HEIDENHAIN

User's Manual

PROFIBUS-DP

Interface for Encoders

English (en)
12/2010

List of Tables

List of Figures

1 General Information

This manual describes installation and configuration options of the HEIDENHAIN encoders with PROFIBUS-DP interface. The PROFIBUS-DP gateway is therefore the solution of choice for applications with high ambient temperature. Encoders with integral PROFIBUS-DP interface are advantageous if a very compact solution is required.

In view of the certification by PNO (PROFIBUS user organization) all products can be used in all PROFIBUS-DP systems without restrictions. Among other things this means that all possible baud rates, the complete address range and the device characteristics are supported according to the PROFIBUS device profile for encoders.

1.1 The PROFIBUS Technology

PROFIBUS is a manufacturer-independent and open field bus standard defined by the international standards EN 50170 and EN 50254. PROFIBUS enables communication between devices of differing manufacturers. PROFIBUS is suited for time-critical applications as well as for complex tasks. Other technical and manufacturer-independent information is available on the Internet at http://www.profibus.com.

Parameters and diagnostic ranges are reserved for manufacturer-specific functions. The position value of the encoder is transferred in binary format.

The encoder profile can be obtained from the Profibus user organization (PNO) in Karlsruhe, Germany, under the order number 3.062.

1.1.1 Abbreviations

PROFIBUS	**Pro**cess **Fi**eld **Bus** (standardized field bus for automation and production technology)
PROFIdrive	**Pro**cess **Fi**eld **drive** (standard profile for drive technology in combination with the Profibus communication system)
PI	**P**ROFIBUS **I**nternational
PNO	**P**ROFIBUS **N**utzer**o**rganisation e.V. (PROFIBUS user organization)
GSD	German expression “Gerätestammdaten”. A GSD is the device database file, also called “device datasheet”.
DP	**D**ecentral **P**eriphery (Profibus user interface — layer 7 in the OSI reference model)
Input data	Data that the master receives from the encoder
Output data	Data that the encoder receives form the master
PDU	**P**rotocol **D**ata **U**nit
DDLM	**D**irect **D**ata **L**ink **M**apper, the interface between PROFIBUS-DP functions and the encoder software
DDLM_Set_Prm	Interface during parameterization
DDLM_Data_Exchange	Interface during data exchange (normal operation)
DDLM_Slave_Diag	Interface during diagnostics data transmission
I&M	**I**dentification and **M**aintenance

2 Encoder Installation

2.1 Settings Inside the Encoder

The encoder node address and bus termination must be configured during commissioning of the device. This is done by removing the back cover, i.e. unscrewing the three screws on the rear of the encoder.

2.1.1 Node address

The node address of the encoder can be set via two decimal rotary switches located inside the back cover. The weighting (x10 and x1) is specified beside the switches. The permissible address range is between 0 and 99, but the lowest addresses 0 to 2 are usually used by the master, and should not be used by the encoder. Each address used in a PROFIBUS network must be unique and may not be used by other devices.

The device address is only read and adopted when the encoder power supply is switched on. A restart of the encoder is therefore required in order to adopt changes made to the address settings.

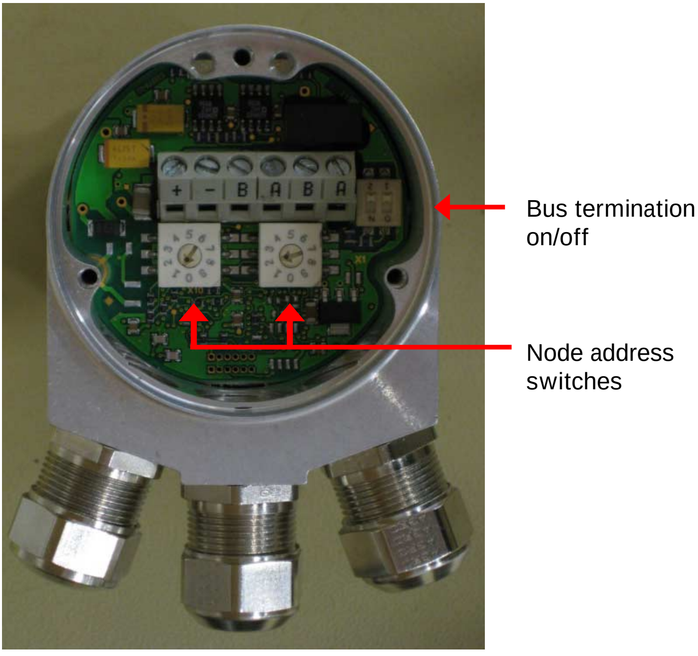

Figure 1 View of PROFIBUS encoder PCB and cable glands

2.1.2 Bus termination

In a PROFIBUS network, all devices are connected with each other in a bus structure. Up to 32 devices (masters and/or slaves) can be connected per segment. If more devices are needed, repeaters must be used to amplify the signals between segments. An active termination must be added to the beginning and end of each bus segment in order to ensure error-free operation. In rotary encoders such terminators are integrated on the PCB, and can be activated via dip switches as shown in Figure 1. If the power supply to the device is interrupted, the A and B lines are internally terminated by a 220 Ω resistor.

If an encoder with M12 flange sockets is used, a terminating resistor plug is necessary for termination. This plug is attached similar to an M12 connector. Male as well as female contacts can be used to terminate the two ends of the bus.

2.2 Connecting the Encoder

The unit may only be installed by an authorized electrician. National and international regulations regarding the installation of electrical facilities must be followed.

2.2.1 Power supply

Necessary **mating connector** for **rotary encoders with M12 connecting element:**
Power supply:
M12 connector, 4-pin, A-coded

Power supply

Figure 2 Position of the M12 power supply connector

Power supply for M12 version	
Function	***PIN***
DC: 9 V to 36 V	1
Not connected	2
0 V	3
Not connected	4

Table 1 Pin layout of the M12 power supply connector

The **rotary encoders with cable glands** must always have a shielded power supply cable with a line cross-section between 0.34 mm2 and 1.5 mm2. The permissible cable outside diameter is 8 mm to 10 mm. On the PCB there are two screw terminals with the power supply terminals marked (+) and (–).

The (+) terminal is used to connect the U_P line (DC: 9 V to 36 V).
The (–) terminal is used to connect the 0 V line.

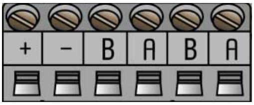

Figure 3 Terminal connection of power supply cables

2.2.2 Bus lines

Necessary **mating connectors** for **rotary encoders with M12 connecting element:**
Bus input:
M12 connector (female), 5-pin, B-coded
Bus output:
M12 coupling (male), 5-pin, B-coded

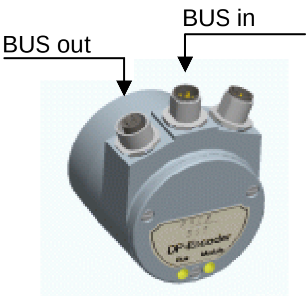

Figure 4 Position of the M12 bus connectors

BUS in lines		BUS out lines	
Function	***PIN***	***Function***	***PIN***
Not connected	1	VP	1
A	2	A	2
Not connected	3	DGND	3
B	4	B	4
Shield	5	Shield	5

Table 2 Pin layout of the M12 BUS in/out lines

The **rotary encoders with cable glands** must have twisted pair shielded cables in accordance with EN 50170 and PROFIBUS guidelines. The guidelines recommend a line cross-section greater than 0.34 mm². The permissible cable outside diameter is 6 mm to 8 mm. On the PCB there are four screw terminals with the bus line terminals marked (A) and (B).

The (A) terminal is used to connect the A line (green).
The (B) terminal is used to connect the B line (red).

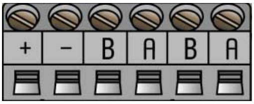

Figure 5 Terminal connection of bus line cables

Note:
Since the two A terminals are internally connected to each other (as are the two B terminals), it does not matter to which A or B terminal the bus lines are connected.

2.3 Installation of the Gateway

1. Remove the cover of the gateway housing.
2. Strip the cable ends by a suitable length, leaving approx. 15 mm of the cable shield for connection to the cable gland.
3. Slide the power cable through the cable gland.
4. Connect the wires of the power supply through the terminal block +E and 0 V. Tighten the terminal screws.
5. Tighten the cable gland and ensure that the shielding is connected with the gland.

For the installation of the encoder with PROFIBUS-DP interface, please see the mounting instructions supplied with the product.

2.4 Shielding Strategy

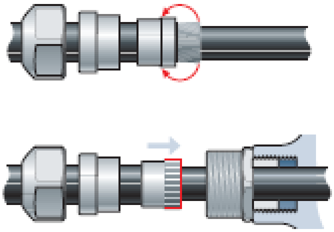

Figure 6 Cable assembly principle

To achieve the highest possible noise immunity and resistance against EMI related disturbances, the bus and power supply cables must always be shielded. The shield must be grounded at both ends of the cable. In certain cases compensation current might flow through the braiding. Therefore a potential compensation line is recommended.

2.5 GSD Files

Absolute encoders with PROFIBUS can be configured and parameterized corresponding to the requirements of the user. When the system is started, the PROFIBUS devices are set and configured in DDLM_Set_Prm mode, i.e. the encoder class is set by means of the GSD file in the configuration tool and the operating parameters are transmitted to the respective slave.

HEIDENHAIN offers various GSD files, depending on the type of PROFIBUS device used (integrated encoder or gateway). In addition, a distinction between DPV0 or DPV2 functionality is made by selecting a different GSD file. All available GSD files can be ordered or downloaded from www.heidenhain.de.

GSD files	
Encoder type and functionality	***GSD file***
Integrated encoder, DPV0	enc_a401
Integrated encoder, DPV2	enc_0aaa

Table 3 Available GSD files

During configuration of the encoders, the various encoder classes can be selected as described in the following chapters. The selectable parameters and functionality of the device depend on the selected encoder class. This data, saved in the PROFIBUS master, is transferred to the encoder once the system is powered on.

After the configuration and parameter data have been received the encoder enters normal operation with cyclic data transfer, i.e. “DDLM_Data_Exchange mode”.

Installation of the GSD files:

1. On the data carrier, select the GSD file of the respective device and copy the *.gsd file into the appropriate directory of the PROFIBUS configuration tool.

2. On the data carrier, select the bitmap file of the respective device and copy the *.bmp file into the appropriate directory of the PROFIBUS configuration tool.

3. Update the GSD files (SCAN).

2.6 LED Display

Two LEDs on the rear of the encoder indicate the encoder status. The module LED indicates the status of the module itself. The bus LED indicates the status of the bus. The table below defines the diagnostic messages using the red (BUS) and red/green (MODULE) LEDs. The function of the LED display is the same in DPV0 and DPV2 modes.

Bus	Module	Meaning	Cause
Dark	Dark	No power	
Red	Green	No connection to another device Criterion: no data exchange	– Bus not connected – Master not available / switched off
Red 2)	Red 2)	No connection to another device No connection between EnDat base encoder and PROFIBUS PCB	– No connection to EnDat encoder at power up
Blinking red 1)	Green	Parameterization or configuration fault	– The received configuration differs from the supported configuration – Parameter error in the parameterization
Dark	Red	System failure	– Diagnosis available, slave in data exchange mode – Position error
Dark	Green	Data exchange Slave and operation OK	

Table 4 LED display

1) The **blinking** frequency is 0.5 Hz. The minimum indication time is 3 s.
2) There is a position error when an alarm occurs in the encoder or if the EnDat base encoder is disconnected from the PROFIBUS interface PCB.

3 Profile Overview

The encoder device profiles for PROFIBUS-DPV0, DPV1 and DPV2 define the functionality of encoders connected to a PROFIBUS-DP bus. There are two encoder profiles available (3.062 and 3.162) for defining the functionality of the encoder for the different versions of PROFIBUS DP. Please refer to the illustration on the following page for an overview of the two different encoder profiles and the standards related to these profiles.

Encoder profile for DPV0, version 1.1, order no. 3.062.

The operating functions of this profile are divided into two device classes. Class 1 encoders offer basic functions that all PROFIBUS-DP encoders must support. A class 1 encoder can optionally support selected functions of class 2, but these functions must be implemented according to the profile. In order to support earlier PROFIBUS-DP implementations, the size of the protocol data units (PDU) is limited to 16 bytes. Class 2 encoders must support all functions of class 1 as well as those of class 2. Parameters and diagnostic ranges are reserved for manufacturer-specific functions.

Encoder profile for DPV1 and DPV2, version 3.1, order no. 3.162.

This profile also has two classes of devices: Class 3 with the basic functions, and class 4 with the full range of scaling and preset functions. Optional functions are defined in addition to the mandatory functions of classes 3 and 4.

For further information regarding the encoder functionality, please refer to the device profiles. These profiles and PROFIBUS technical information can be ordered from the PNO in Karlsruhe, Germany (www.PROFIBUS.com).

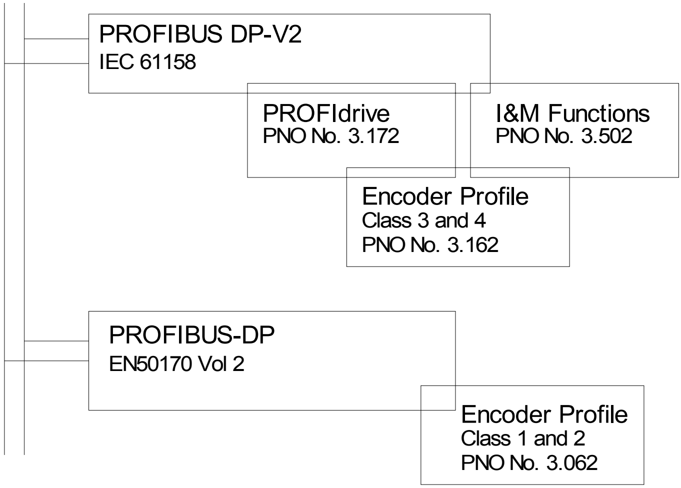

Figure 7 Overview of encoder profiles and related PROFIBUS documents

A GSD file is used to choose between the different profile versions. The user can select the version that fits his hardware and software. The GSD file can be downloaded from www.heidenhain.de.

3.1 DPV0 Encoder Classes

The encoder can be configured as a class 1 or class 2 PROFIBUS slave device. As an option, the rotational speed information of the encoder can be accessed for Class 2 encoders.

CLASS 1 In class 1 configuration only output values are assigned. Depending on the encoder resolution, this is one output word (16 bits) or two (32 bits).

The following functions can be performed:

- Reversal of counting direction
- Diagnostic data up to octet 16

Configuration data:

Singleturn	**Class 1 – 16 bits: D0$_{hex}$, 1 input data word, data consistency**
Multiturn	**Class 1 – 32 bits: D0$_{hex}$, 2 input data words, data consistency***)

*) The data values to be transmitted are double words. Therefore, buffer consistency is used in this case. The buffer consistency ensures that the entire data buffer is transmitted as one unit, and cannot be interrupted by other CPU processes.

CLASS 2 In class 2 configuration output values and input words are assigned. Depending on the encoder resolution, this is one output word (16 bits) or two (32 bits).

The following functions are available in addition to the class 1 functions:

- Scaling function
- Preset function
- Speed read-out
- Extended diagnostic data

Configuration data:

Singleturn	**Class 2 – 16 bits:** **$F0_{hex}$** **1 input data word** **1 output data word for the preset value** **Data consistency**
Multiturn	**Class 2 – 32 bits:** **$F0_{hex}$** **2 input data words** **2 output data words for the preset value** **Data consistency**
Position + velocity	**Class 2 – 32 + 16 bits:** **$F1+D0_{hex}$** **3 input data words** **2 output data words for the preset value** **Data consistency**

The selection of the class depends on the demands required by the application, but for enabling full functionality of the encoder, choosing class 2, 32-bit speed, is recommended.

3.2 DPV2 Encoder Classes

In general the encoders with PROFIBUS-DPV2 interface are divided into two classes. As opposed to DPV0 there is only one configuration option, telegram 81, regardless of the class.

CLASS 3 In class 3 configuration only output position values are assigned. Further functions are not available.

Configuration data:
Standard telegram 81

CLASS 4

In class 4 configuration output values and input words are assigned. Depending on the encoder resolution, this is one output word (16 bits) or two (32 bits).

The following functions are available in class 4 parameterization:

- Code sequence
- Scaling function
- Preset function
- Extended diagnostic data

Configuration data:
Standard telegram 81

4 Encoder Functions, DPV0

4.1 Basic Encoder Functions

The figure below gives an overview of the basic encoder functions and how these functions are implemented within the encoder.

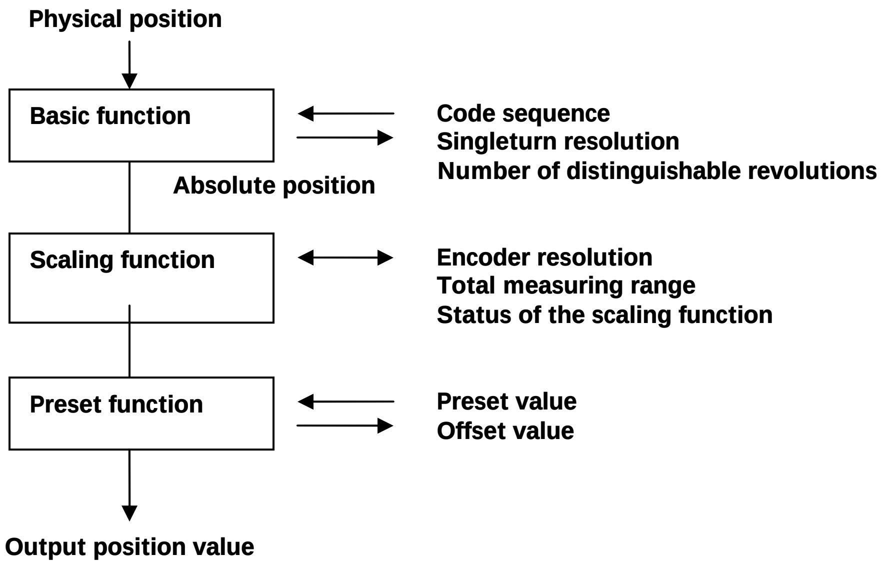

Figure 8 Basic encoder functions

4.2 PROFIBUS Data Transmission Principle

PROFIBUS-DP devices can be configured according to the user's needs, and the parameters can be set to fit these requirements. In this context it is useful to know that PROFIBUS offers three different types of data transmission.

4.2.1 Selection of the parameterization (DDLM_Set_Prm mode)

When the system is started, the PROFIBUS devices are parameterized (DDLM_Set_Prm mode), i.e. the encoder class is set by means of the GSD file in the configuration tool (see Chapter 3) and the operating parameters (see Chapter 4) are transferred to the respective slave.

4.2.2 Normal mode (DDLM_Data-Exchange mode)

In the normal mode (DDLM_Data-Exchange mode), data is exchanged between master and slaves. The preset function can be carried out only in this operating mode. Data exchange is described in Chapter 4.5.

4.3 Configuration, DPV0

The configuration of a DPV0 encoder is conducted by choosing the encoder class, i.e. by setting the input/output data structure. The configuration options are 16-bit, 32-bit or 32-bit + 16-bit speed input data (for an explanation, see Chapter 3.1).

4.4 Parameterization, DPV0

The PROFIBUS-DPV0 encoder is parameterized by means of the operating parameters. The values selected in the configuration tool are saved in the DP master and are transferred to the PROFIBUS-DP slave each time the network is started.

The following table lists all available parameters:

Parameter	**Data type**	**Parameter octet number**	**Device class**
Code sequence	Bit	9	1
Class 2 functions	Bit	9	2
Configuration diagnostics	Bit	9	Optional
Scaling function	Bit	9	2
Encoder resolution	32-bit unsigned	10 – 13	2
Total measuring range (steps)	32-bit unsigned	14 – 17	2
Manufacturer-specific functions	Bit	26 – 28	Optional
Speed control	2 bits	39	2 ext.

Table 5 Operating parameters in DPV0

The operating parameters described in octet 9 are defined bit by bit as follows:

Octet	**9**
Bits	7 – 0
Data	$2^7 – 2^0$
	Operating parameters

Bit	Definition	= 0	= 1
0	Code sequence	*Clockwise (CW)* Rising position values when shaft rotated clockwise (seen from flange side)	*Counterclockwise (CCW)* Rising position values when shaft rotated counterclockwise (seen from flange side)
1	Class 2 functions	Deactivated	Activated
2	Configuration diagnostics	No	Yes
3	Scaling function	Scaling deactivated	*Scaling activated* Scaling parameters are loaded into octets 10 to 17
4 … 7	*Reserved for future applications*		

Table 6 Octet 9, parameter definition

4.4.1 Code sequence

The code sequence defines whether the absolute position value should increase during clockwise or counterclockwise rotation of the shaft encoder (seen from flange side). The code sequence is by default set to increase the absolute position value when the shaft is turned clockwise (0).

4.4.2 Class 2 functions

This bit activates or deactivates class 2 functionality. As a default, the class 2 function bit for PROFIBUS-DP encoders is set to inactive (0). This means that this bit must be activated during parameterization to support the class 2 functions.

Note: **If a class 1 encoder uses some optional class 2 functions, the class 2 bit must be set.**

4.4.3 Configuration diagnostics

The commissioning diagnostics function makes it possible for the encoder to perform an internal diagnostic test of the encoder components responsible for position detection during a standstill of the encoder (i.e. light unit, photovoltaic cells etc.). In combination with the position alarms it enables thorough checking of whether the position values provided by the absolute encoder are correct. The commissioning diagnostics function is started by the commissioning bit in the operating parameters. If an error is found within the absolute encoder, the diagnostic function indicates this with the commissioning diagnostics alarm bit (see Chapter 4.6.2).

The commissioning diagnostics function is an option. To find out whether the encoder supports commissioning diagnostics, the diagnostic function must read the "operating status" and the commissioning diagnostics bit must be checked.

4.4.4 Scaling function

The scaling function uses a software program to convert the encoder's physical absolute position value in order to change the resolution of the encoder.

The parameters "Measuring units per revolution" and "Total measuring range in measuring steps" are the scaling parameters set by the parameter function in octets 10 to 17. Scaling is active only if the control bit for the scaling function is set. If the scaling function bit is set to 0, the scaling function is disabled.

Note: **After downloading new scaling parameters, the Preset function must be used to set the encoder starting point to the absolute position 0 or to any desired starting position within the scaled operating range.**

4.4.5 Measuring steps per revolution

The total measuring range is calculated by multiplying the singleturn resolution with the number of distinguishable revolutions.

The default settings for singleturn encoders are:
Measuring steps per revolution = 8192_{10} (2^{13})
Total measuring range in measuring steps = 8192_{10} ($2^{13} \cdot 2^{0}$)

The default settings for multiturn encoders are:
Measuring steps per revolution = 8192_{10} (2^{13})
Total measuring range in measuring steps =
$33\ 554\ 432_{10}$ ($2^{13} \cdot 2^{12}$)

Format of the scaling parameters:

Octet:	10	11	12	13
Bits	31 – 24	23 – 16	15 – 8	7 – 0
Data	2^{31} – 2^{24}	2^{23} – 2^{16}	2^{15} – 2^{8}	2^{7} – 2^{0}
	Encoder resolution			

Table 7 Format of the singleturn scaling parameters

Octet:	14	15	16	17
Bits	31 – 24	23 – 16	15 – 8	7 – 0
Data	2^{31} – 2^{24}	2^{23} – 2^{16}	2^{15} – 2^{8}	2^{7} – 2^{0}
	Total measuring range			

Table 8 Format of the multiturn scaling parameters

The data format for both scaling parameters is 32 bits without algebraic sign, with a value range from 2^0 to 2^{32}. The permissible value range is limited by the resolution of the rotary encoder. For a 25-bit encoder with a singleturn resolution of 13 bits, the permissible value range for "Measuring steps per revolution" is from 2^0 to 2^{13} (8192), and for the "Total measuring range in measuring steps" the permissible value range is from 2^0 to 2^{25} (33 554 432). The scaling parameters are securely stored in the PROFIBUS-DP master and are reloaded into the encoder upon each power-up. Both parameters are output data in 32-bit format.

Example of scaling and entry:
If the user wants to scale the encoder to a singleturn resolution of 4000 unique positions per revolution and the total number of revolutions to 3200, the following configuration is to be selected:

Encoder resolution
$= 4000_{10}$ steps

Total measuring range in measuring steps
= 4000 steps x 3200 revolutions
$= 12\,800\,000_{10}$

Entry in the master configuration software:
Measuring steps per revolution = 4000
Total measuring range (steps) = 12 800 000

4.4.6 Total measuring range (steps)

The total measuring range is defined by the parameter "Total measuring range in measuring steps." The encoder has two different operating modes, depending on the specified measuring range. When the encoder receives a parameter message, it checks the scaling parameters for whether binary scaling can be used. If binary scaling can be used, the encoder selects operating mode A (see following explanation). If not, operating mode B is selected.

A. Cyclic operation (binary scaling)

Measuring mode A is selected if the encoder operates with 2^x revolutions (number of revolutions equals 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048 or 4096).

If the desired measuring range is equal to the specified singleturn resolution $\leq 2^x$ (with $x \leq 12$), the rotary encoder operates in endless cyclic operation (from 0 to max. position value, from 0 to max. position value, etc.). If rotation of the axis to be measured causes the position value of the encoder to exceed the maximum value (total measuring range), the encoder indicates 0 as the position value again.

Example of cyclic scaling:

Measuring steps per revolution	=	1000
Total measuring range	=	32 000 (2^5 = number of revolutions: 32)

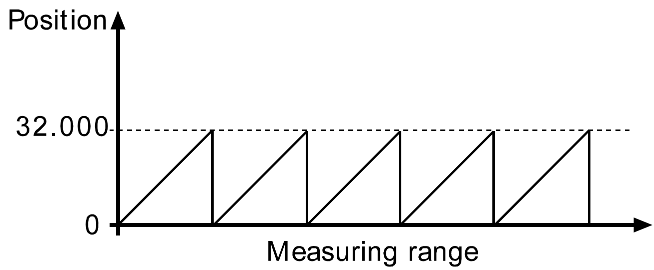

Figure 9 Cyclic scaling

B. Acyclic operation

If the measuring range is used to limit the value range of the encoder to a value other than the specified singleturn resolution **$* 2^x$**, the output position value is limited within the operating range. If rotation of the encoder shaft causes the position value to exceed the maximum value or fall below 0, the encoder indicates the value of the measuring range. See figure below.

Example of acyclic scaling:

Measuring steps per revolution	=	100
Total measuring range	=	5000 (number of revolutions: 50)

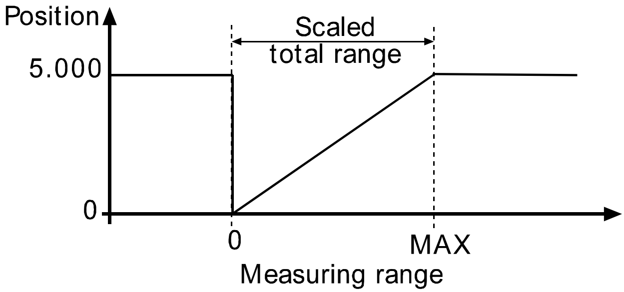

Figure 10 Acyclic scaling

4.4.7 Velocity function

The velocity data can be accessed if class 2 32-bit + velocity configuration is used. In this case the input data consists of 32-bit position data plus 16-bit signed velocity data. The velocity value is negative in counterclockwise direction if the code sequence is set to clockwise. If the measured velocity is greater than the value that can be preset for the selected velocity unit, the value is set to 0x7FFF (32768) or 0x8000 (–32768) depending on the direction of shaft rotation.

Note: **If one of the time-based velocity units is used and scaling is set for the encoder, the velocity calculation is based on the scaled position value. Consequently, the accuracy of the velocity value depends on the scaling set for the encoder.**

Parameter for the velocity unit, octet 39.

Octet:	39
Bits	7 – 0
Data	$2^7 – 2^0$
	Velocity function

Bit	7	6	5	4	3	2	1	0	Velocity unit
			0	0					Steps/s
			0	1					Steps/100 ms
			1	0					Steps/10 ms
			1	1					Revolutions per minute

Table 9 Octet 39, velocity function

4.5 Data Transmission in Normal Mode (DDLM_Data_Exchange)

The DDLM_Data_Exchange mode is the normal status of the absolute encoder during operation. In this mode the position value is transmitted from the encoder cyclically. The output data can also be sent to the encoder as preset commands.

4.5.1 Data exchange mode

The current position value is transmitted to the master as 32-bit values (double word) or optionally: the encoder supports a position value length of 16 bits for singleturn encoders. The position value is right-aligned in the data field.

DDLM_Data_Exchange mode

Standard configuration:

Octet:	1	2	3	4
Bits	31 – 24	23 – 16	15 – 8	7 – 0
Data	$2^{31} – 2^{24}$	$2^{23} – 2^{16}$	$2^{15} – 2^8$	$2^7 – 2^0$
	Data_Exchange – 32 bits			

Table 10 Data exchange, 32 bits

Configuration data:

Encoder class 1 **D1**$_{16}$ 2 input data words, data consistency
Encoder class 2 **F1**$_{16}$ 2 input data words, 2 output data words for the preset value, data consistency

Optional configuration:

Octet:	1	2
Bits	15 – 8	7 – 0
Data	$2^{15} – 2^{8}$	$2^{7} – 2^{0}$
	Data_Exchange – 16 bits	

Table 11 Data exchange, 16 bits

Configuration data:
Encoder class 1 **$D1_{16}$** 1 input data word, data consistency
Encoder class 2 **$F0_{16}$** 1 input data word, 1 output data word for the preset value, data consistency

4.5.2 Preset function

The preset function enables adapting the encoder's position value to a known mechanical reference point of the system. The preset function sets the actual value of the encoder to zero or to the selected preset value. If the Data_Exchange function is activated the preset value is stored in non-volatile memory in the encoder as an input value. In case of a power interruption the preset value is reloaded at start-up. If the scaling function is active, the preset function is applied after the scaling function. This means that the preset value is entered in the current measuring step unit.

The most significant bit (MSB) of the preset value controls the preset function as follows:

Standard mode: MSB = 0 (bit 31, optionally bit 15)
The encoder does not change the preset value.

Activated mode: MSB = 1 (bit 31, optionally bit 15)
For MSB = 1 the encoder accepts the transmitted value (bits 0 to 30) as preset value in binary code. The encoder reads the current position value and calculates an offset value on the basis of the preset value. The position value is shifted by the calculated offset value. If the output position value equals the preset value, the preset mode is terminated and the MSB can be set to 0 by the master. The resulting offset value can be read by means of the diagnostic function.

Note: **The preset function should be used only during standstill of the encoder. The encoder type limits the number of possible preset cycles; please consult HEIDENHAIN for more information.**

Preset value format (2 words, 32 bits):

Octet:	1		2	3	4
Bits	31	30 –- 24	23 – 16	15 – 8	7 – 0
Data	0 / 1	$2^{30} – 2^{24}$	$2^{23} – 2^{16}$	$2^{15} – 2^{8}$	$2^{7} – 2^{0}$
	Preset control bit	Preset value, up to 31 bits			

Table 12 Preset value, 32-bit format

Preset value format (1 word, 16 bits):

Octet:	1		2
Bits	15	14 – 8	7 – 0
Data	0 / 1	$2^{14} – 2^{8}$	$2^{7} – 2^{0}$
	Preset control bit	Preset value, up to 15 bits	

Table 13 Preset value, 16-bit format

4.6 Diagnostics

The diagnostic information contains diagnostic data that is defined in the PROFIBUS-DP specification (octet 1 to 6), as well as encoder-specific diagnostic data:

DDLM_Slave_Diag

Diagnostic function	**Data type**	**Diagnostic octet number**	**Device class**
Station status 1	Bit	1	1
Station status 2	Bit	2	1
Station status 3	Bit	3	1
Diagnostic master address	Bit	4	1
PNO identification number	Bit	5 – 6	1
Extended diagnostic header	Octet string	7	1
Alarms	Octet string	8	1
Operating status	Octet string	9	1
Encoder type	Octet string	10	1
Singleturn resolution (rotary encoder) Measuring step (linear encoder)	32 without sign	11 – 14	1
Number of distinguishable revolutions	16 without sign	15, 16	1
Additional alarms	Octet string	17	2
Supported alarms	Octet string	18, 19	2
Warnings	Octet string	20, 21	2
Supported warnings	Octet string	22, 23	2
Profile version	Octet string	24, 25	2
Software version	Octet string	26, 27	2
Operating time	32 without sign	28 – 31	2
Offset value	32 with sign	32 – 35	2
Manufacturer offset value	32 with sign	36 – 39	2
Encoder resolution	32 without sign	40 – 43	2
Total measuring range	32 without sign	44 – 47	2
Serial number	ASCII string	48 – 57	2
Reserved for future definitions		58 – 61	2

Table 14 Diagnostic information, DPV0

Note: **The length of the diagnostic information of class 1 is limited to 16 bytes. This is compatible with former DP versions. For PROFIBUS-DP class 2 encoders the length of the encoder-specific diagnostic data including the extended diagnostic header is 57 bytes.**

The DDLM_Slave_Diag memory range up to octet 99 is reserved for future diagnostic data of class 2.

4.6.1 Diagnostic header

The header byte specifies the length of the encoder diagnostics including the header byte. The format of the transmission length is hexadecimal. For PROFIBUS-DP class 1 encoders the length of the encoder-specific diagnostic data is 10 bytes ($0A_{hex}$).

DDLM_Slave_Diag

Octet	7		
Bits	7	6	5 – 0
Data	0	0	xxh
	Set to 00	Length including header	
	Extended diagnostics		

Table 15 Diagnostic header

4.6.2 Alarms

An alarm is triggered if a malfunction in the encoder can lead to incorrect position values. Octet 8 in the diagnostic function (DDLM_Slave_Diag) indicates the status of the alarms. Additional alarms for device class 2 are added to diagnostic octet 17.

If an alarm is triggered, the Ext_Diag bit and the Stat_Diag bit in the diagnostic function are set to high until the alarm is reset and the encoder can provide correct position values. Alarms can be reset (deleted) when all encoder parameters are within the specified value ranges and the position value is correct.

Note: **Not every encoder supports every alarm. For class 2 encoders the “Supported alarms” diagnostic information (see chapter 4.6.8) enables you to find out which specific alarm bits are supported.**

DDLM_Slave_Diag

Octet	**8**
Bits	7 – 0
	Alarms

Bit	**Definition**	**= 0**	**= 1**
0	Position error	No	Yes
1	Voltage supply error	No	Yes
2	Current is too high	No	Yes
3	Configuration diagnostics	OK	Errors
4	Memory error	No	Yes
5	*Currently not assigned*		
6			
7			

Table 16 Alarms

4.6.3 Operating status

Octet 9 in the diagnostic function provides information about encoder-specific parameters. A class 2 encoder sets the functionality bit for class 2 commands to show the DP master that all commands of class 2 are supported. The DP master must activate the functionality bit of class 2 in the parameter message (DDLM_Set-Prm) to enable the use of class 2 functions.

The status bit of the scaling function is set when the scaling function is activated and the resolution of the encoder is calculated using the scaling parameters.

DDLM_Slave_Diag

Octet	**9**
Bits	7 – 0
	Operating status

Bit	Definition	= 0	= 1
0	Code sequence	Increasing position values for clockwise revolutions (seen from the flange)	Increasing position values for counterclockwise revolutions (seen from the flange)
1	Class 2 functions	No, not supported	Yes
2	Configuration diagnostics	No, not supported	Yes
3	Scaling function status	Scaling disabled	Scaling enabled
4	*Currently not assigned*		
5			
6			
7			

Table 17 Operating status

4.6.4 Encoder type

The type of encoder can be read in octet 10 of the diagnostic function. The type of encoder is defined in hexadecimal coding in the range from 0 to FF.

DDLM_Slave_Diag

Octet	10
Bits	0 - FF
	Encoder type

Code	Definition
00	Absolute singleturn encoder
01	Absolute multiturn encoder
02	Absolute singleturn encoder with electronic revolution counter
03	Incremental rotary encoder
04	Incremental rotary encoder with battery buffer
05	Incremental linear encoder
06	Incremental linear encoder with battery buffer
07	Absolute linear encoder
08	Absolute linear encoder with periodic coding
09	*Currently not assigned*
•	
•	
•	
FF	

Table 18 Diagnostics, encoder type

4.6.5 Singleturn resolution or measuring step

The meaning of the singleturn resolution in the diagnostic function differs depending on the type of encoder.

For rotary or angle encoders, the diagnostic octets 11 to 14 indicate the physical resolution as the number of measuring steps per revolution that is transmitted for the absolute singleturn position value. The maximum singleturn resolution is 2^{32}.

For linear encoders the measuring steps are shown in respect to the resolution of the encoder, i.e. each increment of the measuring step equals the actual resolution of the linear encoder in use. Typical values for linear resolution are 1 µm to 40 µm.

DDLM_Slave_Diag

Octet	**11**	**12**	**13**	**14**
Bits	31 – 24	23 – 16	15 – 8	7 – 0
Data	$2^{31} – 2^{24}$	$2^{23} – 2^{16}$	$2^{15} – 2^{8}$	$2^{7} – 2^{0}$
	Singleturn resolution			

Table 19 Diagnostics, singleturn resolution

4.6.6 Number of distinguishable revolutions

The number of distinguishable revolutions the encoder can transmit is defined by octets 15 and 16 of the diagnostic function. In accordance with the formula below, the measuring range for a multiturn encoder results from the number of distinguishable revolutions multiplied by the singleturn resolution. The maximum number of distinguishable revolutions is 65 536 (16 bits).

Measuring range = number of distinguishable revolutions **x** singleturn resolution

DDLM_Slave_Diag

Octet	**15**	**16**
Bits	15 – 8	7 – 0
	Number of distinguishable revolutions	

Table 20 Diagnostics, number of distinguishable revolutions

4.6.7 Additional alarms

Diagnostic octet 17 indicates additional alarms for device class 2.

DDLM_Slave_Diag

Octet	**17**
Bits	7 – 0
	Additional alarms

Bit	**Definition**	**= 0**	**= 1**
0	*Currently not assigned*		
•			
7			

Table 21 Diagnostics, additional alarms

4.6.8 Supported alarms

Diagnostic octets 18 and 19 contain information on the supported alarms.

DDLM_Slave_Diag

Octet	**18**	**19**
Bits	15 – 8	7 – 0
	Supported alarms	

Bit	**Definition**	**= 0**	**= 1**
0	Position error	Not supported	Supported
1	Voltage supply error	Not supported	Supported
2	Current is too high	Not supported	Supported
3	Configuration diagnostics	Not supported	Supported
4	Memory error	Not supported	Supported
5	*Currently not assigned*		
•			
15			

Table 22 Diagnostics, supported alarms

4.6.9 Warnings

Warnings indicate that tolerances for certain internal parameters of the encoders have been exceeded. Contrary to alarms, no faulty position values are expected in case of warnings.

Octets 20 and 21 of the diagnostic function indicate the status of the warnings. If a warning is set, the Ext_Diag bit in the diagnostic function is set to logical 1 until the warning is reset. All warnings are deleted as soon as the diagnostic message of the encoder has been read. However, if the tolerances are still exceeded, the warning is activated again. The warning "Maximum operating time exceeded" (bit 4) is not activated again until the next time the system is switched on.

Note: **Not every encoder supports every warning. Please refer to the diagnostic information under "Supported Warnings" (see chapter 4.6.10) for information on the support of specific warnings.**

DDLM_Slave_Diag

Octet	**20**	**21**
Bits	15 – 8	7 – 0
	Warnings	

Bit	**Definition**	**= 0**	**= 1**
0	Frequency exceeded	No	Yes
1	Temperature exceeded	No	Yes
2	Light control reserve	Not reached	Reached
3	CPU monitoring status	OK	Reset
4	Maximum operating time exceeded	No	Yes
5	Battery charge	OK	Too low
6	Reference point	Reached	Not reached
7	*Currently not assigned*		
•			
15			

Table 23 Diagnostics, warnings

4.6.10 Supported warnings

Diagnostic octets 22 and 23 contain information on supported warnings.

DDLM_Slave_Diag

Octet	22	23
Bits	15 – 8	7 – 0
	Supported warnings	

Bit	Definition	= 0	= 1
0	Frequency warning	Not supported	Supported
1	Temperature warning	Not supported	Supported
2	Light control reserve warning	Not supported	Supported
3	CPU monitoring status warning	Not supported	Supported
4	Maximum operating time exceeded warning	Not supported	Supported
5	Battery charge warning	Not supported	Supported
6	Reference point warning	Not supported	Supported
7	*Currently not assigned*		
•			
15			

Table 24 Diagnostics, supported warnings

4.6.11 Profile version

Octets 24 and 25 of the diagnostic function contain the PROFIBUS-DP profile version implemented in the encoder. The octets are combined as revision number and index.

Example:

Profile version:	1.40	
Octet no.:	24	25
Binary code:	00000001	01000000
Hex:	1	40

DDLM_Slave_Diag

Octet	24	25
Bits	15 – 8	7 – 0
Data	$2^7 – 2^0$	$2^7 – 2^0$
	Revision number	Index
	Profile version	

Table 25 Diagnostics, profile version

4.6.12 Software version

Octets 26 and 27 of the DDLM_Slave_Diag function contain the software version of the encoder. The octets are combined as revision number and index.

Example:

Software version:	1.40	
Octet no.:	26	27
Binary code:	00000001	01000000
Hex:	1	40

DDLM_Slave_Diag

Octet	26	27
Bits	15 – 8	7 – 0
Data	$2^7 – 2^0$	$2^7 – 2^0$
	Revision number	Index
	Software version	

Table 26 Diagnostics, software version

4.6.13 Operating time

The operating time monitor stores the operating time of the encoder in operating hours. The operating time is saved every six minutes in the encoder's non-volatile memory. This happens as long as the encoder is under power. The DDLM_Slave_Diag function displays the operating time as a 32-bit value without algebraic sign in increments of 0.1 h.

If the operating time function is not used, the encoder manufacturer sets it to the maximum value (FFFF FFFF_{hex}). The encoder manufacturer can define a maximum operating time. If this limit is exceeded, the "Maximum operating time exceeded" bit is activated (see Chapter 4.6.9).

DDLM_Slave_Diag

Octet	28	29	30	31
Bits	31 – 24	23 – 16	15 – 8	7 – 0
Data	$2^{31} – 2^{24}$	$2^{23} – 2^{16}$	$2^{15} – 2^{8}$	$2^{7} – 2^{0}$
	Operating time			

Table 27 Diagnostics, operating time

4.6.14 Offset value

The offset value is calculated by the preset function, and shifts the position value by the calculated value. The offset value is stored in the encoder and can be read from the diagnostic octets 32 to 35. The data type for the offset value is a 32-bit binary value with algebraic sign, and the offset value range is equal to the measuring range of the encoder.

The preset function is applied after the scaling function. This means that the offset value is indicated according to the scaled resolution of the encoder.

DDLM_Slave_Diag

Octet	32	33	34	35
Bits	31 – 24	23 – 16	15 – 8	7 – 0
Data	$2^{31} – 2^{24}$	$2^{23} – 2^{16}$	$2^{15} – 2^{8}$	$2^{7} – 2^{0}$
	Offset value			

Table 28 Diagnostics, offset value

4.6.15 Manufacturer offset value

The manufacturer offset value indicates the offset value set by the encoder manufacturer. This value gives information on the shift of the position zero point relative to the physical zero point of the encoder. The data type for the offset value is a 32-bit binary value with algebraic sign. The value range corresponds to the measuring range of the encoder. The manufacturer offset value is given in the number of steps corresponding to the basic resolution of the encoder. The value is stored in write-protected memory and can only be changed by the encoder manufacturer. In practice this value is of no importance to the user.

DDLM_Slave_Diag

Octet	36	37	38	39
Bits	31 – 24	23 – 16	15 – 8	7 – 0
Data	$2^{31} – 2^{24}$	$2^{23} – 2^{16}$	$2^{15} – 2^{8}$	$2^{7} – 2^{0}$
	Manufacturer offset value			

Table 29 Diagnostics, manufacturer offset value

4.6.16 Scaling parameters settings

The scaling parameters are set in the DDLM_Set_Prm function. The parameters are stored in octets 40 to 47 of the diagnostic data. The “Measuring steps per revolution” and “Total measuring range in measuring steps” parameters specify the desired resolution of the encoder. The status bit of the scaling function in the operating status (octet 9 of the diagnostic data) indicates whether the scaling function is active.

Values preset by the encoder manufacturer:

Measuring steps per revolution = singleturn resolution
Total measuring range in measuring steps =
singleturn resolution **x** number of distinguishable revolutions

The data type for both values is 32 bits without algebraic sign.

DDLM_Slave_Diag

Octet	40	41	42	43
Bits	31 – 24	23 – 16	15 – 8	7 – 0
Data	$2^{31} – 2^{24}$	$2^{23} – 2^{16}$	$2^{15} – 2^{8}$	$2^{7} – 2^{0}$
	Encoder resolution			

DDLM_Slave_Diag

Octet	44	45	46	47
Bits	31 – 24	23 – 16	15 – 8	7 – 0
Data	$2^{31} – 2^{24}$	$2^{23} – 2^{16}$	$2^{15} – 2^{8}$	$2^{7} – 2^{0}$
	Total measuring range			

Table 30 Diagnostics, scaling parameter settings

4.6.17 Encoder serial number

Octets 48 to 57 of the diagnostic function provide the serial number of the encoder as an ASCII string of 10 characters.

DDLM_Slave_Diag

Octet	48 – 57
Bits	79 – 0
Data	ASCII
	Serial number

Example of a serial number:

Octet	48	49	50	51	52	53	54	55	56	57
ASCII string	30	30	30	35	39	46	38	44	45	35
Serial (hex.)	0	0	0	5	9	F	8	D	E	5
Serial (dec.)	9434 2629									

Table 31 Diagnostics, encoder serial number

5 Example for Commissioning a Rotary Encoder, DPV0

This example uses a Siemens master and the SCOUT configuration software. The example is intended to illustrate the commissioning of a PROFUBUS-DPV0 encoder with a 25-bit absolute rotary encoder and velocity information.

Copying the GSD file

First, copy the GSD file enc_a401.gsd and the bitmap file into the appropriate directory for the Siemens configuration software: *...\GSD*.

Selecting the DPV0 slave

To select the encoder: click the “PROFIBUS encoder” icon in the tree structure on the right side of the window. Drag the encoder onto the bus to add it, as shown in the upper left window.

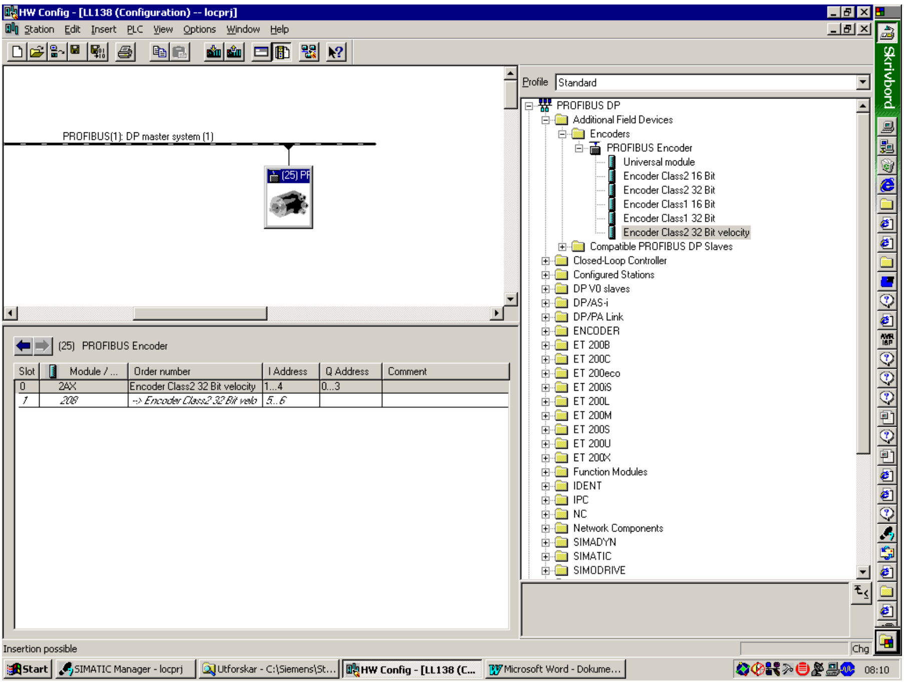

Figure 11 Commissioning example, DPV0

A PROFIBUS address must be assigned when dropping the encoder onto the bus. Naturally this address must be the same as that assigned using the hardware address switches on the encoder PCB (see chapter 2.1.1).

Configuring the DPV0 slave

To configure the encoder for 25-bit position value plus velocity data, choose the “Encoder Class 2 32-Bit velocity” configuration option in the map structure. Insert the chosen configuration by dragging it to the configuration area in the lower left of the window.

Assigning parameters to the DPV0 slave

Open the parameterization view by double-clicking the configuration row in the configuration view.

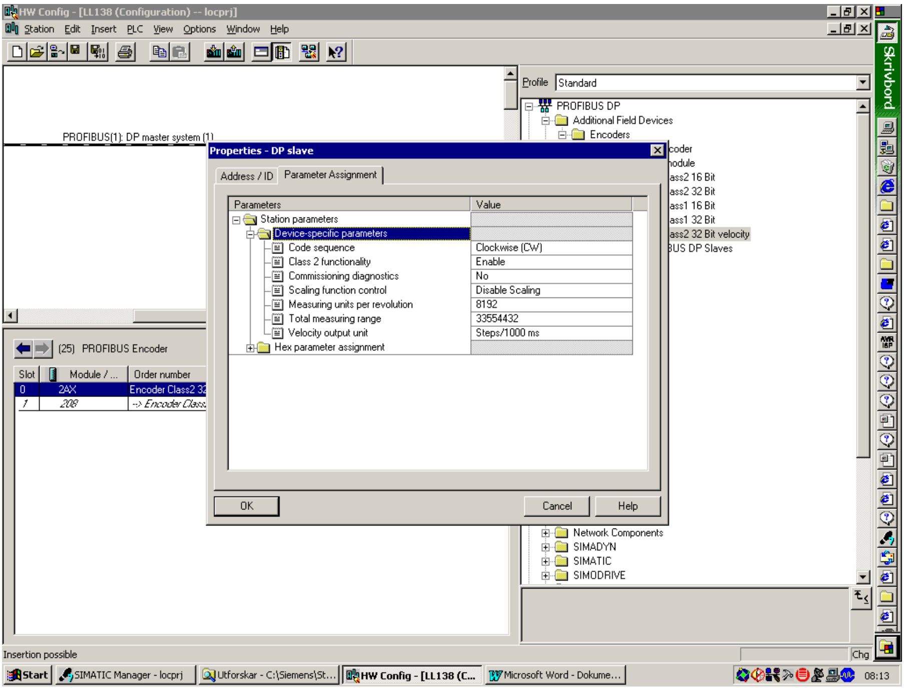

Figure 12 Parameter assignment, DPV0

The desired parameter values are added in the value field. Chapter 4.4 describes the functions and possibilities of each parameter.

After the parameters have been added, the encoder will enter data exchange mode and is thereby commissioned for the bus.

Note: **Please refer to the respective manufacturer's information on the configuration of other PROFIBUS-DP master interface modules.**

6 Encoder Functions, DPV2

The DPV2 GSD file can be used to configure the PROFIBUS DP encoder to include DPV2 functionality. DPV2 functionality includes isochronous operation, acyclic data exchange and slave-to-slave communication. A DPV2 encoder can only be configured to use standard telegram 81 for I/O data, meaning 4-byte output and 12-byte input. Standard telegram 81 is defined in the PROFIdrive profile and is adapted to the DPV2 PROFIBUS profile for encoders (3.162).

Standard telegram 81:

PZD number (process data exchange)	**1**	**2**
Setpoint	STW2	*G1_STW1*

Output data from master

PZD number	**1**	**2**	**3**	**4**
Actual value	ZSW2	*G1_ZSW1*	*G1_XIST1*	*G1_XIST2*

Input data to master

Table 32 Standard telegram 81

The mapped signals are described in the following table:

Signal	**Abbreviation**	**Length 16 or 32 bits**	**Input data / Output data**
Control word 2	STW2	16	Output, control word from master
Status word 2	ZSW2	16	Output, status word from master
Sensor 1 control word	G1_STW1	16	Input, control word from encoder
Sensor 1 status word	G1_ZSW1	16	Input, status word from encoder
Sensor 1 Actual position value 1	G1_XIST1	32	Input, left-justified absolute position value from encoder
Sensor 1 Actual position value 2	G1_XIST2	32	Input, right-justified absolute position value from encoder

Table 33 Telegram 81, signals

Control word 2 (bits 12 to 15) is referred to as the master's sign of life, and status word 2 (bits 12 to 15) as the slave's sign of life. These signals are essential for controlling the clock synchronization. The G1_XIST1 and G1_XIST2 signals consist of the absolute position values in binary format. By default, G1_XIST1 is left-aligned and G1_XIST2 is right-aligned; in case of differing formats the shift factor is in parameter P979 (see chapter 6.2.1). Both G1_XIST1 and G1_XIST2 are affected by changes in the parameterization, and in case of encoder error the error message is displayed in G1_XIST2.

6.1 Isochronous Operation

The isochronous operation mode is used when real-time positioning is required. The basic principle is that all PROFIBUS devices on the network are clock-synchronized with the master using a global control broadcast enabling simultaneous data acquisition from all slaves with microsecond accuracy. The synchronization is monitored using "sign of life" messages.

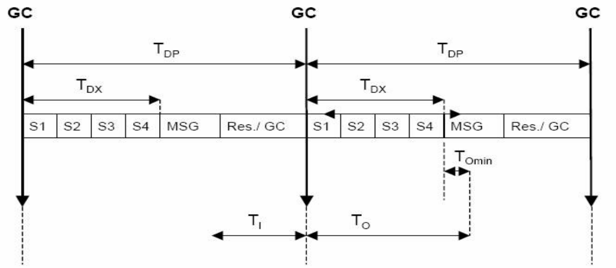

Figure 13 Basic principle of the DP cycle in isochronous mode

GC	Global control signal
T_{DP}	DP cycle time, 1 ms to 32 ms (default: 2 ms), depending on the number of slaves on the bus
T_I	At the start of T_I all slaves must read the position data. During T_I all slaves must put the sampled data in the respective buffer ready for the Master to read (this process must be completed before the next GC).
TT_0	During T_0 the slave reads the diagnostic data from the master and executes it.
MSG,Res/GC	Channel for acyclic data (parameter channel)

6.2 Exchange of Acyclic Data

The exchange of acyclic data is conducted in the parameter channel. The exchange of acyclic data enables parameterization during runtime. The exchange of acyclic data is conducted parallel to the cyclic data communication but with a lower priority. The parameters accessible in the acyclic data channel are divided into different categories.

6.2.1 PROFIdrive parameters

The encoder profile for DPV2 has adopted certain standard PROFIdrive parameters. The HEIDENHAIN encoder supports the following parameters:

PNU (parameter number)	Significance	Data type	R/W
918	Node address	Unsigned16	R
922	Telegram selection	Unsigned16	R
925	Number of master sign-of-life failures that can be tolerated		R/W
964	Device identification	Array [n] Unsigned16	R
965	PROFIdrive profile number	Octet string 2	R
971	Transfer to non-volatile memory	Unsigned16	W
979	Sensor format	Array [n] Unsigned32	R

Table 34 Supported PROFIdrive parameters

6.2.2 Encoder-specific parameters

In addition to the PROFIdrive parameters, the DPV2 encoder profile also defines encoder-specific parameters.

PNU (parameter number)	Significance	Data type	R/W
65000	Preset value	Integer 32	R/W
65001	Operating parameters	Array [n] Unsigned32	R

Table 35 Supported encoder-specific parameters

The HEIDENHAIN encoder supports preset values and the following subindex parameters of operating parameters (65001).

Subindex	Meaning
0	Header
1	Operating status
2	Alarms
3	Supported alarms
4	Warnings
5	Supported warnings
6	Encoder profile version
7	Not supported (operating time)
8	Offset value
9	Encoder resolution
10	Total measuring range

Table 36 Supported operating parameters

6.2.3 I&M functions

In addition to PROFIdrive parameter 964 (device identification), the encoder also supports the I&M functions. The I&M functions can be accessed with record index 255. The HEIDENHAIN encoder supports the following I&M functions:

Contents	Coding
Header	
Manufacturer-specific	Security code for write-access to parameters
I&M block	
MANUFACTURER_ID	Manufacturer_Id (284)
ORDER_ID	Encoder part number
SERIAL_NUMBER	Encoder serial number
HARDWARE_REVISION	0x0000 (not used)
SOFTWARE_REVISION	Software revision including software version status, e.g. “V1.3.0”
REVISION_COUNTER	0x0000 (not used)
PROFILE_ID	“3D00“ (encoder profile DPV2)
PROFILE_SPECIFIC_TYPE	See table in encoder profile
IM_VERSION	Version of the I&M profile
IM_SUPPORTED	= 0 (obligatory I&M support)

Table 37 Supported I&M functions

6.3 Slave-to-Slave Communication

The HEIDENHAIN PROFIBUS encoder supports the slave-to-slave communication principle as a slave, i.e. as “publisher.”

6.4 Configuration (Isochronous Operation)

A class 3 or class 4 encoder type can be selected to configure a DV2 encoder. Chapter 3.2 describes the functionality of the various encoder class types, but standard telegram 81 is used for I/O data regardless of the class.

6.5 Parameterization (Isochronous Parameters)

The parameterization of the DPV2 encoder functionality is divided into two steps. The parameterization data is transferred to the encoder in Structure_ Prm_Data blocks.

The parameters for the general encoder functionality are listed below.

Parameter	Data type	Octet number	Class
Code sequence	Bit	4 bit 0	4
Class 4 enable	Bit	4 bit 1	4
G1_XIST1 preset control	Bit	4 bit 2	4
Scaling function control	Bit	4 bit 3	4
Ext_Diag enable	Bit	4 bit 4	4
Measuring steps per revolution	Unsigned32	5 – 8	4
Total measuring range	Unsigned32	9 – 12	4
Maximum tolerated failures of MasterLifeSign	Unsigned8	13	4

Table 38 Encoder parameters, DPV2

The parameter functions, code sequence, class 4 enable, scaling and scaling control are analogous to the corresponding parameters in DPV0. For an explanation, see chapter 4.4.

Note: **In order to meet the timing requirement during isochronous operation, the encoder only tolerates binary scaling for the singleturn and multiturn resolutions.**

The G1_XIST1 control bit determines whether the preset value can affect the position value presented in G1_XIST1. If the control bit is set to 1, the preset value will not affect the position value in G1_XIST1.

Note: **This bit only affects G1_XIST1. If the preset is set it will affect the position value presented in G1_XIST2, regardless of the status of this control bit.**

If the Ext_Diag enable control bit is set to 0 (default value), only the first six bytes of the diagnostics message are transmitted. If the bit is set to 1, the complete diagnosis is available, i.e. the channel-related diagnosis is transmitted.

The MasterLifeSign byte is used for enabling programming of the number of allowed failures of the master sign of life. When the number is reached, an error message (0x0F02) is sent as diagnosis in the G1_XIST2 signal.

The following parameters must be considered when parameterizing the isochronous mode. The time-based parameters are globally set by the master application, and can't be set individually for each slave.

Parameter	Data type	Value	Comments
Structure_Length	Unsigned8	0x1C (decimal 28)	
Structure_Type	Unsigned8	0x04	IsoM parameters
Slot no.	Unsigned8	0x00	Communication with entire device
Reserved	Unsigned8	0x00	
Version	Unsigned8	0x01	First revision
T_{BASE_DP}	Unsigned32	375/750/1500/…	Set by master
T_{DP}	Unsigned16		Set by master
T_{MAPC}	Unsigned8		Set by master
T_{BASE_IO}	Unsigned32		Set by master
T_{I}	Unsigned16		Set by master
T_{O}	Unsigned16		Set by master
T_{DX}	Unsigned32		Set by master
T_{PLL_W}	Unsigned16		Set by master
T_{PLL_D}	Unsigned16		Set by master

Table 39 Parameters of the isochronous mode

The various time-based parameters are defined in the PROFIdrive V3.1 profile (chapter 6.2.1). For general explanations and comments, see chapter 6.1 of this manual.

6.6 Diagnostic Messages, DPV2

6.6.1 Overview

Encoder profile 3.162 defines the support for alarms and warning messages. The HEIDENHAIN PROFIBUS encoder supports the following alarm:

Bit	Definition	Error type
0	Position error	22

Table 40 Diagnostic messages, DPV2

Error type:	22
Definition:	Position value error
GSD inputs:	
Channel_Diag (22) =	"Position value error"
Channel_Diag_Help (22) =	"The encoder has an internal error and is not able to provide an accurate position value; change encoder"

6.6.2 Error messages

Error messages are sent in G1_XIST2. The HEIDENHAIN PROFIBUS encoder supports error messages according to the profile.

Error	Meaning	Description
0x0001	Sensor group error (position error)	The encoder is not able to provide a correct position value.
0x0F01	The command is not supported	In G1_STW1 the master application sent a command that is not supported by the encoder.
0x0F02	Master's sign of life fault	The number of permissible failures of the master's life sign was exceeded.
0x0F04	Synchronization fault	The number of permissible failures for the bus cycle signal was exceeded.

Table 41 Error messages, DPV2

Note: **If the preset value is negative and an absolute preset is entered, error message 0xF01 (command not supported) is set.**

The limit for error 0x0F04 (Synchronization fault) is by default 5, i.e. up to five consecutive synchronization faults are allowed before an error message is sent.

6.6.3 Isochronous synchronization principle

The chart below describes the synchronization principle of the encoder when adapting to a synchronized DP cycle, IRT mode operation.

1. Start-up
Standard PROFIBUS commissioning, i.e.
– Installation
– Power-up
– Configuration (DPV2 GSD file mandatory)
– Parameterization

2. Synchronization
The encoder is synchronized with the DP cycle according to the parameterization selected.

3. Master Life Sign
After synchronization the encoder expects to read the Master Life Sign (MLS). The MLS is generated by the master and presented in STW2 (control word 2, bits 12 to 15). The MLS is counted during each DP cycle: 1 to 15 cyclically (0 is not a valid value).

4. Slave Life Sign
After the encoder is synchronized with the MLS, it acknowledges this by generating the Slave Life Sign (SLS). The SLS is presented in ZSW2 (status word 2, bits 12 to 15). In accordance with the MLS, it must be counted from 1 to 15 cyclically (0 is not a valid value), although it is not mandatory that MLS and SLS be identical in each DP cycle.

5. Operating mode
After detection of the correct SLS by the master, any current error codes must be acknowledged. This is done by the master clearing bit 15 in the sensor control word (G1_STW). The encoder acknowledges this by resetting the sensor error code bit (15) in the sensor status word (G1_ZSW), and also clears the error message presented in G1_XIST2. If this is done successfully, the encoder is in operating mode and fully synchronized with the DP cycle.

7 Encoder Commissioning Example, DPV2 (Isochronous Operation)

This example is intended to illustrate the commissioning of a PROFIBUS-DPV2 encoder in isochronous operation. The basic principle for adding the encoder to the bus is the same as for DPV0 (see chapter 5). The exceptions are that the GSD file enc_0aaa.gsd must be used and that “Encoder Class 4” must be chosen during configuration.

Assigning parameters to the DPV2 slave

The parameterization view of the DPV2 Class 4 encoder.

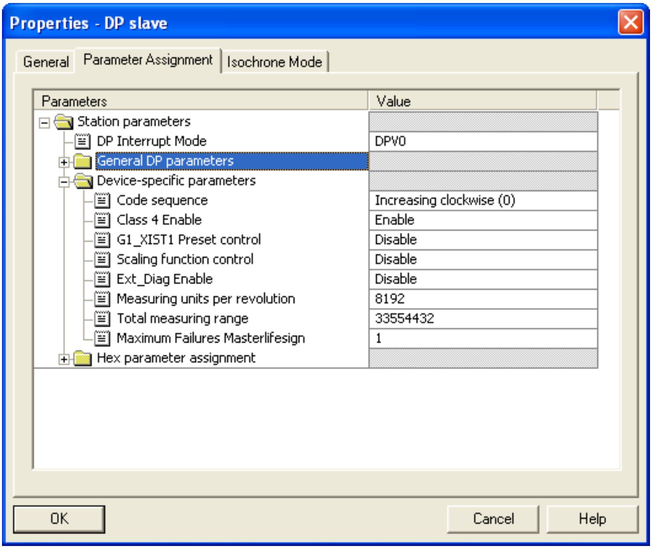

Figure 14 Parameter assignment, DPV2, Class 4

The desired parameterization is added in the value field. Chapter 6.5 describes the functions and possibilities of each parameter.

7.1 Parameter Settings for the Isochronous Mode: DPV2 Slave

The parameters for the isochronous operation mode can be set on the “Isochronous Mode” tab of the DP slave properties.

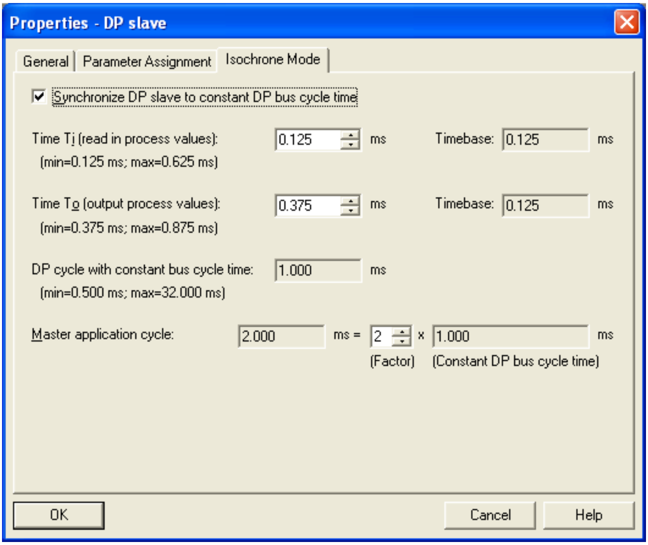

Figure 15 Parameter settings for the isochronous mode, DP slave

The various time parameters can be set, whereas the time-based parameters are controlled by the master. The individual settings for the DP slave isochronous mode enable individual data sample times, as T_I can be set separately for each slave. The “master application cycle factor” is used if the application requires that the master application cycle time be different from the bus cycle time. Please note that if the factor is ≠1, the slave will not read the “Master’s Life Sign” in each bus cycle (for example, if the factor is set to 2, the Master’s Life Sign will only come every second bus cycle).

7.2 Parameter Settings for the Isochronous Mode: Bus

The "Isochronous Mode" parameter can also be set on the bus. Double-click the bus in the bus structure view (at upper left, see chapter 5) to access the properties of the DP master system.

Proceed as described below to access the general bus "Isochronous Mode" parameters:

Click the Properties... button.

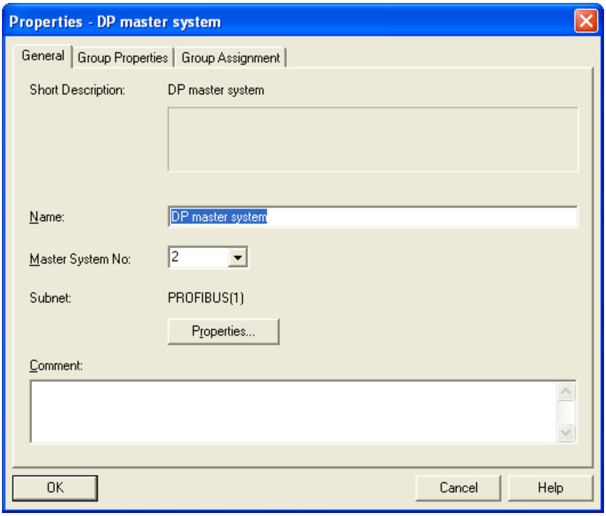

Figure 16 IDP master settings, bus

Select the Network Settings tab. For highest performance, select the 12 Mbps baud rate and the DP profile.

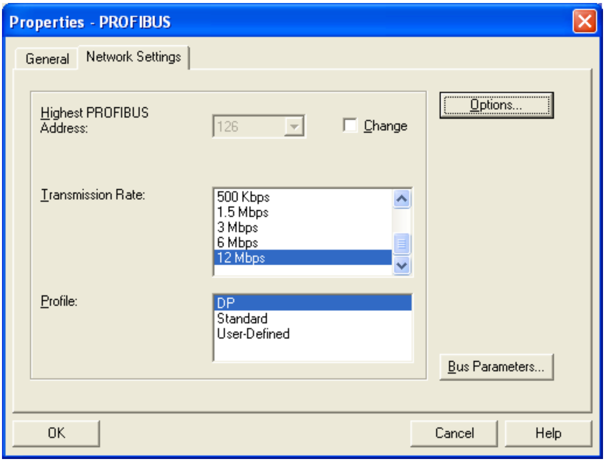

Figure 17 Network settings, bus

Click the Options... button.

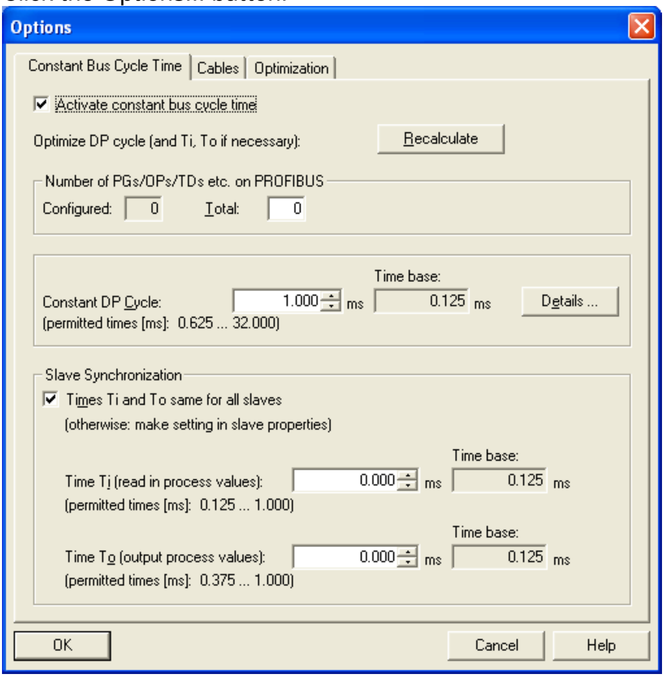

Figure 18 Parameter settings for the isochronous mode, bus

The DP cycle time and the time-based parameters can be set on this tab. If the Slave Synchronization box is checked, all slaves of the bus have the same time-based parameters. In this mode all slaves on the bus will sample data at the same time, and the real isochronous mode is achieved.

Note: **Please refer to the respective manufacturer's information on the configuration of other PROFIBUS-DP master interface modules.**

HEIDENHAIN

DR. JOHANNES HEIDENHAIN GmbH
Dr.-Johannes-Heidenhain-Straße 5
83301 Traunreut, Germany
☏ +49 8669 31-0
FAX +49 8669 5061
E-mail: info@heidenhain.de

www.heidenhain.de

Zum Abheften hier falzen! / *Fold here for filing!*

749 176 · 00 · A · 02 · 12/2010 · PDF