Baumer

Manual

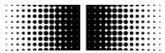## Absolute encoder with Profibus-DP
with functional extensions according to
Profibus-DPV1 and DPV2

Firmware Version 1.00 and up

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1. Introduction

1.1. Scope of delivery

Please check the delivery upon completeness prior to commissioning.
Depending on encoder configuration and part number delivery is including:

- Basic encoder
- Profibus bus cover
- Sealing bolt for any unused cable gland
- CD with GSD file and manual (also available as download in the Internet)

1.2. Product classification

Shaft encoders

Product	GSD file	Product family
GBAMW	GBAM09F6.gsd	multivoPlus - Singleturn
GBLMW	GBMM09F6.gsd	multivoPlus - Multiturn
GBMMW	GBMM09F6.gsd	multivoPlus - Multiturn
GCAMW	GCAM09F6.gsd	magtivo® - Singleturn
GCMMW	GCMM09F6.gsd	magtivo® - Multiturn
GEMMW	GXMM09F6.gsd	multivo® - Multiturn (stainless steel)
GXAMW	GXAM09F6.gsd	multivo® - Singleturn
GXLMW	GXMM09F6.gsd	multivo® - Multiturn
GXMMW	GXMM09F6.gsd	multivo® - Multiturn

End shaft encoders

Product	GSD file	Product family
GBAMS	GBAM09F6.gsd	multivoPlus - Singleturn
GBLMS	GBMM09F6.gsd	multivoPlus - Multiturn
GBMMS	GBMM09F6.gsd	multivoPlus - Multiturn
GCAMS	GCAM09F6.gsd	magtivo® - Singleturn
GCMMS	GCMM09F6.gsd	magtivo® - Multiturn
GXAMS	GXAM09F6.gsd	multivo® - Singleturn
GXLMS	GXMM09F6.gsd	multivo® - Multiturn
GXMMS	GXMM09F6.gsd	multivo® - Multiturn

2. Safety and operating instructions

Supplementary information
* The present manual is intended as a supplement to already existing documentation (catalogues, product data sheets and mounting instructions).
* The manual must be studied carefully prior to initial commissioning of the equipment.

Intended purpose of the equipment
* The encoder is a precision measurement device. It is utilized to determine angular positions and revolutions, and to prepare and supply measured values in the form of electrical output signals for the downstream device. Encoders may only be used for this purpose.

Commissioning
* The encoder must be initialised and mounted only by a qualified expert.
* Observe the operating instructions of the machine manufacturer.

Safety instructions
* Check all electrical connections prior to commissioning of the equipment.
* If mounting, electrical connections or any other work performed at the encoder and the equipment is not correctly executed this can result in malfunction or failure of the encoder.
* Corresponding safety precautions must be provided and observed to exclude any risk of personal injury, damage to material or operating equipment as a result of encoder failure or malfunction.
* Encoders must not be operated outside the specified limited values (see further documentation).

Failure to observe these safety instructions can result in malfunctions, material damage or personal injury.

Transport and storage
* Only ever transport or store the encoder in its original packaging.
* Never drop the encoder nor expose it to major shocks.

Mounting
* Avoid impacts or shocks on housing and shaft/end shaft.
* End shaft/Hollow shaft encoder: Open clamping ring completely before mounting the encoder
* Avoid any twist or torsion on the housing.
* Shaft encoders: never make rigid connections between encoder shaft and drive shaft.
* Do not open the encoder or proceed any mechanical modifications.

Shaft, ball bearings, glass pane or electronic components can be damage thereby and a safe and reliable operation is no longer guaranteed.

Electrical commissioning
* Do not proceed any electrical modifications at the encoder.
* Do not proceed any wiring work while encoder is live.
* Never plug or unplug connector while encoder is live (the bus cover however may be removed or docked to the basic encoder when live).
* Ensure that the entire system is installed in line with EMC/EMI requirements. Operating environment and wiring have an impact on the electromagnetic compatibility of the encoder. Install encoder and supply cables separately or far away from sources with high emitted interference (frequency converters, contactors, etc).
* When working with consumers with high emitted interference provide separate encoder supply voltage.
* Completely shield encoder housing and connecting cables..
* Connect encoder to protective earth (PE) using shielded cables. The braided shield must be connected to the cable gland or connector. Ideally, aim at dual connection to protective earth (PE), i.e. housing by mechanical assembly and cable shield by the downstream devices. In case of earth loop problems, earth at least on one side.

Failure to observe these instructions can result in malfunctions, material damage or personal injury!

3. Product family

The product family architecture is modular. Depending on what is required from the encoder, the basic encoder and bus covers can be combined at will with the selected bus system.
The basic encoders differ in terms of accuracy, ambient conditions and the utilized sensing principle.

Bus cover
The bus cover accommodates the field bus interface and the complete electronics for processing the measured values. EtherNet/IP communication is performed via the specialized EtherNet/IP-ASIC ERTEC200 with integrated high-performance microcontroller ARM9.

Magres / magtivo®
Utilizes a magnetic sensing principle and endures harsh industrial environments.

Procoder / multivo®
Utilizes a photoelectric sensing principle and is the recommended product for precise applications.

Dignalizer / activo® / multivoPlus®
Utilizes a photoelectric sensing principle with integrated analog/digital signal conversion and is the product to choose for ultra-precise sensing applications.

The bus covers differ by the respectively integrated bus interface.
Available bus interfaces: CANopen, DeviceNet, EtherCAT, Ethernet/IP, Profibus-DP, Profinet, Powerlink, Power over EtherCAT, SAE J1939, SSI.
All encoders enable parameterization by bus interface.

Functional principle:
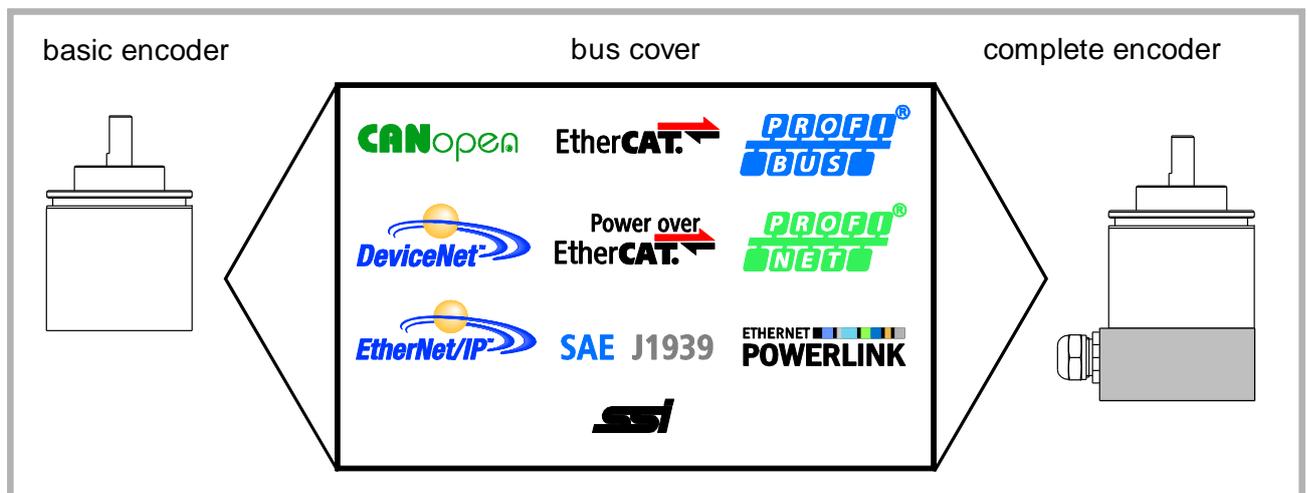
4. Commissioning

4.1. Mechanical mounting

Shaft encoders
- Mount the encoder by help of the mounting holes and three screws (square flange: 4 screws) provided at the encoder flange. Observe thread diameter and depth.
- There is an alternative mounting option in any angular position by eccentric fixings, see under accessories.
- Connect drive shaft and encoder shaft by using an appropriate coupling. The shaft ends must not touch each other. The coupling must compensate temperature and mechanical tolerances. Observe the maximum permitted axial or radial shaft load. For appropriate couplings please refer to accessories.
- Tighten the mounting screws firmly.

End shaft/hollow shaft encoders
- Mounting by clamping ring
  Prior to mounting the encoder open the clamping ring completely. Push encoder onto the drive shaft and tighten the clamping ring firmly.
- Adjusting element with rubber buffer
  Push the encoder onto the drive shaft and insert the cylindrical pin into the adjusting element (provided by customer) and the rubber buffer.
- Adjusting angle
  Push the encoder onto the drive shaft. Insert adjusting angle into the encoder's rubber buffer and fasten the adjusting angle at the contact surface.
- Stud screw
  Push the encoder onto the drive shaft and insert the stud screw provided by customer into the encoder's rubber buffer.
- Spring coupling
  Fasten the spring coupling at the mounting holes of the encoder housing using screws. Push the encoder onto the drive shaft and mount the spring coupling to the contact surface.

4.2. Electrical connection

Ever store and transport the bus cover in the ESD bag only.

For electrical connection remove the bus cover as follows:
- Release the fastening screws of the bus cover
- Carefully loosen the bus cover and lift off in an axial direction

4.2.1. Cabling

EN 50170 specifies two types of PROFIBUS cable, type A and B. Type B is obsolete and should not be used in new applications. With type A all transmission rates up to 12Mbit/s are possible. Common baud rate in clock synchronous operation according to PROFIBUS-DPV2 is 12Mbit/s.

Properties	Data
Impedance in Ohm	135 to 165 at 3 to 20 MHz
Operating capacity (pF/m)	less than 30
Loop impedance (Ohm/km)	less than 110
Core diameter (mm)	greater than 0.64
Core cross section (mm)	greater than 0.34

Transmission speed depending on line distance

Baudrate in kBaud	9,6	19,2	93,75	187,5	500	1500	3000	6000	12000
Line distance in m	1200	1200	1200	1000	400	200	100	100	100

4.2.2. Setting the user address

The user address is set decimally using the two rotary switches provided in the bus cover.
The maximum number of users is 99.

- Decimal setting of the user address by the help of rotary switches 1 and 2 (default setting 00).

Example: 23
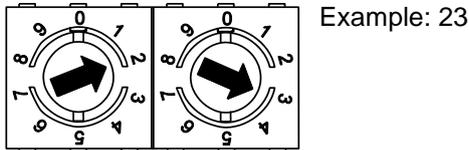
4.2.3. Terminating resistor

If the encoder is the final device in the bus line it is mandatory to terminate the bus by resistors. The resistors are integrated in the bus cover and connected by means of a two-pole DIP switch.

- The internal terminating resistors must be switched to „ON" in case of final user by help of the 2-pole DIP switch (default setting OFF). The two switches must always be set in the same direction.
-

both ON = final user
both OFF = all other users

Clamp	Resistance
A to GND	390 Ohm
B to +5 V	390 Ohm
A to B	220 Ohm

4.2.4. Connecting the bus cover

- Release the cap nut of the cable gland
- Push the cap nut and seal insert with contact sleeve onto the cable sheath.
- Strip the cable heath and cores, shorten the shield film where it exists (see fig.)
- Bend over the braided shield by approx. 90°.
- Push the sealing insert with contact sleeve along as far as the braided shield. Insert the sealing insert with contact sleeve and cable flush into the cable gland and tighten the cap nut.
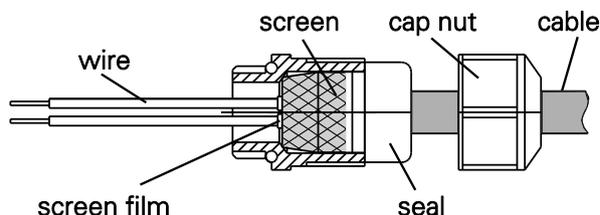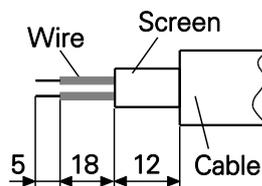
Take care that by no means the voltage supply is assigned to bus terminals A/B, this could damage electronics components in the bus cover.

- Avoid stub lines, especially with bus clocks greater than 1.5Mbit/s
- Clamps with the same designation are internally connected to each other and identical in functionality.
  Maximum load on the internal clamped connections UB-UB and GND-GND is 1 A each.
  Signals A and B are decoupled at 100 nH inductivity each.
- For voltage supply use cable gland 3 only. For the bus lines, either cable gland 1 or 2 may be used.
  Please observe the admissible cable cross-sections.
- Guide the cores the shortest way from the cable gland to the terminal connector. Observe the admissible core-cross sections, use ferrules with flexible cores.
- Avoid any crossings of data lines and supply line.

- Seal up the unused cable gland using a sealing bolt (included in the delivery).
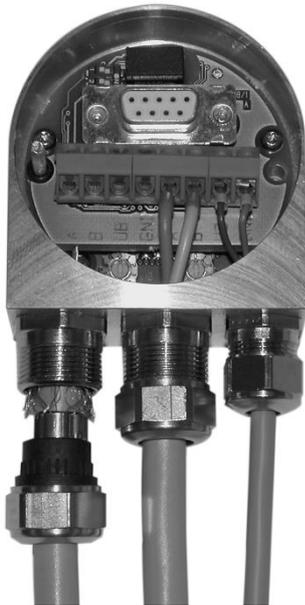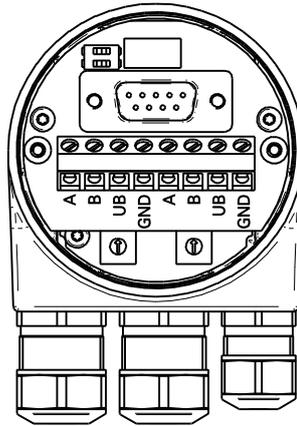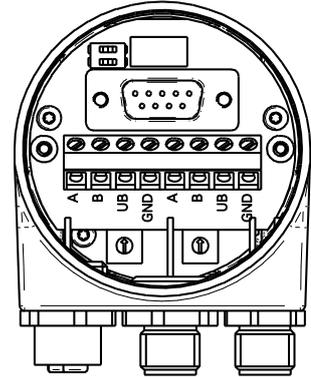
1   2   3   Cable gland   M12 connector

Terminal assignment

M12 connector	Clamp:	Significance
M12, 4 pins: Pin 1	UB	Supply voltage 10...30 VDC
M12, 4 pins: Pin 3	GND	Ground connection related to UB
M12, 5 pins: Pin 2	A	Negative serial data line
M12, 5 pins: Pin 4	B	Positive serial data line

M12 connector
for serial data lines   for voltage supply
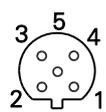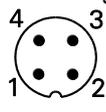
male   female

Clamps with the same designation are internally connected to each other and identical in function.
Maximum load on the internal clamped connections UB-UB and GND-GND is 1 A each.
Signals A and B are decoupled with an inductivity of 100 nH each.

Assembly of basic encoder and bus cover:
- Carefully plug the bus cover onto the D-SUB connector of the basic encoder, then press it over the seal taking care not to tilt it.
- Tighten both fastening screws firmly in the same direction.
- The bus cover must fully rest on the housing of the basic encoder and be firmly screwed on.

The encoder housing and braided shield of the connecting cable are only ideally connected if the bus cover is resting fully on the basic encoder (positive locking).

5. Projecting

All examples in the present manual relate to SIEMENS® controls and the corresponding projecting software Step7® , since they are commonly used as PROFIBUS controls. Please proceed in a corresponding way with other controls.

5.1. Importing the GSD file

To implement the DP-Slave in the projecting software first the attached GSD file must be imported. All required modifications of basic settings are implemented by parameterization (see "Parameterization"). The GSD file itself is not modified.

Step7® software is imported in the hardware window („Extras – install GSD-files"). Prior to the import operation the actual hardware project must be closed („Station - close"). Now the encoder appears at right in the hardware catalogue under „PROFIBUS-DP" – „More field devices" – „Encoder" – (xx corresponding to the encoder type).

5.2. Encoder bus implementation

Use the mouse to drag text „GxxMW_H IsoM" from the right out of the hardware catalogue to the bus bar. A window pops up to enter the PROFIBUS node ID that must correspond to the settings of the BCD switch in the bus cover. All other entries may remain unchanged. Close the entry by OK.

Use the mouse again to drag encoder module „telegram 81" from the right out of the hardware catalogue to plug-in position 1 of the module window at left below in the hardware window. Do not utilize the universal module, this is not considered.

5.3. Assigning the user address

If not already done in a previous step or if required at a later date you may alter the PROFIBUS node ID of the encoder. Upon a double click the window „Properties – DP-Slave" pops up. Click on „PROFIBUS…" and enter the required node ID here. The node ID must correspond to the settings of the BCD switch in the bus cover.

5.4. Assigning addresses for input and output data

Later access to encoder input and output data via master software requires assigning E/A addresses to the input and output data. Click on the encoder icon on the bus bar HW config of Step7 to select the encoder. Then double-click on module "telegram 81" (plug-in position 1) at left below. The window "Properties - DP-slave" with tab "Address/ID" pops up (see screenshot).
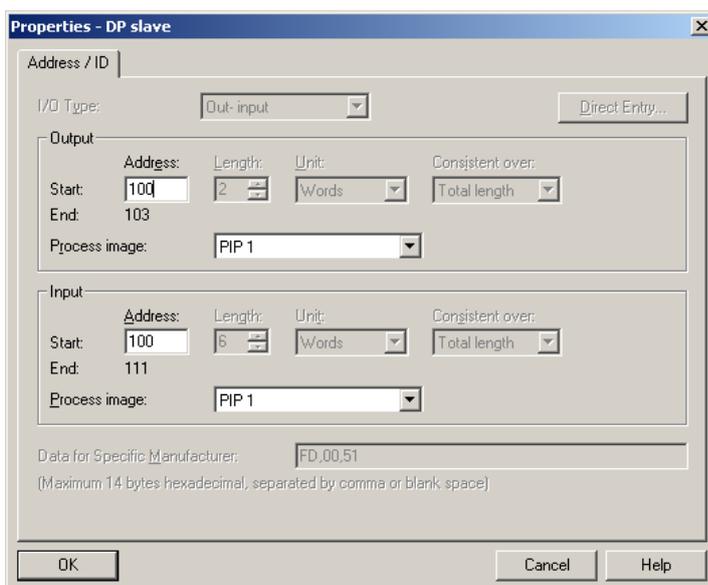
Enter the respective initial addresses. It is admissible to use Identical or overlapping addresses for output and input.

E/A fields require defining partial process images in clock-synchronous operation, in the example it is TPA1. Take care that the selected partial process image comprises the initial address. If not it will result in an error signal when interpreting the project.

5.5. Parameterization

Upon double-click on the encoder icon at the bus bar, the window „Properties-DP-Slave" pops up, showing the tabs "General", "Parameter Assignment" and "Clock synchronisation".
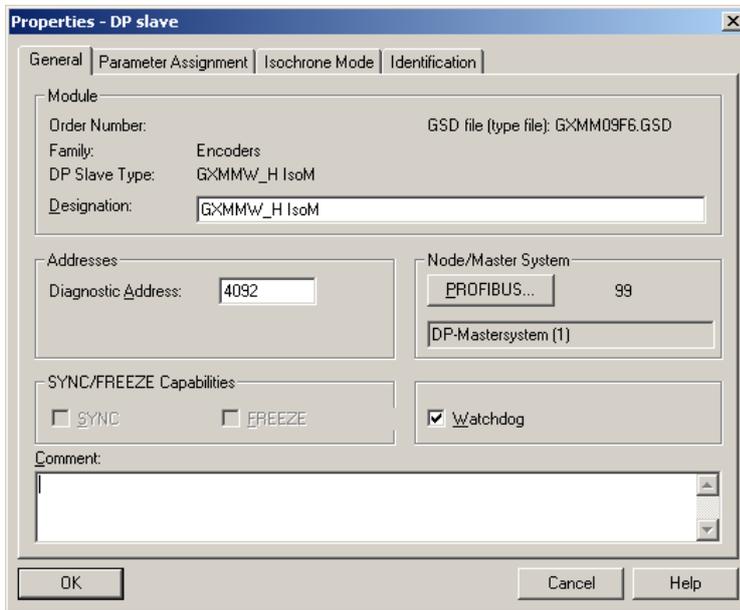
5.5.1. General

System parameters under tab „General" may usually be adopted without modifications.
If required, encoder name, diagnosis address and node ID under button „Profibus…" may be altered. Further here is the option to deactivate the encoder's response monitoring.

5.5.2. Parameter assignment
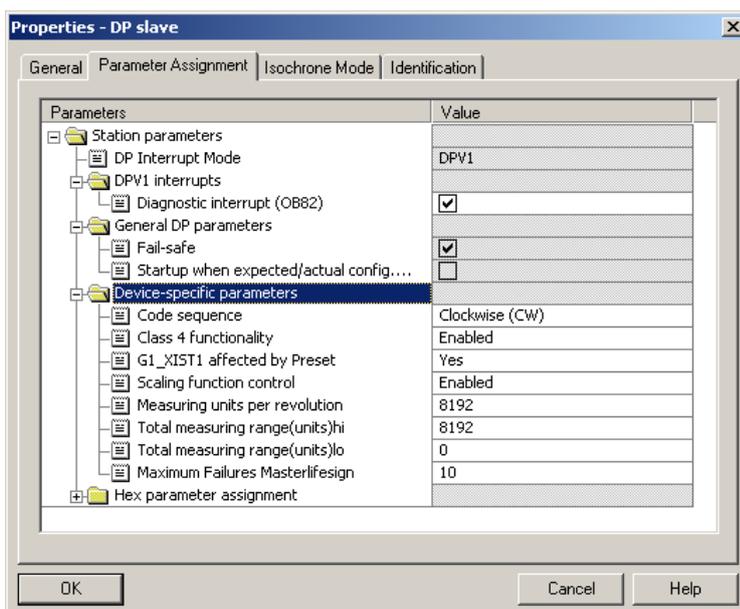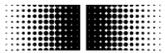
Device-specific parameters

- **Code sequence**
  Behaviour of the position data in relation to the sense of rotation of the encoder shaft when looking at flange.
  CW („clockwise") = Ascending values with clockwise rotation
  CCW („counter-clockwise") = Ascending values with counter-clockwise rotation

- **Class 4 functionality**
  If active („enabled"), the encoder operates as a Class 4 Device of the encoder profile.
  If not active („disabled), the encoder operates as a Class 3 Device of the encoder profile.
  Here setting a preset is disabled.

- **G1_XIST1 affected by preset**
  If active ("Yes"), setting a preset will affect both the left-aligned position value G1_XIST1 and the right-aligned position value G1_XIST2.

  If not active ("No"), the left-aligned position value G1_XIST1 is not added an offset that is internally calculated upon setting a preset. In this case, both position values G1_XIST1 and G1_XIST2 may be different!

- **Scaling function control**
  If active ("enabled"), resolution („steps per revolution", "measuring units per revolution") and the total measuring range can be parameterized at will within the admissible limits.

  If not active ("disabled"), the previous encoder settings for resolution and total measuring range will remain, i.e. the maximum limits. Any try to enter deviating parameters will result in a parameterization error signal.

- **Measuring units per revolution**
  Parameterization of the required resolution („steps per revolution", „measuring units per revolution").
  Admissible values range from 1 to the maximum encoder resolution. Usually the limits are indicated in the parameterization software.

  multivoPlus encoders require a 32 bit value here to get two input fields, i.e. „measuring units per revolution (hi)" and „(lo)". Ho to split the 32 bit value into two 16 bit values please see under 8.1.4.

  A re-parameterization may clear the previous offset value (see "note" under 6.6. Preset function).

- **Total measuring range (units)**
  Parameterization of the required total measuring range, „TMR".

  Singleturn encoders require here the same parameter as for the resolution ("Measuring units per revolution").

  Admissible values range from 2 to the product of programmed resolution multiplied by maximum number of revolutions. The maximum limit of the parameterization software is only applicable if the resolution is also the maximum.

  All multiturn encoders and multivoPlus singleturn encoders need a 32 bit value here to get two input fields, „Total measuring range (units) hi" and „lo". How to split up the 32 bit value into two 16 bit values please see under 8.1.4.

  Any alteration of the total measuring range clears the previous offset value (see "note" under 6.6 Preset Function)
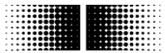
Important note for multiturn encoder operation
This encoder supports „Endless Operation" automatically if required.

Thus, there are no special requirements for the encoder parameters "total measuring range" and "measuring units per revolution" to stand in a certain ratio.

With endless operation active, the encoder shaft must not rotate when the encoder is not powered. In those cases where powerless motion cannot be avoided, the encoder has to be referenced (presetted) after each power-up. With Endless Operation inactive, the encoder shaft may rotate unlimited when encoder not powered.

How to determine if „Endless Operation" is in use:
- Multiply the encoder's „max. possible revolutions" (depending on encoder 16 bit = 65536 or 13 bit = 8192) by your chosen parameter „measuring units per revolution".
- Divide this value by your chosen „total measuring range".
- If there is a division remainder, endless operation is in use.

Example for parameters without endless operation:
Maximum possible revolutions   65536   (16 bit multiturn)
    Measuring units per revolution   3600
    Total measuring range   29.491.200   (8192 x 3600)
    Calculation: 65536 x 3600 / 29.491.200 = 8 (no remainder)

Example for parameters with endless operation:
Maximum possible revolutions   65536   (16 bit multiturn)
    Measuring units per revolution   3600
    Total measuring range   100.000
    Calculation: 65536 x 3600 / 100.000 = 2359 remainder 29600

- **Maximum Failures Master lifesign**
  Designation of the maximum number of tolerated failures in master lifesign transmission in output word STW2. Upon exceeding the number of tolerated failures an error signal is output in G1_XIST2 which has to be acknowledged.

  Any monitoring of the Master lifesign will only take place respectively begin if the values transmitted by the control in master lifesign are unequal to zero.

- **Hex parameterization**
  The hexadecimal data described only reflect the actual settings in the form they are transmitted to the encoder and by no means should be altered in any way.

5.5.3. Clock synchronisation

Clock-synchronous operation is activated by a tick on "SynchronizeDP-Slave at equidistant DP-cycle".

Time Ti marks the time before the equidistant bus clock (Global Control Message, GC) where the encoder is sensing the position data with micro-second precision. It should be aimed at the smallest possible value. 250 μs minimum is admissible if encoder operation is without scaling, i.e. always with the maximum resolution. For enabled scaling the minimum value is 375μs. In case several clock-synchronous DP-slaves exist in the bus that require more time for data evaluation automatically the maximum value will be utilized.

Time To is insignificant to the encoder. Usually the projecting software makes a proposal under consideration of correlations to other bus parameters.
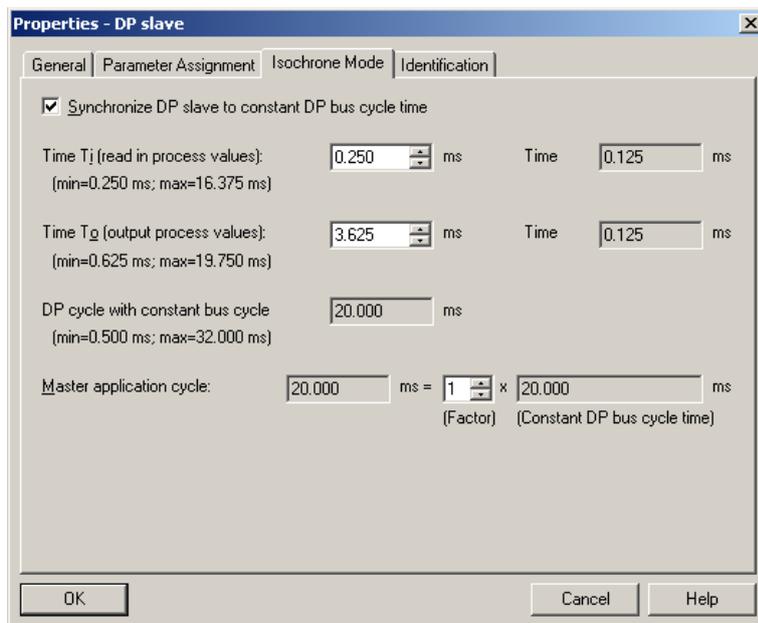
Also in the encoder hardware configuration, under „Properties - DP-Slave" – „PROFIBUS..." – „Properties" – „Network settings" – the "options" „Activate constant bus cycle time" and „Times Ti and To the same for all slaves" must be ticked, otherwise the control may not perform the clock-synchronous operation.
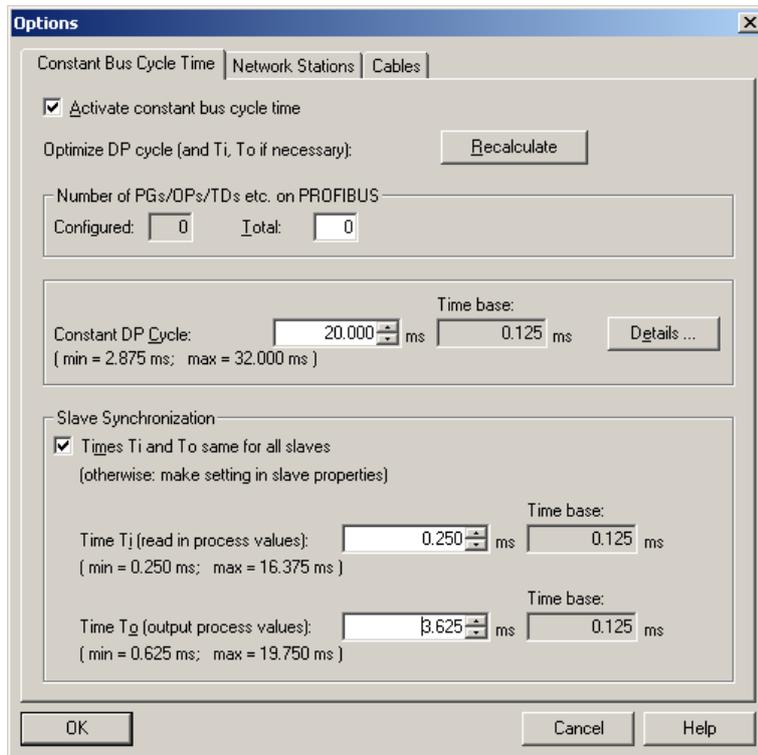
5.6. Implementing the system functions for alarm handling

Make sure that the system components necessary for alarm handling have been implemented in the project. With regard to Siemens Step7 projects there are in particular OB82 ("I/O Point Fault") and OB86 ("Loss Of Rack Fault"). Missing these components will result in a control STOP in case of alarm.

5.7. Compilation and load of hardware and software configuration

After the complete hardware project configuration and once entered all parameters the project has to be compiled and exported to the control.

6. Profibus operation

6.1. Master Class 1 (Parameterization master)

After encoder connection and start of master class 1 (parameterization master) PROFIBUS boots up automatically. Based on the inactive status „Wait Prm" (wait for parameterization) the encoder will go through the operating statuses "Parameterization" and "Configuration" until the final status "Data Exchange" where it usually remains.

6.2. Status indicator (multi-colour LED)

The back of the bus cover provides an integrated multi-colour LED indicating the encoder operating status. When the encoder is under power supply, always one the following operation statuses is indicated by the LED:

Colour	Status
LED yellow continuous	Encoder not active in the bus, not (yet) parameterized.
LED green continuous	Encoder in „Data_Exchange" mode. Active data exchange.
LED red continuous 2,5 s	Inadmissible position leap or the maximum electric speed is exceeded
LED red flashing slowly (1 Hz)	Parameterization error
LED red flashing fast (5 Hz)	Transmitted preset value beyond the admissible value range

At encoder power on the LED remains yellow continuous until the PROFIBUS master (PLC) has begun data communication with the slave (encoder). Usually this status is just an instant and nearly unnoticed since normally the encoder is immediately tracked by master. However, yellow continuous may remain in case of unsuccessful data communication, for example in case of an incorrect address or failure in the PROFIBUS cable.

After successful encoder configuration and parameterization (automated process) the encoder goes to „Data Exchange" starting cyclic data communication. A green LED now signalizes cyclic transmission of position data to the master.

Upon occurrence of a position leap („code consistency error") or speed exceeding approx. 6200 rpm the LED is red continuous for at least 2.5 s. If the indicated error remains or occurs repeatedly within this time, the red continuous period is correspondingly extended.

If the encoder is transmitted a preset value outside the limits the LED will change to red flashing fast (5 Hz). This status remains until the encoder receives an admissible preset value.

In case of inadmissible parameterization by master the LED is flashing red slowly (1 Hz) what may occur with incorrect parameter input in the projecting phase. Most of incorrect inputs are compensated by the GSD file, but it is impossible to eliminate every error.

6.3. Telegram 81 of profile PROFIdrive

In line with PROFIBUS DP-V2 profile the encoder applies for cyclic communication in clock-synchronous operation telegram81 of the PROFIdrive profile which means cyclic and clock-synchronous transmission of 12 bytes input data and 4 bytes output data.

Input data

There is a cyclic transmission of input data from encoder to control.

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ZSW2	Slave Sign-of-Life				0	0	0	0	0	0	0	0	0	0	0	0

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
G1_ZSW1	SE	PS	TA	PA	EA	0	0	0	0	0	0	0	0	0	0	0

	31															0
G1_XIST1	encoder position (left-aligned) with / less preset offset															

	31															0
G1_XIST2	Encoder position (right-aligned) or error message															

Bit SE: Sensor Error
If this bit is set, G1_XIST2 will come with an error code instead of the position value
Bit PS: Parking Sensor Active (Acknowledgement)
If this bit is set, the function „Parking Sensor" will be enabled (error output suppressed)
Bit TA: Transmit absolute value cyclically (Acknowledgement)
If this bit is set, there will be cyclic position transmission in G1_XIST2.
This always applies to the present encoder.
Bit PA: Preset Acknowledgement
When this bit is set, the preset setting operation at the encoder was successful. The bit mirrors the preset bit of the output data and is automatically taken back after reset.
Bit EA: Error Acknowledge Required
If this bit is set, an encoder error will have to be acknowledged. This is not general practice with the present encoder (bit ever 0)

Position data are transmitted by both input double words G1_XIST1 and G1_XIST2. G1_XIST1 comprises the left-aligned position value, e.g. bit 31 = 1 as maximum position value (corresponding to scaling). G1_XIST2 contains the right-aligned position value in the standard structure. G1_XIST2 further comprises an error code in case of error. The scaling operation always affects both double words. The effect of the preset on position value G1_XIST1 can be eliminated by parameterization („G1_XIST1 affected by Preset"). In this case G1_XIST1 and G1_XIST2 show different position values. G1_XIST2 is always affected by preset.

Output data

There is a cyclic transmission of output data to the encoder.

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
STW2	Master Sign-of-Life				0	0	0	0	0	0	0	0	0	0	0	0

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
G1_STW1	SEA	PS	TA	PR	REL	0	0	0	0	0	0	0	0	0	0	0

Bit SEA: Sensor Error Acknowledgement
If this bit is set, the error code in G1_XIST2 will be acknowledged what is not not necessarily required with the present encoder.
Bit PS: Parking Sensor Active (acknowledgement)
It this bit is set, the function „Parking Sensor" will be enabled (error output suppressed
Bit TA: Transmit absolute value cyclically (Acknowledgement)
If this bit is set, there will be a cyclic position transmission in G1_XIST2.
This ever applies to the present encoder, no matter if the bit is set or not.

Bit PR: Preset
If bit PR is set, the preset operation will be enabled. Once the Preset Acknowledge bit of the input data is set, bit PR should be reset.

Bit REL: Preset Relative
If this bit is set, the function Preset Relative will be enabled, e.g. the actual position is added the preset value as offset (negative values as complement on two). If this bit is not set, the preset operation will be absolute. In other words, the encoder position is set to the preset value.

6.4. Position readout

Position data are transmitted by telegram81 of the PROFIdrive profile as described above. Control access to the data should only be enabled during clock-synchronous alarm. Only then it is guaranteed that the encoder position is derived from the desired clock-synchronous bus cycle.

By principle, there could also be a direct control access to the parameterized I/O address using the peripheral input words. We strongly recommend to refrain from this in clock-synchronous operation, since in this case consistency and clock synchrony are not ensured.

6.5. Error signals in G1_XIST2

Bit 15 in G1_ZSW1 means that the value in G1_XIST2 is not a position value but an error code. Should several errors occur at the same time only the first one will be transmitted.

Value	Error	Significance
0x0001	Position error	Presently the encoder cannot provide a correct position
0x0F01	Unknown command	In G1_STW1 the master has transmitted a command which is unknown to the encoder
0x0F02	Sign-of-Life error (Master)	Number of admissible failures in the master-sign-of-life has been exceeded
0x0F04	Synchronisation error	Number of admissible failures in the bus cycle signal has been exceeded

6.6. Preset function

Preset default setting is 0. Preset alteration is enabled by acyclic parameter 65000. The value is saved volatile, i.e. it is lost at encoder power off. For non-volatile saving utilize parameter 971.

The actual preset operation is triggered by output word „G1_STW1" bit 12. A feedback after a successful operation is given by input word „G1_ZSW1", bit12. This bit remains until the control will reset the corresponding bit in the output word.

The preset value (volatile) must not be confused with the internal preset offset (non-volatile). The preset-offset is automatically saved in the non-volatile memory so that the encoder will be in the same position after power off and at power on.

The preset effect on position value G1_XIST1 can be compensated by parameterization („G1_XIST1 affected by Preset"). In this case G1_XIST1 and G1_XIST2 provide different position values. G1_XIST2 is always affected by preset.

Upon performing a preset operation an internal offset value is calculated and immediately saved non-volatile in EEPROM. EEPROM provides 1 million writing cycles, however, frequent software or event-triggered preset operations can exhaust the service life despite this high number of writing cycles. This should be considered in the control software layout.

Note:
At altering the encoder's total measuring range during re-parameterization the internal preset-offset-value will be cleared. This is insignificant for the application since in this case the relation to the position gets lost anyway. The preset value saved by parameter 971 will of course remain. It must be ensured however that the former preset value is within the new total measuring range, otherwise a new value has to be stored.

6.7. Alarms

Diagnosis alarms are triggered in line with acyclic services according to DPV1.
A diagnosis alarm is triggered upon the encoder having detected a probably incorrect position. The next position data telegram is added a high priority bit in the function code (bit 1) by the encoder what makes the control transmit a acyclic diagnosis alarm request. The encoder responds by an acyclic diagnosis telegram. "Data Unit" (DU) of this telegram provides the following structure: Octets 1 to 6 correspond to the diagnosis telegram of cyclic data exchange.

Data Unit:		Value	Significance
Octet 1	Station_status_1		Diverse bits, see PROFIBUS literature (e.g. Ext. Diagnose Bit)
Octet 2	Station_status_2		Diverse bits, see PROFIBUS literature (e.g. Stat. Diagnose Bit)
Octet 3	Station_status_3		External diagnosis overflow bit
Octet 4	Diag_Master_Add		Master address after parameterization (otherwise 0xFF)
Octet 5	Ident_Number		Ident number high byte
Octet 6	Ident_Number		Ident number low byte
Octet 7	Block Length	0x07	Following block length in bytes (including this one)
Octet 8	Alarmtyp	0x01	1 = Diagnostic alarm
Octet 9	Slot	0x01	Slot number
Octet 10	Alarm Spec	xx	Alarm Specifier (in / out) and sequence number (0..31)
Octet 11	Header	0x81	see DPV2 encoder profile
Octet 12	Channel	0x40	see DPV2 encoder profile
Octet 13	Type of Diagnosis	0x16	see DPV2 encoder profile / Alarm definition

The alarm is acknowledged by the control under reference to the running alarm sequence number.

The encoder will only consider value 22 (0x16) indicating a position error as „Type of Diagnosis / Alarm Definition).

A diagnosis alarm is triggered once with each inbound and outbound event. An outbound event alarm comprises an „Alarm Specifier" for „outbound event" together with a specific sequence number that is incremented towards the inbound event.

Siemens controls proceed diagnosis OB82 in case of alarm. If this is not implemented in the project the control will go to STOP in case of alarm.

Alarms resulting from a probably incorrect position can be signalized in three different ways:

- DPV1 Diagnosis alarm (as described)
- Error signal in G1_XIST2 (see under „Error signals in G1_XIST2")
- LED in the bus cover is red continuous for at least 2.5 s

6.8. Warnings

A diagnostic warning is triggered upon the encoder recognizing that specific internal tolerance limits have been achieved. Conversely to alarms a warning does not consequently mean a position error.
The process sequence of a diagnostic warning is fully identical to that of a diagnosis alarm described in the above. The difference is made in „Type of Diagnosis" defining several reasons for warning.

Type of diagnosis:
- 16 (0x10): "Frequency exceeded" (threshold signal when exceeding the maximum encoder speed)
- 17 (0x11): „Light Control" (threshold signal for being at the infrared LED regulating limit)
- 20 (0x14): "Battery Voltage Low" (threshold signal for low battery voltage)

6.9. Acyclic data communication according to DPV1

6.9.1. Overview

The parameterization master utilizes acyclic telegrams in line with PROFIBUS-DPV1 to read and if required to write addressed data in the DP slave by slot, index and parameter number. Prior condition is that the DP slave is in Data Exchange mode.
Acyclic data communication utilizes system functions DS_Read and DS_Write. DS_Write is appropriate for writing parameters („Change Parameter").
A parameter reading operation by DS_Read („Request Parameter") is always preceded by DS_Write supplying the slave with all necessary information on the requested parameter read access. Successful exit of DS_Write may take several bus cycles, afterwards DS_Read can be launched.

6.9.2. DS_Write

SIEMENS controls apply system function SFB53 / WRREC for DS_Write. Parameters to be delivered are among others index and ID (Slot), "Index=47" as encoder profile parameter, Index=255" for I&M parameters. The slot address is the "ID". For Slot1 it is the programmed E/A address of telegram 81, in the examples below 512 = 0x200. Slot0 is addressed via the diagnosis address of the DP-Slaves, in the examples below 4093 = 0xFFD.
An additional data block must be prepared for accommodating more parameters. The schematic structure of this data block is described in the following. Length depending on read/ write access and parameter length are between 10 and 16 bytes.

DS_WRITE

Called parameter	Value	Example
ID	Slot no.1 (E/A address telegram81) Slot no.0 (diagnisos address slave)	0x0200 0xFFD
Index	47 = 0x2F 255 = 0xFF	0x2F 0xFF
Length	Length of data to be exported out of the data block (write)	0x0A

Data block (write)

Byte	Significance	Explanation	Example
0	Request Reference	Selectable at will by master, mirrored in response	0xAA
1	Request ID	Request=1 Change=2	0x01
2	Shaft no.	0= whole slave	0x00
3	Number of parameters	Only one parameter: 1	0x01
4	Attribute	0x10=Value = 0x20=Description 0x30=Text	0x10
5	Number of parameter elements	Several elements (Sub-IDs) during read/write, counted from Sub-ID	0x04
6	Prm_no hi	High byte of parameter number, in the example 65000=$FDE8	0xFD
7	Prm_no lo	Low byte of parameter number	0xE8
8	Subindex hi		0x00
9	Subindex lo		0x02
Supplementary bytes 10...15 only with "Change Parameter":			
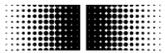
10	Format of the following parameter	0x40=Zero 41=Byte 42=Word 43=Dword 44=Error	0x43
11	Number of parameter values	Encoder: ever "1"	0x01
12	Value	with byte: Parameter with word: Parameter Hi Byte (MSB) with Dword: Parameter Byte 3 (MSB)	0x00
13	Value	with Word: Parameter Lo Byte (LSB) with Dword: Parameter Byte 2	0x01
14	Value	with Dword: Parameter Byte 1	0x00
15	Value	with Dword: Parameter Byte 0 (LSB)	0x00

6.9.3. DS_Read

Controls by SIEMENS apply system function SFB52 / RDREC for DS_Read. Index and ID (Slot) parameters correspond to those of DS_Write. Parameter MLEN corresponds to the size of the import data block. It may always remain the maximum amount (for example 64).

An additional data block of sufficient capacity must be provided to accommodate the imported data. A volume of 68 byte is sufficient for parameters implemented in the encoder. Its content according to DS_Read is described in the following.

DS_READ

Called parameter	Value	Example
ID	Slot no.1 (E/A address telegram81) Slot no.0 (diagnosis address slave)	0x0200 0xFFD
Index	47 = 0x2F 255 = 0xFF	0x2F 0xFF
Length	Maximum length of data to be transmitted that can be imported in data block	0x40

Data block (read)

Byte	Significance	Explanation	Example
0	Request Reference	Mirrored value out of DS_Write	0xAA
1	Response ID	0x01 = Request parameter (success) 0x02 = Change parameter(success) 0x81 = Request parameter(error) 0x82 = Change parameter(error)	0x01
2	Shaft no.	always 0= whole slave	0x00
3	Number of parameters	Only one parameter: 1	0x01
4	Format	0x01 = Boolean 0x02 = Integer8 0x03 = Integer16 0x04 = Integer32 0x05 = Unsigned8 0x06 = Unsigned16 0x07 = Unsigned32 0x08 = FloatingPoint 0x09 = VisibleString 0x10 = OctetString	0x10
5	Number of values		0xnn
6	Value 1		
7	Value 2		
8	Value 3		
9	Value n		

The following acyclic functional parameters of the PROFIdrive profile V3.3 (parameter numbers 9xx) respectively of DPV2 encoder profile V3.2 (65xxx) are supported by GXMMW:

Parameter 918   (read only)   Profibus node ID (BCD switches)
Parameter 922   (read only)   Telegram type (=81)
Parameter 964   (read only)   Device identification
Parameter 965   (read only)   Profile number (3.2)
Parameter 971   (read/write)   Transfer to non-volatile memory
Parameter 979   (read only)   Sensor format
Parameter 65000   (read/write)   Preset value

All parameters are accessed by Slot 1 (indicate E/A address under „ID" in Step7), index 47 and subindex 0. Additional access to block 0 of I&M functions (Identification and Maintenance) via index 255, Slot 0 or 1, parameter 65000.

6.9.4.   PROFIdrive parameter 918 PROFIBUS node ID

Readout of the PROFIBUS node ID (BCD switch). Example node ID: 55 (0x37)

DS_WRITE

DP-V1 Header

Called parameter	Value	Example
Function ID	Permanent for DS_Write	0x5F
ID	Slot no.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Length	10 = 0x0A	0x0A

Data Unit - (write):

Byte #		Example
0	Request Reference (Example)	0xAA
1	Request ID=0x01 Change ID=0x02	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Attribute = "Value"	0x10
5	Number of parameter elements	0x01
6	Prm_no hi: 918 = 0x**03**96	0x03
7	Prm_no lo: 918 = 0x03**96**	0x96
8	Subindex hi	0x00
9	Subindex lo	0x00

DS_READ

DP-V1 Header

Called parameter	Value	
Function ID	Permanent for DS_Read	0x5E
ID	Slot no.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Max.length	64 = 0x40	0x40

Data Unit - (read):

Byte #		Example
0	Request Reference: mirrored	0xAA
1	Request ID (not: Change)	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Format: Unsigned16	0x06
5	Number of values	0x01
6	Value (hi): ever 0	0x00
7	Value (lo): Node address	0x37

6.9.5. PROFIdrive parameter 922 telegram type

Readout of the telegram type. The DPV2 encoder applies always telegram 81 (0x51).

DS_WRITE

DP-V1 Header

Called parameter	Value	Example
Function ID	Permanent for DS_Write	0x5F
ID	Slot no.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Length	10 = 0x0A	0x0A

Data Unit - (write):

Byte #		Example
0	Request Reference (example)	0xAA
1	Request ID=0x01 Change ID=0x02	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Attribute = "Value"	0x10
5	Number of parameter elements	0x01
6	Prm_no hi: 922 = 0x**03**9A	0x03
7	Prm_no lo: 922 = 0x03**9A**	0x9A
8	Subindex hi	0x00
9	Subindex lo	0x00

DS_READ

DP-V1 Header

Called parameter	Value	
Function ID	Permanent for DS_Read	0x5E
ID	Slot No.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Max.Length	64 = 0x40	0x40

Data Unit - (read):

Byte #		Example
0	Request Reference: mirrored	0xAA
1	Request ID (not: Change)	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Format: Unsigned16	0x06
5	Number of values	0x01
6	Value (hi): ever 0	0x00
7	Value (lo): telegram no.	0x51

6.9.6. PROFIdrive parameter 964 device ID

Readout of the device ID (device identification data). This data block provides information on manufacturer, device name, firmware version and firmware date. This information can be called up individually utilizing the sub indexes.

DS_WRITE

DP-V1 Header

Called parameter	Value	Example
Function ID	Permanent for DS_Write	0x5F
ID	Slot no.1 (E/A address/telegram81)	0x0200
Index	47 = 0x2F	0x2F
Length	10 = 0x0A	0x0A

Data Unit - (write):

Byte #		Example
0	Request Reference (Example)	0xAA
1	Request ID=0x01 Change ID=0x02	0x01
2	Achse Nr. (0=whole device)	0x00
3	Number of parameters	0x01
4	Attribute = "Value"	0x10
5	Number of parameter elements	0x01
6	Prm_no hi: 964 = 0x**03**C4	0x03
7	Prm_no lo: 964 = 0x03**C4**	0xC4
8	Subindex hi	0x00
9	Subindex lo	0x00

DS_READ

DP-V1 Header

Called parameter	Value	
Function ID	Permanent for DS_Read	0x5E
ID	Slot no.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Max.Length	64 = 0x40	0x40

Data Unit - (read):

Byte #		Example
0	Request Reference: mirrored	0xAA
1	Request ID (not: Change)	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Format: Array of U16	0x06
5	Number of values	0x05
6	Manufacturer ID Baumer=012A	0x01
7	(LSB)	0x2A
8	Device Type (Manufacturer specific)	0x00
9	(LSB)	0x00
10	Firmware Version e.g. V1.00	0x10
11	(LSB)	0x00
12	Firmware date (year), e.g. 2007	0x07
13	(LSB)	0xD7
14	Firmware date (day) , e.g. 17	0x11
15	Firmware date (month), e.g. 09	0x09

6.9.7. PROFIdrive parameter 965 profile number

Readout of the profile number. The encoder relates to the DPV2 encoder profile (PNO Order Nr 3.162), version V3.2 of December 2004. For this reason the value replied is ever 0x03, 0x02.

DS_WRITE

DP-V1 Header

Called up parameter	Value	Example
Function ID	Permanent for DS_Write	0x5F
ID	Slot no.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Length	8 = 0x08	0x08

Data Unit - (write):

Byte #		Example
0	Request Reference (example)	0xAA
1	Request ID=0x01 Change ID=0x02	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Attribute = "Value"	0x10
5	Number of parameter elements	0x01
6	Prm_no hi: 965 = 0x**03**C5	0x03
7	Prm_no lo: 965 = 0x03**C5**	0xC5

DS_READ

DP-V1 Header

Called parameter	Value	
Function ID	Permanent for DS_Read	0x5E
ID	Slot no.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Max.Length	64 = 0x40	0x40

Data Unit - (read):

Byte #		Example
0	Request Reference: mirrored	0xAA
1	Request ID	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Format: Unsigned16	0x06
5	Number of values	0x01
6	Profile number (hi)	0x03
7	Profile number (lo)	0x02

6.9.8. PROFIdrive parameter 971 transfer to non-volatile memory

By calling this parameter all volatile parameter are stored into the encoder's non-volatile memory. At the present DPV2 encoder this procedure relates only to the preset value (profile parameter 65000). The saving operation is performed in DS_WRITE.

DS_WRITE

DP-V1 Header

Called parameter	Value	Example
Function ID	Permanent for DS_Write	0x5F
ID	Slot no.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Length	10 = 0x0A	0x0A

Data Unit - (write):

Byte #		Example
0	Request Reference (example)	0xAA
1	Request ID=0x01 Change ID=0x02	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Attribute = "Value"	0x10
5	Number of parameter elements	0x01
6	Prm_no hi: 971 = 0x**03**CB	0x03
7	Prm_no lo: 971 = 0x03**CB**	0xCB
8	Subindex hi	0x00
9	Subindex lo	0x00
10	Format Word	0x06
11	Number of values	0x01
12	Save command (MSB)	0x00
13	Save command (LSB)	0x01

DS_READ

DP-V1 Header

Called parameter	Value	
Function ID	Permanent for DS_Read	0x5E
ID	Slot no.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Max.Length	64 = 0x40	0x40

Data Unit - (read):

Byte #		Example
0	Request Reference: mirrored	0xAA
1	Request ID (not: Change)	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Format: Unsigned16	0x06
5	Number of values	0x01
6	Value (hi): ever 0	0x00
7	Value (lo): ever 0	0x00

6.9.9. PROFIdrive parameter 979 sensor format

Readout of data block „Sensor Format". The data block informs on sensor parameters as sensor type, programmed singleturn resolution, shift factor for G1_XIST1 and G1_XIST2 as well as the number of possible turns (multiturn encoders). This information can also be called up individually utilizing the sub indexes.
The example shows how to call all elements of an encoder with a parameterized resolution of 8192 steps/revolution, revolution counter 65536 revs. (in this case 0xFFFF). Left-aligned display in G1_XIST1 by shift factor =3.
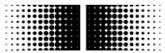
DS_WRITE

DP-V1 Header

Called parameter	Value	Example
Function ID	Permanent for DS_Write	0x5F
ID	Slot no.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Length	10 = 0x0A	0x0A

Data Unit - (write):

Byte #		Example
0	Request Reference (example)	0xAA
1	Request ID=0x01 Change ID=0x02	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Attribute = "Value"	0x10
5	Number of parameter elements	0x06
6	Prm_no hi: 979 = 0x**03**D3	0x03
7	Prm_no lo: 979 = 0x03**D3**	0xD3
8	Subindex hi	0x00
9	Subindex lo	0x00

DS_READ

DP-V1 Header

Called parameter	Value	
Function ID	Permanent for DS_Read	0x5E
ID	Slot no.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Max.Length	64 = 0x40	0x40

Data Unit - (read):

Byte #		Example
0	Request Reference: mirrored	0xAA
1	Request ID (not: Change)	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Format: Array of U32	0x07
5	Number of values	0x06
6	Header Prm.979 lt. Profidrive Profile	0x00
7		0x00
8		0x51
9		0x11
10	Sensor Type lt. Profidrive Profile (fix)	0x80
11		0x00
12		0x00
13		0x02
14	param. steps per revolution (MSB)	0x00
15		0x00
16		0x20
17	(LSB)	0x00
18	shift factor" for G1_XIST1 (MSB)	0x00
19		0x00
20		0x00
21	(LSB)	0x03
22	shift factor" for G1_XIST2 (MSB)	0x00
23		0x00
24		0x00
25	(LSB)	0x00
26	number of revolutions (MSB)	0x00
27		0x00
28		0xFF
29	(LSB)	0xFF
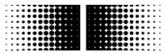
6.9.10. Profile parameter 65000 preset value

This parameter is to read or write the preset value the encoder is set to upon having accomplished the preset command using output data word G1_STW1, bit „PR". The preset value is not automatically saved (see parameter 971 to save).

Note:
It goes without saying that the absolute encoder position will remain also during power off and at power on, even if the encoder received a preset command before.

DS_WRITE

DP-V1 Header

Called parameter	Value	Example
Function ID	fix für DS_Write	0x5F
ID	Slot-Nr.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Length	8= 0x08	0x08

Data Unit - (write):

Byte #		Example
0	Request reference (example)	0xAA
1	Request ID=0x01 Change ID=0x02	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Attribute = "Value"	0x10
5	Number of parameter elements	0x01
6	Prm_no hi: 65000 = 0x**FD**E8	0xFD
7	Prm_no lo: 65000 = 0xFD**E8**	0xE8

DS_READ

DP-V1 Header

Called parameter	Value	
Function ID	Permanent for DS_Read	0x5E
ID	Slot no.1 (E/A address telegram81)	0x0200
Index	47 = 0x2F	0x2F
Max.Length	64 = 0x40	0x40

Data Unit - (read):

Byte #		Example
0	Request reference: mirrored	0xAA
1	Request ID=0x01 Change ID=0x02	0x01
2	Shaft no. (0=whole device)	0x00
3	Number of parameters	0x01
4	Format: Unsigned32	0x07
5	Number of values	0x01
6	Preset value (hi byte)	0xXX
7	Preset value	0xXX
8	Preset value	0xXX
9	Preset value (lo byte)	0xXX

6.9.11. I&M parameter 65000 block 0

I&M is a concept for uniform identification of field devices and is neither manufacturer nor industry-specific. For this purpose, the field device provides particular information on an electronic product label.

Readout of block 0 of I&M functions (I&M0) is in line with PROFIBUS Identification & Maintenance Guideline 3502 and DPV2 encoder profile 3162. Data blocks I&M1 to I&M4 are not implemented.

I&M functions are accessed by Slot 0 or Slot 1 and index 255. Access to block I&M0 is by parameter number 65000 (0xFDE8).

Slot 0 of SIEMENS controls is addressed by the diagnosis address of the DP slave, in the example below 4093 (0x0FFD).

DS_WRITE

DP-V1 Header

Called parameter	Value	Example
Function ID	Permanent for DS_Write	0x5F
ID	Slot 0 (diagnosis address DP-Slave)	0x0FFD
Index	255 = 0xFF	0xFF
User data length	4 = 0x04	0x04

Data Unit - Call Header (read):

		Example
EXTENDED_ FUNCTION_NUM	0x08 permanent for CALL	0x08
reserved	ever 0x00	0x00
IM_INDEX (hi)	65000 = 0x**FD**E8	0xFD
IM_INDEX (lo)	65000 = 0xFD**E8**	0xE8

DS_READ

DP-V1 Header

Called parameter	Value	Example
Function ID	Permanent for DS_Read	0x5E
ID	Slot 0 (Diagnose-Adresse DP-Slave)	0x0FFD
Index	255 = 0xFF	0xFF
Usere data length	68 = 0x44 max.	0x40

Data Unit - Call Header (read):

		Example
EXTENDED_ FUNCTION_NUM	0x08 permanent for CALL	0x08
reserved	ever 0x00	0x00
IM_INDEX (hi)	65000 = 0x**FD**E8	0xFD
IM_INDEX (lo)	65000 = 0xFD**E8**	0xE8

Data Unit - Body (read):

Byte #			Example
0...9	Header		0x00
10	I&M Block	MANUFACTURER_ID	0x01
11		MANUFACTURER_ID	0x2A
12...31		ORDER_ID (20)	0x20
32...47		SERIAL_NUMBER (16)	0x20
48		HARDWARE_REVISION	0x00
49		HARDWARE_REVISION	0x00
50		SOFTWARE_REVISION (*4)	0x56 = 'V'
51		SOFTWARE_REVISION	0x31 = '1'
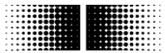
52		SOFTWARE_REVISION	0x30 = '0'
53		SOFTWARE_REVISION	0x30 = '0'
54		REVISION_COUNTER	0x00
55		REVISION_COUNTER	0x00
56		PROFILE_ID (*2)	0x3D
57		PROFILE_ID	0x00
58		PROFILE_SPECIFIC_TYPE	0x00
59		PROFILE_SPECIFIC_TYPE	(*1)
60		IM_VERSION	0x01
61		IM_VERSION	0x01
62		IM_SUPPORTED	0x00
63		IM_SUPPORTED	0x01

(*1)   0x00 for singleturn encoders; 0x01 for multiturn encoders
(*2)   0x3D00 permanent for DPV2 encoder profile
(*3)   0x012A manufacturer ID of Baumer Germany GmbH & Co. KG
(*4)   'V'(ersion,official),'R'(evision),'P'(rototype),'U'(nder Field Test) or 'T'(est Device)

7. System documentation: Profibus-DP

7.1. General information

PROFIBUS is a manufacturer-unspecific open communication system for applications in the fields of production, process and building automation. It is broken down into three variants:
- PROFIBUS FMS for data communication between control units on the production and process management level.
- PROFIBUS PA for process engineering applications.
- PROFIBUS DP for fast data exchange between control units and decentralized peripherals in process automation.

PROFIBUS-DP is characterized by the following properties:
- Short response times (1 ms with 32 users and 12 MBaud)
- Reliable transmission procedure (Hamming distance 4)
- Availability of a wide range of standardized system components
- Good diagnostic capability
- Simple handling and facility for upgrading
- User-oriented bus system
- Open system

PROFIBUS-DP ist standardized by EN 50170 Vol. 2 defining communication and user profiles. To clock-synchronous encoders applies „Profile for DP-V2 Encoders Version 3.2, Order No: 3.162" in the respective actual amendment.

The profile differs by the number of supported functions according to device class 3 and 4. Device class 4 comprises functional extensions and all functions of class 3. Parameterization and preset functions are only supported by class 4. The product supports classes 3 and 4.

7.2. GSD file

The device master data file (GSD file) describes all encoder data required for operation. Format and content are defined by standard EN 50170.
The GSD file provides ident number 09F6 for all encoders described. The GSD file is an essential configuration tool for encoder parameterization and configuration.

The GSD file provides two kinds of information:

- General information such as manufacturer's name, product designation, ident number, PROFIBUS - specific parameters and Baud rates.
- Application-relevant information such as configuration options, parameters, parameter descriptions, hardware and software status and diagnostic possibilities.

7.3. Encoder operating parameters

Description of operating parameters

Parameter	Significance
Sense of rotation	Behaviour of the output code relating to the shaft's sense of rotation when looking at the flange. CW („clockwise") = ascending values with clockwise rotation CCW („counter-clockwise") = ascending values with counter-clockwise rotation
Resolution („Measuring units per revolution")	Number of steps per revolution, input in integral steps
Measuring range („Total Measuring Range")	Total resolution = number of steps per revolution x number of revolutions, input in integral steps
Steps	The actual encoder position is assigned to a certain position value (referencing)

Operating parameter values

Parameter	Value range	Default setting	Data type
Sense of rotation	CW/CCW	CW	Byte
Resolution	1 to 4096 – magtivo 1 to 8192 – multivo 1 to 262144 – multivoPlus	4096 8192 262144	Unsigned 32
Measuring range	1 to 67108864 (2^{26}) – magtivo 1 to 536870912 (2^{29}) – multivo 1 to 2147483648 (2^{31}) – multivoPlus	67108864 536870912 2147483648	Unsigned 32
Peset value	0 to (measuring range - 1 step)	0	Unsigned 32

7.4. Data exchange between PROFIBUS-DP devices

Initializing, restart and user data communication
Prior to any user data exchange between master and slave every slave is re-initialized. The master transmits parameterization and configuration data to the slave. Only if the parameterization and configuration data coincide with the data stored in the slave the user data exchange will be proceeded as follows:

Diagnostic request by master
The master transmits a Slave Diagnose Request (Slave_Diag), the slave responds by a Slave Diagnose Response.
This way, the master verifies whether the slave exists in the bus and is ready for parameterization and configuration.

Slave parameterization
The master transmits a Slave Parameter Request (Set_Prm).
By the parameterization data the slave is informed about actual bus parameters, monitoring times and slave-specific parameters. During the projecting process the parameters are directly or indirectly adopted by the GSD file. The slave compares these parameterization data with its own stored data.

Slave configuration
The master transmits a Check Configuration Request (Chk_Cfg).
The master informs the slave about volume (number of data bytes) and structure (data consistency) of the input and output ranges to be exchanged. The slave compares this configuration with its own configuration.

Diagnosis request prior to data exchange
The master transmits another Slave Diagnose Request (Slave_Diag), the slave responds by a Slave Diagnose Response.
The master now verifies if parameterization and configuration coincide with the data stored in the slave. If the data requested by master is admissible and correct the slave signalizes its readiness for user data transfer via the diagnostic data.

Data_Exchange
The slave now will react exclusively to the master it was parameterized and configured by.
The master transmits a user data request (Data_Exchange), the slave responds by a user data response informing the master about any current diagnostic events. The slave provides the true diagnosis and status information only after the master's diagnosis telegram.

7.5. Parameterization and configuration

7.5.1. Parameterization

By parameterization the control provides the slave with information required for process data exchange. The information comprises PROFIBUS –specific data (octet 1 to 6) and user-specific information as for example the required measuring resolution. User-specific information can be altered any time during the projecting phase using an input window.

The slave verifies the data transmitted by master with its own stored data upon admissibility. The slave will not inform the master of the result until a diagnosis request after configuration.

7.5.2. Configuration

Configuration defines the scope of cyclic process data communication in both directions. The slave compares the target configuration with its own stored one and informs the master about the result in a subsequent diagnosis request.

From the master's point of view, encoder position values are input data and data transmitted to the encoder are output data.

The present clock-synchronous encoder applies telegram 81 of the PROFIdrive profile. This telegram comprises two words output data and 6 words input data.

7.6. Diagnostic signals

Clock-synchronous encoders utilize alarms in line with PROFIBUS DP-V1 replacing device-specific diagnostic signals as per DP-V0. There is no distinction between alarms and warnings.

Diagnostic data comprise the standard diagnosis (bytes 1 to 6) and, in case several alarms must be transmitted, both the length of the diagnosis extension and the channel-specific diagnosis (3 bytes each) of each alarm to enable a clear alarm specification.

7.6.1. Description of the diagnostic data block

Byte no.	Diagnostic data	Significance
1	Station status 1	Status of • parameterization • configuration • diagnostic data (diag.ext. bit and d diag.stat. bit at alarms and warnings)
2	Station status 2	Status of • Response monitoring • Freeze or Sync mode
3	Station status 3	Not supported
4	Diagnostic_Master_Address	Address of master that proceeded the initial slave parameterization. 0xFF before successful parameterization
5	Ident number high byte	0x09 (device ident number 0x09F6)
6	Ident number low byte	0xF6 (device ident number 0x09F6)
7	Extended diagnosis: length	Length of the extended encoder diagnosis including this diagnosis header byte
8	Alarm type	Channel-specific diagnosis – byte 1 0x01: diagnosis alarm 0x02: process alarm
9	Slot no.	Channel-specific diagnosis – byte 2

10	Alarm specifier	Channel-specific diagnosis Diagnose – byte 3
		• Sequence number of the higher six bytes bit
		• Alarm specifier in lower two bits
		   - 01: alarm inbound, slot error
		   - 10: alarm outbound, slot ok again
		   - 11: alarm outbound, more slot errors

7.6.2. Alarms

The following alarms are supported:

Position error alarm
The encoder has recognized a probably incorrect actual position value. The last two consecutive position values are continuously compared to each other. If the value exceeds a certain number, the last position value is implausible.
This alarm is also triggered upon exceeding the electrical admissible maximum speed of 6000 rpm or in case of an inadmissible (too high) preset value. The alarm will disappear automatically without acknowledgement after 2.5 s. If another event occurs during this time, the period is automatically extended by 2.5 s.
In case of an inadmissible preset value the alarm remains until the master has transmitted the correct value.
Code consistency errors and inadmissible preset values are also visualized by the LED in the bus cover.

Warning lithium cell voltage (only with multiturn encoders)
The alarm is triggered if the lithium cell voltage drops below the prescribed value.

If the encoder is not powered by external supply, the internal lithium cell will supply the operating voltage for the circuitry responsible for counting the number of revolutions.
After the first warning the encoder will still operate reliably for some weeks more. If the time of the first alarm occurrence is not known or the encoder has not been operated for several weeks, the encoder must be withdrawn from service immediately or permanently powered by an external voltage supply.

8. Troubleshooting – FAQ

8.1. FAQ: Projecting

8.1.1. Where do I get an encoder manual?

If included in the order, the manual will come as pdf-file on data carrier (disc or CD). The manual is also available as download under www.baumerivo.com. Opening the file requires „Adobe Reader" ® that is available free-of-charge. Make sure that it is the appropriate manual for your encoder using the table at the beginning of the manual. You will find the encoder type on the product label (for example GXMMW or GCAMW).

Should your encoder not be on the list please contact Baumer Germany.

8.1.2. Where do I get the appropriate GSD file?

If included in the order, the GSD file required for projecting is attached to the encoder on data carrier (disc or CD). The GSD file is also available as download in the Internet under www.baumerivo.com.
The GSD file suitable for your encoder can be seen in the table at the beginning of the manual. You will find the encoder type on the product label (for example GXMMW or GCAMW).

Should your encoder not be on the list please contact Baumer Germany.

8.1.3. Class3 or Class4 parameterization?

The only difference between Class 4 and Class 3 is that setting a preset is disabled in Class 3.

We therefore recommend to utilize Class3 only in specialized applications where a preset is not required.

8.1.4. Input of 32bit parameter data in Siemens Step7 software

Some projecting software for PROFIBUS master, also Step7® by SIEMENS, do not support direct input of 32bit parameters.

For this reason the parameters have to be split up in two of 16bit each prior to the input operation for later entry in the fields marked "hi" and "lo" in the parameterization window.

The 32bit parameter of maximum 65535 (16 bit) is just entered = 0 in field „hi". The parameter itself is entered decimally directly in field „lo".

Parameters greater than 65535 must be split up first and converted according to the scheme below. Use a calculator featuring a hexadecimal calculating function as provided for example in „Windows accessory tools".

Proceed as follows:
- Convert the numeric value from decimal into hexadecimal format using the calculator.
- Split the hexadecimal value in two blocks „hi" and „lo", by counting 4 digits from the right (numerals/letters). This is block "lo". The remaining digits at left (max. four, numerals or letters) form block „hi".
- Take each block separately and convert it from hexadecimal to decimal format.
- Both values can now be entered in the parameterization window.

Example:

Vvalue	= dec. 500.000.000
Converted in hexadecimal format	= hex. 1DCD6500
Split in block "lo" (4 digits from the right)	= hex. 6500
Split in block "hi" (4 digits at left)	= hex. 1DCD
Converted into decimal format block "lo"	= dec. 25.856
Converted into decimal format block "hi"	= dec. 7.629

8.2. FAQ: Operation

8.2.1. Position readout

In line with PROFIBUS DP-V2-encoder-profile, the encoder applies telegram 81 of the ROFIdrive profile (see 6.3.) for cyclic communication in clock-synchronous operation with cyclic and clock-synchronous transmission of 12 bytes input data and 4 bytes output data.

Conversely to DP-V0, access to input and output data is only enabled by implementing a clock-synchronous alarm in the project. Only the alarm can access the E/A section of the clock-synchronous slave. Siemens controls utilize functions SFC126 and 127 in clock-synchronous OBs (OB6x) to update the partial process images.

Afterwards input and output data are accessed as usual.

Direct access by peripheral input and output words is not possible.

8.2.2. How to set and save a preset value?

In line with PROFIBUS DP-V2-encoder-profile, the encoder applies telegram 81 of the ROFIdrive profile (see 6.3.) for cyclic communication in clock-synchronous operation with cyclic and clock-synchronous transmission of 12 bytes input data and 4 bytes output data.

Defining a preset position value and performing a preset operation are two separate procedures. The actual stored value enables acyclic readout and alteration using parameter 65000 of the encoder profile. Default setting is 0. The preset parameter is saved non-volatile using parameter 971 (see 6.9.8.).

The preset operation is enabled by setting bit PR of output word G1_STW1 to „1".
If the operation was successful, the Preset Acknowledge bit of input dataword G1_ZSW1 is also set to „1".Bit PR now should be reset.

For maximum alignment of mechanical position and preset value the preset should only be set with idle encoder shaft. Inferior requirements however also enable the setting operation with running shaft.

With „Class3" parameterization the preset function is disabled.

A preset operation has always to be performed <u>after</u> having programmed the required resolution or direction of rotation (cw/ccw).

8.2.3. What is the LED in the bus cover for?

The bus cover provides at rear an integrated multi-colour LED indicating the encoder operating status. In particular upon commissioning and in case of error it is providing first information on the system status. For the respective status description refer to 6.2.

8.2.4.   How to alter the resolution ?

The encoder resolution in steps per revolution („Measuring units per revolution") is programmed during projecting by parameterization of the PROFIBUS slave in the PROFIBUS project.

Normally this is performed by the control's projecting software (for example Siemens Step7) using a PC.

The encoder resolution is programmable in individual steps between the maximum limit (encoder-specific, for example 8192 at GXMMW) and the minimum limit of 1 step/revolution.

Important: The encoder's total measuring range (units, "hi/lo") must be adapted to the programmed resolution. If not, this will result in parameterization errors indicated by the LED in the bus cover flashing red. The maximum total measuring range is calculated by multiplying the resolution (steps per revolution) by the maximum number of revolutions the encoder is capable of.

8.2.5.   How to read diagnostic data out of the control?

There is no device-specific diagnosis for DPV2 encoders as known by DPV0 encoders. Diagnostic operations are performed in line with the DPV2 encoder profile as module-relevant diagnosis according to alarm model DPV1.

8.3.   FAQ: Troubleshooting

8.3.1.   No encoder communication (LED yellow continuous)

The encoder connected is not recognized in the bus. No configuration nor parameterization, the LED is yellow continuous.

This phenomenon may be due to the following reasons:
- PROFIBUS not connected or broken wire.

- PROFIBUS is connected but lines A and B were confused. Original PROFIBUS cable provides green for line A and red for line B.

- The PROFIBUS node ID set by BCD switch in the bus cover does not coincide with the PROFIBUS system parameterization. Please verify upon coincidence. Encoder default setting upon delivery is 00. Node IDs 00, 01 and 02 are often reserved to masters and not common for slaves. Mind the orientation of the tens digit (left) and units digit (right) when zero is on top the BCD switches.

- Incorrect encoder implementation in the PROFIBUS project, now the control does not know it exists.

- Correct encoder implementation in the PROFIBUS project, but accidentally the compiled project has not yet been transmitted to the control.

- Bus termination incorrect. If the encoder is the final device in the bus it has to be terminated by resistor. Terminating resistors are integrated in the bus cover and connected by two-pole DIP switch. Do not utilize so-called PROFIBUS D-SUB connectors for bus termination. Due to missing bus reference voltage it is only a passive termination that rather would disturb the bus.
  In particular baud rates of 6 and 12 MHZ call for proper bus termination. Stub and branched lines are generally not allowed.

- Should the above troubleshooting be unsuccessful, try to connect the encoder by the other two bus terminals A and B. Try also another node ID at the BCD switches, for example 22, 44 or 88 to exclude any additional problem.

8.3.2.   No encoder communication (LED flashing red once per second)

Incorrect encoder parameterization, i.e. one of the programmed values is outside the limits.
Typically, during re-parameterization of the encoder resolution (steps per revolution, measuring units per
revolution") the encoder's total measuring range was not adapted correspondingly.

Singleturn encoders
The total measuring range of a singleturn encoder comprises exactly one complete or partial revolution,
reason why the value in parameter "total measuring range" must always be the same as in parameter
"measuring units per revolution".

Multiturn encoders
Multiturn encoders are capable of sensing max. 65536 revolutions (multivoPlus even 8192 revolutions).
Maximum admissible value for the total measuring range is the result of "steps per revolution" multiplied by
the encoder's maximum number of revolutions (65536 respectively 8192). Once this value is exceeded in the
parameterization this will result in an error signal (flashing LED) together with a "parameterization alarm" in
the diagnostic data.

Any other, inferior value may be programmed as total measuring range. All encoders with PROFIBUS bus
covers provide integrated endless operation ensuring admissible values for all resolutions and total
measuring ranges even during overrun.

Integer relations of singleturn resolution and total measuring range are not mandatory, as sometimes required
by other manufacturers.

Example:
The standard multiturn encoder GXMMW provides a 13 bit (8192 steps per revolution) singleturn
resolution and is capable of sensing 65536 completed revolutions.

Consequently the total measuring range is 8.192 x 65.536 = 536.870.912 steps.

The singleturn resolution is reduced to 3600 steps / revolution.
Total measuring range now only 3.600 x 65.536 = 235.929.600 steps.

If the total measuring range was not correspondingly adapted to this new maximum value, the encoder
would have to count 149.130 completed turns. That is impossible, and as a result there will be an error
signal (flashing LED) and a „parameterization error" in the diagnostic data.