

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 |
| GXMLW | 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®

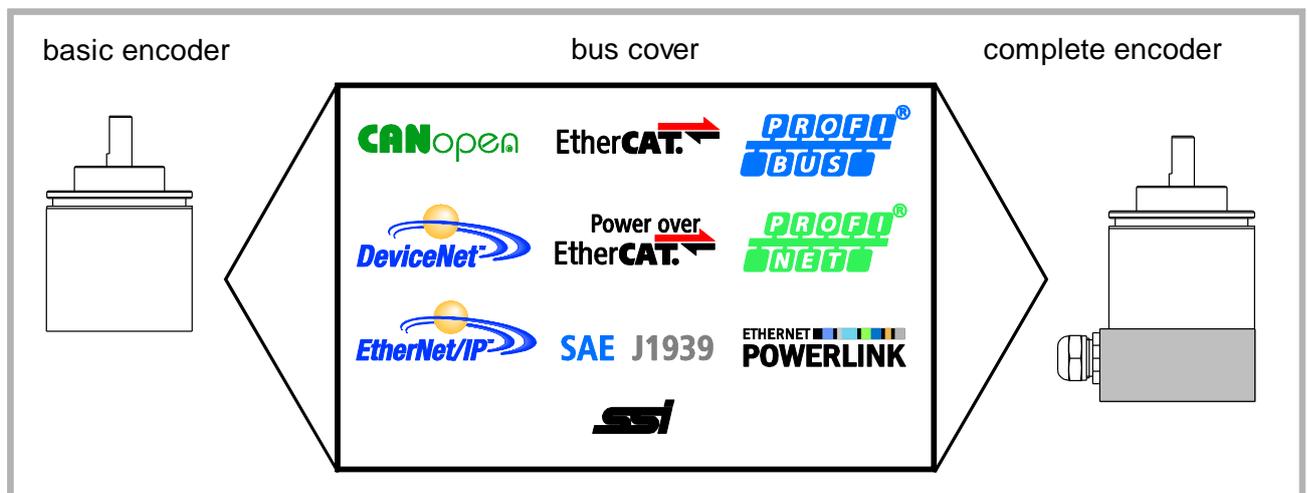
Utilizes a photoelectric sensing principle with integrated analog/digital signal conversion and is the product to choose for ultra-precise sensing applications.

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 |

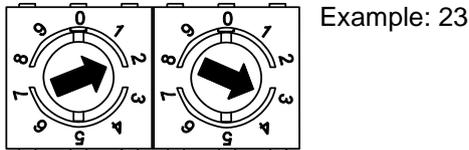
Transmission speed depending on line distance

| 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).



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.

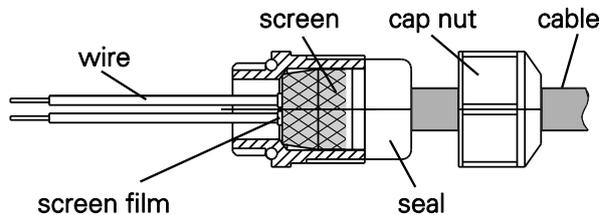
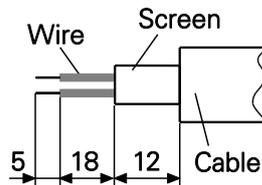


both ON = final user
both OFF = all other users

| 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

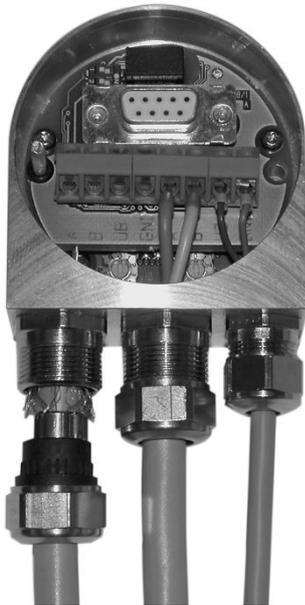
- Release the cap nut of the cable gland
- Push the cap nut and seal insert with contact sleeve onto the cable sheath.
- Strip the cable sheath and cores, shorten the shield film where it exists (see fig.)
- Bend over the braided shield by approx. 90°.
- Push the sealing insert with contact sleeve along 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.



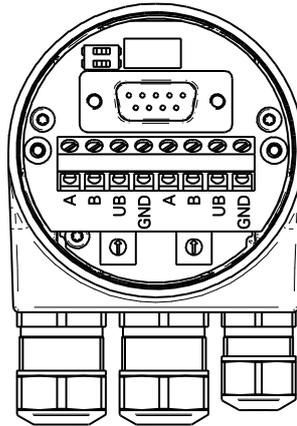
Take care that by no means the voltage supply is assigned to bus terminals A/B, this could damage electronics components in the bus cover.

- 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.

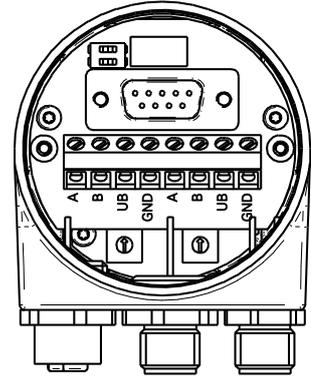
- Seal up the unused cable gland using a sealing bolt (included in the delivery).



1 2 3



Cable gland



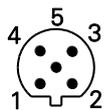
M12 connector

Terminal assignment

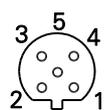
| M12 connector | Clamp: | Significance |
|--------------------|--------|---------------------------------|
| M12, 4 pins: Pin 1 | UB | Supply voltage 10...30 VDC |
| M12, 4 pins: Pin 3 | GND | Ground connection related to UB |
| M12, 5 pins: Pin 2 | A | Negative serial data line |
| M12, 5 pins: Pin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

M12 connector

for serial data lines

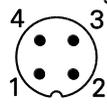


male



female

for voltage supply



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.

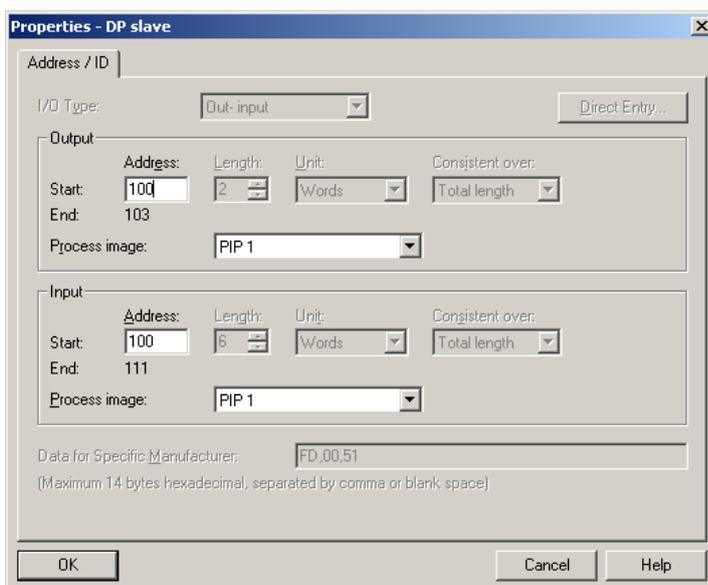
Use the mouse again to drag encoder module „telegram 81“ from the right out of the hardware catalogue to plug-in position 1 of the module window at left below in the hardware window. Do not utilize the universal module, this is not considered.

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).



Properties - DP slave

Address / ID

I/O Type:

Output

| Address: | Length: | Unit: | Consistent over: |
|------------|---------|-------|------------------|
| Start: 100 | 2 | Words | Total length |
| End: 103 | | | |

Process image:

Input

| Address: | Length: | Unit: | Consistent over: |
|------------|---------|-------|------------------|
| Start: 100 | 6 | Words | Total length |
| End: 111 | | | |

Process image:

Data for Specific Manufacturer:
(Maximum 14 bytes hexadecimal, separated by comma or blank space)

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”.

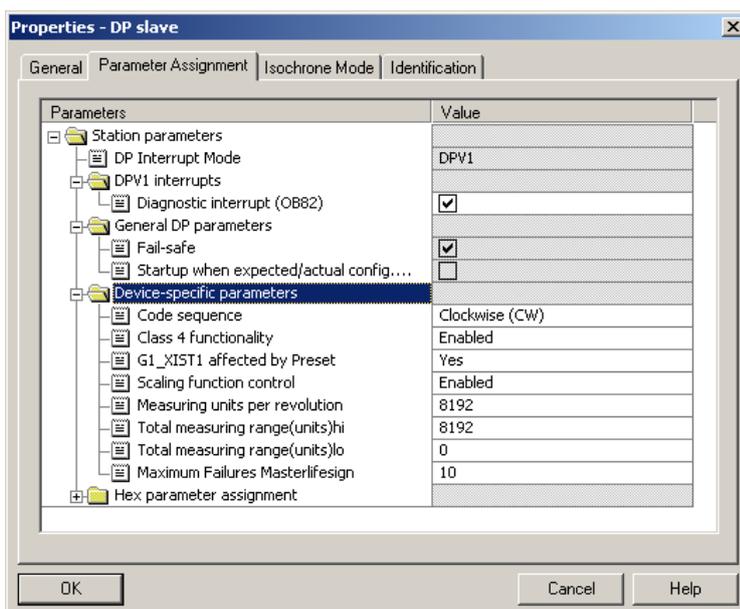


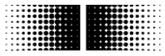
5.5.1. General

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)**

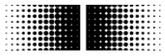
Parameterization of the required total measuring range, „TMR“.

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 (presettled) 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: | $65536 \times 3600 / 29.491.200 = 8$ (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: | $65536 \times 3600 / 100.000 = 2359$ 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**

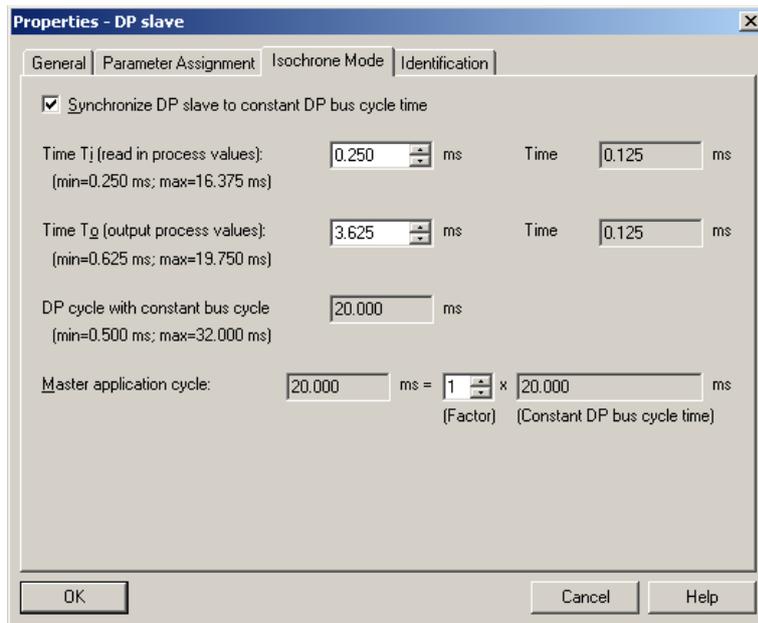
The hexadecimal data described only reflect the actual settings in the form they are transmitted to the encoder and by no means should be altered in any way.

5.5.3. Clock synchronisation

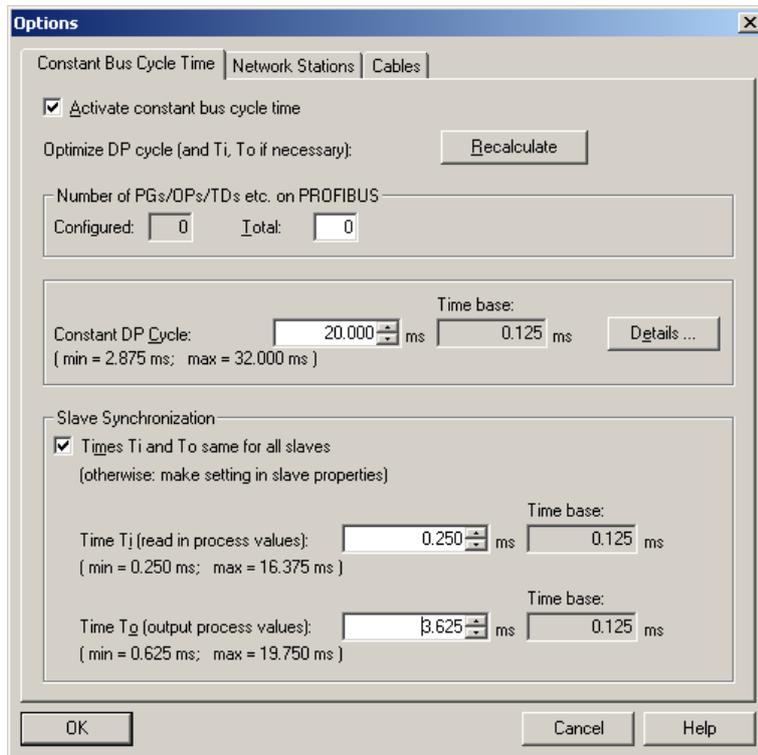
Clock-synchronous operation is activated by a tick on “SynchronizeDP-Slave at equidistant DP-cycle“.

Time T_i 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 μ s minimum is admissible if encoder operation is without scaling, i.e. always with the maximum resolution. For enabled scaling the minimum value is 375 μ s. 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 T_o 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 T_i and T_o 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.

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 signaled 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.

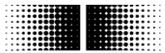
An additional data block must be prepared for accommodating more parameters. The schematic structure of this data block is described in the following. Length depending on read/ write access and parameter length are between 10 and 16 bytes.

DS_WRITE

| Called parameter | Value | Example |
|------------------|---|-----------------|
| ID | Slot no.1 (E/A address telegram81) Slot no.0 (diagnosis 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 = 0x0396 | 0x03 |
| 7 | Prm_no lo: 918 = 0x0396 | 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 039A | 0x03 |
| 7 | Prm_no lo: 922 = 0x 039A | 0x9A |
| 8 | Subindex hi | 0x00 |
| 9 | Subindex lo | 0x00 |

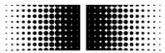
DS_READ

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 = 0x03C4 | 0x03 |
| 7 | Prm_no lo: 964 = 0x03C4 | 0xC4 |
| 8 | Subindex hi | 0x00 |
| 9 | Subindex lo | 0x00 |

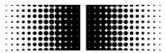
DS_READ

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 IVO=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 = 0x03C5 | 0x03 |
| 7 | Prm_no lo: 965 = 0x03C5 | 0xC5 |

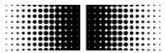
DS_READ

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 = 0x03CB | 0x03 |
| 7 | Prm_no lo: 971 = 0x03CB | 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.

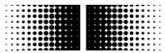
DS_WRITE

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 = 0x03D3 | 0x03 |
| 7 | Prm_no lo: 979 = 0x03D3 | 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 = 0xFDE8 | 0xFD |
| 7 | Prm_no lo: 65000 = 0xFDE8 | 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) | 0xFF |
| 7 | Preset value | 0xFF |
| 8 | Preset value | 0xFF |
| 9 | Preset value (lo byte) | 0xFF |

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 = 0xFDE8 | 0xFD |
| IM_INDEX (lo) | 65000 = 0xFDE8 | 0xE8 |

DS_READ

DP-V1 Header

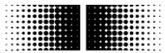
| Called parameter | Value | Example |
|-------------------|------------------------------------|---------|
| Function ID | Permanent for DS_Read | 0x5E |
| ID | Slot 0 (Diagnose-Adresse DP-Slave) | 0x0FFD |
| Index | 255 = 0xFF | 0xFF |
| Usere data length | 68 = 0x44 max. | 0x40 |

Data Unit - Call Header (read):

| | | Example |
|-----------------------|-------------------------|---------|
| EXTENDED_FUNCTION_NUM | 0x08 permanent for CALL | 0x08 |
| reserved | ever 0x00 | 0x00 |
| IM_INDEX (hi) | 65000 = 0xFDE8 | 0xFD |
| IM_INDEX (lo) | 65000 = 0xFDE8 | 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 IVO 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.

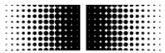
From the master's point of view, encoder position values are input data and data transmitted to the encoder are output data.

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 <ul style="list-style-type: none"> parameterization configuration diagnostic data (diag.ext. bit and d diag.stat. bit at alarms and warnings) |
| 2 | Station status 2 | Status of <ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> Sequence number of the higher six bytes bit Alarm specifier in lower two bits <ul style="list-style-type: none"> 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 IVO.

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 IVO.

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 after 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 $8.192 \times 65.536 = 536.870.912$ steps.

The singleturn resolution is reduced to 3600 steps / revolution.

Total measuring range now only $3.600 \times 65.536 = 235.929.600$ 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.