PROFIBUS DP

Manual / Users Guide

DPV0 & DPV2 Encoders

Part No 634814-01, Doc. No 634814 Ver. 01

LEINE LINDE

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Specifications and content in this document are subject to change without prior notice due to our continuous strives to improve functionality and performance of our products.

1 General information

1.1 Absolute encoders

With an absolute encoder each angular position is assigned a coded position value generated by a code disc equipped with several parallel fine graduations tracks which are scanned individually. On singleturn encoders, i.e. an encoder producing absolute positions within one revolution, the absolute position information repeats itself with every revolution. So called multiturn encoders can also distinguish between revolutions. The numbers of unique revolutions is determined by the resolution of the multiturn scanning and repeats itself after the total resolution is reached.

1.2 PROFIBUS technology

PROFIBUS is a powerful and versatile 2-wire non-proprietary open fieldbus standard defined by several international standards such as EN 50170, IEC 61158 together with different device profiles. There are 3 different PROFIBUS versions available today, DP, FMS and PA. Leine & Linde products support the DP version. In addition to manufacturer-specific functions, the Leine & Linde products support classes 1, 2, 3 and 4 according to the encoder profile 3.062 and 3.162 respectively. The encoder device profile describing encoder functionality and additional information about PROFIBUS can be ordered from PROFIBUS User Organization, PNO or directly from Leine & Linde AB.

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1.3 About Leine & Linde AB

For almost 40 years the Swedish based company Leine & Linde has concentrated on one thing – development and manufacturing of advanced encoders that meet the most rigorous demands a user can place on them. That is why a wide assortment of incremental and absolute encoders with obvious concentration on robust products and quality down to the last detail can be offered. Leine & Lindes encoders provide the utmost in reliability year after year, in working conditions where vibration, dirt, cold and other harsh environments are common.

Leine & Linde can meet very specific individual demands. The encoders are easily adopted due to a modular design in the collection exactly to the customers needs with respect resolution, electrical connections and interfaces, voltage, casings, etc. That is due to the fact that tomorrow's technology already is used today in Leine & Linde products. Leine & Linde concentrate on advanced development of intelligent encoders with integrated ASICs, new special features and with adaptations to different fieldbus systems. This enables us to meet the need for increasingly effective and dependable machines and automation to an even higher degree.

1.3.1 Technical and commercial support

Leine & Linde are represented by subsidiaries in many countries around the world. In addition to the address listed here, there are many services agencies and distributors located worldwide ready to reply to commercial enquires or technical support. For more contact information, please visit our web site or contact Leine & Linde in Strängnäs, Sweden.

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1.3.2 Certification of PROFIBUS products

In order to achieve interoperability between vendors and appropriate device functionality all PROFIBUS products developed and manufactured by Leine & Linde AB has been verified by external bodies. Leine & Linde AB are proud to announce that all PROFIBUS enabled products described in chapter 1.3.2 successfully passed a certification process performed by *COMDEC*. A copy of the certificate is attached in the appendix section.

1.4 References

PROFIBUS Encoder profile V1.1, Order No. 3.062
PROFIBUS Profile for DP-V2 Encoders V3.1, Order No 3.162
PROFIdrive V3.1, PROFIBUS Profile, Order No. 3.172

1.4.1 Abbreviations

PROFIBUS	**P**rocess **F**ield **Bus**
PROFIdrive	**P**rocess **F**ield **drive**
PI	**PROFIBUS I**nternational
PNO	**PROFIBUS N**utzer**o**rganisation e.V. (PROFIBUS user organization)
GSD	German term "Gerätestammdaten". A GSD is the device database file, also called "device datasheet".
DP	**D**ecentral **P**eriphery
Input data	Data which the master receives from the encoder
Output data	Data which 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 transfer
I&M	**I**dentification & **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. screwing off the three screws at the rear of the encoder.

2.1.1 Node address

The node address of the device can be set via two decimal rotary switches located inside the back cover. The weighting, x10 or x1 are specified beside the switches. Permissible address range is between 0 and 99 but the lower addresses 0 to 2 are usually used by the master and not recommended to be used by the device. 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 done to the address settings.

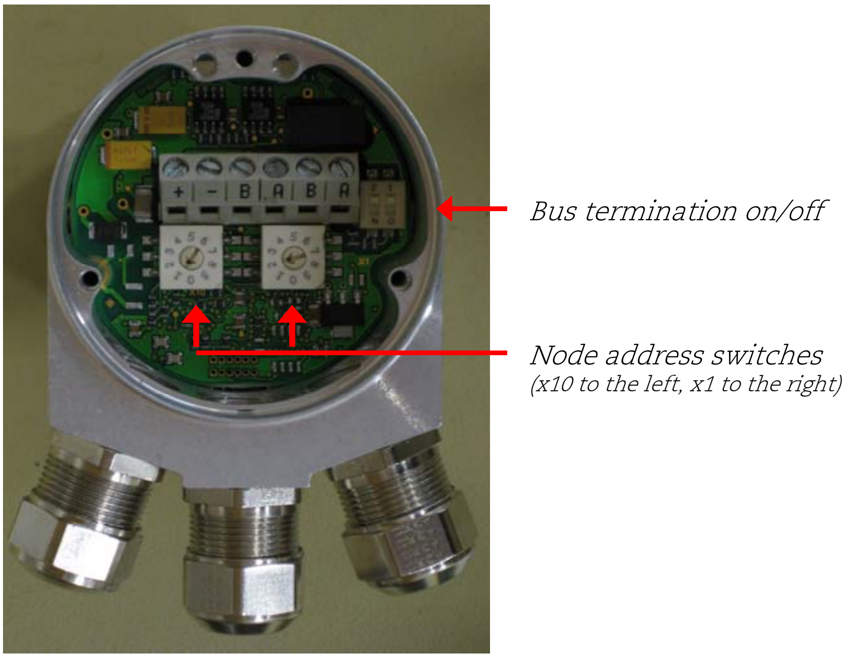


Figure 1 *PCB-view of a cable gland PROFIBUS encoder*

2.1.2 Bus termination

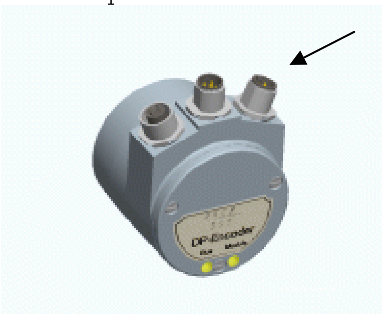
In a PROFIBUS net, all devices are connected in a bus structure. Up to 32 devices (master and/or slaves) can be connected in one segment. When more devices are needed repeaters should be used to amplify the signals between segments. An active termination must be added in the beginning and end of each bus segment in order to ensure error-free operation. In case of the encoder such terminators are integrated inside the back cover and can be activated via dip switches as shown in figure 1. If the device is un-powered the A and B lines are internally terminated by a 220Ω resistor.

When encoder with M12 connectors is used the termination is conducted using terminating resistor plug. The plug is assembled in resemblance to the M12 cables and both male and female contacts are available in order to enable termination in both ends of the bus.

2.2 Connecting the encoder

2.2.1 Power supply

The power supply connection of M12 equipped encoders are constituted by a male A-coded 4 pin M12 connector.



Power supply

Power supply M12 version	
Function	*Pin*
+EV (9-36Vdc)	1
Not connected	2
0V	3
Not connected	4

Figure 2 *Orientation of M12 power supply connector connector*

Table 1 *Pinning M12 power supply*

The cable gland encoders should always be equipped with a shielded power supply cable with conductor area between 0,34mm^2 to 1.5mm^2. Permissible outer cable diameter is ø8mm to ø10mm. Located inside the back cover are two screw terminals containing the required power supply terminals marked (+) and (-).

The (+) terminal shall be used to connect the +EV-line (9-36Vdc).
The (-) terminal shall be used to connect the 0V-line.

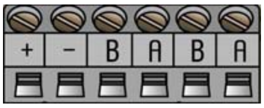


Figure 3 *Terminal connection of power supply cables*

2.2.1 BUS lines

The PROFIBUS bus line connections of the M12 equipped devices are constituted by a male B-coded 5 pin M12 connector (bus in), and a female B-coded 5 pin M12 connector (bus out).
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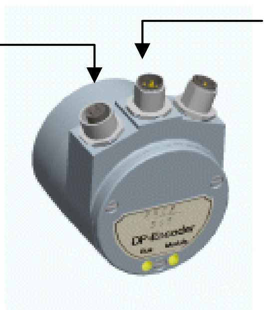
Bus out



Bus in

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
Chassi	5	Chassi	5

Figure 4 *Orientation of M12 bus connectors*

Table 2 *Pinning M12 bus in/out - lines*

The cable gland encoders shall be equipped with twisted pair shielded cable in accordance with EN 50170 and PROFIBUS guidelines. The guidelines recommend a conductor area higher than 0,34mm^2. Permissible outer cable diameter is ø6mm to ø8mm. Located inside the back cover are four screw terminals containing the required bus line terminals marked (A) and (B).

The (A) terminal shall be used to connect the A-line (color green).
The (B) terminal shall be used to connect the B-line (color red).

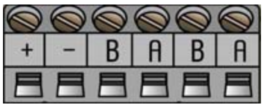


Figure 5 Terminal connection of bus line cables

Note: The two A and B-terminals are internally connected to each other so it does not matter to which the bus lines are connected to.

2.3 Shielding philosophy

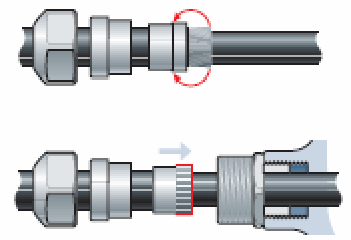


Figure 6 Cable assembling principal

To achieve the highest possible noise immunity and resistance against other EMI related disturbances the bus and power supply cables shall always be shielded. The screen should be connected to ground on both ends of the cable. In certain cases compensation current might flow over the screen. Therefore a potential compensation wire is recommended.

2.4 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 set by means of the GSD file in the configuration tool and the operating parameters are transferred to the respective slave.

Leine & Linde offers different GSD files depending on what type of PROFIBUS device used (integrated encoder or gateway). In addition differentiation between DPV0 or DPV2 functionality is also made by selecting different GSD file. All GSD files available can be ordered or downloaded at www.leinelinde.com, for part numbers please view datasheets or contact your nearest Leine & Linde representative.

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

Table 3 GSD files available

When configuring the encoders various encoder classes can be selected as described in the following chapters. Selectable parameters and functionality of the device depend on the selected encoder class. This data, saved in the PROFIBUS master is transferred once to the encoder when 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 GSD-files:

1. Select the GSD file of the respective device on the floppy disk and copy the *.gsd file into the respective directory of the PROFIBUS configuration tool.

2. Select the bitmap file of the respective device on the floppy disk and copy the *.bmp file into the respective directory of the PROFIBUS configuration tool.

3. Update the GSD files (SCAN).

2.5 LED indication

In order to determine the status of the encoder two LEDs are visible from the rear end of the encoder. The module LED indicates status of the module itself. The bus LED indicates the status of the bus. The table below defines the diagnostic messages using a red (BUS) and a bicolor, Red/Green, LED (MODULE). Function of the led indication is the same in DPV0 and DPV2 mode.

Bus	Module	Meaning	Cause
Dark	Dark	No Power	
Red	Green	No connection to another device Criterion: no data exchange	- Bus disconnected - 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	- Configuration received differs from the supported configuration. - Parameter error in the parameterization.
Dark	Red	System Failure	- Diagnosis exists, slave in data Exchange mode - Position error
Dark	Green	Data exchange. Slave and operation ok.	

Table 4 LED indication

1) The blinking frequency is 0.5 Hz. Minimal indication time is 3 sec.
2) Position error is when an alarm occurs in the Encoder or if 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 defining the functionality of encoder for the different versions of PROFIBUS DP. Please advise the picture below 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 in this profile are divided into two device classes. Class 1 encoders offer basic functions that all PROFIBUS-DP encoders must support. An encoder of class 1 can optionally support selected functions of class 2 but these functions must be implemented according to the profile. To support early PROFIBUS-DP implementations the size of the protocol data units (PDU) is limited to 16 bytes. Encoders of class 2 must support all functions of class 1 as well as the additional functionality of class 2. In addition to the two classes, parameters and diagnostic ranges are reserved for manufacturer-specific functions.

Encoder Profile for DPV1 and DPV2, version 3.1, order no 3.162.
Also in this profile there are two device classed: Class 3 offers the basic functionality and Class 4 full scaling and preset functionality. In addition to the mandatory functionality of Class 3 and 4 there are optional functions defined.

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

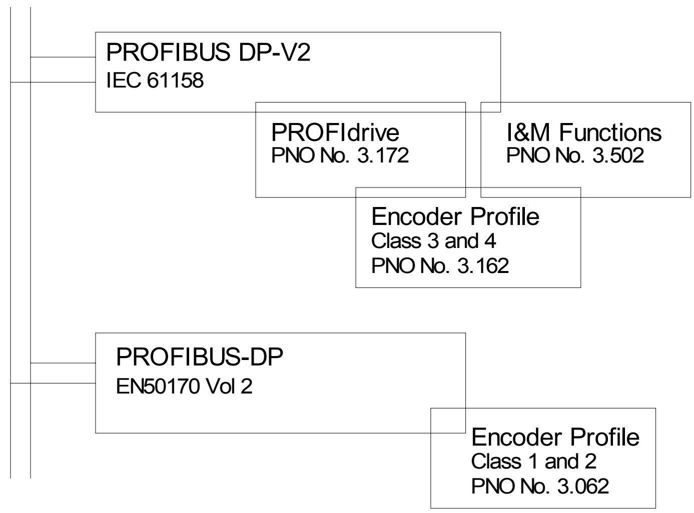


Figure 7 Overview encoder profiles and related documents for PROFIBUS

To choose between the different profile versions a GSD-File is used. The user can select the version that fits their hard- and software. The GSD-file can be ordered form Leine & Linde AB or downloaded from www.leinelinde.com.

3.1 DPV0 encoder classes

The encoder can be configured as a class 1 or class 2 PROFIBUS slave device. Class 2 configuration is extended to optionally access velocity information from the encoder.

CLASS 1 In the 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:

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

Configuration data:

Singleturn	Class 1 – 16 Bit: $D0_{hex}$, 1 input data word, data consistency
Multiturn	Class 1 – 32 Bit: $D1_{hex}$, 2 input data words, data consistency

CLASS 2 In the CLASS 2 configuration output values and input words are transferred. 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 Value Function
- Velocity read-out
- Extended diagnostic data

Configuration data:

Singleturn	Class 2 – 16 bits: $F0_{hex}$, 1 input data word, 1 output data word for preset value, data consistency
Multiturn	Class 2 – 32 bits: $F1_{hex}$, 2 input data word, 2 output data words for preset value, data consistency
Position + Velocity	Class 2 – 32+16 bits: $F1+D0_{hex}$, 3 input data word, 2 output data words for preset value, data consistency

The selection of class depends on the demands required by the application but for enabling full functionality of the encoder it is recommended to choose; Encoder class 2 32-bit velocity.

3.2 DPV2 encoder classes

In general, the encoders with PROFIBUS-DPV2 interface are divided into two classes. Unlike in DPV0 there is only one configuration option, telegram 81, independently of class.

CLASS 3 In the CLASS 3 configuration only output position values are assigned. No added functionality can be accessed.

Configuration data:
Standard Telegram 81

CLASS 4 In the CLASS 4 configuration output values and input words are transferred. 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 Value Function
- Extended diagnostic data

Configuration data:
Standard Telegram 81

4 Encoder functionality, DPV0

4.1 Basic encoder functionality

The figure below gives an overview of the basic encoder functions and how the functionality is conduced within the encoder.

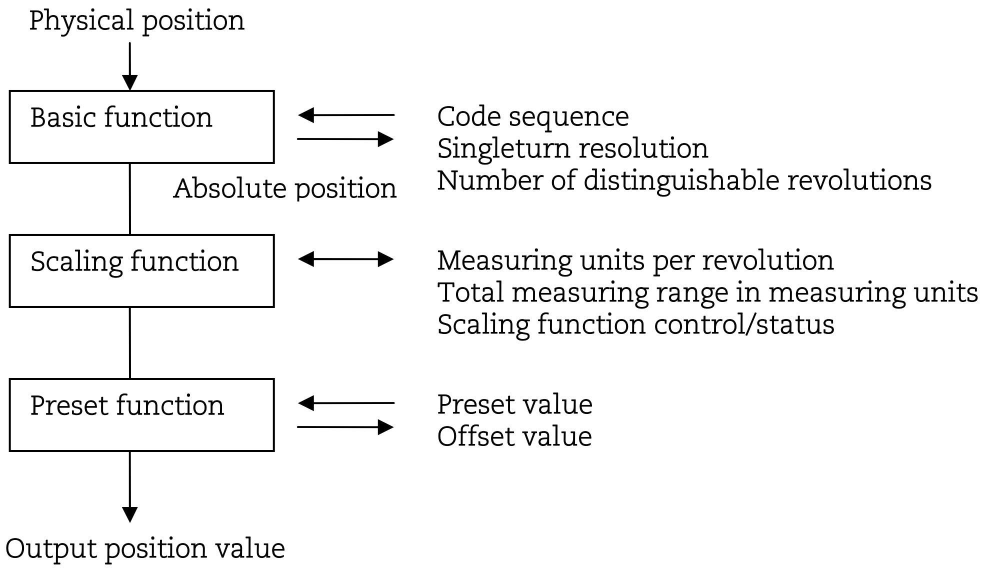


Figure 8 Basic encoder functionality

4.2 PROFIBUS data transfer principle

The PROFIBUS-DP devices can be configured and parameters set according to the user's needs. In this context it is useful to know that with PROFIBUS there are different types of data transmission.

4.2.1 During parameterization (DDLM_Set_Prm mode)

When the system is started, the PROFIBUS devices are parameterized (DDLM_Set_Prm mode), i.e. the encoder class set by means of the GSD file in the configuration tool (see chapter 3) and the set operating parameters (see chapter 4.4) are transferred to the respective slave.

4.2.2 Normal operation (DDLM_Data-Exchange mode)

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

4.3 Configuration, DPV0

The configuration of a DPV0 encoder is conducted by choosing encoder class, i.e. setting the input/output data structure. The configuration options are 16-bit, 32-bit or 32-bit + 16-bit velocity input data, for explanation view 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:

Parameters	Data type	Parameter octet number	Device class
Code sequence	Bit	9	1
Class 2 functionality	Bit	9	2
Commissioning diagnostics	Bit	9	Optional
Scaling function control	Bit	9	2
Measuring units per revolution	Unsigned 32 bits	10 – 13	2
Total measuring range (units)	Unsigned 32 bits	14 – 17	2
Manufacturer specific functions	Bit	26 – 28	Optional
Velocity control	2 bit	39	2 ext.

Table 5 Operating parameters in DPV0

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

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

Bits	Definition	= 0	= 1
0	Code sequence	*Clockwise (CW)* Increasing position values when rotated clockwise (seen from flange side)	*Counter clockwise (CCW)* Increasing position values when rotated counter clockwise (seen from flange side)
1	Class 2 functionality	Disable	Enable
2	Commissioning diagnostics	No	Yes
3	Scaling function control	Disable scaling	*Enable scaling* Scaling parameters are taken into octets 10 to 17.
4	*Reserved for future applications*		
…			
7			

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 counter clockwise 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 functionality

This bit enables or disables class 2 functionality. The Class 2 functionality bit for PROFIBUS-DP devices is by default disabled (0). This means that this control bit must be activated during parameterization in order to support the class 2 functions.

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

4.4.3 Commissioning diagnostics

The commissioning diagnostics function makes enable the encoder to perform 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 conjunction 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, this is indicated in the diagnostic function by 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 “operating status” should be read by the diagnostic function and the commissioning diagnostics bit should be checked.

4.4.4 Scaling function control

The scaling function converts the encoder’s physical absolute position value by means of software 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 octet 10 to 17. Scaling is active only if the control bit for the scaling function is set. When the scaling function control 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 absolute position 0 or to any required starting position within the scaled operating range.

4.4.5 Measuring units per revolution

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

The default setting for singleturn encoders RxA 607 are:

Measuring units per revolution = 8192_{10} (2^{13})
Total measuring range in measuring units = 8192_{10} ($2^{13} \cdot 2^{0}$)

The default setting for multiturn encoders RxA 608 are:

Measuring units per revolution = 8192_{10} (2^{13})
Total measuring range in measuring units = 3355 4432_{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	$2^{31} - 2^{24}$	$2^{23} - 2^{16}$	$2^{15} - 2^{8}$	$2^{7} - 2^{0}$
	Measuring units per revolution			

Table 7 Singleturn scaling parameter format

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 in measuring units			

Table 8 Multiturn scaling parameter format

The data format for both scaling parameters is 32 bits without sign, with a value range from 2^0 to 2^{32}. The permissible value range is limited by the resolution of the encoder. For a 25-bit encoder with a singleturn resolution of 13 bits the permissible value range for "Measuring units per revolution" is between 2^0 and 2^{13} (8192) and for the "Total measuring range in measuring steps" the permissible value range is between 2^0 and 2^{25} (33 554 432). The scaling parameters are securely stored in the PROFIBUS-DP master and are reloaded into the encoder at 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 single turn resolution of 4000 unique positions per revolution and a total number of turn count equal to 3200 revolutions shall the configuration be as:

Measuring units per revolution
= 4000_{10} steps

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

Entry in the master configuration software:
Measuring units per revolution = 4000
Total measuring range (steps) = 12800000

4.4.6 Total measuring range (units)

The total measuring range is defined by the parameter "Total measuring range in measuring units." 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 if a 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 used if the encoder is scaled to 2^x number of revolutions (number of revolutions 2, 4, 8, 16, 32, 64 128, 256, 512, 1024, 2048 and 4096).

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

Example of a cyclic scaling:
Measuring units per revolution = 1000
Total measuring range = 32 000 (2^5 = number of revolutions 32)

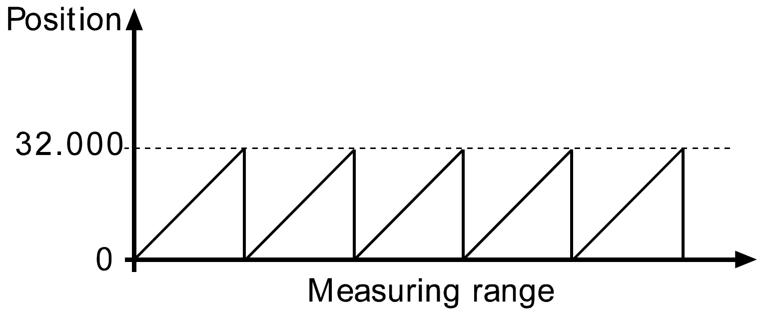


Figure 9 Cyclic scaling

B. Non-cyclic 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 position value is limited within the operating range. If the position value resulting from rotation of the encoder exceeds the maximum value or falls below 0, the encoder indicates the value of the measuring range. See figure below.

Example of non-cyclic scaling:
Measuring units per revolution = 100
Total measuring range = 5000 (number of revolutions 50)

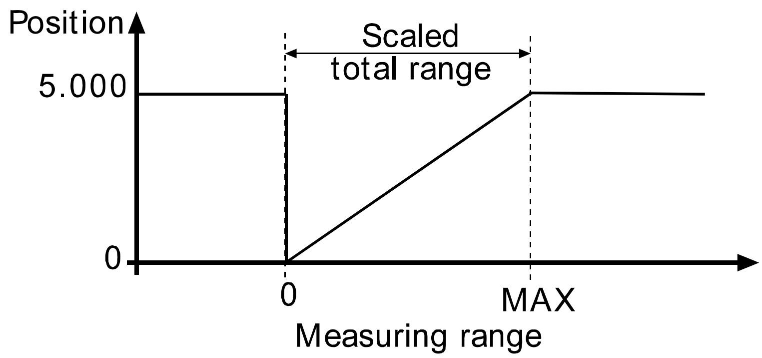


Figure 10 Non-cyclic scaling

4.4.7 Velocity control

The velocity data can be access if class 2 32-bit + velocity configuration is used. In this case the input data consists of 32-position data plus 16-bit signed velocity data. The input velocity value is negative in CCW direction if code sequence is set to CW. If the measured velocity is higher then what is possible to present with the selected velocity unit the value is set to 0x7FFF(32768) or 0x8000(-32768) depending on direction of shaft rotation.

Note: If any of the time based velocity units is used and scaling is set to the encoder the velocity calculation is based on the scaled position value. Consequently the accuracy of the velocity value is dependent of the scaling set to the encoder.

The parameter for velocity unit, octet 39.

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

Bit	7	6	5	4	3	2	1	0	Velocity unit
			0	0					Steps/s
			0	1					Steps/100ms
			1	0					Steps/10ms
			1	1					RPM(revolutions/min)

Table 9 Octet 39 Velocity Control

4.5 Data transfer in normal operation (DDLM_Data_Exchange)

The DDLM_Data_Exchange mode is the normal status of the absolute encoder when operated. In this mode the position value is transmitted from the encoder in a cyclic manner. Output data can also be sent to the encoder i.e. preset commands.

4.5.1 Data exchange mode

The actual position value is transferred to the master as 32-bit values (double word) or optional, the encoder supports a position value length of 16-bit for singleturn encoder. 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:
Device class 1 $D1_{16}$ 2 input data words, data consistency
Device class 2 $F1_{16}$ 2 input data words, 2 output data words for 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:
Device class 1 $D0_{16}$ 1 input data word, data consistency
Device class 2: $F0_{16}$ 1 input data words, 1 output data word for preset value, data consistency

4.5.2 Preset function

The preset value function enables adaptation of the position value form the encoder to a known mechanical reference point of the system. The preset value function sets the actual value of the encoder to zero or to the selected preset value. The preset value is stored in a non-violate memory in the encoder as input value when the Data_Exchange function is activated. In case of a power interruption the preset value is reloaded at start-up. If scaling is used the preset value function shall be used after the scaling function. This means that the preset value is entered in the current measuring unit.

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

Normal operating mode: MSB = 0 (bit 31, optional bit 15)
The encoder will not change the preset value.

Activated mode: MSB = 1 (bit 31, optionally bit 15)
With MSB = 1, the encoder accepts the transferred value (bits 0 – 30) as preset value in the binary code. The encoder reads the current position value and calculates an offset value using the preset value. The position value is shifted by the calculated offset value. If the input 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 in the diagnostic data.

Note: The preset function should only be used at encoder standstill. Depending on encoder type the number of possible preset cycles is limited; please consult Leine & Linde 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 - max. 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 - max. 15 bits	

Table 13 Preset value, 16-bit format

4.6 Diagnostics

The diagnostic information contains diagnostic data which are on the one hand defined in the PROFIBUS-DP specification (octets 1 to 6) but also encoder-specific diagnostic data:

DDLM_Slave_Diag

Diagnostic function	Data type	Diagnostic. octet number	Device class
Station status 1	Bits	1	1
Station status 2	Bits	2	1
Station status 3	Bits	3	1
Diagnostic master address	Bits	4	1
PNO identification number	Bits	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 (encoder) Measuring unit (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
Measuring units per revolution	32 without sign	40 – 43	2
Total measuring range in measuring units	32 without sign	44 – 47	2
Serial number	ASCII string	48 – 57	2
Reserved for future definitions		58 - 61	2

Table 14 Diagnostics message, DPV0

Note: The length of the diagnostic information of class 1 is limited to 16 bytes, compatible with previous DP versions. For PROFIBUS-DP encoders of class 2, 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 the PROFIBUS-DP encoder of class 1 the length of the encoder-specific diagnostic data is 10 bytes (0Ahex).

DDLM_Slave_Diag

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

Table 15 Diagnostic header

4.6.2 Alarms

Alarm is generated by the encoder when failure occurs which effects the position value. Octet 8 in the diagnostic function (DDLM_Slave_Diag) indicates the status of the alarms. Additional alarms for device class 2 are added in the diagnostic octet 17.

If an alarm is given, the Ext_Diag bit and the Stat_Diag bit in the diagnostic function are set to high and remain high until the alarm is reset and the encoder can provide a correct position value. 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 encoders of class 2 the diagnostic information "supported alarms" (see Chapter 0) makes it possible to find out which individual alarm bits are supported.

DDLM_Slave_Diag

Octet	8
Bits	7 – 0
	Alarms

Bits	Definition	= 0	= 1
0	Position error	No	Yes
1	Voltage supply error	No	Yes
2	Current is too high	No	Yes
3	Commissioning	OK	Error
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 in order to show the DP master that all class 2 commands are supported. The DP master must activate the class 2 functionality bit 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 by means of the scaling parameters.

DDLM_Slave_Diag

Octet	9
Bits	7 – 0
	Operating Status

Bits	Definition	= 0	= 1
0	Code sequence	Increasing position values for clockwise revolutions (seen from flange side)	Increasing position values for counterclockwise revolutions (seen from flange side)
1	Class 2 functionality	No, not supported	Yes
2	Commissioning 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 hex code 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 singleturn resolution in the diagnostic function has different meanings depending on the type of encoder.

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

For linear encoders the measuring steps is presented with respect to the resolution of the linear encoder, i.e. each increment of the measuring step is equal the actual resolution for the linear encoder in use. Typical values for the linear resolution are 1µm - 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 that the encoder can transfer is defined by octets 15 and 16 of the diagnostic function. In accordance with the formula below, the measuring range for an 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

The diagnostic octet 17 indicates additional alarms for device class 2.

DDLM_Slave_Diag

Octet	17
Bits	7 – 0
	Additional alarms

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

Table 21 Diagnostics, additional alarms

4.6.8 Supported Alarms

The diagnostic octets 18 and 19 contain information on the supported alarms.

DDLM_Slave_Diag

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

Bits	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	Commissioning 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 logically set to 1 until the warning is reset. All warnings are deleted when 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 before the system is switched on again.

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	

Bits	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 charging	OK	Too low
6	Reference point	Reached	Not reached
7	*Currently not assigned*		
•			
15			

Table 23 Diagnostics, warnings

4.6.10 Supported Warnings

The diagnostic octets 22 and 23 contain information on supported warnings.

DDLM_Slave_Diag

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

Bits	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 charging 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 provide the PROFIBUS-DP encoder profile version that is implemented in the encoder. The octets revision number and index are combined.

Example:

Profile version:	1.40	
Octet no.	24	25
Binary code.	00000001	00000001
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 provide the software version of encoder. The octets revision number and index are combined.

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 for the encoder in operating hours. The operating time is saved every six minutes in the encoder non-volatile memory. This happens as long as the encoder is under power. The operating time is displayed as a 32-bit value without sign in 0.1 h by the DDLM_Slave_Diag function.

If the operating time function is not supported by the encoder, it is set to the maximum value (FFFF FFFFhex). The manufacturer of the encoder 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 value function and shifts the position value by the calculated value. The offset value is stored in the encoder and can be provided by the diagnostic octets 32 to 35. The data type for the offset value is a 32-bit binary value with algebraic sign, whereby the offset value range is equal to the measuring range of the encoder.

The preset value function is used 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 Offset Value of the Encoder Manufacturer

The manufacturer offset value indicates the encoder offset set by the manufacturer. This value gives information on the shift of the position zero point in number of positions from the physical zero point of the encoder. The data type for the offset value is a 32-bit binary value with sign. The value range corresponds to the measuring range of the encoder. The offset value of the manufacturer of the encoder is indicated in the number of units according to the basic resolution of the encoder. The value is stored in write-protected memory, which can be changed only by the encoder manufacturer. This value has practically no importance for the user.

DDLM_Slave_Diag

Octet	36	37	38	39
Bits	31 – 24	23 – 16	15 – 8	7 – 0
Data	$2^{31} – 2^{24}$	$2^{23} – 2^{16}$	$2^{15} – 2^{8}$	$2^{7} – 2^{0}$
	Offset Value of the Encoder Manufacturer			

Table 29 Diagnostics, offset value of the encoder manufacturer

4.6.16 Scaling Parameters Settings

The scaling parameters are set in the DDLM_Set_Prm function. The parameters are stored in the octets 40 to 47 of the diagnostic data. The "Measuring units per revolution" and "Total measuring range in measuring units" parameters define the selected resolution of the encoders. The status bit of the scaling function in the operating status (octet 9 of the diagnostic data) indicates whether the scaling function is enabled.

Values preset by the manufacturer of the encoder:

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

The data type for both values is unsigned 32 bits.

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}
	Measuring units per revolution			

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 in measuring units			

Table 30 Diagnostics, scaling parameters setting

4.6.17 Encoder Serial Number

Octets 48 to 57 of the diagnostic function provide the serial number of the encoder as a 10-character ASCII string.

DDLM_Slave_Diag

Octets	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 Encoder commissioning example, DPV0

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

Copying the GSD file

First, copy the GSD file “enc_a401.gsd” and bitmap into the corresponding directory in the Siemens configuration software,…*GSD.*

Selecting the DPV0 Slave

To select the encoder click on the “PROFIBUS encoder” icon in the map structure on the right side of the window. Use “drag-and-drop” to add the encoder on the BUS, upper left view.

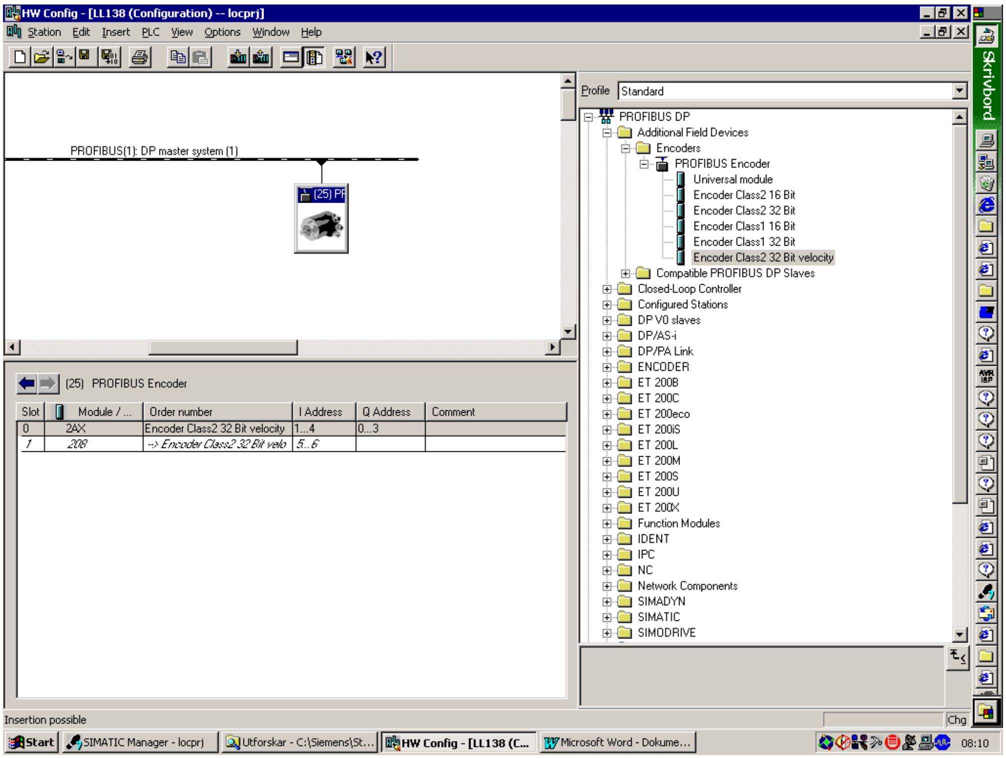


Figure 11 *Commissioning example, DPV0*

When dropping the encoder on the BUS a PROFIBUS address must be assigned, naturally this address must be the same as assigned on the hardware address switches on the back of the encoder, see chapter 2.1.1.

Configure 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. Add the chosen configuration by “drag-and-drop” to the configuration window in lower left view.

Assigning parameters to the DPV0 slave

By "double-clicking" on the configuration row in the configuration view the parameterization view will be opened

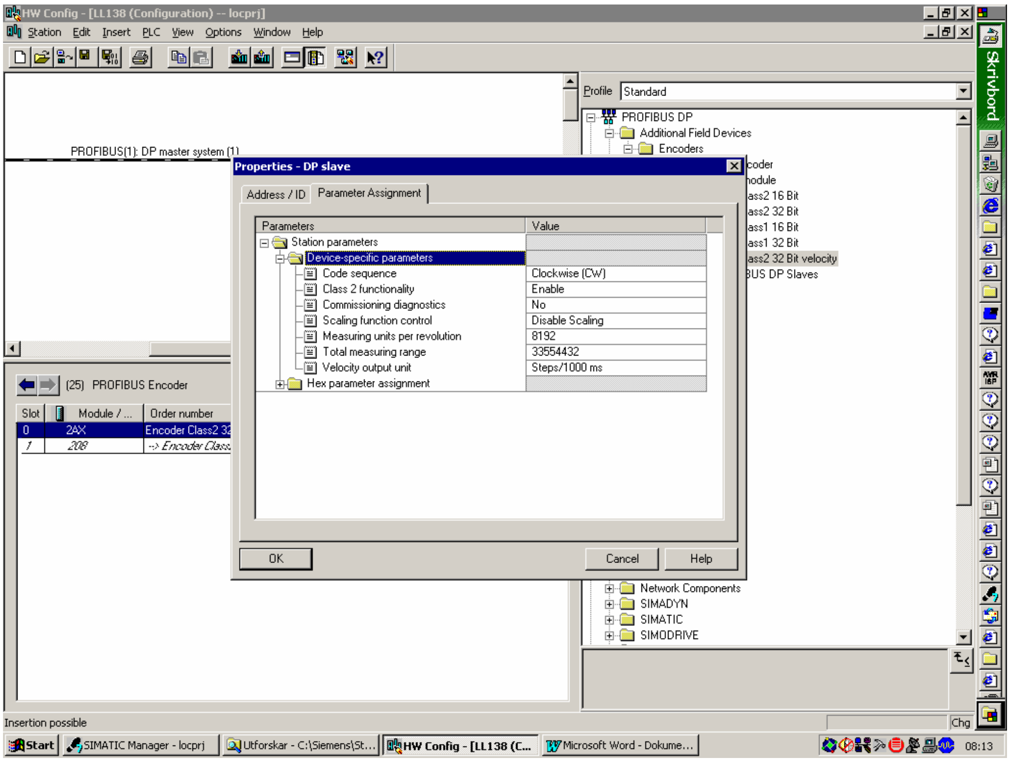


Figure 12 *Parameter assign, DPV0*

In the "value field" the desired parameterization is added. Chapter 4.4 describes the functionality and possibility of each parameter.

After adding the parameters the encoder will enter data exchange mode and is thereby commissioned on the BUS.

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

6 Encoder functionality, DPV2

The PROFIBUS DP encoder can, by using the DPV2 GSD-file, be configured 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 adopted to the DPV2 PROFIBUS profile for encoders (3.162).

Standard Telegram 81:

PZD number	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-/32 bit	Input/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_STW	16	Input, control word from encoder
Sensor 1 status word	G1_ZSW	16	Input, status word from encoder
Sensor 1 position actual value 1	G1_XIST1	32	Input, left aligned absolute position value from encoder
Sensor 1 position actual value 2	G1_XIST2	32	Input, right aligned absolute position value from encoder

Table 33 Telegram 81, signals

Control word 2 (bit 12-15) is referred to as “master’s sign of life” and the Status word 2 (bit 12-15) as Slave’s sign of life. These signals are mandatory 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 are left aligned and G1_XIST2 right aligned, in case of different format the shift factor is presented in parameter P979 (see chapter 6.2.1). Both G1_XIST1 and G1_XIST2 is affect 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 principal is that all PROFIBUS devices on the net are clock synchronized with the master using a global control broadcast enabling simultaneous data accusation from all slaves with microsecond accuracy. The synchronization is monitored using “sign-of-life” messages.

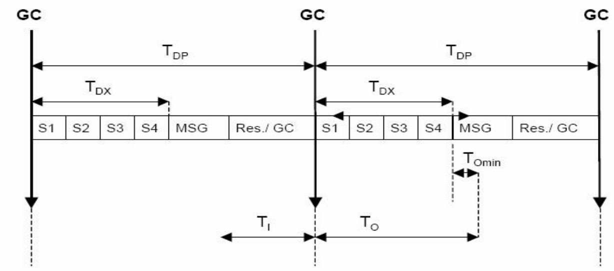


Figure 13 Basic principal of the DP-cycle in isochronous mode

GC — Global Control signal

T_{DP} — DP cycle time, 1ms-32ms (default 2ms) depending on number of slaves on the bus

T_I — At start of T_I all slaves must read position data. During T_I all slaves must put the sampled data in respective buffer ready for the Master to read (must be finished before next GC).

T_0 — During T_0 the slave will read diagnostics data from the Master. This data will be executed at T_0.

MSG,Res/GC — The acyclic data channel (parameter channel)

6.2 Acyclic data exchange

The acyclic data exchange is conducted in the parameter channel. The principal of the acyclic data exchange is to enable parameterization during runtime. The acyclic data exchange is conducted in 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 parameter. The Leine & Linde encoder supports the following:

PNU (Prm no.)	Significance	Data type	R/W
918	Node address	Unsigned16	R
922	Telegram selection	Unsigned16	R
925	Number of Master sign-of-life-failures which can be tolerated		R/W
964	Device identification	Array [n] unsigned 16	R
965	PROFIdrive Profile number	Octet string 2	R
971	Transfer to non-volatile memory	Unsigned 16	W
979	Sensor format	Array[n] Unsigned32	R

Table 34 PROFIdrive parameters supported

6.2.2 Encoder specific parameters

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

PNU (Prm no.)	Significance	Data type	R/W
65000	Preset value	Integer 32	R/W
65001	Operating parameters	Array[n] Unsigned32	R

Table 35 Encoder specific parameters supported

The Leine & Linde encoder supports preset value and the following sub index parameters of operating parameters (65001).

Sub index	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	Measuring units per revolution
10	Total measuring range in measuring units

Table 36 Operating parameters supported

6.2.3 I&M functions

In addition to the PROFIdrive parameter 964, Device Identification, I&M functions are supported by the encoder. The I&M functions can be accessed with data set index 255. The Leine & Linde encoder supports the following I&M functions.

Content	Coding
Header	
Manufacturer specific	Security code for parameter write access
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 release 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 (Mandatory I&M supported)

Table 37 I&M functions supported

6.3 Slave to slave communication

The Leine & Linde PROFIBUS encoder is supporting the slave-to-slave communication principal as a slave i.e. as “publisher”.

6.4 Configuration (Isochronous operation)

To configure DV2 encoder class 3 or class 4 encoder type can be selected. In chapter 3.2 the functionality of the different encoder class types are described but independently standard telegram 81 is used for I/O data.

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 units / 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 function of parameters, code sequence, class 4 enable, scaling and scaling control is in analogy to the corresponding parameters in DPV0, for explanation see chapter 4.4.

Note: In order to match the timing requirement during isochronous operation the encoder only tolerates binary scaling on the single- as well as multiturn resolution.

The G1_XIST1 preset control bit enables the preset value to affect the position value presented in G1_XIST1 or not. If the control bit is =1 the preset value will not affect the position value in G1_XIST1.

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

If the Ext_Diag enable control bit is set to =0 (default value) only the first 6-bytes of diagnostics message is transmitted. If the bit is set to =1 extended diagnostics will be available, i.e. the channel related diagnostics is transmitted.

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

To parameterize the isochronous mode the following parameters must be considered. The time based parameters are globally set by the master application and can't be individually set to each slave.

Parameter	Data type	Value	Comments
Structure_Length	Unsigned8	0x1C (decimal 28)	
Structure_Type	Unsigned8	0x04	IsoM parameters
Slot Number	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 Isochronous mode parameters

The different time based parameters are defined in the PROFIdrive V3.1 profile (chapter 6.2.1). For general explanation and understanding see chapter 6.1 in this manual.

6.6 Diagnostic messages, DPV2

6.6.1 Overview

The encoder profile 3.162 defines support for alarm and warning messages. The Leine & Linde PROFIBUS encoder supports the following alarm message.

Bit	Definition	Error type
0	Position error	22

Table 40 Diagnostics messages, DPV2

Error type:	22
Definition:	Position value error
GSD entries:	
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 message

Error messages are sent in G1_XIST2. The Leine & Linde 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	Command not supported	The master application sent a command in G1_STW1 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 preset value is negative and an absolute preset is made error message 0xF01 (command not supported) is set.

The limit for error 0x0F04, Synchronization fault, is by default 5, i.e. up to 5 consecutive synchronization faults is allowed before sending error message.

6.7 Isochronous synchronization principal

The flow chart below describes the synchronization principal 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 will synchronize with the DP-cycle according to the parameterization selected.

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

4. Slave Life Sign — After the encoder is synchronized with MLS it acknowledge by producing Slave Life Sign, SLS. The SLS is presented in ZSW2, Status word 2 (bit 12-15). In accordance to MLS it must be counted 1-15 cyclically (0 is not a valid value) although it is not mandatory that MLS and SLS is equal for each DP-cycle.

5. Operation mode — After detecting correct SLS by the Master, potential error codes must be acknowledge. This is done by the Master, clearing bit 15 in the Sensor Control word, G1_STW. The encoder will acknowledge by resetting the sensor error code bit (15) in Sensor Status Word, G1_ZSW, and also clear the error code message presented in G1_XIST2. If this is done successfully, the encoder is in operating mode 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 principal for adding the encoder on the BUS is the same as for the DPV0, see chapter 5. The exceptions are that 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.

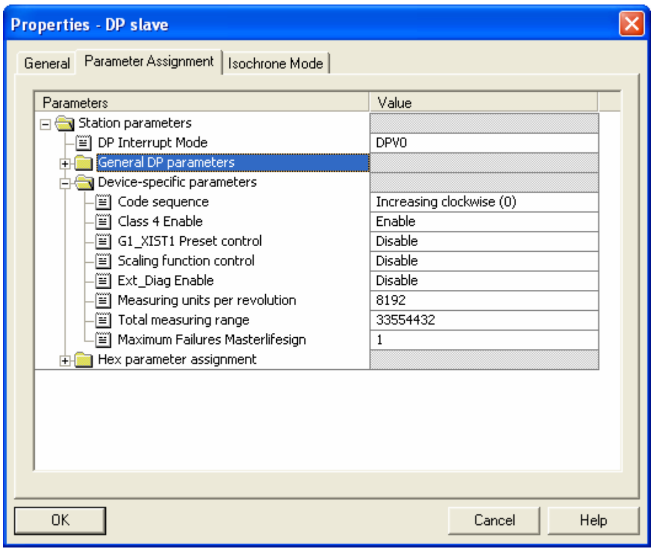


Figure 14 Assigning parameters, DPV2 Class 4

In the "value field" the desired parameterization is added. Chapter 6.5 describes the functionality and possibility of each parameter.

7.1 Isochrone mode parameter settings-DPV2 slave

In the "Isochrone Mode" view of the DP slave properties the parameters for the isochronous operation mode can be set.

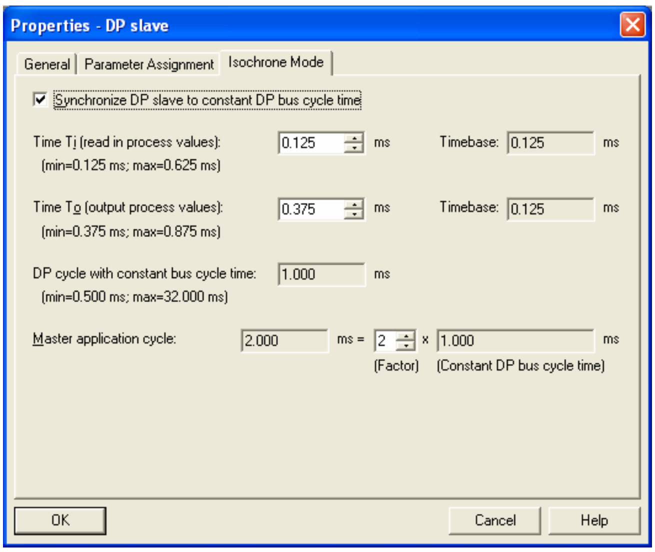


Figure 15 Isochrone mode parameter settings, DP-slave

The different time parameter can be set whereas the time base parameters are controlled by the master. The individual DP slave isochronous mode settings enable individual data sample time as the T_I can be set uniquely for each slave. The "master application cycle factor" is used if the application requires that the master application cycle time is different from the BUS cycle time. Be aware that if the factor is ≠1 the slave will not read "Master's Life Sign" on 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 Isochrone Mode parameters settings-BUS

The "Isochrone Mode" parameter can also be set from the BUS. By "double clicking on the BUS in the BUS structure view, see chapter 5 (upper left view), the properties of the DP master system is accessed.

To access the general BUS "Isochrone Mode" parameters take the following actions:

Click on the "Properties" button

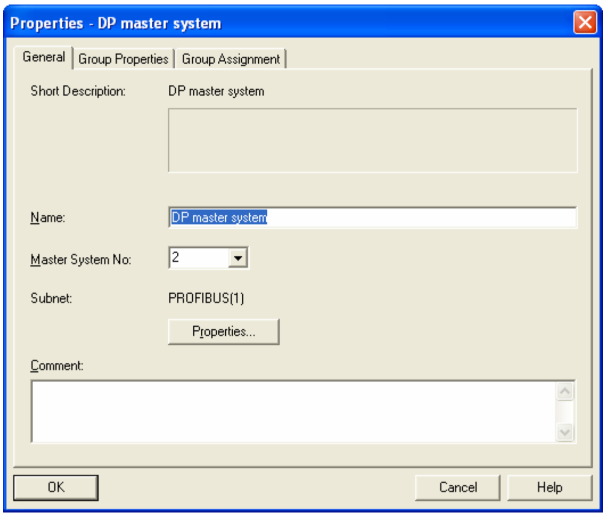


Figure 16 IDP master settings, BUS

Choose the "Network Settings" view. For highest performance make sure that 12Mbps baudrate and DP profile is chosen.

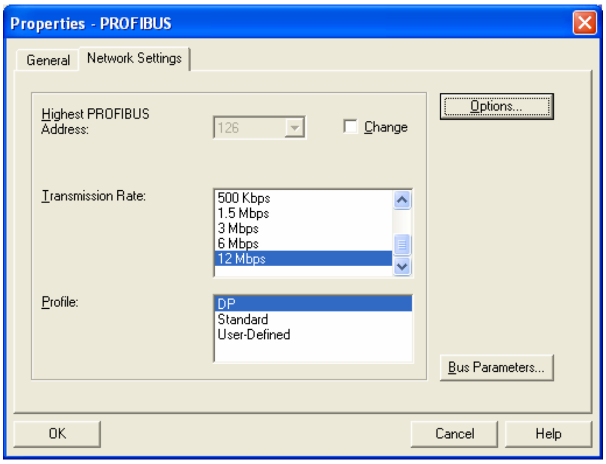


Figure 17 *Network settings, BUS*

Click on the “Options” button

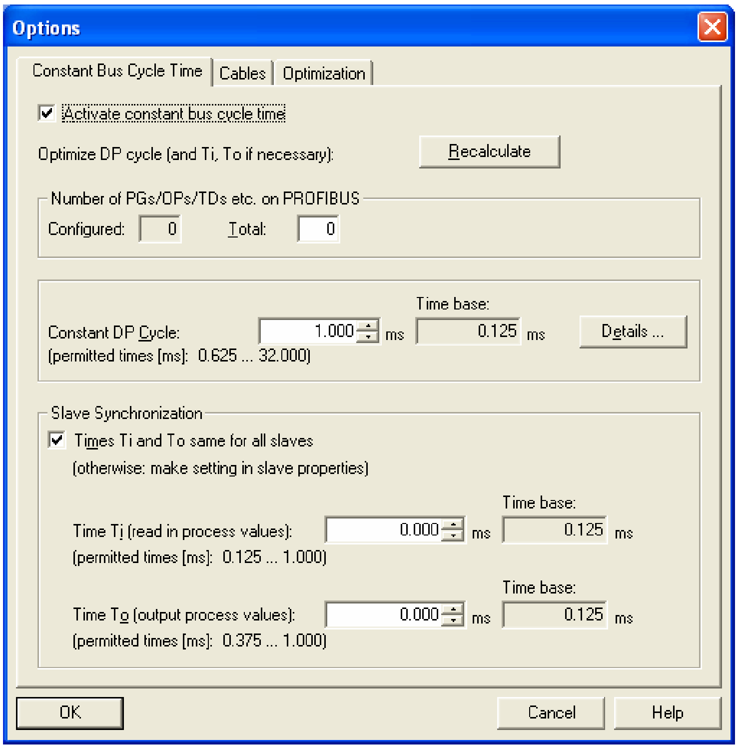


Figure 18 *Isochrone mode parameter settings, BUS*

In this view the DP cycle time as well as the time parameters can be set. If the “Slave Synchronization” button is marked all slaves on the bus will have the same time parameters. In this mode all slaves on the BUS will sample data at the same time and the real isochronous mode is obtained.

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

Appendix A History

Revision	Date	Changes
Rev. 1.0	07-07-13	First release
Rev. 1.1	08.01.24	Additional information with respect to the preset functionality.