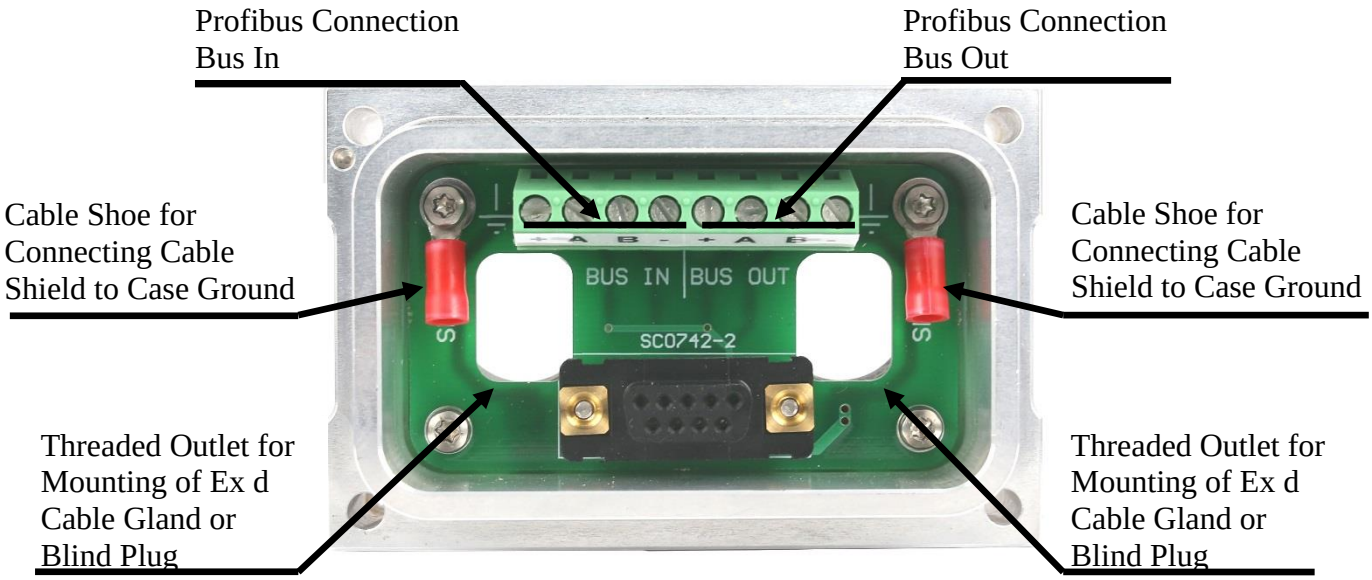
The **SCH88BEX** has the following features:

- Profibus DP Interface for exchange of data with a Master Controller.
- Supports the Profile for Absolute Encoders ver. 1.1 class 1 and class 2 from the Profibus Nutzerorganisation as well as manufacturer specific functions.
- Setting of station address over rotary switches or over Profibus interface by Change Station Address function.
- Measurement of Velocity and Acceleration with programmable sample interval.
- Removable end cap for easy onsite setting and cable replacement.
- Large through hollow bore (up to 30 mm) for easy mounting.
- Rugged, heavy duty ball bearings for high reliability.
- Available in Aluminum and Stainless Steel (AISI 316).

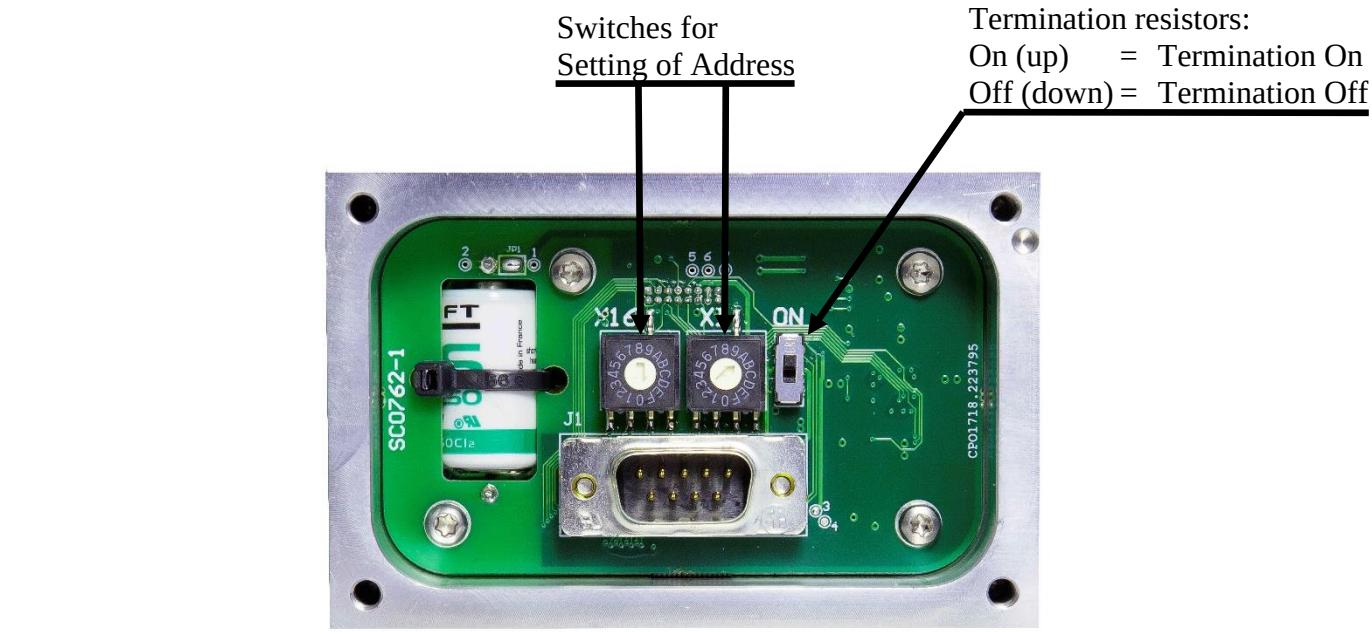
This manual describes the implementation and use of the **SCH88BEX** Encoder with the **2PB** firmware revision.

2 Removable End Cap

The picture below shows the end cap when removed from the encoder.



When the end cap is removed there will be access to the switches for setting the device address and the termination resistors.



3 Installation

As the installation of the SCH88BEX may differ from location to location, it is not possible to give exact instructions on all aspects on how to install the encoder. Below are some general recommendations and procedures. The Installation Guide found on Scancons website should also be consulted.

3.1 Mechanical Installation

Before the encoder is mechanically installed, the required Ex d cable glands or blind plug must be mounted onto the encoder. Do not mount or tighten the cable glands or blind plug while the encoder is attached to the shaft as excessive torque may result in damage to the encoder ball bearings.

The mechanical installation consists of the following steps:

1. Mount the bracket for the torque arm or spring coupling to the encoder face, using the supplied screws.
2. Mount the torque arm onto the bracket if a torque arm is used.
3. Connect the ground wire to machine ground (earth). Observe handling precautions for ESD sensitive devices.
4. Ensure that the hollow bore fixing clamp (collet) is loose.
5. Slide encoder hollow shaft onto motor shaft (or other device).
6. Align encoder torque arm or spring coupling mounting hole(s) with motor faceplate hole(s). Insert screw(s) and tighten.
7. Tighten the hollow bore fixing clamp (collet) screw (max. torque 1.5 Nm – 13.3 lbf-in).

3.2 Electrical Installation

The electrical installation consists of the following steps.

1. Remove the screws for the end cap and pull out the end cap. Note that the end cap must be pulled out in a straight, firm pull. Do not try to rock or twist the end cap as this may lock it in position. Notice orientation of the end cap.
2. Prepare the cable(s) by uncovering the individual wires including the shield.
3. Insert the cable(s) into the cable gland(s) and tighten the cable gland(s).
4. Estimate the necessary wire length of the individual wires and cut them to length. Note that wire lengths will vary depending on which terminal they shall be inserted into. See below for description of connections.

5. Insert wires into terminals and tighten screws. Do not over tighten.
6. Set, if necessary, switches for termination resistors and device address (see below).
7. Push the end cap back into the encoder. Again, a straight, firm push is needed. Ensure that the end cap orientation is correct.
8. Secure the end cap with the screws (max. torque 6 Nm –53 lbf-in).

The connection table below applies to both the Bus In terminals and the Bus Out terminals.

Terminal Name	Type	Description
+	Power	Positive supply for Encoder (9V – 30V)
A	Bidirectional	Negative Data I/O for Profibus Interface
B	Bidirectional	Positive Data I/O for Profibus Interface
-	Power	0V supply for Encoder (Circuit Ground)

Note that the Cable Shield(s) must not be left unconnected but must be connected to the encoder's Case Ground through the red cable shoe(s).

3.3 Termination Resistors

The physically first and the last device on the bus must be equipped with termination resistors. If the SCH88BEX is connected as the first or the last device the switch for the termination resistors must be set to the "On" position. If the SCH88BEX is not connected as the first or the last device the switch for the termination resistors must be set to the "Off" position.

The termination resistor switch is accessible when the end cap is removed from the encoder. Refer to picture on page 3 for location of the termination resistor switch.

3.4 Device Address

The device address of the SCH88BEX can be set to any value between 1 and 126. The device address can be set either by the rotary switches that are located inside the end cap or over the Profibus interface by the Change Station Address function.

The rotary switches are accessible when the end cap is removed from the encoder. Refer to picture on page 3 for location of address setting rotary switches.

Setting the address over the Profibus interface is only possible if the rotary switches are set to address 126 (0x7E hex). If the address is set to any other value by the rotary switches this will take precedence and a change over the Profibus interface is not possible.

At delivery the device address on the rotary switches is set to 126 decimal (0x7E hex).

This means that the user must actively set the address switches to an address between 1 and 125 or connect the encoder to a Profibus master for setting the address. Address 126 cannot be used for data exchange; it is dedicated for use in setting the address over the Profibus interface. Note that if the device address is set to a value outside the range 1 to 125 the encoder will not go into data exchange.

When setting the address over the rotary switches it should be noted that these are hexadecimal and the address must therefore be set as a hexadecimal number. The switch denoted X1sets the lower part of the number and the switch denoted X16 sets the higher part of the number. For example, setting the X1 switch to A and setting the X16 switch to 2 will set the address to 0x2A (42 decimal).

For information on how to set the address over the Profibus interface, consult the documentation for the Profibus master.

In the definition of the Change Station Address function, it is defined that the user can prevent further changing of the address by checking a check field in the master's set-up panel. This possibility has not been implemented in the SCH88BEX as this will "lock" the encoder forever to a particular address and prevent it from future changes by the Change Station Address function.

4 Profibus Communication

Profibus is an international, open, non-proprietary field bus standard which is defined in the European Standard EN 50170. For more information about the standard, visit the official Profibus website at www.profibus.com.

The SCH88BEX encoder implements the DP-V0 variant of the Profibus standard.

The SCH88BEX supports the Profibus "Profile for Encoders" ver. 1.1 and manufacturer specific functionality. The Profile for Encoders can be acquired from the Profibus Nutzerorganisation under the order no. 3.062. The different functionalities are:

1. **Class 1 Multiturn.** This is a 32-bit multiturn encoder. The encoder has only the possibility to return the position and has limited possibilities for configuration. This functionality conforms to the Profibus Profile.
2. **Class 2 Multiturn.** This is a 32-bit multiturn encoder that, besides all functions for the class 1 encoder, also has the possibility for presetting the position and a more detailed configuration, including the possibility for scaling. This functionality conforms to the Profibus Profile.
3. **Scancon 2.1 Multiturn.** This is a 32-bit multiturn encoder that, besides all functions for the class 2 encoder, also has further functionality. It has the possibility to change the direction of rotation "on the fly", Teach-In, Limit Switches and more. This functionality is manufacturer specific.
4. **Scancon 2.2 Multiturn.** This is a 32-bit multiturn encoder that, besides all functions for the Scancon 2.1 encoder, also will return velocity. This functionality is manufacturer specific.
5. **Scancon 3.0 Multiturn.** This is a 32-bit multiturn encoder that, besides all functions for the Scancon 2.2 encoder, also will return velocity and acceleration. This functionality is manufacturer specific.

The functionalities and the parameter settings are specified in the GSD file which has to be loaded into the Master Set-up Tool. The name of the GSD file is **SCAN11B1.gsd** and can be found at Scancons website www.scancon.dk.

The functionality is selected in the Master Set-up Tool and, as this may differ from master to master, it is not described here. Consult the documentation for the Profibus Master in use for further information.

Note that in the following description, data direction is always described from the master's point of view, i.e., data from the master to the slave is named as "output data" and data from the slave to the master is named as "input data". All exchanged values are unsigned unless otherwise noted.

Below is a table that in details describes the possibilities for the different functionalities.

Designation	Cyclic Communication	Programmable Parameters	Additional Functions
Class 1 Multiturn	Position Value – 32 bit Input	Code Sequence	None
Class 2 Multiturn	Position Value – 32 bit Input Preset Value – 32 bit Output	Code Sequence Scaling Factor	Preset Function
Scancon 2.1 Multiturn	Position Value – 32 bit Input Preset Value – 32 bit Output Teach-In – 32 bit Output	Code Sequence Scaling Factor Shorter Diagnostics Limit Switches	Preset Function Commissioning Mode Change Direction on The Fly Teach-In Status Bits in Input Value
Scancon 2.2 Multiturn	Position Value – 32 bit Input Velocity – 16 bit Input Preset Value – 32 bit Output Teach-In – 32 bit Output	Code Sequence Scaling Factor Shorter Diagnostics Limit Switches Velocity Time Base	Preset Function Commissioning Mode Change Direction on The Fly Teach-In Status Bits in Input Value Velocity Input
Scancon 3.0 Multiturn	Position Value – 32 bit Input Velocity – 16 bit Input Acceleration – 16 bit Input Preset Value – 32 bit Output Teach-In – 32 bit Output	Code Sequence Scaling Factor Shorter Diagnostics Limit Switches Velocity/Acceleration Time Base	Preset Function Commissioning Mode Change Direction on The Fly Teach-In Status Bits in Input Value Suppress Status Bits Velocity Input Acceleration Input

4.1 Parameterization

During the initialization of the bus communication, the master sends a parameterization telegram to the slave. This telegram can consist of two parts, the mandatory part according to the Profibus specifications (octet 1 to 8) and the user part (octet 9 and up). The length of the parameterization telegram for the SCH88BEX varies depending on which functionality is selected.

In the table below, the octet number is shown as the position in the whole parameterization telegram. Octet no. 9 in the telegram will therefore also be parameter no. 1 within the user parameters and so on. The table also describes in which functionality the parameter is present. Notice that if class 2 is used all parameters from class 1 must be present and if Scancon 2.1 is used all parameters from class 1 and class 2 must be present ect.

Note that for default values, this is the default value set by the GSD file. Note also that some values are dependent on the resolution of the encoder.

Octet no.	Parameter Name	Bit no.	Description	Used for
9	Operating Parameters 1	0	Code Sequence	Class 1
		1	Class 2 functionality	Class 2
		2	Commissioning Diagnostics	Class 2
		3	Scaling Function Control	Class 2
		4 - 5	Not Assigned – Must be 0	-----
		6	Activate Octet 26	Scancon 2.1
		7	Not Assigned – Must be 0	-----
10 - 13	Measuring Units per Rev. Desired Measuring Units	---	Measuring Units per Revolution Desired measuring Units	Class 2 Scancon 2.1
14 - 17	Total Measuring Range	---	Total Measuring Range	Class 2
18 - 25	Reserved for Future Use	---	Must be 0	-----
26	Operating Parameters 2	0 - 1	Desired Measuring Units	Scancon 2.1
		2	Commissioning Mode Enable	Scancon 2.1
		3	Shorter Diagnostic	Scancon 2.1
		4	Without Status Bits	Scancon 3.0
		5	Enable Lower Limit Switch	Scancon 2.1
		6	Enable Upper Limit Switch	Scancon 2.1
		7	Activate Octets 27 - 39	Scancon 2.1
27 - 30	Lower Limit Switch	---	Lower Limit Switch	Scancon 2.1
31 - 34	Upper Limit Switch	---	Upper Limit Svitch	Scancon 2.1
35 - 38	Physical Impulses	---	Physical Impulses	Scancon 2.1
39	Operating Parameters 3	0	Not Assigned – Must be 0	-----
		1	Encoder Type	Scancon 2.1
		2 - 3	Not Assigned – Must be 0	-----
		4 - 5	Time Base for Velocity	Scancon 2.2
		6 - 7	Not Assigned – Must be 0	-----

4.1.1 Octet no. 9 – Operating Parameters 1

This byte is used for operating parameters.

Bit no. 0 – Code Sequence

The setting of this bit will affect the direction for the position measurement and for the velocity measurement.

Bit 0 = 0 (off) – CW, increasing clockwise seen from shaft side of encoder
Bit 0 = 1 (on) – CCW, increasing counterclockwise seen from shaft side of encoder

Default value: 0 ~ Increasing clockwise
Valid range: 0 – 1

Bit no. 1 – Class 2 Functionality

This bit is only active if class 2 or higher functionality is enabled. The bit must always be 1.

Default value: 1 ~ Class 2 functionality enabled.
Valid range: 1 – 1

Bit no. 2 – Commissioning Diagnostics

The SCH88BEX does not support commissioning diagnostics, so this bit must always be 0.

Default value: 0 ~ Commissioning diagnostics disabled.
Valid range: 0 – 0

Bit no. 3 – Scaling Function Control

The setting of this bit controls whether the position value is scaled with the parameters measuring units per revolution and total measuring range or for Scancon 2.1 to 3.0 (see below) other paremeters. Note that if the scaling function is disabled, the values of the scaling parameters are ignored regardless of their value.

Bit 3 = 0 (off) – Scaling function is disabled.
Bit 3 = 1 (on) – Scaling function is enabled.

Default value: 0 ~ Scaling function is disabled.
Valid range: 0 – 1

Bit no. 6 – Activate Octet 26

This setting of this bit controls whether manufacturer specific parameters are activated. This is handled automatically if Scancon 2.1, 2.2 or 3.0 functionality is selected.

4.1.2 Octet no. 10-13 – Measuring Units per Revolution/Desired Measuring Units

For Class 2 – Named Measuring Units per Revolution

This double word (32-bit) is used for setting the desired number of measuring steps over one revolution of the encoder shaft. The value must not be higher than the physical resolution of one revolution of the encoder, i.e. 2^n where n is the number of singleturn bits. This parameter only has effect if the scaling function is enabled (see above).

Default value: 4096
Valid range: $1 – 2^n$ where n is the number of single turn bits

Measuring Units per Revolutions must not exceed the physical number of steps over one revolution. For example, with an encoder with 13 single turn bits, it must not exceed 8192. If it does, the encoder will not go into data exchange.

For Scancon 2.1, 2.2 or 3.0 – Named Desired Measuring Units.

The value of this double word (32-bit) depends on what is selected under Desired Measuring Units Select (see: 4.1.5) This parameter only has effect if the scaling function is enabled (see above).

Default value: 4096
Valid range: $1 – 2^{n+m}$ where n is the number of single turn bits and m is the number of multiturn bits.

Desired Measuring Units must not exceed the physical number of steps over the full measuring range. For example, with an encoder with 12 multi turn bits and 13 single turn bits (25 bits total), it must not exceed 33554432. If it does the encoder will not go into data exchange.

4.1.3 Octet no. 14-17 – Total Measuring Range

This double word (32-bit) is used for setting the desired number of measuring steps over the full measuring range of the encoder. The value must not be higher than the total physical resolution of the encoder, i.e. 2^{n+m} where n is the number of singleturn bits and m is the number of multiturn bits. This parameter only has effect if the scaling function is enabled (see above).

Default value: 16777216
Valid range: $1 – 2^{n+m}$

Total Measuring Range must not exceed the physical number of steps over the full measuring range. For example, with an encoder with 12 multi turn bits and 13 single turn bits (25 bits total), it must not exceed 33554432. If it does the encoder will not go into data exchange. Notice, that for a single turn encoder multiturn bits is 0. Therefore, Total Measuring Range must not exceed the physical number of steps over one revolution.

For Scancon 2.1, 2.2 or 3.0.

The use of this double word (32-bit) depends on what is selected under Desired Measuring Units Select (see: 4.5.1). For some selections it is not used.

There are also some additional rules that must be followed concerning the use of Measuring Units per Revolution and Total Measuring Range.

1. Total Measuring Range / Measuring Units per Revolution must be an integer. If it is not, the encoder will not go into data exchange.
2. If the encoder is used in endless operation (when crossing the physical zero point) both Total Measuring Range and Measuring Units per Revolution must be powers of 2 to assure a proper roll-over. If it is not used in endless operation there are no restrictions.

If the encoder does not go into data exchange it is often a violation of the above rules that are the cause.

4.1.4 Octet no. 18-25 – Reserved for Future Use

These bytes are marked as “Reserved for Future Use” in the encoder profile and should therefore all be set to 0.

Additional parameters for Scancon 2.1, 2.2 and 3.0.

4.1.5 Octet no. 26 – Operating Parameters 2

Bit no. 0 and 1 – Desired Measuring Units Select

The settings of these bits select the Desired Measurement Units. It is used to select any required number of steps over 1 revolution, over the whole measuring range or over a part of the measuring range.

1. Desired measuring units per **revolution**
   In this case the position value increases by the programmed number of steps (desired measuring units) over one revolution. Additionally, the parameter "Total Measuring Range" is used to achieve an adaptation of the total measuring range.

2. Desired measuring units per **maximum total measuring range**
   The parameter Desired Measuring Units refers to the complete measuring range of the encoder, i.e. the encoder gives out the programmed number of measuring units over the full physical measuring range.

3. Desired measuring units per **physical impulses**
   The desired measuring units refer to the physical impulses entered in octets 35-39. Physical impulses means: The real value depending on the full (native) resolution of the encoder. With this option it is possible to set gearing factors freely, including non-integer steps per revolution.

Selection	**Bit 0**	**Bit 1**
Per Revolution	0	0
Per Maximum Total Measuring Range	1	0
Per Physical Impulses	0	1

Default value: 0b00 – Per Revolution
Valid range: 0b00 – 0b10

Bit no. 2 – Commissioning Mode Enable

The setting of this bit controls whether Commissioning Mode is active. Some functions are only accessible when the encoder is in commissioning mode. See later under their respective

descriptions. Though it is possible to constantly run in commissioning mode, it is recommended only to run in commission mode when it is necessary.

Bit 2 = 0 (off) – Commissioning Mode is not active.
Bit 2 = 1 (on) – Commissioning Mode not active.

Default value: 0 ~ Commissioning Mode is not active.
Valid range: 0 – 1

Bit no. 3 – Shorter Diagnostic Select

The setting of this bit controls whether the diagnostic message is shorter. For all functionalities, except Class 1 the diagnostic message has a length of 57 octets. Class 1 has a length of 16 octets.

The setting of this bit ensures that all functionalities have a length of 16 octets.

Bit 3 = 0 (off) – 57 octets diagnostic message.
Bit 3 = 1 (on) – 16 octets diagnostic message.

Default value: 0 ~ 57 octets diagnostic message.
Valid range: 0 – 1

Bit no. 4 – Without Status Bits

The setting of this bit controls whether the position data input is transmitted with or without status bits. This bit is only accessible with the Scancon 3.0 functionality. See later under 4.3: Data Exchange.

The ability to run without status bits can be used if the position value is higher than what can be expressed in 25 bits. Notice that if Without Status bits is selected, it is not possible to put the encoder in commissioning mode. Likewise, limit switches cannot be selected (see: 4.1.5).

Bit 4 = 0 (off) – With status bits.
Bit 4 = 1 (on) – Without status bits.

Default value: 0 ~ With status bits.
Valid range: 0 – 1

Bit no. 5 – Enable Lower Limit Switch

The setting of this bit controls whether the Lower Limit Switch is enabled.

Bit 5 = 0 (off) – Lower Limit Switch is not enabled.
Bit 5 = 1 (on) – Lower Limit Switch is enabled.

Default value: 0 ~ Lower Limit Switch is not enabled.
Valid range: 0 – 1

Bit no. 6 – Enable Upper Limit Switch

The setting of this bit controls whether the Upper Limit Switch is enabled.

Bit 6 = 0 (off) – Lower Limit Switch is not enabled.
Bit 6 = 1 (on) – Lower Limit Switch is enabled.

Default value: 0 ~ Upper Limit Switch is not enabled.
Valid range: 0 – 1

Bit no. 7 – Activate Octet 27 – 39

The setting of this bit controls whether octet 27 – 29 are activated. This is handled automatically when Scancon 2.1, 2.2 or 3.0 functionality is selected.

4.1.6 Octet no. 27-30 – Lower Limit Switch

This double word (32-bit) is used for setting the value where the lower limit switch status bit is set. The status bit is set if position value is less than limit switch value.

Default value: 0
Valid range: $0 – 2^{n+m}-1$

4.1.7 Octet no. 31-34 – Upper Limit Switch

This double word (32-bit) is used for setting the value where the upper limit switch status bit is set. The status bit is set if position value is higher than upper limit switch value.

Default value: 32767
Valid range: $1 – 2^{n+m}-1$

4.1.8 Octet no. 35-38 – Physical Impulses

This double word (32-bit) is used for setting the value if Desired Measuring Units Select is set to Physical Impulses (see 4.1.5). With physical impulses, it is possible to set any gearing factor freely. Also gearing factors that requires are non-integers.

The procedure is to set Desired Measuring Units (see 4.1.2) to the number of units that are desired and Physical Impulses to how many physical (native) units that should correspond to.

Default value: 4096
Valid range: $1 – 2^{n+m}$

4.1.9 Octet no. 39 – Operating Parameters 3

Bit no. 1 – Encoder Type

The setting of this bit controls whether the encoder is a multi turn or single turn encoder . This is handled automatically if Scancon 2.1, 2.2 or 3.0 functionality is selected.

Bit no. 4 and 5 – Time Base for Velocity

The settings of these bits control the Time Base for Velocity. It is used to select the sample time over which the speed is measured and is therefore also responsible for the time base used for acceleration.

Selection	Bit 4	Bit 5
Steps per Second	0	0
Steps per 100 Millisecond	1	0
Steps per 10 Millisecond	0	1
RPM – Revolutions per minute	1	1

Default value: 0b00 – Steps per Second
Valid range: 0b00 – 0b11

Though the various parameters and their settings have been described in detail above, it is normally not necessary for the user to set them directly as the settings are performed in a "user-friendly" form in the Profibus Master Preparation software tool. The information on how to set up the necessary menus is imported from the GSD file to the software tool. The procedure for setting the parameters may vary from tool to tool. Consult the documentation for the tool in use. Also note that the naming conventions for the octets may vary. Some tools may name the first octet as octet 0 and others may name it as octet 1. Also, some tools may use the word byte instead of octet.

4.2 Diagnostic Information

The master can at any time request a diagnostic message from the slave so it can check for the capabilities of the slave and important warnings or errors. This is particularly important after the parameterization as the diagnostic message may reflect changes in the functioning of the encoder or even parameters that are illegal. The diagnostic message can consist of two parts, the mandatory part according to the Profibus specifications (octet 1 to 6) and the extended part (octet 7 and up). The length of the diagnostic message for the SCH88BEX varies depending on which functionality is selected.

In the table below the octet number is shown as the position in the whole diagnostic message. Octet no. 7 in the message will therefore also be parameter no. 1 in the extended diagnostic block and so on. The table also describes in which functionality the parameter will be present. Notice that if class 2 is used all parameters from class 1 will be present and if Scancon 2.0 is used all parameters from class 1 and class 2 will be present.

The table below shows the parameters that are contained in the diagnostic message.

Octet no.	Parameter Name	Bit no.	Description	Used for
7	Header	---	Extended Diagnostic Header	Class 1
8	Alarms	0	Position Error	Class 1
		1	Supply Voltage Error	Class 1
		2	Current Too High	Class 1
		3	Commissioning Diagnostics	Class 1
		4	Memory Error	Class 1
		5 - 7	Not Assigned – Send as 0	Class 1
9	Operating Status	0	Code Sequence	Class 1
		1	Class 2 Functionality	Class 1
		2	Commissioning Diagnostics	Class 1
		3	Scaling Function Status	Class 1
		4 - 7	Not Assigned – Send as 0	Class 1

10	Encoder Type	---	Encoder Type	Class 1
11 - 14	Singleturn Resolution	---	Singleturn Resolution	Class 1
15 - 16	Number of Revolutions	---	Total Number of Revolutions	Class 1
17	Additional Alarms	0 - 7	Not Assigned – Send as 0	Class 2
18 - 19	Supported Alarms	0	Position Error	Class 2
		1	Supply Voltage Error	Class 2
		2	Current Too High	Class 2
		3	Commissioning Diagnostics	Class 2
		4	Memory Error	Class 2
		5 - 15	Not Assigned – Send as 0	Class 2
20 - 21	Warnings	0	Frequency Exceeded	Class 2
		1	Temperature Exceeded	Class 2
		2	Light Control Reserve	Class 2
		3	CPU Watchdog Status	Class 2
		4	Operating Time Limit Warning	Class 2
		5	Battery Charge	Class 2
		6	Reference Point	Class 2
		7 - 15	Not Assigned – Send as 0	Class 2
22 - 23	Supported Warnings	0	Frequency Exceeded	Class 2
		1	Temperature Exceeded	Class 2
		2	Light Control Reserve	Class 2
		3	CPU Watchdog Status	Class 2
		4	Operating Time Limit Warning	Class 2
		5	Battery Charge	Class 2
		6	Reference Point	Class 2
		7 - 15	Not Assigned – Send as 0	Class 2
24 - 25	Profile Version	---	Encoder Profile Version	Class 2
26 - 27	Software Version	---	Encoder Software Version	Class 2
28 - 31	Operating Time	---	Encoder Operating Time	Class 2
32 - 35	Offset Value	---	Offset Value	Class 2
36 - 39	Manufacturer Offset Value	---	Manufacturer Offset Value	Class 2
40 - 43	Measuring Units per Rev.	---	Measuring Units per Revolution	Class 2
44 - 47	Total Measuring Units	---	Total Range Measuring Units	Class 2
48 - 57	Serial Number	---	Serial Number of encoder	Class 2

For Class 1 the Diagnostic message has a total length of 16 octet. For Class 2 it has a total length of 57 octets. For Scancon 2.1, 2.2 and 3.0 it, default, has a length of 57 octets, unless the parameter Shorter Diagnostic Select is set. In this case the Shorter Diagnostic has a length of 16 octets.

4.2.1 Octet no. 7 – Header

The extended diagnostic header specifies the length in bytes of the extended diagnostic block including the header itself. The length of the extended diagnostic block is 10 for class 1 functionality and 51 for class 2 and Scancon 2.1 2.2 and 3.0 functionality.

4.2.2 Octet no. 8 – Alarms

This byte will indicate various alarms for the encoder. Only bit 0 – 4 are used. The rest of the bits (bit 5 – 7) will be sent as 0.

Bit no. 0 – Position Error

The setting of this bit indicates whether there is or can be expected to be a position error. If this bit is set, a normal remedy will be to switch off the encoder and switch it on again. It must be expected that an eventual preset value will be lost and that the encoder must be preset again.

Bit 0 = 0 (off) – No position error alarm
Bit 0 = 1 (on) – Position error alarm

Bit no. 1 – Supply Voltage Error

The setting of this bit indicates whether the supply voltage is within range (9V – 30V). If this bit is set, the supply voltage must be checked and, if necessary, adjusted.

Bit 1 = 0 (off) – No supply voltage error alarm
Bit 1 = 1 (on) – Supply voltage alarm

Bit no. 2 – Current too High

This alarm is not supported by the SCH88BEX and will therefore be sent as 0.

Bit no. 3 – Commissioning Diagnostics

This alarm is not supported by the SCH88BEX and will therefore be sent as 0.

Bit no. 4 – Memory Error

This alarm is not supported by the SCH88BEX and will therefore be sent as 0.

4.2.3 Octet no. 9 – Operating Status

This byte will indicate the operating status of the encoder. Only bits 0 – 3 are used. The rest of the bits (bit 4 – 7) will be sent as 0.

Bit no. 0 – Code Sequence

The setting of this bit indicates the counting direction of the encoder. The counting direction is defined as seen from the shaft side of the encoder (the motor side).

Bit 0 = 0 (off) – Increasing with clockwise rotation
Bit 0 = 1 (on) – Increasing with counterclockwise rotation

Bit no. 1 – Class 2 functionality

The setting of this bit indicates whether the encoder supports class 2 functionality.

Bit 1 = 0 (off) – Class 2 functionality not supported
Bit 1 = 1 (on) – Class 2 functionality supported

Bit no. 2 – Commissioning Diagnostics

Commissioning Diagnostics is not supported by the SCH88BEX and will therefore be sent as 0.

Bit no. 3 – Scaling Function Status

The setting of this bit indicates whether the scaling function is enabled.

Bit 3 = 0 (off) – Scaling Function Disabled
Bit 3 = 1 (on) – Scaling Function Enabled

4.2.4 Octet no. 10 – Encoder Type

This byte will indicate the encoder type.

0 = Single Turn Absolute Rotary Encoder
1 = Multi Turn Absolute Rotary Encoder.

4.2.5 Octet no. 11-14 – Singleturn Resolution

This double word (32-bit) value will indicate the physical number of positions on one revolution of the encoder shaft. The value depends on the number of singleturn bits with which the encoder is delivered.

4.2.6 Octet no. 15-16 – Number of Revolutions

This word (16-bit) value will indicate the physical number of distinguishable revolutions of the encoder shaft the encoder can detect. The value depends on the number of multiturn bits with which the encoder is delivered.

4.2.7 Octet no. 17 – Additional Alarms

The Profibus Profile for Encoders does not assign any definitions for additional alarms. This value will be sent as 0.

4.2.8 Octet no. 18-19 – Supported Alarms

This word (16-bit) will indicate the alarms that are supported by the SCH88BEX. Only bit 0 – 4 are used. The rest of the bits (bit 5 – 15) will be sent as 0.

Bit no. 0 – Position Error

This alarm is supported by the SCH88BEX and will therefore be sent as 1.

Bit no. 1 – Supply Voltage Error

This alarm is supported by the SCH88BEX and will therefore be sent as 1.

Bit no. 2 – Current too High

This alarm is not supported by the SCH88BEX and will therefore be sent as 0.

Bit no. 3 – Commissioning Diagnostics

This alarm is not supported by the SCH88BEX and will therefore be sent as 0.

Bit no. 4 – Memory Error

This alarm is not supported by the SCH88BEX and will therefore be sent as 0.

4.2.9 Octet no. 20-21 – Warnings

This word (16-bit) will indicate various warnings for the encoder. Only bits 0 – 6 are used. The rest of the bits (bit 7 – 15) will be sent as 0. Note that these are warnings and not errors. They indicate that the encoder will be operating but may need service in the near future.

Bit no. 0 – Frequency Exceeded

This warning is not supported by the SCH88BEX and will therefore be sent as 0.

Bit no. 1 – Temperature Exceeded

This warning indicates whether the temperature is high inside the encoder. The threshold value is 65°C (149°F).

Bit 1 = 0 (off) – Temperature below 65°C
Bit 1 = 1 (on) – Temperature above 65°C

Bit no. 2 – Light Control Reserve

This warning indicates whether the light output from the LED has degraded below a certain limit. A degraded LED must be exchanged at the factory.

Bit 2 = 0 (off) – Light output within limits
Bit 2 = 1 (on) – Light output outside limits

Bit no. 3 – CPU Watchdog Status

This warning is not supported by the SCH88BEX and will therefore be sent as 0.

Bit no. 4 – Operating Time Limit Warning

This warning indicates whether the operating time of the encoder has exceeded a limit. The limit is set as 87600 hours (10 years)

Bit 4 = 0 (off) – Operating time below limit
Bit 4 = 1 (on) – Operating time above limit

Bit no. 5 – Battery Charge

This warning indicates whether the voltage of the battery has dropped below a limit. The encoder will still be operating but the battery will need to be replaced in the near future. The battery is not replaceable by the user and must be replaced at the factory.

Bit 5 = 0 (off) – Battery voltage above limit
Bit 5 = 1 (on) – Battery voltage below limit

Bit no. 6 – Reference Point

This warning is not supported by the SCH88BEX and will therefore be sent as 0.

4.2.10 Octet no. 22-23 – Supported Warnings

This word (16-bit) will indicate the warnings that are supported by the SCH88BEX. Only bits 0 – 6 are used. The rest of the bits (bit 7 – 15) will be sent as 0.

Bit no. 0 – Frequency Exceeded

This warning is not supported by the SCH88BEX and will therefore be sent as 0.

Bit no. 1 – Temperature Exceeded

This warning is supported by the SCH88BEX and will therefore be sent as 1.

Bit no. 2 – Light Control Reserve

This warning is supported in the SCH88BEX and will therefore be sent as 1.

Bit no. 3 – CPU Watchdog Status

This warning is not supported by the SCH88BEX and will therefore be sent as 0.

Bit no. 4 – Operating Time Limit Warning

This warning is supported in the SCH88BEX and will therefore be sent as 1.

Bit no. 5 – Battery Charge

This warning is supported by the SCH88BEX and will therefore be sent as 1.

Bit no. 6 – Reference Point

This warning is not supported by the SCH88BEX and will therefore be sent as 0.

4.2.11 Octet no. 24-25 – Profile Version

These two bytes will give the version of the Profibus Profile for Encoders that is supported by the SCH88BEX. The first byte (octet 24) gives the major version number and the second byte (octet 25) gives the minor version number. As an example 0x01 – 0x01 will give version 1.1.

4.2.12 Octet no. 26-27 – Encoder Software Version

These two bytes will give the version of the encoder software The first byte (octet 26) gives the major version number, and the second byte (octet 27) gives the minor version number. As an example 0x01 – 0x01 will give version 1.1.

4.2.13 Octet no. 28-31 – Operating Time

This double word (32-bit) value will indicate the operating time of the encoder. The operating time is defined as the total amount of time the encoder has been under external power. The operating time is given with a resolution of 0.1 hours. A value of 61 (decimal) will therefore mean 6 hours and 6 minutes.

4.2.14 Octet no. 32-35 – Offset Value

This double word (32-bit) value will indicate the offset of the encoder value from the physical zero point of the encoder. The offset value is calculated in the preset function and is used to shift the internal position value with the offset value. The offset value is given in scaled units if scaling is activated. If the encoder has not been preset the offset value will be 0. The offset value is stored in the internal non-volatile E^2Prom and will therefore be saved, even when the encoder is not powered by external power. The offset value is a signed binary value.

4.2.15 Octet no. 36-39 – Offset Value of the Encoder Manufacturer

This double word (32-bit) value will indicate the offset value of the encoder manufacturer. As there is no manufacturer offset in the SCH88BEX this value will be sent as 0.

4.2.16 Octet no. 40-43 – Measuring Units per Revolution

This double word (32-bit) value will indicate the measuring units per revolution. If the scaling function is not enabled it will be the physical number of positions that is equal to the resolution of the disc. If the scaling function is enabled it will be the resolution that has been set during the parameterization.

4.2.17 Octet no. 44-47 – Total Measuring Range in Measuring Units

This double word (32-bit) value will indicate the measuring units for the total measuring range. If the scaling function is not enabled it will be the physical number of positions that is equal to the resolution of the disc multiplied by the total number of revolutions the encoder can measure. If the scaling function is enabled it will be the total measuring range that has been set during the parameterization.

4.2.18 Octet no. 48-57 – Encoder Serial Number

The serial number is sent as an ASCII string of 10 bytes. For the SCH88BEX, the serial number is not used and will therefore be send as 10 times * (0x2A).

4.3 Data Exchange

After a successful initialization, the communication will go into the data exchange phase where data is exchanged cyclically between the master and the slave.

The used notation:
Output Data is data sent from the master to the slave.
Input Data is data sent from the slave to master.

Depending on which functionality the encoder has been set for, the number of output bytes and input bytes will differ. The following number of bytes will be exchanged:

1. **Class 1 Multiturn** – 0 output bytes, 4 input bytes.
2. **Class 2 Multiturn** – 4 output bytes, 4 input bytes.
3. **Scancon 2.1 Multiturn** – 4 output bytes, 4 input bytes.
4. **Scancon 2.2 Multiturn** – 4 output bytes, 6 input bytes.
5. **Scancon 3.0 Multiturn** – 4 output bytes, 8 input bytes.

It is recommended that all output data, when it is not used for something else, is sent as 0 (0x0000:0000).

4.3.1 – Class 1 Multiturn

For a class 1 multiturn encoder, only data from the encoder to the master (input data) will be sent.

The encoder will send its position to the master as a long word (32-bit) value. The value will be sent in big endian format (first byte is MSB) and the value is unsigned. 31 bits are used for the value.

Input Data for Class 1 Multiturn

Function	Position Value																															
Word	Word 1																Word 0															
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

4.3.2 – Class 2 Multiturn

For a Class 2 multiturn encoder, there will be both output data and input data. The input data will be the process value and the output data will either be "don't care" if bit 31 is clear or be a preset value if bit 31 is set.

The encoder will send its position to the master as a long word (32-bit) value. The value will be sent in big endian format (first byte is MSB) and the value is unsigned.

Input Data for Class 2 Multiturn

Function	Position Value																															
Word	Word 1																Word 0															
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

The master will send a preset value to the encoder as a long word (32-bit) value. If the most significant bit (bit 31) is set (1) the encoder will preset itself to the lowest 31 bits of the value. Note that the lowest 31 bits must not have a value that is higher than the Total Measuring Range in Measuring Units - 1, see section 4.2.17 above. The preset value is unsigned.

Preset Sequence for Class 2 Multiturn

Function	Preset Value																															
Word	Word 1																Word 0															
Bit no.	31	30	29	28	27	26	24	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Output	**1**	31 bit Preset value from master with bit 31 set																														
Input	0	New position value sent from slave																														
Output	**0**	Bit 31 cleared from master																														
Input	0	New position value sent from slave																														

4.3.3 – Scancon 2.1 Multiturn

For a Scancon 2.1 multiturn encoder there will be both output data and input data. The input data will be the process value that consists of 25 bits and a status block that consists of 7 bits. The output data will either be "don't care" if bit 31 is clear or be a preset value if bit 31 is set.

The encoder will send its position and status bits to the master as a long word (32-bit) value. The value will be sent in big endian format (first byte is MSB) and the value is unsigned.

Notice, that for Scancon 2.1, the process value must be contained in 25 bits (less than 33554432).

Input Data for Scancon 2.1 Multiturn

Function	Position Value and Status Bits																														
Word	Word 1																Word 0														
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	Status bits – 7 bits							Position value – 25 bits																								

The status bits have the following meanings:

Bit 25: Ready	Set if the encoder is ready for operation – Clear if the encoder is not ready for operation.
Bit 26: Mode	Set if the encoder is not in commission mode – Clear if the encoder is in commission mode.
Bit 27: Limit Switch	Set if the encoder position is outside specified limits – Clear if the encoder position is inside specified limits.
Bit 28: Code Sequence	Set if the encoder is increasing counterclockwise – Clear if the encoder is increasing clockwise.

The master will send a preset value to the encoder as a long word (32-bit) value. If the most significant bit (bit 31) is set (1) the encoder will preset itself to the lowest 25 bits of the value. Note that the lowest 25 bits must not have a value that is higher than the Total Measuring Range in Measuring Units - 1, see section 4.2.17 above. The preset value is unsigned.

Preset Sequence for Scancon 2.1 Multiturn

Function	Preset Value																														
Word	Word 1																Word 0														
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Output	**1**	0	0	0	0	0	0	25 bit Preset value from master with bit 31 set																								
Input	**1**	0	0	0	0	0	1	New position value from slave																								
Output	**0**	0	0	0	0	0	0	Bit 31 cleared from master																								
Input	**0**	0	0	0	0	0	1	New position value from slave																								

4.3.4 – Scancon 2.2 Multiturn

For a Scancon 2.2 multiturn encoder, the only difference from the Scancon 2.1 multiturn encoder is the addition of Velocity. The Velocity is a word (16-bit) value. The Velocity value will be sent in big endian format (first byte is MSB) and the value is signed.

Full Input Message for Scancon 2.2 Multiturn

Function	Position Value				Velocity Value	
Byte no.	1 (MSB)	2	3	4 (LSB)	5 (MSB)	6 (LSB)
Value	Position Value + Status bits – 32 bits				Velocity Value – 16 bits	

The Velocity being signed means that the most significant bit (bit 15) is the sign. 0 for positive and 1 for negative values. The rest 15 bits (bit 14 – 0) are the value. The Velocity can therefore have a value between -32768 and 32767. The value is positive with increasing position values and negative with decreasing position values.

The velocity value may overflow for high velocities and long sample time for Velocity. In that case the velocity value is set to the most positive value (32767) for increasing position values and the most negative value (-32768) for decreasing position values.

The position part of the input data and the Preset Sequence are identical to the Scancon 2.1 (see: 4.3.3).

Input Data for Scancon 2.2 Multiturn (Position Part)

Function	Position Value and Status Bits																													
Word	Word 1																Word 0													
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	Status – 7 bits							Position value – 25 bits																								

Scancon Encoders Huginsvej 8 3400 Hillerød Denmark
Tel. +45 48 17 27 02 www.scancon.dk

Preset Sequence for Scancon 2.2 Multiturn

Function	Preset																													
Word	Word 1																Word 0													
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Output	**1**	0	0	0	0	0	0	25 bit Preset value from master with bit 31 set																								
Input	**1**	0	0	0	0	0	1	New position value from slave																								
Output	**0**	0	0	0	0	0	0	Bit 31 cleared from master																								
Input	**0**	0	0	0	0	0	1	New position value from slave																								

4.3.5 – Scancon 3.0 Multiturn

For a Scancon 3.0 multiturn encoder, the only difference from the Scancon 2.2 multiturn encoder is the addition of Acceleration and the possibility to send position data without status bits. The Acceleration is a word (16-bit) value. The Acceleration value will be sent in big endian format (first byte is MSB) and the value is signed.

Full Input Message for Scancon 3.0 Multiturn

Function	Position Value				Velocity Value		Acceleration Value	
Byte no.	1 (MSB)	2	3	4 (LSB)	1 (MSB)	2 (LSB)	1 (MSB)	2 (LSB)
Value	Position – 32 bits				Velocity – 16 bits		Accel. – 16 bits	

The Acceleration being signed means that the most significant bit (bit 15) is the sign. 0 for positive and 1 for negative values. The remaining 15 bits (bit 14 – 0) are the value. The Acceleration can therefore have a value between -32768 and 32767. The value is positive with increasing velocity and negative with decreasing velocity.

The Acceleration value may overflow for high acceleration values and long sample time for Velocity. In that case the acceleration value is set to the most positive value (32767) for increasing velocity values and the most negative value (-32768) for decreasing velocity values.

The position part of the input data and the Preset Sequence are identical to the to the Scancon 2.2 (see: 4.3.4) with the exception that it gives the possibility to send the input position value without status bits. The reason for excluding the status bits is most likely the need for more data bits in the position value. With status bits the position value cannot be more than 25 bits total (33554432 positions) whereas without status bits, it can be up to 31 bits (2147483648 positions).

For use without status bits, the data exchange looks like this:

Input Data for Scancon 3.0 Multiturn without Status Bits

Function	Position Value																															
Word	Word 1																Word 0															
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

The master will send a preset value to the encoder as a long word (32-bit) value. If the most significant bit (bit 31) is set (1) the encoder will preset itself to the lowest 31 bits of the value. Note that the lowest 31 bits must not have a value that is higher than the Total Measuring Range in Measuring Units - 1, see section 4.2.17 above. The preset value is unsigned.

Preset Sequence for Scancon 3.0 Multiturn without Status Bits

Function	Preset Value																															
Word	Word 1																Word 0															
Bit no.	31	30	29	28	27	26	24	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Output	**1**	31 bit Preset value from master with bit 31 set																														
Input	0	New position value sent from slave																														
Output	**0**	Bit 31 cleared from master																														
Input	0	New position value sent from slave																														

For use with status bits, the position part of the input data and the Preset Sequence are identical to the to Scancon 2.1 (see: 4.3.3).

Input Data for Scancon 3.0 Multiturn with Status Bits (Position Part)

Function	Position Value and Status Bits																															
Word	Word 1																Word 0															
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Value	Status – 7 bits							Position value – 25 bits																								

Preset Sequence for Scancon 3.0 Multiturn with Status Bits

Function	Preset																														
Word	Word 1																Word 0														
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Output	**1**	0	0	0	0	0	0	25 bit Preset value from master with bit 31 set																								
Input	**1**	0	0	0	0	0	1	New position value from slave																								
Output	**0**	0	0	0	0	0	0	Bit 31 cleared from master																								
Input	**0**	0	0	0	0	0	1	New position value from slave																								

4.4 Manufacturer Specific Functions

For Scancon 2.1, 2.2 and 3.0 the encoder has some additional functionality that can be executed when the encoder is in commissioning mode. These are the ability to change direction “on the fly” and to adapt the measuring range through a Teach-In procedure.

Note if Scancon 3.0 has been set to send out position data without status bits, this functionality is not possible. The encoder cannot be set to commissioning mode when there are no status bits.

4.4.1 – Setting the Counting Direction

The encoder has the possibility to change the counting direction (code sequence) under normal operation. This is signaled from the master by setting bit 28. In the response from the encoder 0 indicates increasing clockwise and 1 indicates increasing counterclockwise.

Setting the Counting Direction Sequence

Function	Setting the Counting Direction																														
Word	Word 1																Word 0														
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Output	0	0	0	**1**	0	0	0	Changing counting direction from master with bit 28 set																								
Input	0	0	0	**0/1**	0	0	1	Slave sends acknowledge in bit 0 and bit 28																								**0/1**
Output	0	0	0	0	0	0	0	Bit 28 cleared from master																								
Input	0	0	0	**0/1**	X	0	1	New position value from slave with new counting direction in bit 28																								

The new counting direction is stored non-volatile in the internal EEPROM.

4.4.2 – Teach-In

The Teach-In procedure consists of two steps, Start Teach-In, and End Teach-In.

4.4.2.1 – Start Teach-In

The operator moves the system to the position where the Teach-In shall start. and starts the Teach-In procedure in the following way. This is signaled from the master by setting bit 30.

Notice that the whole Teach-In procedure is executed in the un-scaled mode and with an offset of 0.

It should also be noted that the whole Teach-In procedure should be executed with the Desired Measuring Units Select bits set to Maximum Total Measuring Range (0b01) and that scaling must be enabled.

Starting the Teach-In Sequence

Function	Teach-In Start																															
Word	Word 1																Word 0															
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Output	0	**1**	0	0	0	0	0	Starting Teach-In from master with bit 30 set																								
Input	0	**1**	0	X	X	0	1	Slave acknowledges with bit 30 set																								
Output	0	**0**	0	0	0	0	0	Bit 30 cleared from master																								
Input	0	**1**	0	X	X	0	1	Un-scaled position value from slave																								

The operator moves the system to the endpoint. It does not matter whether this is in clockwise or counterclockwise direction as it is the distance that is measured. But the physical (native) zero point must not be crossed. Note, that after having started Teach-In, bit 30 in the input message will be set to indicate that we are in the in the Teach-In procedure. The bit will not be cleared until Teach-In ends.

4.4.2.1 – End Teach-In

The master ends the Teach-In by setting bit 29. It also sends the desired number of units for the traveled distance. After receiving the End Teach-In command from the master, the encoder calculates the total resolution and sends it to the master.

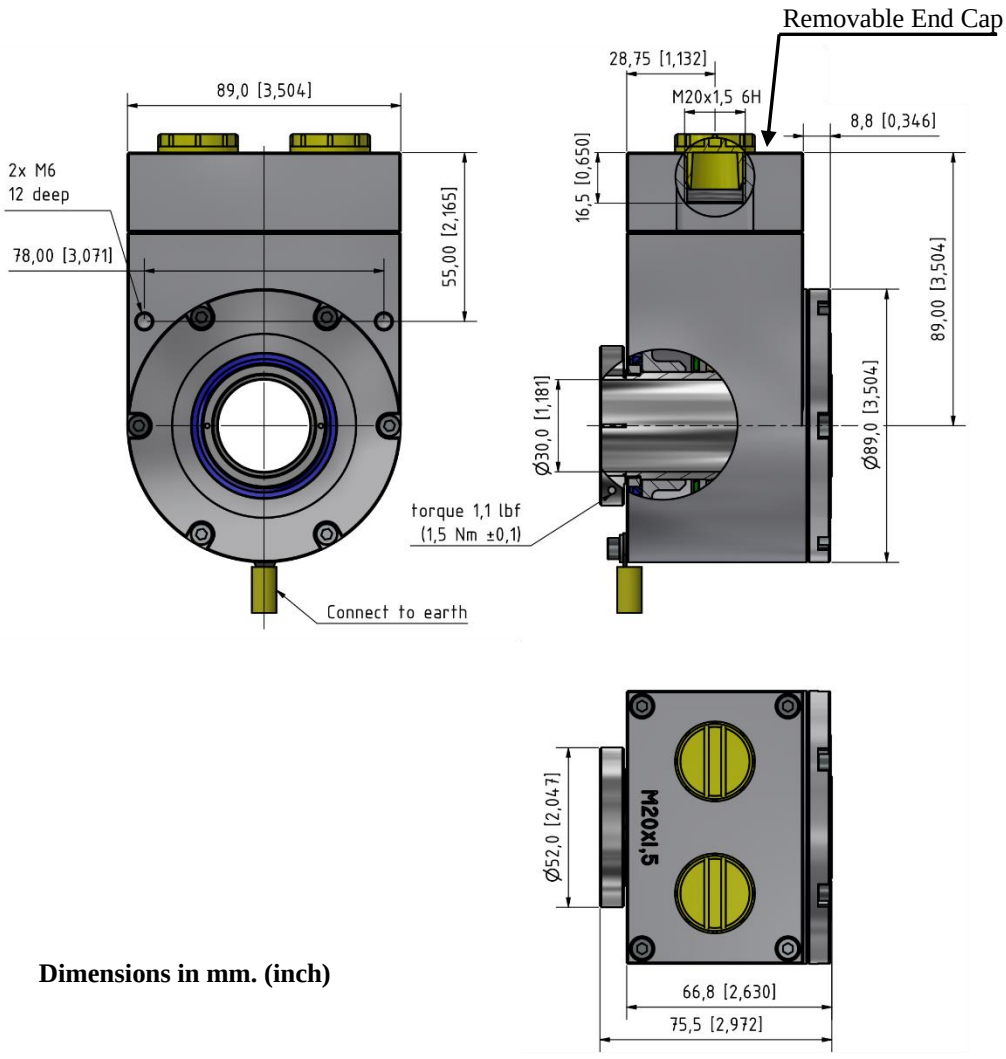
Ending the Teach-In Sequence

Function	Teach-In End																														
Word	Word 1																Word 0														
Bit no.	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Output	0	0	**1**	0	0	0	0	End Teach-In with bit 29 set. Bit 0 – 24 are nominal traveled distance																								
Input	0	1	**1**	X	X	0	1	Slave acknowledges with bit 29 set. Bit 0 – 24 are the total resolution																								
Output	0	0	**0**	0	0	0	0	Bit 29 cleared from master																								
Input	0	0	**0**	X	X	0	1	Position value scaled with new scaling factor from slave																								

The total resolution value sent from the slave must be noted, and later, when the encoder is switched back to normal mode, entered into the parameter settings for Maximum Desired Measuring Units in the master. This will also ensure that a potential replacement encoder will not need a new Teach-In.

The encoder will now operate with the new Maximum Desired Measuring Units and the value of Maximum Desired Measuring Units will also be written to non-volatile EEPROM. But it should be noted that if the encoder is re-parameterized before the new value is entered into the parameter settings in the master, the parameter will be overwritten under the parameterization.

5 Mechanical Dimensions



Dimensions in mm. (inch)

Plastic screw plugs are provided for cable outlet protection during shipping and storage.
These plastic plugs must be replaced by an EX d certified cable gland or blind plug prior to use.

Mechanical Tolerances (mm)	
Hollow Shaft *(ISO tolerance)*: Hollow bore ø > 18 mm to ≤ 30 mm	ISO 286-2 ANSI B4.2 H7 (+ 0 / + 0.021)
Shaft *(recommended ISO tolerance)*: Shaft ø > 18 mm to ≤ 30 mm	ISO 286-2 ANSI B4.2 g6 (- 0.007 / - 0.020)
Shaft Runout (*recommended* TIR):	NEMA Std. MG1, 4.9.7 + / - 0.05 mm (0.002 inch)

6 Technical Specifications

Electrical Specifications	
Encoder Type:	Absolute Multiturn Encoder
Code:	Binary
Protocol	Profibus DP-V0. Supports the Profibus Profile for Absolute Encoders Ver. 1.1 Class 1 and Class 2 and manufacturer specific functions.
Resolution:	Max. 15 bits (32,678) revolutions. Max. 16 bits (65,536) steps per. rev.
Addressing:	Adjustable by rotary switches in the removable end cap and through the Change Station Address function over the Profibus interface
Address Range:	1 - 126
Baud Rate:	Supports all standard baud rates from 9,600 baud to 12 Mbaud
Update Rate:	>1500 updates per second
Termination Resistors:	Switchable On/Off by switch in the removable end cap
Supply Voltage:	9 V min. to 30 V max.
Current Consumption: **Typical without load**	Depending on supply voltage: 80 mA @ Vsup = 10 V 40 mA @ Vsup = 24 V
Power Consumption:	< 1.2 Watts
Electrical Protection:	Reverse polarity protected
Noise Immunity:	Tested to EN61000-6-2 : 2005 and 61000-6-3 : 2007

Mechanical Specifications	
Material:	Housing: Aluminum treated with Chromital TCP. Stainless Steel (AISI 316) as an option Hollow Shaft: Stainless Steel (AISI 316)
Weight:	Aluminum: approx. 1.5kg (3.3 lbs) Stainless Steel: approx. 3.0kg (6.6 lbs)
Bearing Life:	> 1.9 x 10^{10} revolutions at rated load
Shaft Speed:	3000 RPM continuous (max.)
Starting Torque:	< 0.4 Nm (56 oz-in) at 25° C
Mass Moment of Inertia:	1.62 kgcm² (8.9 oz-in²)
Shaft Loads:	250 N (56 lbf) Axial max. 500 N (112 lbf) Radial max.

Environmental Specifications	
Operating Temperature:	-40° to +70° C
Storage Temperature:	-40° to +85° C
Shock:	100G @ 11 mSec
Vibration:	10G @ 10 – 2000 Hz
Bump:	10G @ 16 mSec (1000 x 3 axis)
Humidity:	98% RH without condensation
Enclosure Rating:	IP65 / Nema 4 (approx.) IP66 / Nema 6 (approc.) IP67 / Nema 6 (approx.)

Connection Options	
Connections:	Located on the removable end cap 8-pin terminal block for bus in/out
Cable Glands:	M20, M25 and ½ inch NPT threaded outlets on the removable end cap. Ex d certified cable glands required

7 Document Revision History

Rev.	Date	Section	Notes
1.0	22. Aug. 2018	-----	Initial version
1.1	7. June 2019	2	Exchanged picture to showing 2 cable shoes
2.0	26. August 2023	-----	Major changes due to added functionality

Scancon Encoders Huginsvej 8 3400 Hillerød Denmark
Tel. +45 48 17 27 02 www.scancon.dk