LEINE & LINDE

PROFIBUS DPV2

GATEWAYS & ENCODERS

MANUAL / USERS GUIDE

PROFI ®
BUS

LEINE LINDE

Contents

List of tables

List of figures

1 General information

Thank you for choosing this device produced by the Swedish encoder manufacturer Leine&Linde. In your hands you have a state of the art component that is ready to be used in the outmost demanding environment.

This manual describes the installation procedures and configuration of our absolute encoders and our encoder gateways with PROFIBUS DPV2 functionality. If you are in need of assistance during the commissioning or during operation, please make sure that you contact your local Leine&Linde representative.

1.1 Applicability of manual

This product manual is fully applicable to the encoder gateways with PROFIBUS DPV2 functionality. The manual is also fully applicable to the absolute encoder versions equipped with PROFIBUS DPV2 interface within the following encoder series:

RSA 607	**RHA 607**
RSA 608	**RHA 608**

Leine&Linde is a company that often customizes the product to fit individual requirements of our customers. Such customized products may therefore not be fully compliant with the descriptions in this product manual. Customized encoder devices are indicated by its type label, and marked 69X where the "9" digit in the second position indicate that the device has some customized parameters. Encoder series with the following name and type plate information may therefore have deviating functional performance.

RSA 697	**RHA 697**
RSA 698	**RHA 698**

If your product is of the above mentioned type, contact Leine&Linde to obtain the product's complete functional description.
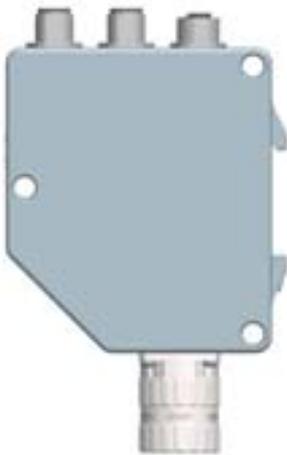
1.2 Encoder gateway

The advantages of the gateway concept is that it allows the use of small and very robust EnDat encoders, which make the encoder gateway solution suitable in applications where very high ambient temperature is a limiting factor. The encoder gateway works with all Leine&Linde EnDat encoders with M23 (EML) connectors. The encoder gateway supports singleturn encoders with up to 31 bit resolution and multiturn encoders with up to 37 bits resolution with the limitations described in this manual.

1.3 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.

1.4 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 Decentralized Peripherals (DP) version. In addition to manufacturer-specific functions, the Leine & Linde devices described in this manual supports application class 3 and 4 according to the encoder profile 3.162 v4.1. 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.

PROFIBUS User Organization

Haid-und-Nue Straße 7
DE-76131 Karlsruhe, Germany

Tel: +49-(0)721-96 58 590
Fax: +49-(0)721-96 58 589
Web: www.profibus.com

1.4.1 PROFIBUS DP functionality levels (DPV0, DVP1, DPV2)

The main functions of the different levels are as follows:

DPV0: Supports the basic functionality for the PROFIBUS protocol. In principal this means the cyclical I/O communication and diagnostics. Leine & Linde have a separate manual for DPV0 devices. The manual for DPV0 devices can be downloaded from www.leinelinde.com.

DPV1: The most important benefits with DPV1 are the expanded functions for the acyclical data communication and alarm handling. This is a precondition for parameterization and calibration of field devices over the bus in runtime.

DPV2: In addition to the functionality above, DPV2 includes expansions that are required for time critical applications such as motion control. This means functions such as slave-to-slave communications and isochronous data exchange (time synchronization).

1.5 About Leine & Linde AB

For more than 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 customer's needs with respect to 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.

1.5.1 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.

Leine & Linde AB

Box 8
SE-645 21 Strängnäs, Sweden

Tel: +46-(0)152-265 00
Fax: +46-(0)152-265 05
E-mail: info@leinelinde.com
Web: www.leinelinde.com

1.6 References

Profile Encoder V4.1, Order No. 3.162

Profile Drive Technology, PROFIdrive V4.1, Profibus International, Order Nr: 3.172

PROFIBUS Guidelines, Part 1: Identification & Maintenance Functions V1.1, Profibus International, Order Nr: 3.502

PROFIBUS Guidelines, Part 3: Diagnosis, Alarms and Time Stamping V1.0, Profibus International, Order No. 3.522

PROFIBUS Guidelines: PROFIBUS Interconnection Technology V1.1, Profibus International, Order No. 2.142

1.6.1 Abbreviations

PROFIBUS	**Pro**cess **Fi**eld **Bus**
PI	**P**ROFIBUS and Profinet **I**nternational
PNO	**P**ROFIBUS **N**utzer**o**rganisation e.V. (PROFIBUS user organization)
GSD	Germn term "**G**eräte**s**tamm**d**aten". 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 from the master.
PDU	**P**rotocol **D**ata **U**nit
I&M	**I**dentification and **M**aintenance
MS1 AR	PROFIBUS MS1 AR (Acyclic data exchange between master (class1) and slave)
MS2 AR	PROFIBUS MS2 AR (Acyclic data exchange between master (class2) and slave)
OB	**O**rganization **B**lock

2 Encoder gateway installation

2.1 Settings inside the gateway

The encoder gateway addressing switches 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 gateway.

Screws to remove the back cover
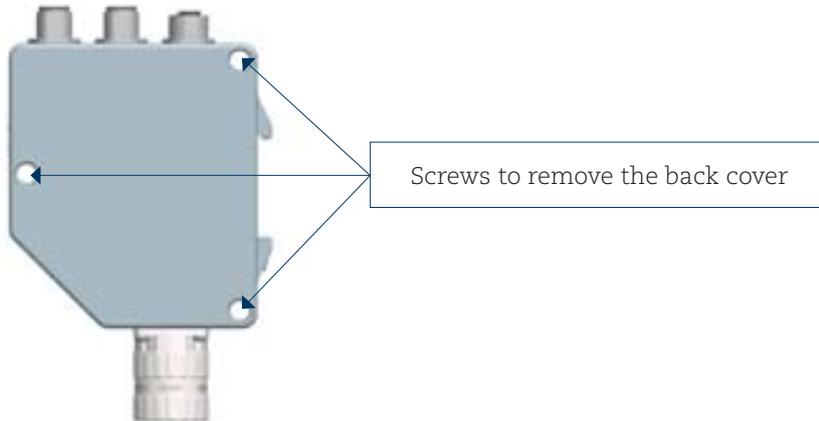
Picture 1 Placement of screws

2.1.1 Node address

The node address of the encoder gateway can be set via three decimal rotary switches located inside the back cover. The weighting, x100, x10 and x1 are specified on the circuit board besides the switches. Permissible address range is between 0 and 126 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 gateway power supply is switched on. A restart of the gateway is therefore required in order to adopt changes done to the address settings.

Screw terminals

Bus termination switch (on/off)

Node address switches (x100 to the left, x10 in the middle and x1 to the right)
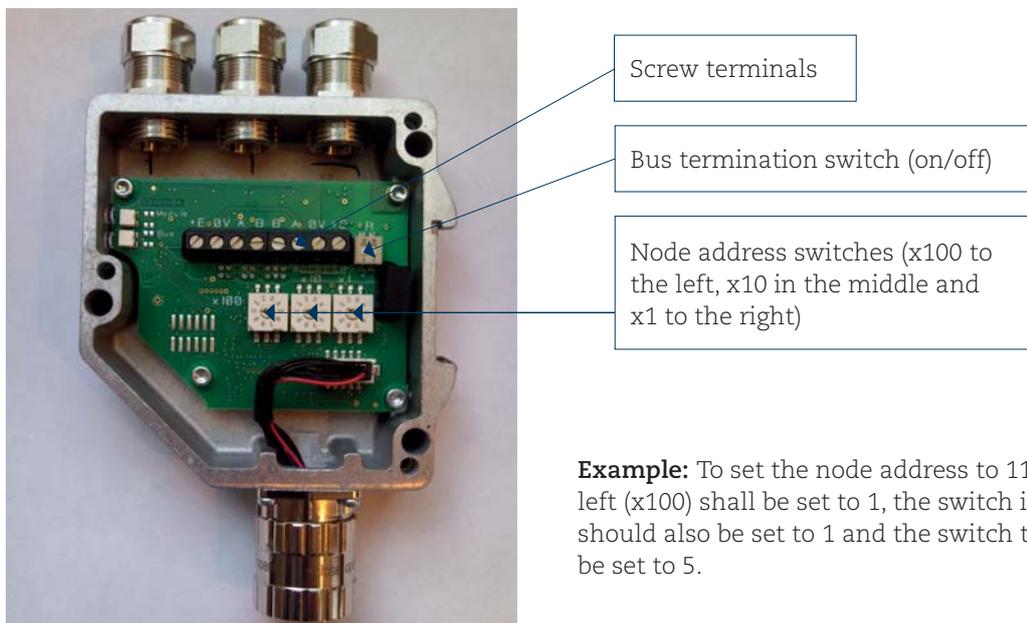
Example: To set the node address to 115, the switch to the left (x100) shall be set to 1, the switch in the middle(x10) should also be set to 1 and the switch to the right(x1) shall be set to 5.

Picture 2 PCB-view of a cable gland PROFIBUS gateway

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 the end of each bus segment in order to ensure error-free operation. In case of the gateway with cable glands such terminators are integrated inside the back cover and can be activated via dip switches as shown in picture 2. If the device is un-powered the A and B lines are internally terminated by a 220Ω resistor.

Bit 1	Bit 2	Effect
ON	ON	There is a 220 ohm resistor between bus A and bus B line
ON	OFF	Not a valid setting
OFF	ON	Not a valid setting
OFF	OFF	There is no resistor between bus A and bus B line.

Table 1 Terminating switch settings

When encoder gateways with M12 connectors are used the termination should be done using a terminating resistor plug. The terminating resistor plug is available as an accessory from Leine & Linde.

Note: **When M12 terminating resistor plugs are used, the internal terminating switch shall not be activated.**

2.1.3 Power supply

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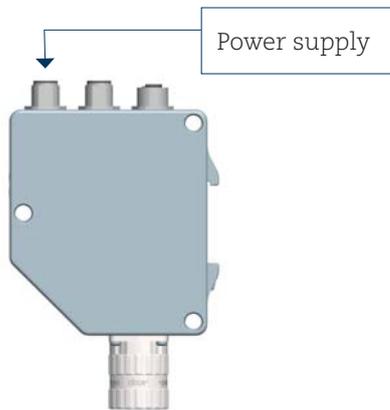
Power supply

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

Picture 3 Orientation of M12 power supply connector

Table 2 Pinning M12 power supply connector

Encoder gateways equipped with cable glands are delivered with a dust protection foil from the factory. The protection foil needs to be removed prior to installing the cables. It is recommended that gateways equipped with cable glands are equipped with a shielded power supply cable with conductor area between 0,34 mm^2 to 1.5 mm^2. Permissible outer cable diameter is ø 6 mm to ø 8 mm for the power supply cable. The power supply screw terminal is located inside the back cover of the gateway. In the case were the gateway is the last node in the bus-structure and only the cable glands for Supply and Bus-in is in use, the Bus out cable gland should be replaced with a M16 filler plug to ensure proper sealing. The M16 filler plug is available as an accessory from Leine & Linde.

The +E terminal shall be used to connect +E Volt (9-36Vdc).
The 0V terminal shall be used to connect 0 Volt.
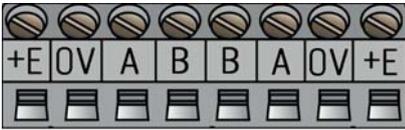
Picture 4 Terminal connections of power supply cables

Note: Tighten all screws in the terminal, even if no cable has been attached.

Note: The two +E terminals are internally connected to each other and the two 0V terminals are also connected to each other, i.e. it does not matter to which pair the +E Volt and 0 Volt are connected to.

2.1.4 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).
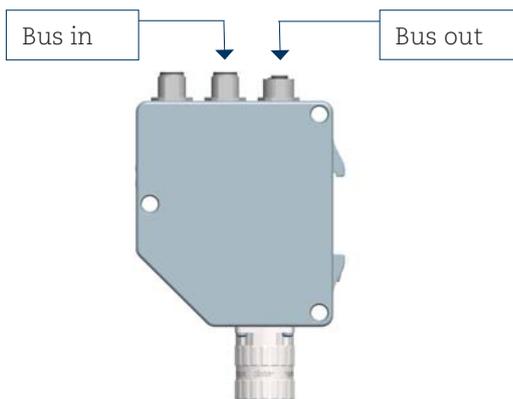
Bus in line		Bus out line	
Function	Pin	Function	Pin
Not connected	1	VP	1
A	2	A	2
Not connected	3	DGND	3
B	4	B	4
Chassis	5	Chassis	5

Picture 5 Orientation of M12 bus connectors

Table 3 Pinning M12 power supply connector

The cable gland gateway shall be equipped with twisted pair shielded cable in accordance with EN 50170 and PROFIBUS guidelines. The guidelines recommend a conductor area higher than 0,34 mm². Permissible outer cable diameter is ø 8 mm to ø 10 mm for the bus lines cables. Located inside the back cover are four screw terminals containing the required bus line terminals marked A and B. Cable glands not used, should be replaced with a M16 filler plug to ensure proper sealing. The M16 filler plug is available as an accessory from Leine&Linde.

The A terminal shall be used to connect the A-line.
The B terminal shall be used to connect the B-line.
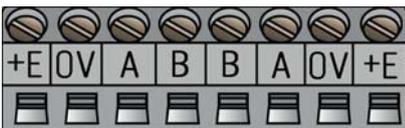
Picture 6 Terminal connection of bus line cables

Note: Tighten all screws in the terminal, even if no cable has been attached.

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

2.3 Shielding philosophy

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

In order to start using the PROFIBUS DP gateway, a device description file needs to be downloaded and imported to the configuration software.

The device description file is called a "Generic Station Description" file and contains the necessary implementation parameters needed for a PROFIBUS DP device.

Available GSD files can be downloaded from www.leinelinde.com.

GSD file	
Gateway functionality	GSD file
Gateway PROFIBUS DPV2	LLPB0B21

Table 4 Available GSD file for DPV2 gateway

The GSD data is saved in the PROFIBUS master and transferred once to the gateway when the system is powered on. If the gateway has been started with one GSD file and a new GSD file with a different ID-number shall be used, the gateway needs to be restarted before it can use the new GSD file.

Installation of GSD-files:

1) Select and save the GSD file for the respective device from our homepage www.leinelinde.com and then copy the *.gsd file into the respective directory of the PROFIBUS configuration tool.
2) If a bitmap picture representing the encoder is requested, make sure that the bitmap file is located in the same folder as the GSD file. A bitmap picture is included in the zip-file downloadable from www.leinelinde.com
3) Update the GSD files (SCAN).

2.5 LED indication

In order to determine the status of the gateway two LEDs are visible on the front of the gateway. 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 bicoloured red/green LED for bus and module.

Bus Status (Bicolour)	Module (Bicolour)	Meaning	Cause
Off	Off	No power	
Red	Green	No connection to another device. Criteria: No data exchange	-Bus disconnected -Master not available / switched off
Red 2)	Red 2)	No connection to another device No connection between EnDat encoder and PROFIBUS PCB	-No connection to EnDat encoder at power up
Blinking 1)	Green	Parameterization or configuration fault	-Configuration received differs from the supported configuration -Parameter error in the parameterization
Green	Red	System failure	-Diagnosis exists, slave in data Exchange mode
Green	Green	Data exchange and encoder function properly	

Table 5 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 the EnDat encoder is disconnected from the PROFIBUS interface PCB.

3 Absolute encoder installations

3.1 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.

3.1.1 Node address

The node address of the encoder can be set via two decimal rotary switches located inside the back cover. The weighting, x10 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.

Screw terminals

Bus termination switch (on/off)

Node address switches
(x10 to the left, x1 to the right)
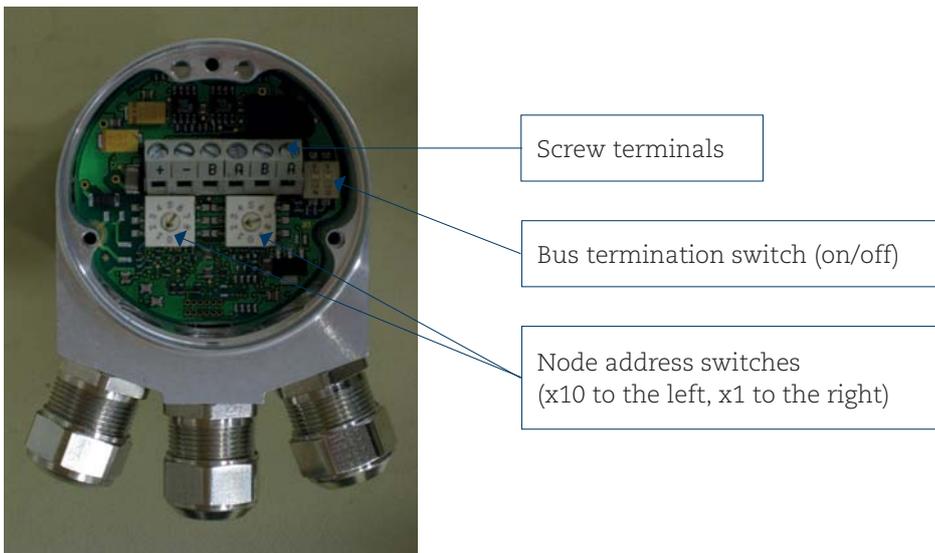
Picture 7 PCB-view of a cable gland PROFIBUS encoder

Example: If the node address shall be set to 85, the left(x10) switch shall be set to 8 and the right(x1) switch shall be set to 5.

3.1.2 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 with cable glands such terminators are integrated inside the back cover and can be activated via dip switches as shown in picture 7. If the device is un-powered the A and B lines are internally terminated by a 220Ω resistor.

BIT 1	BIT 2	Effect
ON	ON	There is a 220 ohm resistor between bus A and bus B line
ON	OFF	Not a valid setting
OFF	ON	Not a valid setting
OFF	OFF	There is no resistor between bus A and bus B line.

Table 6 Terminating switch settings

When encoders with M12 connectors are used the termination should be done using a terminating resistor plug. The terminating resistor plug is available as an accessory from Leine&Linde.

Note: When encoders with M12 terminating resistor plugs are used, the internal terminating switch shall not be activated.

3.2 Connecting the encoder

3.2.1 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
+E Volt (9-36 Vdc	1
Not connected	2
0 Volt	3
Not connected	4
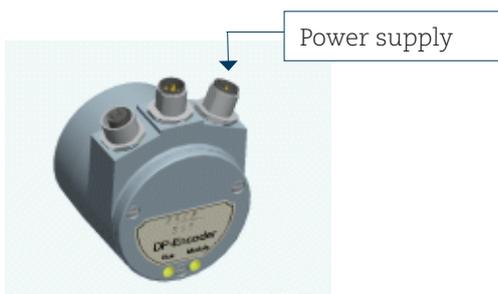
Picture 8 Orientation of M12 power supply connector   **Table 7** Pinning M12 power supply

Encoders equipped with cable glands are delivered with a dust protection foil from the factory.
The protection foil needs to be removed prior to install the cables.

It is recommended that encoders with cable gland are equipped with a shielded power supply cable with conductor area between 0,34mm^2 to 1.5mm^2. Permissible outer cable diameter is ø 6 mm to ø8 mm for the power supply cable. Located inside the back cover are two screw terminals containing the required power supply terminals marked (+) and (-). In the case were the encoder is the last node in the bus-structure and only the cable glands for Supply and Bus-in is in use, the Bus out cable gland should be replaced with a M16 filler plug to ensure proper sealing. The M16 filler plug is available as an accessory from Leine&Linde.

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

Picture 9 Terminal connection of power supply cables

Note: Tighten all screws in the terminal, even if no cable has been attached

3.2.2 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).
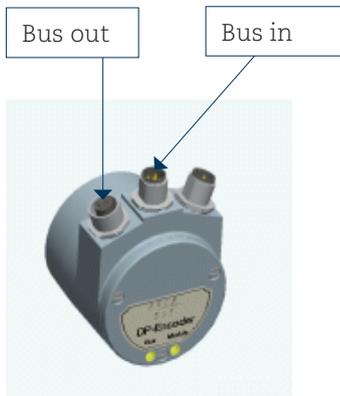

Picture 10 Orientation of M12 bus connectors

Bus in line		Bus out line	
Function	Pin	Function	Pin
Not connected	1	VP	1
A	2	A	2
Not connected	3	DGND	3
B	4	B	4
Chassis	5	Chassis	5

Table 8 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 0,34mm². Permissible outer cable diameter is ø 8 mm to ø 10 mm for the bus line cables. Located inside the back cover are four screw terminals containing the required bus line terminals marked (A) and (B). Cable glands not used should be replaced with a M16 filler plug to ensure proper sealing. The M16 filler plug is available as an accessory from Leine&Linde.

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

Picture 11 Terminal connection of bus line cables

Note: Tighten all screws in the terminal, even if no cable has been attached.

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

3.3 Shielding philosophy

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.

3.4 GSD-files

In order to start using an absolute encoder with PROFIBUS DP interface, a device description file needs to be downloaded and imported to the configuration software.

The device description file is called a "Generic Station Description" file and contains the necessary implementation parameters needed for a PROFIBUS DP device.

Available GSD files can be downloaded from www.leinelinde.com.

GSD file	
Encoder functionality	GSD file
Encoder PROFIBUS DPV2	LLPB0aaa

Table 9 Available GSD file for DPV2 encoder

The GSD data is saved in the PROFIBUS master and transferred once to the encoder when the system is powered on. If the encoder has been started with one GSD file and a new GSD file with a different ID-number shall be used, the encoder needs to be restarted before it can use the new GSD file.

Installation of GSD-files:

1) Select and save the GSD file for the respective device from our homepage www.leinelinde.com and then copy the *.gsd file into the respective directory of the PROFIBUS configuration tool.
2) If a bitmap picture representing the encoder is requested, make sure that the bitmap file is located in the same folders as the GSD file. A bitmap picture is included in the zip-file downloadable from www.leinelinde.com
3) Update the GSD files (SCAN).

3.5 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).

Bus	Module	Meaning	Cause
Off	Off	No power	
Red	Green	No connection to another device. Criteria: No data exchange	-Bus disconnected -Master not available / switched off
Red 2)	Red 2)	No connection to another device. No connection between EnDat 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. -Parameterization error in the parameterization
Green	Red	System failure	-Diagnosis exists. Slave in data exchange mode -Position error
Green	Green	Data exchange. Slave and operation OK	

Table 10 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 the EnDat encoder is disconnected from the PROFIBUS interface PCB

4 Configuration example

This chapter will illustrate how to set up and configure an encoder gateway with PROFIBUS DPV2 in isochronous operation. In the example below a Siemens Step 7 PLC and SIMATIC MANAGER was used.

4.1 Device description file installation (GSD-file)

In order to start using an encoder gateway with PROFIBUS interface, a device description file needs to be downloaded and imported to the configuration software. The device description file is called a "Generic Station Description" file and contains the necessary implementation parameters needed for a PROFIBUS device.

The latest available GSD file can be downloaded from www.leinelinde.com.

Installation of GSD-files in SIMATIC MANAGER:
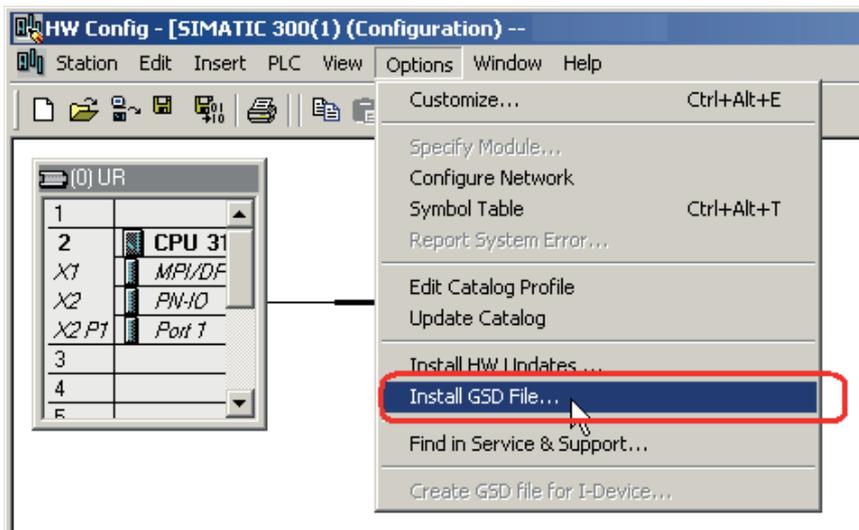
1) Select Options -> Install GSD File and click the "Browse" button to navigate to the location of the GSD file. If a bitmap picture representing the encoder is requested, make sure that the bitmap file is located in the same folder as the GSD file. A bitmap file is included in the zip-file downloadable from www.leinelinde.com.
2) Select the GSD file and click the "Install" button to start installing the selected GSD file.

4.2 Setting the encoder configuration

Once the GSD file has been installed, the encoder gateway can be found in the SIMATIC MANAGER-> HW Config under PROFIBUS DP ->Additional Field Devices->Encoders. Select the appropriate device to be configured. Drag and drop the device onto the PROFIBUS DP system as shown in the picture below. In the example below, the Leine & Linde Gateway DPV2 was chosen. If more than one device is connected and is to be configured, then the following steps need to be performed once for each connected device.
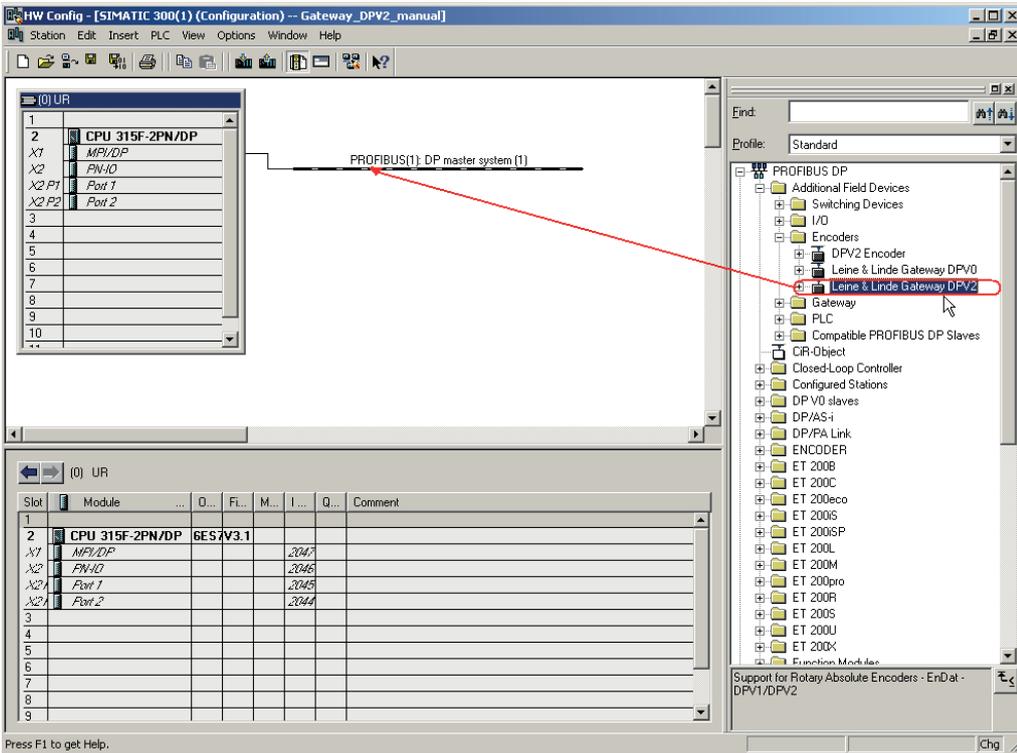
When dropping the encoder on the BUS a PROFIBUS address must be assigned, naturally this address must be the same as assigned on the hardware address switches on the back of the encoder.
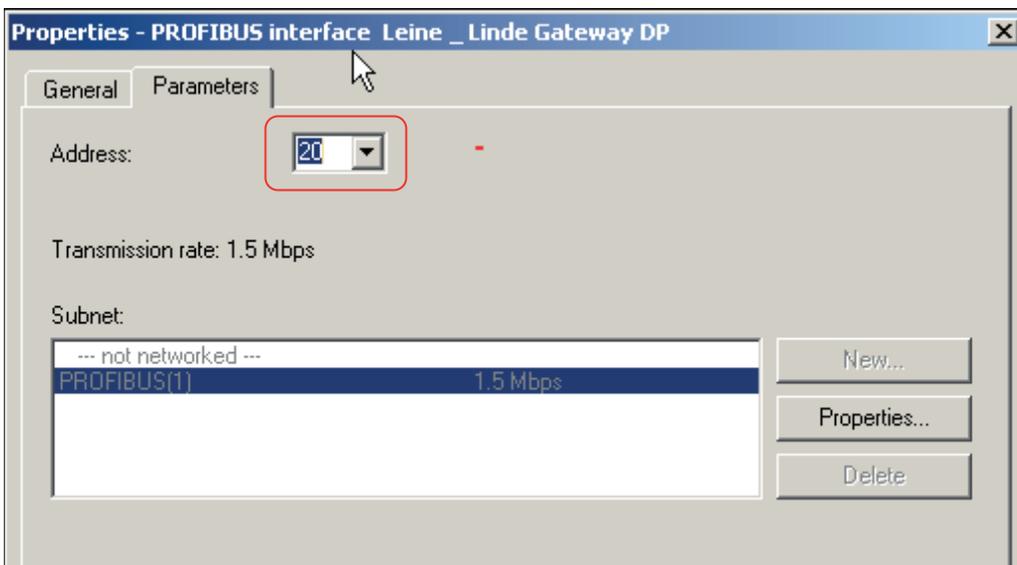
When clicking "OK" the Properties window for the DP slave will open.
If appropriate enter a name for the device.
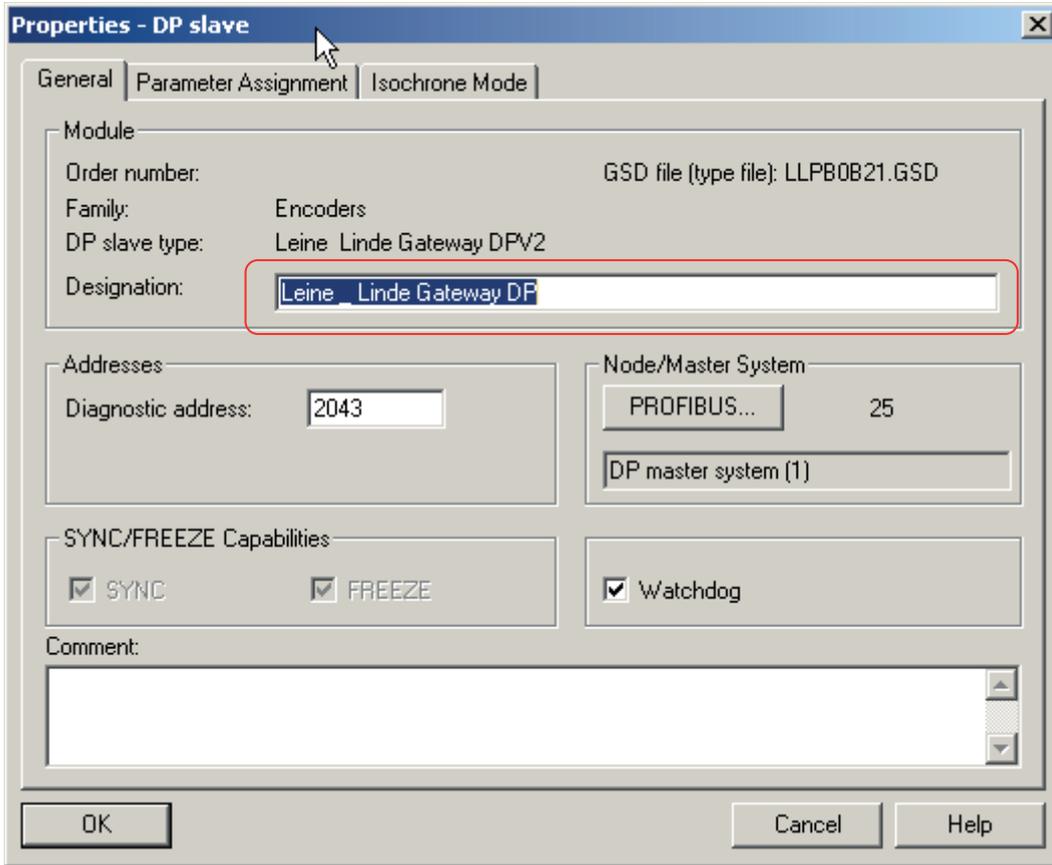
The next step is to choose the data length and the type of data that is to be sent to and from the controller. This is done by choosing different telegrams.

Available telegrams for the Leine & Linde Gateway DPV2 can be found by expanding the device. In the example below, standard telegram 81 is used. Drag and drop the telegram onto slot 1 as shown in the picture below. For more information regarding the different telegrams refer to chapter 5.4.
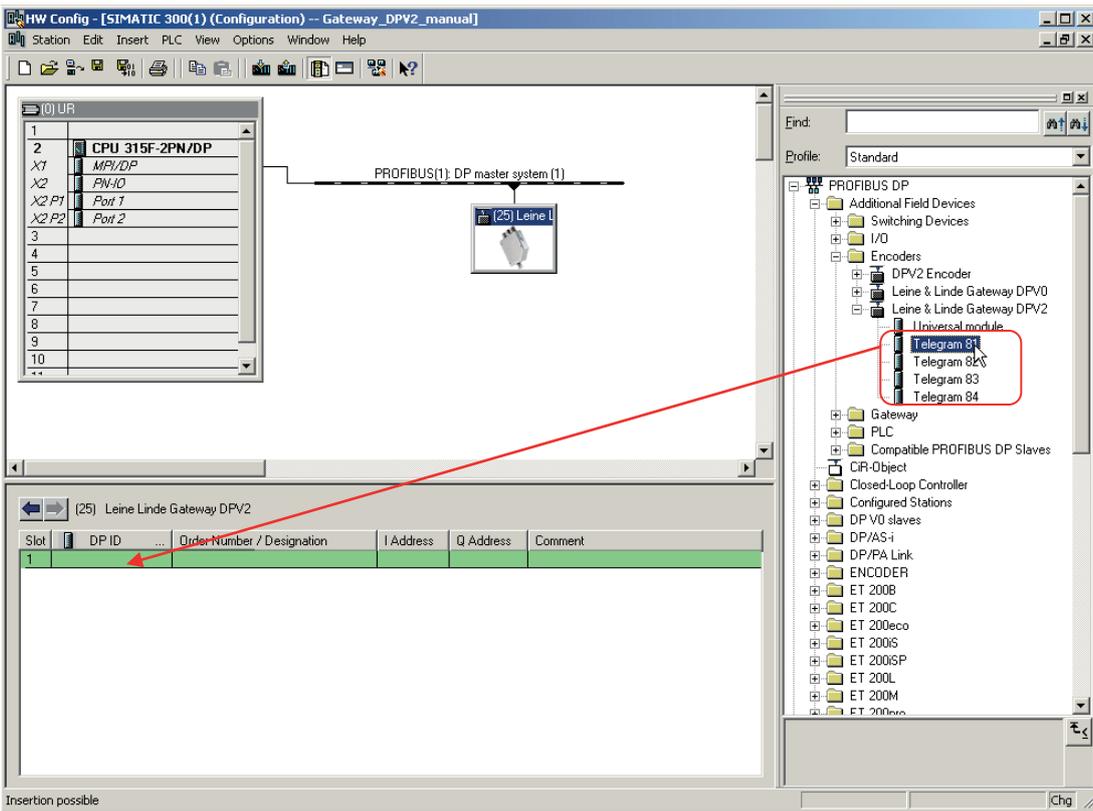
The "Standard Telegram 81" will appear on slot 1.
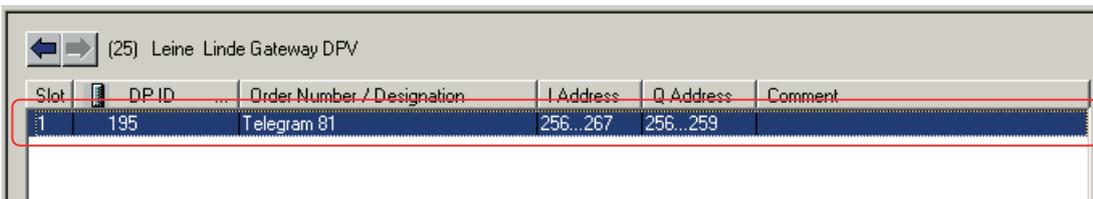
Please note that the steps described above need to be performed for each connected device.

4.3 Setting encoder parameters

To set the parameter data, choose the device and then double click on the line according to below.
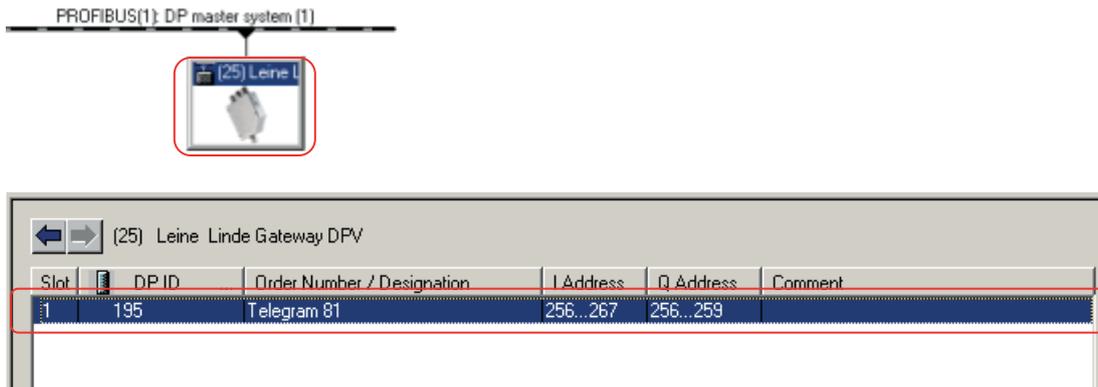
In the Properties windows that opens, open the Parameter Assignment tab. To set the parameter data, change the value of the different parameters by clicking on the "Value" field for the respective parameter. Please note that the parameter "Class 4 Functionality" must be enabled in order to change some of the available parameters. For more information regarding this, see chapter 8.
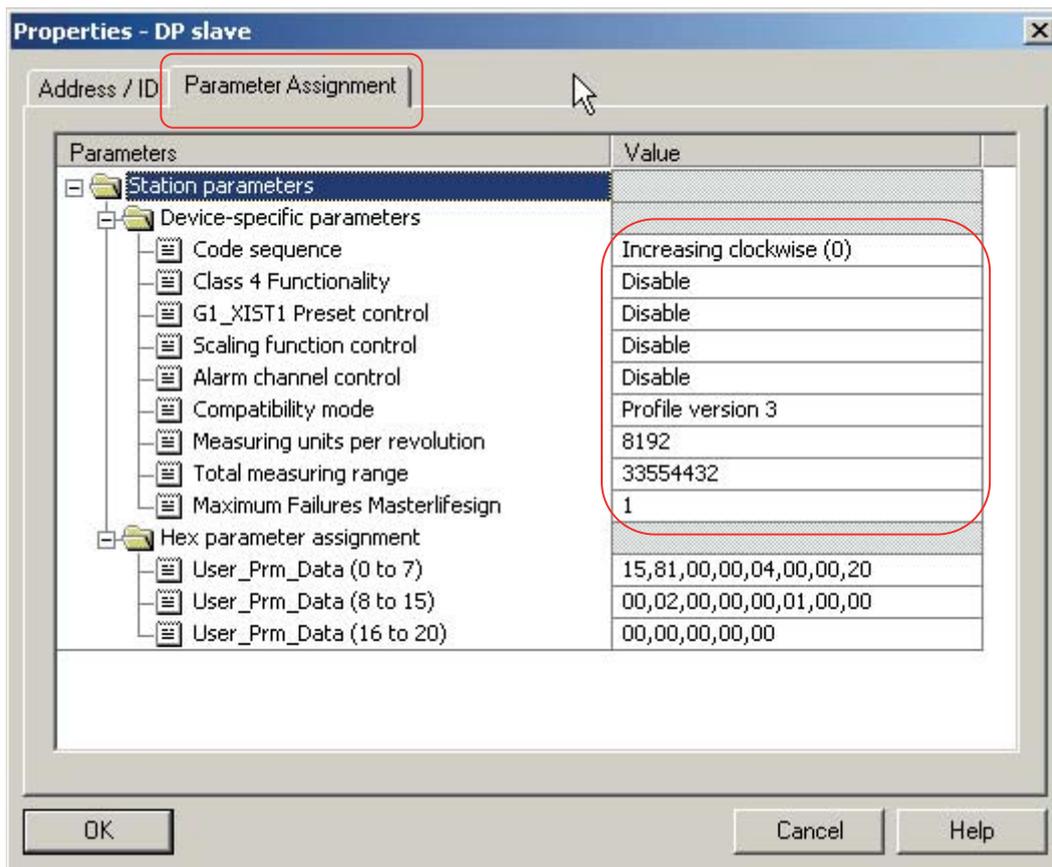
Once the configuration and parameterization of the device has been completed, the settings need to be saved and compiled. This is done by clicking on the "Save and Compile" option under the "Station" tab.
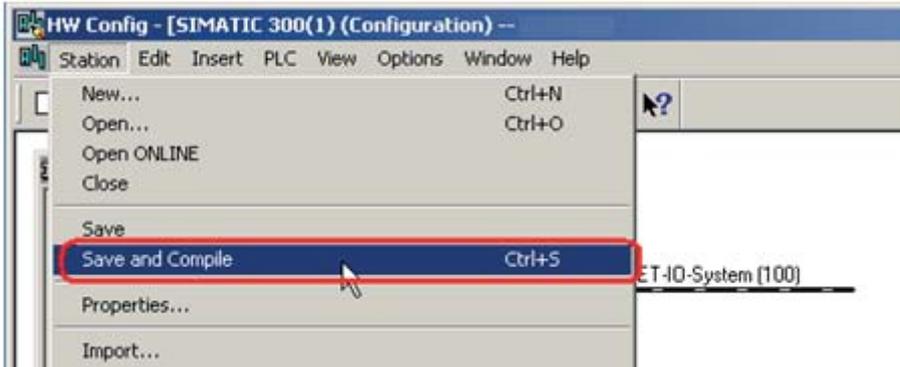
The settings then need to be downloaded to the controller.
This is done by clicking on the "Download" option under the "PLC" Tab.
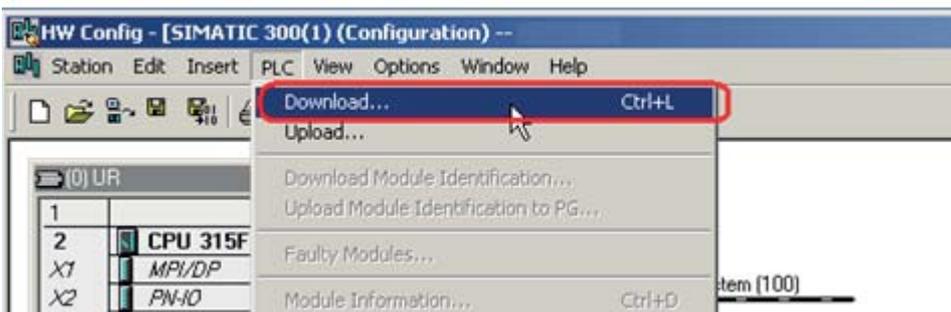
4.4 Isochrone mode parameter settings – BUS

The "Isochronous mode" settings of the BUS are accessed by double clicking on the bus in the BUS structure view. Then the properties for DP master system will open.

Click on the "Properties" button.
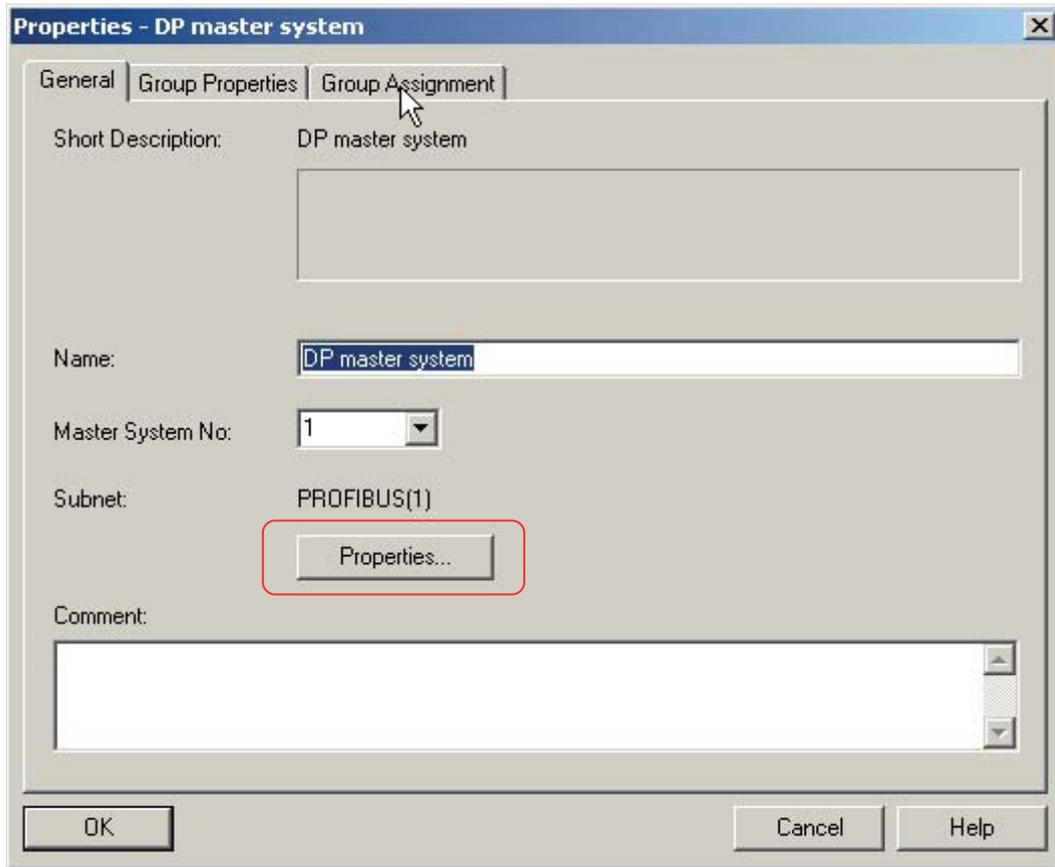
Choose the "Network Settings" tab. For highest performance make sure that 12Mbps baudrate and DP profile is chosen. Then, click on the "options Button"
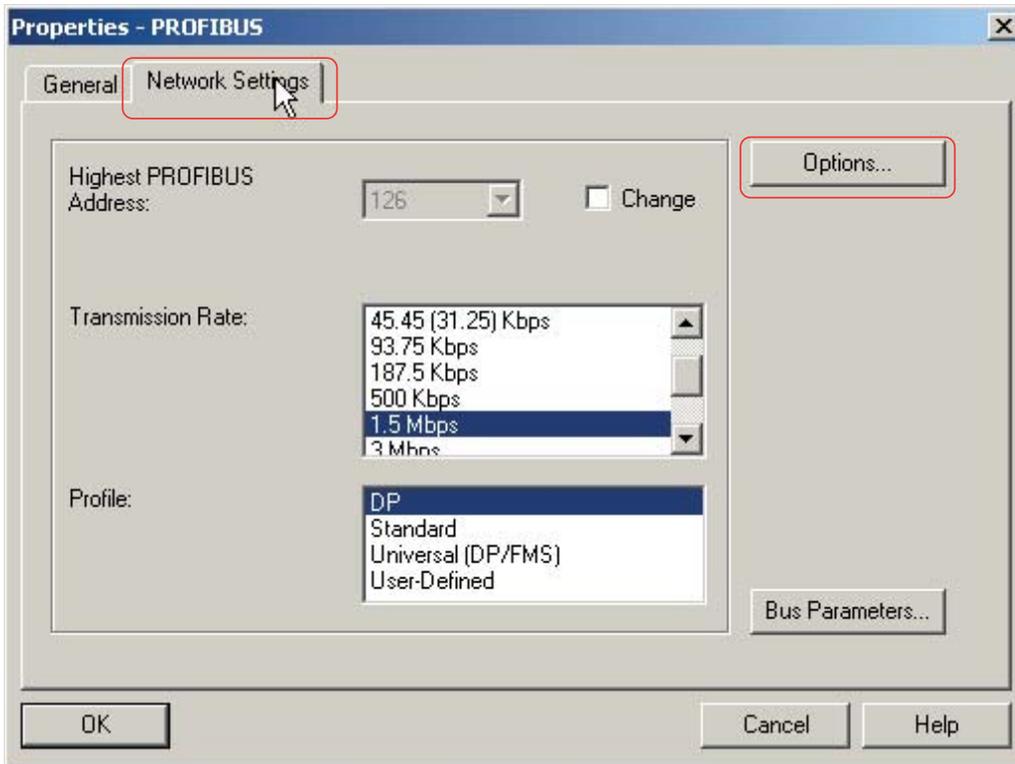
In this view the DP cycle time as well as the time parameters can be set. If the "Slave Synchronization" button is marked all slaves on the bus will have the same time parameters. In this mode all slaves on the BUS will sample data at the same time and the real isochronous mode is obtained. To activate the clock synchronous operation, mark the "check boxes" according to below.
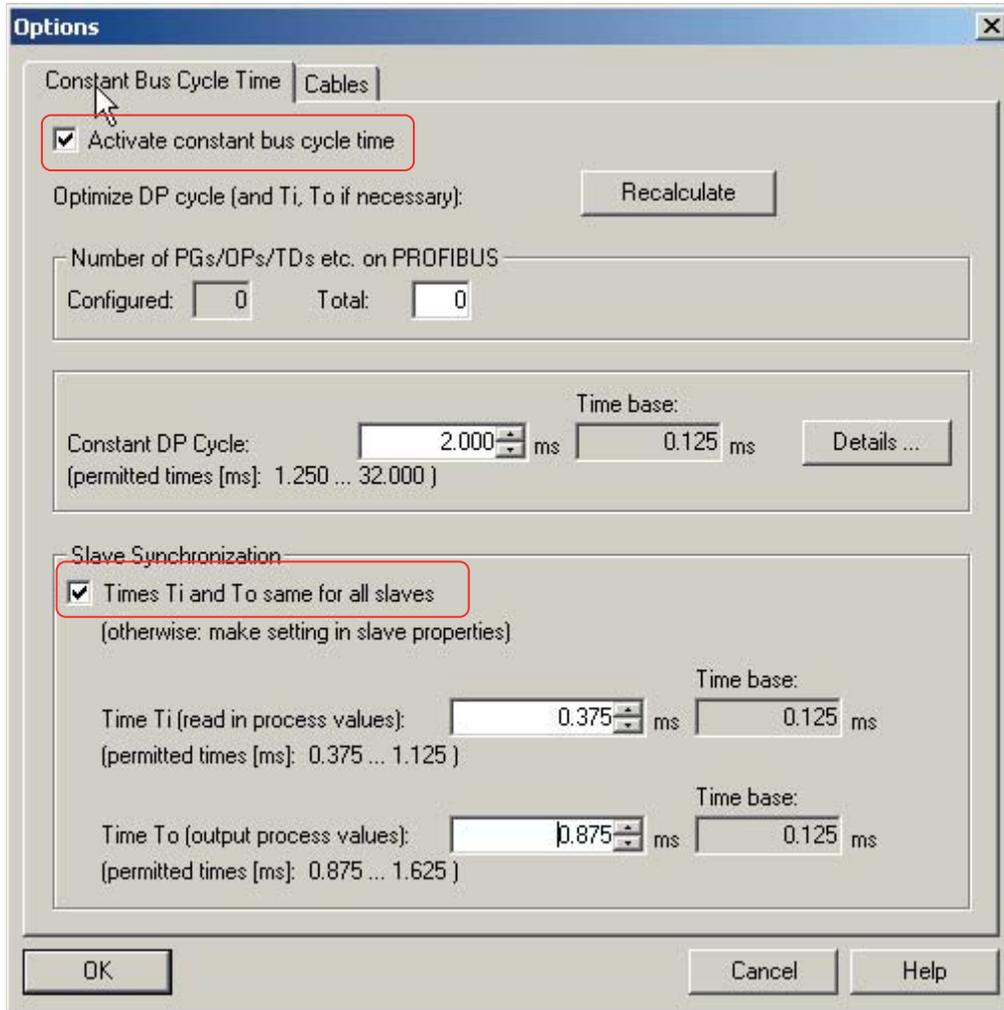
Please note that the steps described above need to be performed for each connected device.

4.5 Isochrone mode parameter settings DPV2 slave

Double click on the slave device to open the properties window and open the "Isochronous Mode" tab to change the settings. Activate the clock synchronous operation by marking the "check box" according to below.
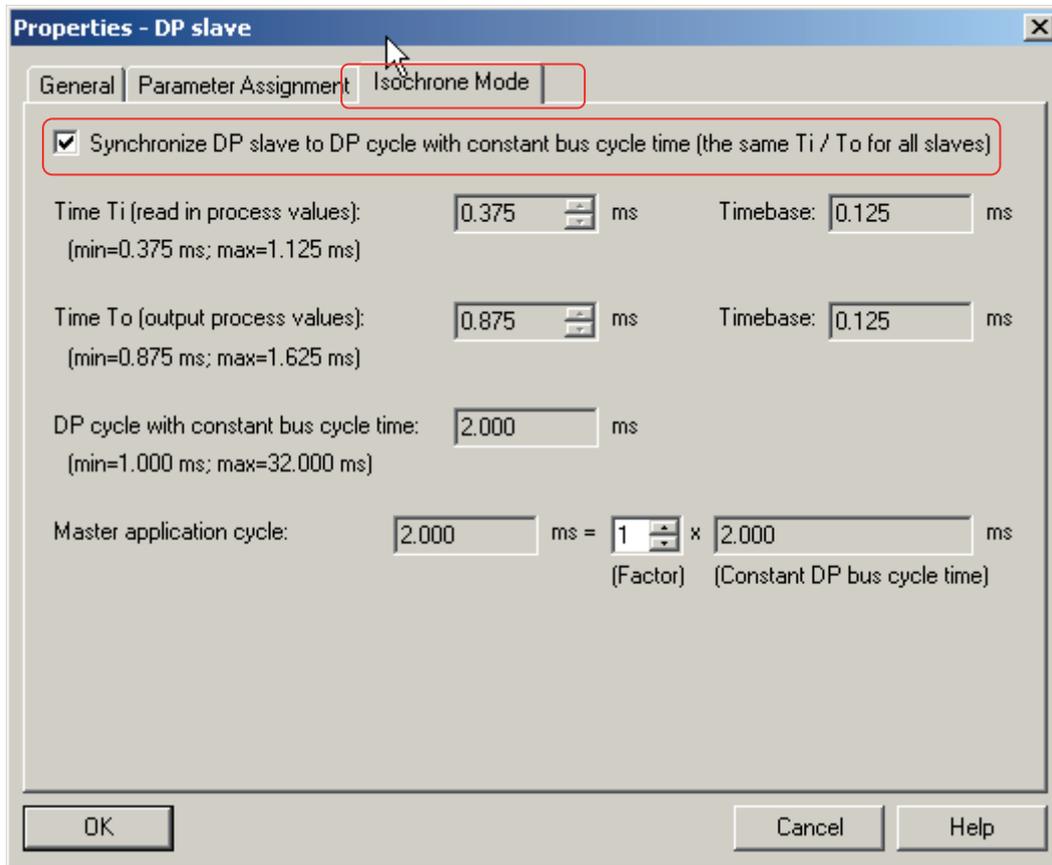
The different time parameter can be set whereas the time base parameters are controlled by the master. The individual DP slave isochronous mode settings enable individual data sample time as the TI can be set uniquely for each slave.

5 PROFIBUS IO data description

5.1 Encoder Profile for PROFIBUS version 4.1, Order no 3.162.

The functionality of this profile is divided in two application classes, Class 3 and Class 4. The use of the name "application class" is new in this profile and conforms to the Encoder class in the DPV0 profile.

For further information regarding the encoder functionality refer to the device profile. The profile and PROFIBUS technical information can be ordered at PNO in Karlsruhe, Germany (www.profibus.com).
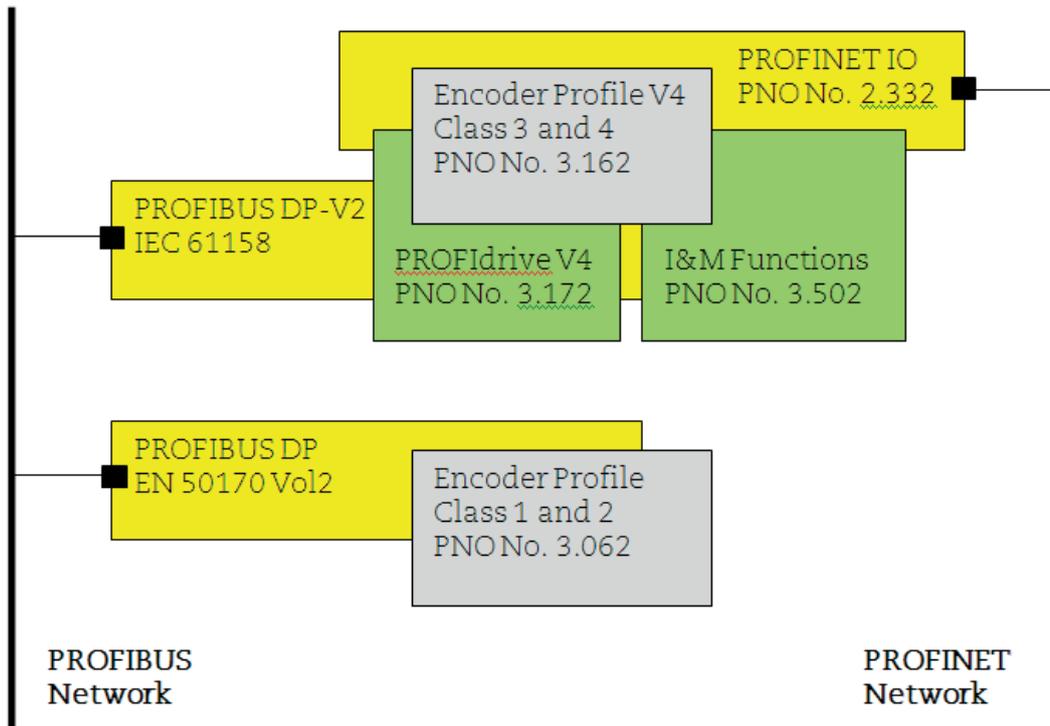
Picture 12 Overview of encoder profile

5.2 Application class definition

Leine&Linde's PROFIBUS devices can be configured as class 3 or class 4 PROFIBUS DP device according to the encoder profile v.4.1 (PNO no 3.162)

Class 3 offers the basic functionality and Class 4 offers the basic functionality and additional full scaling and preset functionality.

CLASS 3   Device with base mode parameter access and limited parameterization of the device functionality. Isochronous mode **is not** supported.

CLASS 4   Device with scaling, preset and base-mode parameter access. Isochronous mode **is** supported.

5.3 Standard signals

The table below describes the standard signals that are used to configure the IO data.

Significance	Abbreviation	Length (Bits)	Data type
Velocity value A	NIST_A	16	Signed
Velocity value B	NIST_B	32	Signed
Control word	G1_STW	16	Unsigned
Status word	G1_ZSW	16	Unsigned
Position value 1	G1_XIST1	32	Unsigned
Position value 2	G1_XIST2	32	Unsigned
Position value 3	G1_XIST3	64	Unsigned
Control word 2	STW2_ENC	16	Unsigned
Status word 2	ZSW2_ENC	16	Unsigned

Table 11 Standard signals

5.4 Standard telegrams

Configuration of the devices is made by choosing different telegram structures. The telegrams are used to specify the data length and which type of data that are sent to and from the master. The supported telegrams for the different devices are shown in table 12 below.

Telegram	Encoder gateway	Absolute encoder
Standard telegram 81	Supported	Supported
Standard telegram 82	Supported	Not supported
Standard telegram 83	Supported	Not supported
Standard telegram 84	Supported	Not supported

Table 12 Supported Telegrams

STANDARD TELEGRAM 81
Standard telegram 81 uses 4 bytes for output data from the master to the device and 12 bytes of input data from the device to the master.

Output data from the master:
2 bytes "Control word 2" (STW2_ENC).
2 bytes "Control word" (G1_STW).

IO Data (word)	1	2
Set point	STW2_ENC	G1_STW

Output data from master

Input data to the master:
2 bytes "Status word 2" (ZSW2_ENC).
2 bytes "Status word" (G1_ZSW).
4 bytes "Position value 1" (G1_XIST1).
4 bytes "Position value 2" (G1_XIST2).

IO Data (word)	1	2	3	4	5	6
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2	

Input data to master

STANDARD TELEGRAM 82
Standard telegram 82 uses 4 bytes for output data from the master to the encoder gateway and 14 bytes of input data from the encoder gateway to the master.

Output data from the master:
2 bytes "Control word 2" (STW2_ENC).
2 bytes "Control word" (G1_STW).

IO Data (word)	1	2
Set point	STW2_ENC	G1_STW

Output data from master

Input data to the master.
2 bytes "Status word 2" (ZSW2_ENC).
2 bytes "Status word" (G1_ZSW).
4 bytes "Position value 1" (G1_XIST1).
4 bytes "position value 2" (G1_XIST2).
2 bytes "Velocity value A" (NIST_A).

IO Data (word)	1	2	3	4	5	6	7
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2		NIST_A

Input data to master

Note: Telegram 82 is only supported by the encoder gateway. It is not supported by the absolute encoder.

STANDARD TELEGRAM 83
Standard telegram 83 uses 4 bytes for output data from the master to the encoder gateway and 16 bytes of input data from the encoder gateway to the master.

Output data from the master:
2 bytes "Control word 2" (STW2_ENC).
2 bytes "Control word" (G1_STW).

IO Data (word)	1	2
Set point	STW2_ENC	G1_STW

Output data from master

Input data to the master:
2 bytes "Status word 2" (ZSW2_ENC).
2 bytes "Status word" (G1_ZSW).
4 bytes "Position value 1" (G1_XIST1).
4 bytes "Position value 2" (G1_XIST2).
4 bytes "Velocity value B" (NIST_B).

IO Data (word)	1	2	3	4	5	6	7	8
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST1		G1_XIST2		NIST_B	

Input data to master

Note: Telegram 83 is only supported by the encoder gateway. It is not supported by the absolute encoder.

STANDARD TELEGRAM 84
Standard telegram 84 uses 4 bytes for output data from the master to the encoder gateway and 20 bytes of input data from the encoder gateway to the master.

Output data from the master:
2 bytes "Control word 2" (STW2_ENC).
2 bytes "Control word" (G1_STW).

IO Data (word)	1	2
Set point	STW2_ENC	G1_STW

Output data from master

Input data to the master:
2 bytes "Status word 2" (ZSW2_ENC).
2 bytes "Status word" (G1_ZSW).
8 bytes "Position value 3" (G1_XIST3).
4 bytes "Position value 2" (G1_XIST2).
4 bytes "Velocity value B" (NIST_B).

IO Data (word)	1	2	3	4	5	6	7	8	9	10
Actual value	ZSW2_ENC	G1_ZSW	G1_XIST3				G1_XIST2		NIST_B	

Input data to master

Note: Telegram 84 is only supported by the encoder gateway. It is not supported by the absolute encoder.

Note: In standard telegram 84, G1_XIST2 is used to transfer error codes and optionally position values if the measuring length exceeds 64 bits.

5.5 Format of G1_XIST1 and G1_XIST2

The G1_XIST1 and G1_XIST2 signals consist of the absolute position value in binary format. By default the G1_XIST 1 signal is equal to the G1_XIST2 signal. The format of the actual position values in G1_XIST1 and G1_XIST2 is shown below.

Format definition for G1_XIST1 and G1_XIST2:
- All values are presented in binary format
- The shift factor is always zero (right aligned value) for both G1_XIST1 and G1_XIST2.
- The setting in the encoder parameter data affects the position value in both G1_XIST1 and G1_XIST2.
- G1_XIST2 displays the error message instead of the position value if an error occurs. See also chapter 5.3 Error Message.

Example: 25 bit multi turn absolute encoder with gateway (8192 steps per revolution, 4096 distinguishable revolutions)

M = Multi turn value (Distinguishable revolutions)
S = Single turn value (number of steps per revolutions)
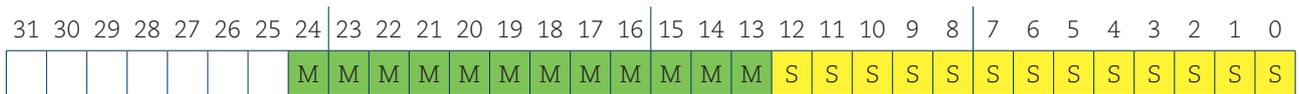
Picture 13 Absolute value in G1_XIST1
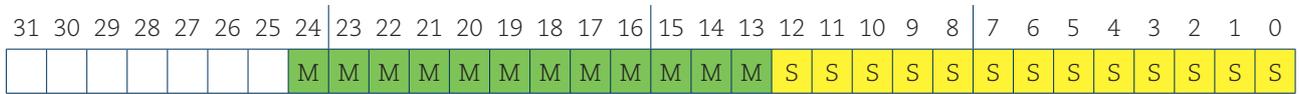
Picture 14 Absolute value in G1_XIST2

5.6 Format of G1_XIST3

G1_XIST3 is a 64 bit position value which is used to support encoders with a resolution exceeding 32 bits.

Format definition for G1_XIST3:
- Binary format
- The actual position value is always right aligned, a shifting factor is not used.
- The settings in the encoder parameter data affect the position value in G1_XIST3 if Class 4 is enabled.

IO Data	1	2	3	4
Format	64 bit position value			

Table 13 Format of G1_XIST3

Note: G1_XIST3 is only used in standard Telegram 84.

5.7 Control word 2 (STW2_ENC)

The control word 2 (ZSW2_ENC) is referred to as the "master sign of life" and it includes the fault buffer handling and Control by PLC mechanism from PROFIdrive STW1 and the Controller Sign-Of-Life mechanism from PROFIdrive STW2. This signal is mandatory for controlling the clock synchronization.

Bit	Function
0…6	Reserved
7	Fault Acknowledge
8, 9	Reserved
10	Control by PLC
11	Reserved
12..15	Controller Sign-of-life

Table 14 STW2_ENC definition and implementation requirements

Bit	Value	Significance	Comments
7	1	Fault Acknowledge (0->1)	The fault signal is acknowledged with a positive edge. The encoder reaction to a fault depends on the type of fault.
	0	No significance	
10	1	Control by PLC	Control via interface, EO IO is valid.
	0	No control by PLC	EO IO data not valid, except sign-of-life
12..15		Controller Sign-of-life	

Table 15 Detailed assignment of the encoder control word 2 (STW2_ENC)

5.8 Status word 2 (ZSW2_ENC)

The status word 2 (ZSW2_ENC) is referred to as the "slave's sign of life" and it includes the fault buffer handling and Control by PLC mechanism from PROFIdrive ZSW1 and the Slave Sign-Of-Life mechanism from PROFIdrive ZSW2. This signal is mandatory for controlling the clock synchronization.

Bit	Function
0…2	Reserved
3	Fault Present / No fault
4…8	Reserved
9	Control requested
10,11	Reserved
12…15	Encoder Sign-of-life

Table 16 ZSW2_ENC definition and implementation requirements3

Bit	Value	Significance	Comments
3	1	Fault present	Unacknowledged faults or currently not acknowledged faults (fault messages) are present (in the buffer).The fault reaction is fault-specific and device-specific. The acknowledging of a fault may only be successful, if the fault cause has disappeared or has been removed before. If the fault has been removed the encoder returns to operation. The related fault numbers are in the fault buffer.
	0	No fault	
9	1	Control requested	The automation system is requested to assume control.
	0	No control requested	Control by automation system is not possible, only possible at the device or by another interface.
12..15		Encoder Sign-of-life	

Table 17 Detailed assignment of status word 2 (ZSW2_ENC

5.9 Control word (G1_STW)

The control word controls the functionality of major encoder functions.

Bit	Function
0…7	Function requests: Reference mark search, measurement on the fly
8…10	Reserved (without effect)
11	Home position mode (absolute/relative)
12	Request set/shift of home position (Preset)
13	Request absolute value cyclically
14	Activate parking sensor
15	Acknowledging a sensor error

Table 18 G1_STW implementation requirements

Note: **If the sensor parking is activated (bit 14 = 1) the device is still on the bus with the slave sign of life active and the encoder error and diagnostics switched off.**

5.10 Status word (G1_ZSW)

The status word defines encoder states, acknowledgements, error messages of major encoder functions.

Bit	Function
0…7	Function status: Reference mark search, measurement on the fly
8	Probe 1 deflected
9	Probe 2 deflected
10	Reserved, set to zero
11	Requirement of error acknowledgement detected
12	Set /shift of home position executed
13	Transmit absolute value cyclically
14	Parking sensor active
15	Sensor error

Table 19 G1_ZSW implementation requirements

Note: **If bit 13 "Transmit absolute value cyclically" or bit 15 "Sensor error" is not set there is no valid value or error code transferred in G1_XIST2.**

Note: **Bit 13 "Transmit absolute value cyclically" cannot be set at the same time as bit 15 "Sensor error" as these bits are used to indicate either a valid position value transmission (bit 13) or the error code transmission (bit 15) in G1_XIST2.**

5.11 Isochronous operation

Clock Synchronous Operation at PROFIBUS DP is done by using the PROFIBUS DP-V2 Isochronous Mode. Clock cycle synchronous operation in the PROFIBUS DP Isochronous Mode is implemented by using an isochronous clock signal. This cyclic, isochronous clock signal is transmitted as Global Control telegram from the DP-master (class 1) to all PROFIBUS slaves. Thus, the slaves supporting isochronous operation may synchronise their applications (internal/Slave Clock) with the Master Clock.
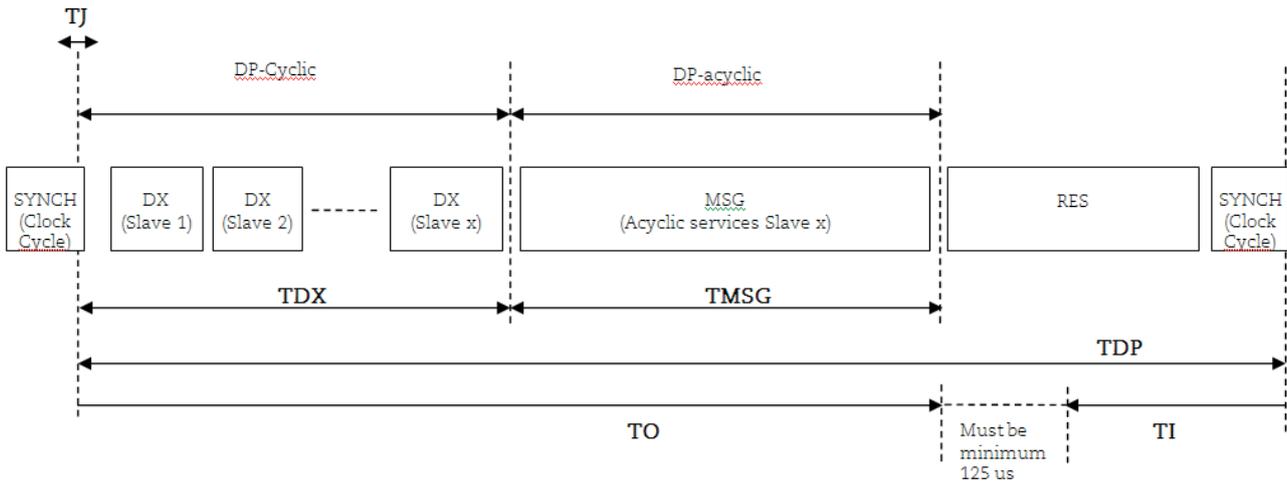
Picture 15 Sequence of the DP-cycle in isochronous mode

TI (Input time)
This is the time for actual value acquisition. The time TI refers to the end of the DP-Cycle. The minimum time for TI is 375µs for the gateway and 125µs for the absolute encoder. There has to be a minimum time of 125µs between TI and TO.

TO(Output time)
Time TO refers to the start of the DP-cycle. The time TO is the time for setpoint transfer . For the encoder and the gateway the time TO is insignificant.

TJ(Jitter Time)
TJ mirrors the time in which the clock jitter lasts. The clock jitter is the shifting of the Global Control (GC) telegram with respect to time.

TDX (Data_Exchange Time)
This time is the sum of the transmission times of all Data_Exchange telegrams for all slaves.

TMSG (Message Time)
The times TMSG may elapse to handle all acyclic services between the master and slave. These acyclic services shall be executed after the cyclic services. To ensure an Isochronous DP cycle this part shall be limited.

TDP (DP-Cycle Time)
TDP is the time a DP cycle lasts.

Content of a DP cycle:

SYNCH: Global_Control telegram for synchronization.
The end of the Global_Control (GC) telegram marks the beginning of a new DP cycle.

DX: Data_Exchange
With the service Data_Exchange, user data exchange between master and slave 1-n is executed sequentially.

MSG: Acyclic services
After cyclic transmission the master may transmit an acyclic service. e.g. parameter request via MS1/MS2 AR.

RES: Reserve
The reserve consists of the "active spar time" which is used as an "active rest" (master
transmits to itself) and the "passive spar time".

6. Alarms and warnings

6.1 Alarm mechanism

There are three ways to get diagnosis information from the PROFIBUS encoder:
- By a read parameter access to the Parameter 65001 where information on the current status of the Faults and Warnings and the support of the individual diagnosis functions can be read out.
- By the evaluation of the Error bit in the Sensor Status word G1_ZSW and additionally the evaluation of the Error code transmitted in G1_XIST2.
- By the use of the Extended Diagnosis in the Diagnosis telegram where the diagnosis objects are transmitted by the "Channel Diagnosis mechanism" further described in this chapter.

6.2 Channel related diagnosis

The encoder diagnosis is reported to the master as Channel Related Diagnosis if the Alarm channel control bit is set. If the Alarm channel is switched-of only the first 6 bytes of the diagnostic telegram are realized (Diag.Ext_Diag = 0): Station_status_1, Station_status_2, Station_status_3, Diag_Master_Add and Ident_Number. The diagnostic reason is entered in turns and the length of each entry is 3 octets.

Diagnostic function	Data type	Value	Comments	Octet number
Header	Unsigned8	0x81	Identifier x	1
Channel	Unsigned8	0x40	Input channel 0	2
Type of diagnosis	Unsigned8		See 6.3	3

Table 20 Channel related Diagnostics

6.3 Faults

If a fault occurs, the corresponding identifier is signaled in a diagnostic telegram. Faults can be cleared after the sensor error is acknowledged by the controller by setting bit 15 in the Control word (G1_STW). A fault is only cleared when the functionality is within the specification and the position value correct. A going fault is indicated by a diagnostic telegram without the previously sent fault.

Definition	Error type
Position error	22
Memory error	24

Table 21 Faults

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"

Error type: 24
Definition: Memory error
GSD entries:
Channel_Diag (24) = "Memory error"
Channel_Diag_Help (24) = "The encoder has an internal error and is not able to provide an accurate position value, change encoder"

6.4 Error message

Diagnosis information can be obtained by monitoring of the Error bit in the Status word G1_ZSW (bit 15) and evaluation of the error code transmitted in G1_XIST2.

Supported diagnosis	Error code in G1_XIST2	Description
Sensor group error	0x0001	The encoder fails to read the correct position value
Memory error	0x1001	The encoder fails to read stored offset or preset values from the non volatile memory.
Command not supported	0x0F01	User parameter data assignment error or command error in commands words G1_STW and STW2_ENC.
Master´s sign of life fault	0x0F02	The number of permissible failures the controllers life sign was exceeded.

Table 22 Sensor status word

7 Acyclic Parameter Data

7.1 Acyclic data exchange

In addition to the cyclic data exchange, the PROFIBUS encoder also supports acyclic data exchange. The acyclic data exchange is transferred over the non-real time channel and is used to read out and write status information from and to the slave device. The acyclic data exchange is conducted in parallel to the cyclic data communication.

Example of acyclic data:
- Reading of diagnostic
- Reading of I&M functions
- Reading of PROFIdrive parameters

7.2 Identification and Maintenance (I&M functions)

Encoders according to the encoder profile 3.162 also support I&M functionality. The main purpose of the I&M functions is to support the end user if the device is acting faulty or missing some of its functionality. The I&M functions could be seen as an electronic nameplate containing common information regarding the device and its manufacturer.

According to the PROFIBUS specification all IO-devices must at least support the following I&M functions:
- Order ID
- Hardware Version
- Software Version
- Product type
- Manufacturer ID

For more information regarding additional I&M functions supported by Leine & Linde encoders, refer to chapter 7.14.6.

7.3 Base Mode Parameter access

7.3.1 General characteristics

A single acyclic parameter can be transmitted in one access. A parameter access can be up to 240 bytes long.

7.3.2 Parameter requests and responses

Request header: Request ID, DO-ID and number of parameters of the access.

Parameter address: One address for each parameter, if several parameters are accessed.

Parameter value: If the Request ID is 0x02 (change value) the value is set in the request and if the Request ID is 0x01 (request value), the value appears in the reply.

7.3.4 Changing the preset value

The table below shows the structure of a change value request.

Write of Preset value, parameter 65000 Parameter request		
Request reference	0x00	
Request ID	0x02	0x02 → Change value, 0x01 → read value
Do-ID (axis)	0x01	Drive Object ID
No of parameters	0x01	
Attribute	0x10	0x10 → Value
No of elements	0x00	
Parameter number	0xFDE8	Parameter 65000
Sub index	0x0000	
Format	0x04	Data type integer 32
Number of values	0x01	

Table 23 Write of Preset value

7.3.5 Reading the preset value

The tables below show the structure of a read value request.

Read of Preset value, parameter 65000, Parameter request		
Request reference	0x00	
Request ID	0x01	0x01 → read value
DO-ID (axis)	0x01	Drive Object ID
No of parameters	0x01	0x01 Read one parameter
Attribute	0x10	0x10 → Value
No of elements	0x00	
Parameter number	0xFDE8	Parameter 65000
Sub index	0x0000	

Table 24 Read of Preset value, parameter request

Read of Preset value, parameter 65000, Parameter response		
Request reference	0x00	mirrored
Response ID	0x01	0x01 → read value
DO-ID (axis)	0x01	mirrored
No of parameters	0x01	
Format	0x04	0x04= Data type unsigned 32
No of values	0x01	
Values or errors	0x00,0x00,0x00,0x64	Preset value 100

Table 25 Read of Preset value, parameter response

7.4 Detailed description of supported parameters

7.4.1 Parameter 918, read only

918 → unsigned int, presents the node address of the device.

7.4.2 Parameter 922, read only

922 → unsigned int, presents which telegram is used. Telegram 81, 82, 83 or 84 is possible.

7.4.3 Parameter 925, read/write

925 → unsigned int, maximum allowed MLS (Master sign-of-life) error. Parameter 925 may be used to set a maximum on how many consecutive Sign-of-life failures may occur.

7.4.4 Parameter 964, read only

964 → unsigned int, Device indentification

964[0] = Manufacturer Id. This is set during manufacturing of the encoder.
964[1] = 0 → DU Drive unit type, always set to 0.
964[2] = 201 → Software version
964[3] = 2009 → Software year
964[4] = 2805 → Software day and month
964[5] = 1 → Number of drive objects (DO)

7.4.5 Parameter 965, read only

965 → OctetString 2, Encoder profile number

965[0] =0x3D → Encoder profile number
965[1] = 31 or 41 → Encoder profile version, set by customer (user_parameters)

7.4.6 Parameter 971, read/write

971 → unsigned int, Store the local parameter set to a non volatile memory. Preset value is saved when writing value 1 and is set to 0 by the encoder firmware when finished. This means that the preset value has been saved when reading back value 0.

7.4.7 Parameter 974, read only

974 → unsigned int

974[0] = 96 → Max array length supported by parameter channel.
974[1] = 1 → Numbers of multi parameters, 1 = no support of multi parameters.
974[2] = 1000 → max time to process parameter request, n x 10 ms.

7.4.8 Parameter 975, read only

975 → unsigned int, Encoder object identification

975[0] = Manufacturer Id, Set in the production.
975[1] = 7011 → DO type
975[2] = 201 → Software version
975[3] = 2009 → Software year
975[4] = 2805 → Software day and month
975[5] = 0x0005 → Profidrive DO type class 5 = encoder interface
975[6] = 0x8000 → Profidrive SUB class 1, Encoder application class 4 supported.
975[7] = 0x0001 → Drive object Id (DO ID).

7.4.9 Parameter 979, read only

979 → unsigned long, Sensor format

979[0] = 0x00005111 → Number of index describing encoders, Numbers of described encoders, Version of parameter structure

979[1] = 0x80000000 → Sensor type
      Bit 31 = 1 if configuration and parameterization is OK
      Bit 0 = 0 Rotary encoder, Bit 0 = 1 linear encoder
      Bit 1 = 0 always set to 0
      Bit 2 = 0 → 32 bit data, Bit 2 = 1 → 64 bit data

979[2] = 8192 → Encoder scaled resolution
979[3] = 0 → Shift factor for G1_XIST1. Always set to 0.
979[4] = 0 → Shift factor for G1_XIST2. Always set to 0.
979[5] = 1 or 4096 → Singleturn = 1, Multiturn = 4096
979[6] = 0
979[7] = 0
979[8] = 0
979[9] = 0
979[10] = 0

7.4.10 Parameter 980, read only

This parameter shows the supported parameters

980 → unsigned int

980[0] = 918	980[8] = 979	980[16] = 65002
980[1] = 922	980[9] = 61000	980[17] = 65003
980[2] = 925	980[10] = 61001	
980[3] = 964	980[11] = 61002	
980[4] = 965	980[12] = 61003	
980[5] = 971	980[13] = 60004	
980[6] = 974	980[14] = 65000	
980[7] = 975	980[15] = 65001	

7.4.11 Parameter 65000, read/write

Used with telegram 81-83
65000 → signed long, preset value 32 bit.

7.4.12 Parameter 65001, read only

Used with telegram 81-84
65001 → unsigned long

65001[0] = 0x000C0101 → Header, Version of parameter structure and numbers of index describing the encoder. 12 index and version 1.01
65001[1] = Operating status (Bit 4 alarm channel control is always set with profile version 4.x)
65001[2] = Alarm
65001[3] = Supported alarms
65001[4] = Warning
65001[5] = Warnings supported
65001[6] = 0x00000401 → Encoder profile version. Always set to this value.
65001[7] = Operating time
65001[8] = Offset value
65001[9] = Singleturn value, scaled value
65001[10] = Total measuring length, scaled value (Linear = 1)
65001[11] = Velocity measuring unit, see chapter 7.10.

7.4.13 Parameter 65002, read/write

Used with telegram 84
65002 → signed long long, Preset value 64 bit.

7.4.14 Parameter 65003, read only

Used with telegram 84
65003 → unsigned long long,

65003[0] = 0x000000000040101 → Header Version of parameter structure and numbers of index describing encoder. 4 index and version 1.01
65003[1] = Offset value 64 bit
65003[2] = Singleturn value 64 bit, scaled value
65003[3] = total measuring range in measuring units 64 bit, scaled value (Linear =1)

7.5 Example of reading and writing to a parameter

This is an example of S7 blocks used for reading and writing to parameter 65000 (preset value). Experience with S7 programming and Statement List programming language STL is required.

Hardware components		
Master	SIEMENS S7F-CPU	CPU 315F-2 PN/DP
Slave device	Leine & Linde PROFIBUS encoder	

Table 26 Used hardware components

Software components	
SIMATIC STEP 7	V5.4 +SP5
GSD file for absolute encoder	GSD LLPB0aaa.gsd

Table 27 Used software components

7.5.1 Used blocs

Write record block SFB53 "WRREC"
Read record block SFB52 "RDREC"
Instance data blocks DB3 and DB4
Request data block DB1
Response data block DB2
Organization blocks OB1, OB82 and OB86

SFB52
SFB52 is standard S7 block for reading parameters.

SFB53
SFB53 is standard S7 block for writing parameters.

DB1
DB1 is the request data block.

Address	Name	Type	Initial value	Actual value	Comment
0.0	Request_reference	BYTE	B#16#1	B#16#01	request number
1.0	Request_ID	BYTE	B#16#2	B#16#02	request parameter = 1; change parameter = 2
2.0	Axis	BYTE	B#16#0	B#16#00	Axis addressing for multi-axis drives
3.0	No_of_parameters	BYTE	B#16#1	B#16#01	write 1 parameters
4.0	Attribute_parameter_01	BYTE	B#16#10	B#16#10	write value
5.0	No_of_elements_01	BYTE	B#16#1	B#16#01	number of elements 1
6.0	parameter_number_01	WORD	W#16#FDE8	W#16#FDE8	parameter 65000 (Preset value 32)
8.0	Subindex_01	WORD	W#16#0	W#16#0000	subindex
10.0	Data_type	BYTE	B#16#4	B#16#04	data type integer 32
11.0	No_of_values	BYTE	B#16#1	B#16#01	Number of values = number of elements
12.0	Value	DINT	L#0	L#33554176	Value 0f 65000

Picture 16 DB1, request data block

DB2

DB2 is the response data block.

Address	Name	Type	Initial value	Comment
0.0		STRUCT		
+0.0	Request_reference_mirror	BYTE	B#16#0	request number mirrored
+1.0	Response_ID	BYTE	B#16#0	request parameter
+2.0	DOID_mirrored	BYTE	B#16#0	Axis mirrored
+3.0	No_of_parameters	BYTE	B#16#0	response about number of parameter
+4.0	Format_parameter_1	BYTE	B#16#0	response about parameter 1 format
+5.0	No_of_values_parameter_1	BYTE	B#16#0	response about number of value of parameter 1
+6.0	parameter_number_01	DWORD	DW#16#0	Read value p65000
=10.0		END_STRUCT		

Picture 17 DB2, response data block

DB3

DB3 is the instance data block of SFB52

Picture 18 DB3, Instance data block of SFB52

DB4

DB4 is the instance data block of SFB53

Picture 19 DB4, instance data block of SFB53

OB1

OB1 controls the read and write operation

```
OB1 :  "Main Program Sweep (Cycle)"

In network 2 and network 2 the user will see how to generate the request /
response DB for writing/reading p65000 using S7 standard function blocks
SFB53/53
easy handled by the VAT_1 vaiable table.

Network 1: Title:

With the SFB53 "WRREC" (write record) you transfer a data record with the
number INDEX to a DP slave device component defined by ID.


        A    M    8.4
        AN   M    8.1
        AN   M    8.3
        AN   M    8.2
        S    M    8.0



        CALL  "WRREC" , "InstanceDB_SFB53"     SFB53 / DB4        -- Write a Process Data Record
         REQ   :=M8.0
         ID    :=DW#16#100
         INDEX :=47
         LEN   :=16
         DONE  :=M14.0
         BUSY  :=M8.1
         ERROR :=M14.2
         STATUS:=MD10
         RECORD:=P#DB1.DBX0.0 BYTE 16



        A    M    8.1
        R    M    8.0




Network 2 : Read request

With the SFB52 "RDREC" (read record) you read a data record with the number
INDEX from a component.

        A    M    8.4
        AN   M    8.1
        AN   M    8.3
        AN   M    8.0
        S    M    8.2


        CALL  "RDREC" , "InstanceDB_SFB52"     SFB52 / DB3        -- Read a Process Data Record
         REQ   :=M8.2
         ID    :=DW#16#100
         INDEX :=47
         MLEN  :=10
         VALID :=M16.0
         BUSY  :=M8.3
         ERROR :=M16.2
         STATUS:=MD18
         LEN   :=MW22
         RECORD:=P#DB2.DBX0.0 BYTE 10



        A    M    8.3
        R    M    8.2
```

Picture 20 OB1, read and write operation

Parameters of SFB52

Parameter	Declaration	Data type	Description
REQ	INPUT	BOOL	REQ =1 Enables data transfer
ID	INPUT	DWORD	Logical address of the PROFIBUS DP module or sub module (PAP-module address 2039)
MLEN*	INPUT	INT	Maximum length of the record information in bytes
VALID	OUTPUT	BOOL	New record has been received and is valid.
BUSY	OUTPUT	BOOL	Busy = 1 during the read operation
ERROR	OUTPUT	BOOL	Error = 1 read error
STATUS	OUTPUT	DWORD	Block status or error code
LEN*	OUTPUT	INT	Length of record information
RECORD	IN_OUT	ANY	Target area for the record

Table 28 Parameters of SFB52

Parameters of SFB53

Parameter	Declaration	Data type	Description
REQ	INPUT	BOOL	REQ = 1 Enables data transfer
ID	INPUT	DWORD	Logical address of the PROFIBUS DP module or sub module (PAP-module address 2039)
LEN*	INPUT	INT	Length of the record information in bytes
DONE	OUTPUT	BOOL	Data record was transferred
BUSY	OUTPUT	BOOL	Busy = 1 during the write operation
ERROR	OUTPUT	BOOL	Error = 1 write error
STATUS	OUTPUT	DWORD	Block status or error code
RECORD	IN_OUT	ANY	Data record

Table 29 Parameters of SFB53

Diagnostic address of slot 1
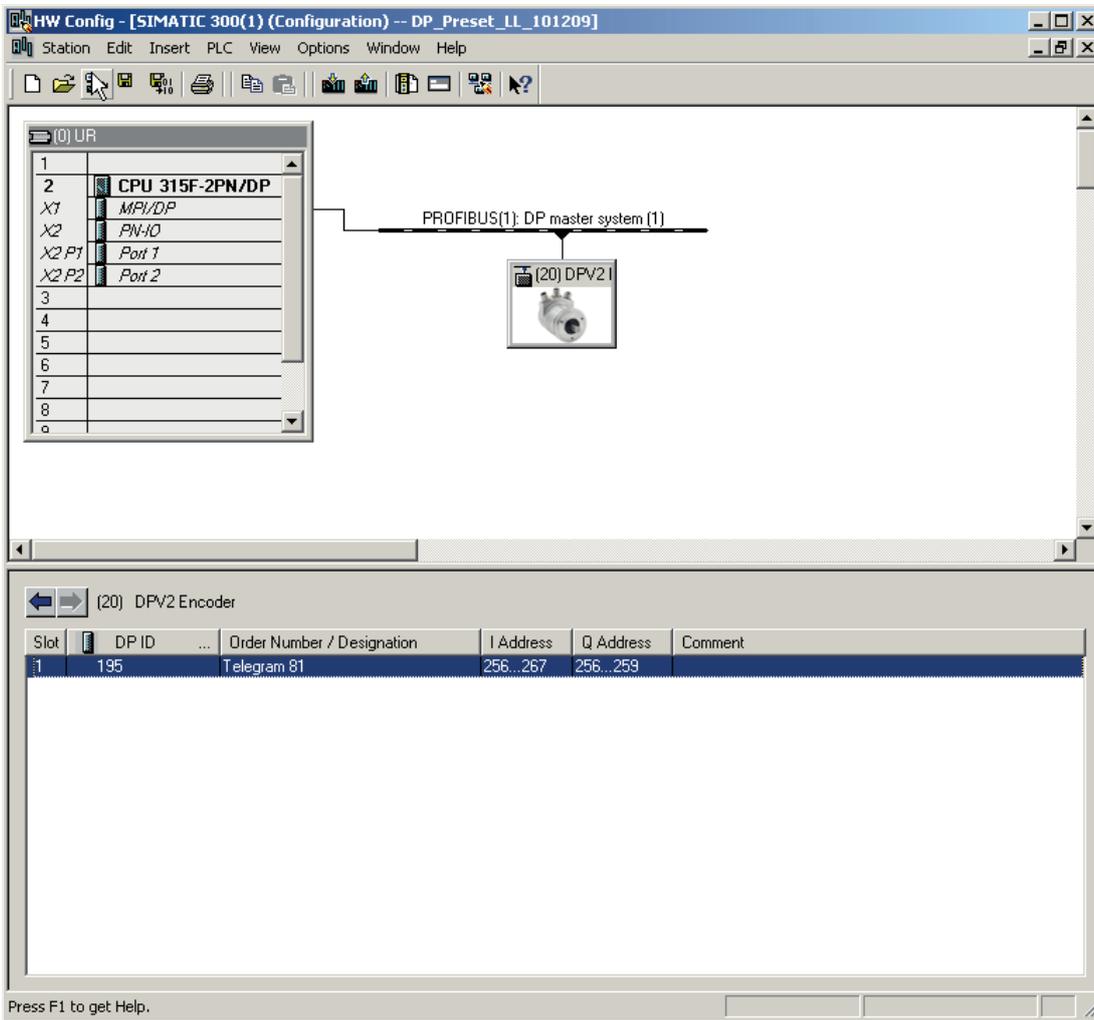
Picture 21 Diagnostic address of slot 1

Variable table

With the variable table the user can monitor and modify variables.

	Address	Symbol	Symbol comment	Display format	Status value	Modify value
1	// Enable parameter write/read 1=enabled					
2	M 8.4			BOOL	false	
3						
4	// The flag M8.1 shows if writing is not yet completed (BUSY = 1: The write process is not yet terminated)					
5	M 8.1			BOOL	false	
6	// ERROR = 1: A write error has occurred					
7	M 14.2			BOOL	false	
8	// Write block status or error information					
9	MD 10			HEX	DW#16#00700000	
10						
11	// The flag M8.3 shows if reading is not yet completed (BUSY = 1: The read process is not yet terminated)					
12	M 8.3			BOOL	false	
13	// ERROR = 1: A read error has occured					
14	M 16.2			BOOL	false	
15	// Read block status or error information					
16	MD 18			HEX	DW#16#00700000	
17						
18	// Position and control/status words					
19	PQW 258	"STW1"	Sensor Control Word 1	HEX	🔒	W#16#0000
20	PIW 258	"ZSW1"	Sensor Status Word 1	HEX	W#16#0000	
21	PQW 256	"STW2"	Sensor Control Word 2	HEX	🔒	
22	PIW 256	"ZSW2"	Sensor Status Word 2	HEX	W#16#0000	
23	PID 260	"XIST1"	Position	HEX	DW#16#01FFFF10	
24						
25	// Write parameters:					
26	DB1.DBB 1	"Request_DB".Request_ID	request parameter = 1; change parameter = 2	HEX	B#16#02	B#16#02
27	DB1.DBD 12	"Request_DB".Value	Value Of 65000	HEX	DW#16#01FFFF10	DW#16#01FFFF10
28	DB2.DBD 6	"Respons_DB".parameter_number_01	parameter value p65000 (Preset value 32)	HEX	DW#16#00000000	
29						
30						
31						

Picture 22 Variable table

8. Functional description of Leine&Linde PROFIBUS DPV2 devices

This chapter describes the functions that have been implemented in PROFIBUS DPV2 devices from Leine&Linde. The table below shows the supported functions and if there are any limitations.

Function	Note/Remarks
Code sequence	
Class 4 functionality	
G1_XIST1 Preset control	
Scaling function control	
Alarm channel control	
Compatibility mode	
Preset value	
Preset value 64 bit	Only supported by the encoder gateway
Measuring units per revolution / Measuring step	
Total measuring range	
Measuring units per revolution 64 bit	Only supported by the encoder gateway
Total measuring range 64 bit	Only supported by the encoder gateway
Maximum Master Sign-Of-Life failures	
Velocity measuring unit	Only Supported by the encoder gateway in DPV1
Encoder Profile version	
Operating time	Supported by absolute encoder and encoder gateway only in DPV1.
Offset value	
Offset value 64 bit	Only supported by the encoder gateway

Table 30 Supported functions

8.1 Code sequence

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

Attribute	Meaning	Value
CW	Increasing position values with clockwise rotation (viewed from shaft side)	0
CCW	Increasing position values with counter clockwise rotation (viewed from shaft side)	1

Table 31 Code sequence attributes

Note: The position value will be affected when the code sequence is changed during operation. It might be necessary to perform a preset after the code sequence has been changed.

8.2 Class 4 functionality

This parameter enables or disables the measuring task functions Scaling, Preset and Code sequence. If the function is enabled, scaling and Code sequence control affects the position value in G1_XIST1, G1_XIST2 and G1_XIST3. A preset will in this case always affect G1_XIST2 and G1_XIST3 but if the parameter "G1_XIST1 Preset control" is disabled the preset will not affect the position value in G1_XIST1.

Attribute	Meaning	Value
Enable	Scaling/preset/code sequence control enabled	1
Disable	Scaling/preset/code sequence control enabled	0

Table 32 Class 4 functionality attributes

8.3 G1_XIST1 Preset control

This parameter controls the effect of a preset on the G1_XIST1 actual value. If "Class 4 functionality" is activated and "G1_XIST1 Preset control" is disabled, the position value in G1_XIST1 will not be affected by a Preset.

Attribute	Meaning	Value
Enable	G1_XIST1 is affected by a Preset command	0
Disable	Preset does not affect G1_XIST1	1

Table 33 G1_XIST1 Preset control attributes

Note: This parameter is disabled by setting the value to 1.

Note: There is no functionality of this parameter if the "Class 4 functionality" parameter is disabled.

8.4 Scaling function control

This parameter enables or disables the Scaling function of the encoder.

Attribute	Meaning	Value
Enable	Scaling function is enabled	1
Disable	Scaling function is disabled	0

Table 34 Scaling function control attributes

Note: **The parameter "Class 4 functionality" must be enabled to use this parameter.**

8.5 Alarm channel control

This parameter enables or disables the encoder specific Alarm channel transferred as Channel Related Diagnosis. This functionality is used to limit the amount of data sent in isochronous mode.

If the value is zero (default value) only the communication related alarms are sent via the alarm channel.
If the value is one (1) also encoder profile specific faults and warnings are sent via the alarm channel.

Attribute	Meaning	Value
Enable	Profile specific diagnosis is switched on	1
Disable	No Profile specific diagnosis (default)	0

Table 35 Alarm channel control attributes

Note: **This parameter is only supported in compatibility mode.**

8.6 Compatibility mode

This parameter defines if the encoder should run in a mode compatible to Version 3.1 of the Encoder Profile. See below for an overview of functions affected when the compatibility mode is enabled.

Attribute	Meaning	Value
Enable	Compatibility with Encoder Profile V 3.1	0
Disable	No backward compatibility (default)	1

Table 36 Compatibility mode attributes

Function	Compatibility mode Enable (= 0)	Compatibility mode Disable (= 1)
Control by PLC (STW2_ENC)	Ignored, the Control word (G1_STW) and set point values are always valid. Control requested (ZSW2_ENC) is not supported and is set to 0.	Supported
User parameter "Maximum" Master Sign-Of-Life failures"	Supported	Not supported, one Sign-Of-Life failure tolerated, PROFIdrive P925 is optional to control the life sign monitoring.
User parameter "Alarm channel control"	Supported	Not supported, the application alarm channel is active and controlled by a PROFIdrive parameter
P965 – Profile Version	31 (V3.1)	41 (V4.1)

Table 37 Compatibility mode definition

8.7 Preset Value

The preset value function enables adaptation of the position value from the encoder to a known mechanical reference point of the system. The preset function sets the actual position of the encoder to zero (= default value) or to the selected preset value. A preset value can be set more than once and it can be stored to the non-volatile memory using PROFIdrive parameter 971.

The preset function has an absolute and a relative operating mode selectable by bit 11 in the Control word (G1_STW). Bit 11 and bit 12 in the Control word controls the preset in the following way.

Normal operating mode: Bit 12 = 0
In this mode, the encoder will make no change in the output value.

Preset mode absolute: Bit 11 =0, Bit 12 = 1
In this mode, the encoder reads the current position value and calculates an internal offset value from the preset value and the current position value. The position value is then shifted with the calculated offset value to get a position value equal to the preset value. No preset will be made if a negative preset value is used while trying to initiate an absolute preset.

Preset mode relative: Bit 11 =1, Bit 12 = 1
In this mode the position value is shifted by the preset value, which could be a negative or a positive value set by encoder parameter 65000 or 65002.

The steps below should be followed from the master when modifying the Preset value parameters:
1. Read the requested Preset value parameter and check if the returned value meets the application requirements. If not, proceed with the following steps.
2. Write the Preset value into the individual parameter.
3. Store the value in the non –volatile memory by PROFIdrive parameter 971 if the value should be valid also after the next power on sequence.

Parameter	Meaning	Data type
Preset value	The preset value for encoders with a measuring range of maximum 32 bits	Integer 32
Preset value 64 bit	The preset value for encoders with a measuring range exceeding 32 bits	Integer 64

Table 38 Preset value parameters

Note: **The preset function should only be used at encoder standstill**

Note: **The number of possible preset cycles is unlimited.**

Note: **If scaling is used the preset function shall be used after the scaling function,**
to ensure that the preset value is entered in the current measuring unit.

Note: **There is no preset activated when the Preset value is written to the encoder. The preset function is controlled by bits in the control and status words (G1_STW and G1_ZSW) and bit in the operating parameters. The preset value is used when a preset is requested by bit 12 in the Control word (G1_STW).**

8.8 Scaling function parameters

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 scaling parameters will only be activated if the parameter "Class 4 functionality" and "Scaling function control" are enabled. The permissible value range for the scaling is limited by the resolution of the encoder.

Singleturn encoders up to 31 bit and multiturn encoders up to 37 bits resolution are supported by the encoder gateway. When using encoders with higher resolution than 31 bits together with the encoder gateway, telegram 84 must be used.

8.8.1 Measuring units per revolution

This parameter sets the single turn resolution of the encoder. In other words it is the number of different measuring steps during one revolution of the encoder.

Example: For a 13-bit encoder with a single turn resolution of 13 bits the permissible value range for "Measuring units per revolution" is between 2^0 and 2^{13} (8192).

Parameter	Meaning	Data type
Measuring units per revolution	The single turn resolution in measuring steps	Unsigned 32
Measuring units per revolution 64 bit	The single turn resolution in measuring steps for encoders with a resolution exceeding 32 bits.	Unsigned 64

Table 39 Single turn scaling parameters

Note: The parameter "Measuring units per revolution 64 bit" is only supported by the encoder gateway.

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.

8.8.2 Total measuring range

This parameter sets the total measuring range of the encoder. The total measuring range is calculated by multiplying the single turn resolution with the number of distinguishable revolutions.

Parameter	Meaning	Data type
Total measuring range in measuring units	The total measuring range in measuring steps	Unsigned 32
Total measuring range in measuring units 64bit	The total measuring range for encoders with a range exceeding 32 bits.	Unsigned 64

Table 40 Total measuring range

Note: The parameter "Total measuring range in measuring units 64 bit" is only supported by the encoder gateway.

Example: The total measuring range for a 25 bit multi turn encoder RxA 608 with a 13 bit single turn resolution and a 12 bit multi turn resolution, the permissible value range for the "Total measuring range" is between 2^0 and 2^{25} (33 554 432).

The total measuring range is calculated as below:
Measuring units per revolution x Total measuring range
= 8192 (2^{13}) x 4096 (2^{12})
= 33554432

If the encoder gateway is used and the total measuring range is higher than 31 bit, telegram 84 and acyclic encoder parameter 65002 and 65003 must be used. In this case the 64 bit values are used and the 32 bit values are set to zero (0) by the encoder.

Note: Telegram 84 and parameter 65002 and 65003 are only supported by the encoder gateway.

The devices have two different operating modes, depending on the specified measuring range. When the device receives a parameter message, it checks the scaling parameters if a binary scaling can be used. If binary scaling can be used, the device selects operating mode A (see following explanation). If not, operating mode B is selected.

A. CYCLIC OPERATION (binary scaling)
Cyclic operation is used when operating with 2^x number of turns (2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048. 4096….. number of turns). If the desired total measuring range is equal to the specified single turn resolution * 2^x (where x<= 12) the encoder operates in endless cyclic operation (0 – max – 0 –max…). If the position value increases above the maximum value by rotating the encoder shaft, the encoder continues from 0.

Example of a cyclic scaling:
Measuring units per revolution   = 1000
Total measuring range   = 32 000 (2^5 = number of revolutions 32)
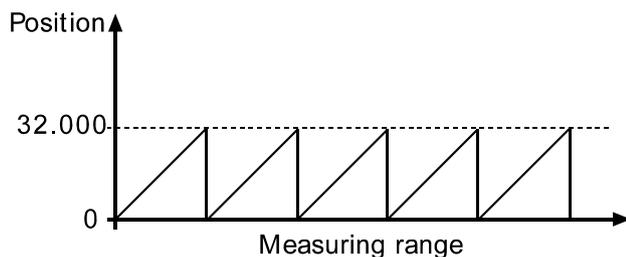
Picture 23 Cyclic Scaling

B. NON-CYCLIC OPERATION

If the desired total measuring range is **not** equal to the specified single turn resolution * 2^x (where x<= 12) the encoder operates in non-cyclic operation. The non-cyclic operation is affected by the parameter G1_XIST 1 Preset control as described below.

G1_XIST 1 Preset control = Enabled

If the position value increases or decreases outside the maximum value or below 0 with the parameter G1_XIST 1 Preset control **enabled**, the device outputs the maximum position value within the scaled total range for both position values G1_XIST 1 and G1_XIST 2.

Example of non-cyclic scaling with G1_XIST 1 Preset control enabled:

Measuring units per revolution   = 100
Total measuring range   = 5000 (number of revolutions 50)
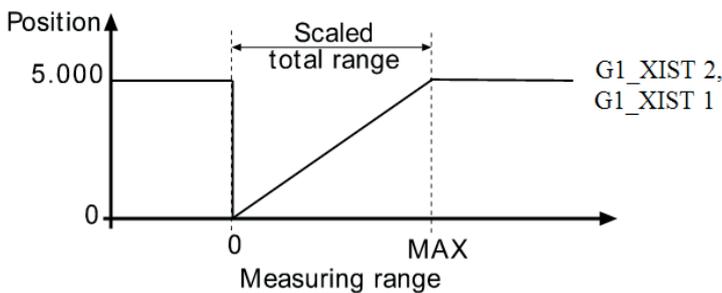
Picture 24 Non-cyclic scaling with G1_XIST 1 Preset control enabled

G1_XIST 1 Preset control = Disabled

With the parameter G1_XIST 1 **disabled**, and if the position value increases or decreases outside the maximum value or below 0, the device will output the maximum position value within the scaled total range for the position value G1_XIST 2. The position value G1_XIST 1 is not limited to the scaled total range. For the position value G1_XIST 1, the device will continue to output a scaled position value within the encoder's total measuring range (up to 33554432 positions for a 25 bit encoder).

Example of non-cyclic scaling with G1_XIST 1 Preset control disabled:

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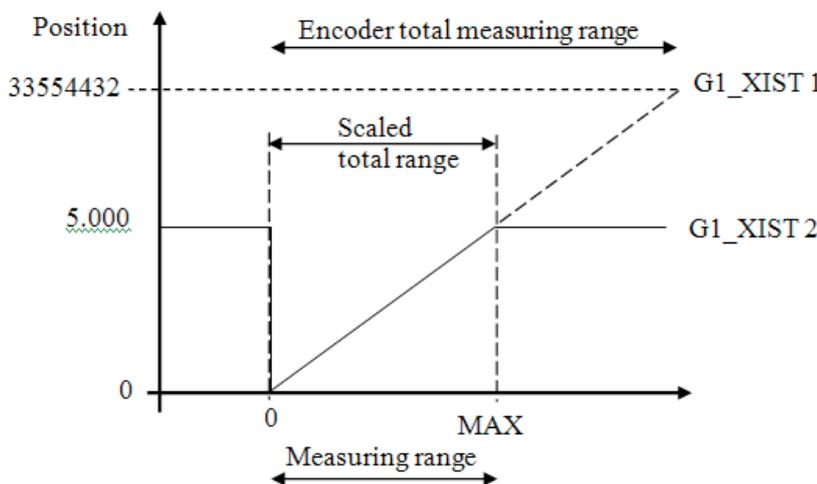

Picture 25 Non-cyclic scaling with G1_XIST 1 Preset control disabled

61

Handling 64 bit data

Siemens hardware configuration tool does not support 64 bit data type, so when writing larger numbers than 32 bit into the configuration tool, this needs to be done according to below:

Example:

Total measuring range in measuring units = 2^{36}

$$2^{36} = 6871947673610 = 0x\underbrace{00\ 00\ 00\ 10}_{4\ byte\ =\ 32\ bit}\overset{LSB}{\underbrace{00\ 00\ 00\ 00}_{4\ byte\ =\ 32\ bit}}$$

Take the 4 least significant bytes above and convert to decimal:
→ 0x00 00 00 00 = **0** = Total measuring range LSB

Then take the 4 most significant bytes above and convert to decimal:
→ 0x00 00 00 10 = **16** = Total measuring range MSB

In the configuration software enter the decimal values:
Total measuring range LSB = **0**
Total measuring range MSB = **16**

8.9 Maximum Master Sign-Of-Life failures

With this parameter the number of allowed failures of the master´s sign of life is defined.
The default value is one (1).

Parameter	Meaning	Value
Maximum Master sign-of-life failures	The number of permissible failures of the master´s life sign.	1…255

Table 41 Maximum Master Sign-Of-Life parameter

Note: This parameter is only supported in compatibility mode.

8.10 Velocity measuring units

This parameter defines the coding of the velocity measuring units used to configure the signals NIST_A and NIST_B which are included in Telegram 82-84. Standard telegram 81 has no velocity information included and the encoder does not use the velocity unit information in this case. The encoder gateway supports Telegram 82, 83 and 84 and needs a declaration of the velocity measuring unit.

Parameter	Meaning	Value
Velocity measuring units	Definition of the units for the Encoder velocity output value.	See table below

Table 42 Parameter Velocity measuring unit

Velocity measuring units	Value
Steps/s	0
Steps/100 ms	1
Steps/10 ms	2
RPM	3

Table 43 Coding of velocity measuring units

The velocity calculations are made with a maximum of 19 bits resolution. If the resolution is higher than 2^{19}, the value used for velocity calculations is automatically reduced to 2^{19}.

Example: For an encoder gateway used with a 37 bit multi turn encoder with a 2^{25} single turn resolution and a 2^{12} multi turn resolution, the maximum single turn value for velocity calculations will be 2^{19}. For a single turn encoder the maximum resolution can be up to 31 bit, but the value used for velocity calculations will in this case also be $2^{19.}$

Note: In case of the steps/s unit, an average is made over 200 ms, and the value is multiplied by 5.

Note: If scaling has been set on the device 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 device.

Note: The velocity function is only supported when using the encoder gateway and DPV1 functionality.

8.11 Encoder profile version

The encoder Profile Version is the version of the encoder profile document implemented in the encoder. This parameter is not affected by the Compatibility mode settings.

Bits	Meaning
0…7	Profile Version, least significant number, (value range: 0-99), decimal coding
8…15	Profile Version, most significant number, (value range: 0-99), decimal coding
16…31	Reserved

Table 44 Encoder profile version Parameter

8.12 Operating time

The operating time monitor stores the operating time for the device in operating hours. The operating time is saved every six minutes in the non-volatile memory in the device. This happens as long as the device is powered on.

If the operating time function is not used the operating time value is set to the maximum value (0xFFFF FFFF).

Parameter	Meaning	Data type
Operating time	The accumulated power on time	Unsigned 32

Table 45 Operating time parameter

Note: **The parameter "Operating time" is only supported by the absolute encoder and encoder gateway in DPV1.**

8.13 Offset value

The offset value is calculated in the preset function and shifts the position value with the calculated value. The offset value is stored in a non volatile memory and can be read from the encoder at any time. The data type for the offset value is a 32 bit or 64 bit binary value with sign, whereby the offset value range is equal to the measuring range of the device.

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

Parameter	Meaning	Data type
Offset value	The offset value for encoders with a measuring range of maximum 32 bits	Integer 32
Offset value 64 bit	The offset value for encoders with a measuring range exceeding 32 bits	Integer 64

Table 46 Offset value parameter

Note: **The offset value is read only and cannot be modified by a parameter write access.**

8.14 Acyclic data

Leine & Linde's PROFIBUS DPV2 devices support the following acyclic data exchange functions.

8.14.1 PROFIdrive parameters

The encoder profile V4.1 (PNO no. 3.162) has adopted certain standard PROFIdrive parameter. The Leine & Linde devices support the following PROFIdrive parameters:

Prm. No	Significance	Data type	Read/write
918	Node address	Unsigned16	R
922	Telegram selection	Unsigned 16	R
925	Number of Controller Sign-Of-Life failures which may be tolerated	Unsigned 16	R/W
964	Device indentification	Array [n] Unsigned 16	R
965	Encoder Profile Number	Octet string 2	R
971	Transfer to non volatile memory	Unsigned 16	W
974	Base Mode Parameter Access service identification	Array [n] Unsigned 16	R
975	Encoder Object identification	Array [n] Unsigned 16	R
979	Sensor format	Array [n] Unsigned 32	R
980	List of supported parameters	Array [n] Unsigned 16	R

Table 47 Supported PROFIdrive parameters

8.14.2 Encoder parameter numbers

The table below specifies the encoder specific parameter that is supported by Leine & Linde PROFIBUS encoders.

Prm. No	Significance	Data type	Read/write	Note
65000	Preset value	Integer 32	R/W	
65001	Operating status	Array [n] Integer 32	R	
65002	Preset value 64 bit	Integer 64	R/W	Only supported by the encoder gateway
65003	Operating status 64 bit	Array [n] Integer 64	R	Only supported by the encoder gateway

Table 48 Encoder specific parameter

Note: The parameters 65002 and 65003 are not supported by the absolute encoder.

8.14.3 Parameter 65000 and 65002 – Preset value

The parameter 65000 and 65002 sets the value for the preset function. The parameter 65002 should be used if the preset value exceeds 32 bits. For more information regarding the Preset function control, see chapter 8.7.

PNU	65000
Significance	Preset value
Data type	Integer 32
Access	Read and write
Validity range	Profile specific
Explanation	The preset value sets the value for the preset function. The preset value can be stored in the non volatile memory by PROFIdrive parameter 971 and will be reloaded at each start up if stored.

Table 49 Structure of parameter 65000 "Preset value"

PNU	65002
Significance	Preset value 64 bit
Data type	Integer 64
Access	Read and write
Validity range	Profile specific
Explanation	The preset value sets the value for the preset function. The preset value can be stored in the non volatile memory by PROFIdrive parameter 971 and will be reloaded at each start up if stored.

Table 50 Structure of parameter 65002 "Preset value 64 bit"

8.14.4 Parameter 65001 – Operating status parameter structure

This parameter structure is a read only structure where information on the Encoder operating status can be found. It is a complement to the PROFIdrive parameter 979 described in the Profile for Drive Technology, PROFIdrive V4.1, order nr 3.172 available from PROFIBUS and PROFINET International.

PNU	65001
Significance	Encoder Operating Status
Data type	Array[n] Integer 32
Access	Read
Validity range	Profile specific
Explanation	The operating status displays the status of the encoder.

Table 51 Strucure of parameter 65001 "Encoder operating status

Sub index	Meaning	Note/Limitations
0	Header	
1	Operating status	
2	Faults	
3	Supported Faults	
4	Warnings	
5	Supported warnings	
6	Encoder profile version	
7	Operating time	Only supported in DPV1 for the encoder gateway and the absolute encoder
8	Offset value	
9	Measuring units per revolution	
10	Total measuring range in measuring units	
11	Velocity measuring unit	Only supported in DPV1 for the encoder gateway

Table 52 Detailed Structure of parameter 65001 "Operating status"

Sub index 1: Operating status

In sub index 1 the status of different encoder functions can be read out. The mapping of the respective functions is according to the table below.

Bits	Definition
0	Code sequence
1	Class 4 functionality
2	G1_XIST1 Preset control
3	Scaling function control
4	Alarm channel control
5	Compatibility mode
6...7	Reserved for the Encoder manufacturer
8...31	Reserved for future use

Table 53 Parameter 65001 Sub index 1: Operating status

8.14.5 Encoder specific parameter 65003 – Operating status 64 bit structure

The parameter structure 65003 is only supported by the encoder gateway and is a read only structure where information on the 64 bit parameter values can be found

PNU	65003
Significance	Encoder Operating Status 64 bit
Data type	Array[n] Integer 64
Access	Read
Validity range	Profile specific
Explanation	The status of encoder operating parameters with 64 bit length.

Table 54 Structure of parameter 65003 "operating status 64 bit"

Sub index	Meaning
0	Header
1	Offset value 64 bit
2	Measuring units per revolution 64 bit
3	Total measuring range in measuring units 64 bit

Table 55 Detailed structure of parameter 65003 "Operating status 64 bit"

**Note: The parameter 65003 is only supported by the encoder gateway.**

8.14.6 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 following I&M functions are supported.

I&M Parameter	Octets	Comment
Header		
Manufacturer specific	10	Not used
I&M Block		
MANUFACTURER_ID	2	Manufacturer Id, (Leine & Linde = 394)
ORDER_ID	20	Encoder part number
SERIAL_NUMBER	16	Encoder serial number
HARDWARE_REVISION	2	Not used
SOFTWARE_REVISION	4	Software revision
REVISION_COUNTER	2	Not used
PROFILE_ID	2	Encoder Profile number
PROFILE_SPECIFIC_TYPE	2	Type of encoder,
IM_VERSION	2	Version of the I&M profile
IM_SUPPORTED	2	Value = 0 means support of I&M

Table 56 Supported I&M functions

9 Encoder state Machine

9.1 Normal operation state

9.1.1 Profile Version 4.x

If using encoder complying with encoder profile v4.1, then bit 10 "Control by PLC" in Control word 2 needs to be set before the data in Control word is valid. If not set, Control word is not used by the encoder firmware.

9.1.2 Profile Version 3.x

If using encoders complying with encoder profile 3.x, the data in Control word is always valid and bit 9 "Control requested" in Status word 2 is always cleared.

9.1.3 Profile Version 3.x and 4.x

When using telegram 81-83 and Control word bit 13 "Request absolute value cyclically" is set, then Status word bit 13 "Transmit absolute value cyclically" is set. Status word bit 13 is cleared (bit 13=0) when Control word bit 13 is cleared. Status word bit 13 is always cleared, when using telegram 84 due to the fact that no absolute value is sent in G1_XIST2.

9.2 Parking state

This state can be reached from any other state. The position value in G1_XIST1, G1_XIST2 and G1_XIST3 are set to zero. Errors are cleared and alarms are disabled in parking mode.

9.3 Set/shift home position (Preset)

The Set/shift home position is initiated when Control word bit 12 "Request set/shift of home position " is set. In this case the Status word bit 12 "Set/shift of home position executed" is set to 1. In order to initiate a set/shift home position, Class 4 functionality must be enabled (see chapter 7.2), otherwise there will be an error in G1_XIST2.

9.3.1 Preset depending on different telegrams

When using standard telegram 81-83, the acyclic encoder parameter 65000 "Preset value 32" bit shall be used to set a preset value (<=32 bit) for the encoder. If the acyclic encoder parameter 65002 "Preset value 64 bit" is used in this case, an error message on the acyclical parameter channel will be returned. With telegram 81-83, the operating status must be read by encoder parameter 65001 "Operating status 32 bit".

With telegram 84, the acyclic encoder parameter 65002 "Preset value 64 bit" shall be used to set a preset value (<=64 bit) for the encoder. If the acyclic encoder parameter 65000 "Preset value 32 bit" is used in this case, an error message on the acyclical parameter channel will be returned. With telegram 84, the operating status must be read by encoder parameter 65003 "Operating status 64 bit".

9.3.2 Absolute preset with negative value

Preset data sent with acyclic encoder parameter 65000 or 65002 are signed values. The relative preset mode uses signed preset values, but with the absolute preset mode no preset will be made if a negative preset value (set with encoder parameter 65000 or 65002) is used while trying to initiate an absolute preset.

9.4 Error state

This state is reached when an error has occurred. The encoder can enter this state from both the normal operation state and the set/shift home position state. If an error occurs, the Status word bit 15 "Sensor error" is set, and the error code is displayed in G1_XIST2 instead of the position value.

9.5 Error acknowledgement

This state is reached when an error has occurred, and Control word bit 15 "Acknowledging a sensor error" has been set. The Status word bit 11 "Requirement of error acknowledgment detected" and Status word bit 15 "Sensor error" are set to 1.

9.6 Start Up

This state is only reached when Control word bit 14 "Activate parking sensor" are cleared (=0). Once the Control word bit 14 are cleared, it takes about 500ms before the Status word bit 14 "Parking sensor active" are set to zero (=0).

The reason for the delay is that before the encoder goes to normal operation mode, an initializing of the encoder is made.

10 Revision history

Revision	Date	Changes
Rev. 1.0	2012-06-01	First release

Table 57 Revision history

The best encoders are those you never have to think about. Those that simply do their job – year after year. Leine & Linde develops and manufactures custom-ised encoder solutions for demanding environments, advanced measuring systems for accurate feedback of speed and position.

LEINE ■ LINDE

+46-(0)152-265 00   www.leinelinde.com