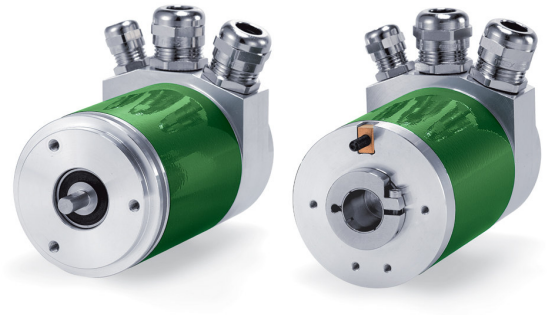
User manual

Ax58x PB
CC-PB, CC-PB-C



Chapters

Profibus-DP Profile for Encoders

1 - Safety summary

Safety

- observe the professional safety and accident prevention regulations applicable to your country during device installation and operation;
- installation has to be carried out by qualified personnel only, without power supply and stationary shaft;
- the encoder must be used only for the purpose appropriate to its design;
- high current, voltage and rotating parts can cause serious or fatal injury.

Electrical safety

- switch OFF the voltage before connecting the device;
- connect according to the chapter 4: "Electrical connections";
- according to the 89/336/CEE norm on electromagnetic compatibility, following precautions must be taken:
  - before handling and installing, discharge electrical charge from your body and tools which may come in touch with the device;
  - power supply must be stable without noise, install EMC filters on device power supply if needed;
  - always use shielded and twisted cables if possible;
  - avoid cables runs longer than necessary;
  - avoid running the signal cable near high voltage power cables;
  - mount the device as far as possible from any capacitive or inductive noise source, shield the device from noise source if needed;
  - minimize noise by connecting shield or connector housing to ground (GND). Make sure that ground (GND) is not affected by noise. The shield connection point to ground can be situated both on the device side and on user's side. The best solution to minimize the interference must be carried out by the user.

Mechanical safety

- solid shaft: use a flexible coupling to connect encoder to motor shaft respecting the coupling misalignment tolerances;
- do not disassemble the encoder;
- do not tool the encoder or its shaft;
- do not subject the encoder and the shaft to knocks or shocks;
- respect the environmental characteristics of the product.

2 - Identification

The device can be identified by the label's data (ordering code, serial number). This information is listed in the delivery document. For technical features of the product, refer to the technical catalogue.

c US File E211871

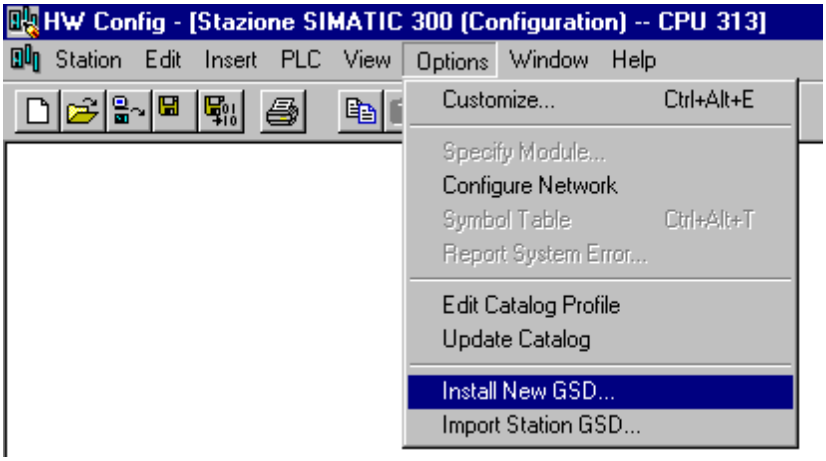
3 - Quick reference

3.1 STEP7 configuration

Import GSD file

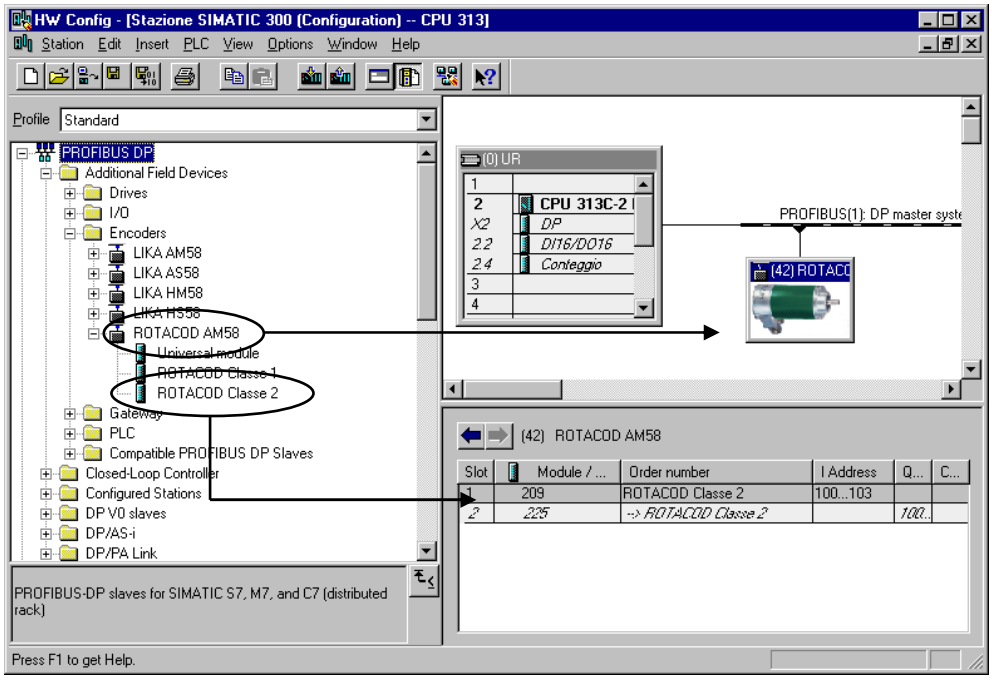
Profibus encoders are supplied with a GSE file **LIKA1655.GSE** (see enclosed support or **www.lika.biz > PRODUCTS > ROTACOD > Ax58x PB**).

In the "HW Config" window, select "Options > Install GSD file...".
Select the correct GSD file in the installation window and install it.



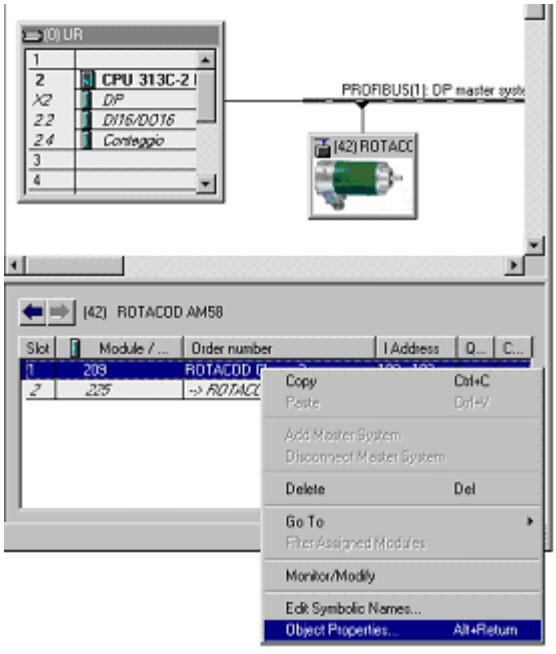
Adding a node to a project

In the "HW Config" window, select "Catalog > PROFIBUS_DP > Additional Field Devices > Encoders", drag "ROTACOD AM58" module and connect it to "BUS".
Drag the desired submodule (Class 1 or Class 2) on the variables table to set the class of the device (for more details see chap.5.2).

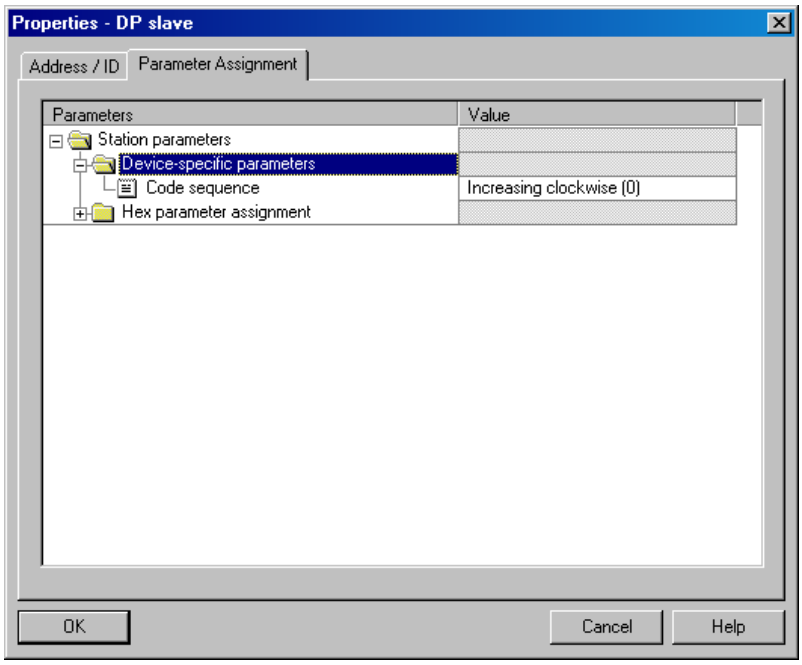


Encoder configuration parameters

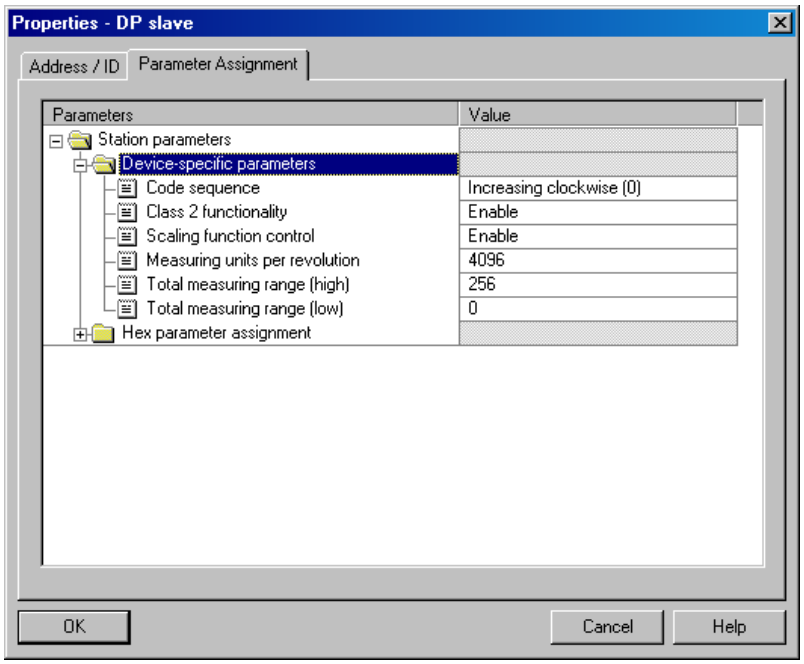
To enter the Encoder configuration parameters window, select the device in the "HW Config" window and right click the mouse.
Click on "Object Properties...".



A window will appear with a list of all encoder parameters.
For Information on correct use and settings reefer to chapter 5.4



Class 1 example



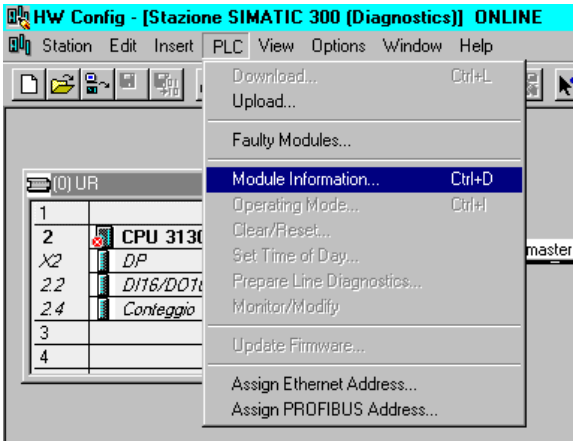
Class 2 example

Click the "OK" and then "Download" button to store the parameters.

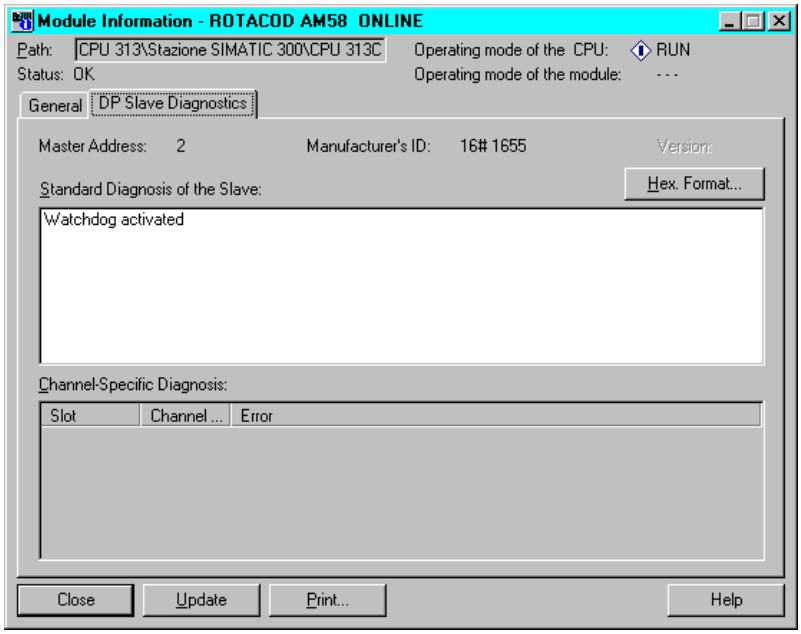
3.2 Reading diagnostic information

The diagnostic information message can be set either to 16 or 63 bytes, see "Diagnostic type" in encoder parameters.

To view the diagnostic information, the encoder must be on-line: click "online<->offline" button or select "Station > Open online".

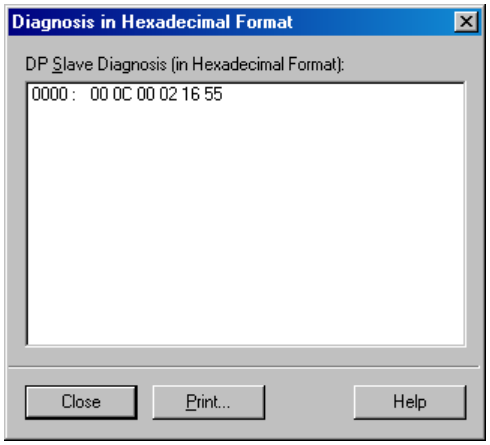


Select "PLC > Module information..." the following window will appear:



Click "Hex Format..." button to display diagnostic information:

6 bytes diagnostic:

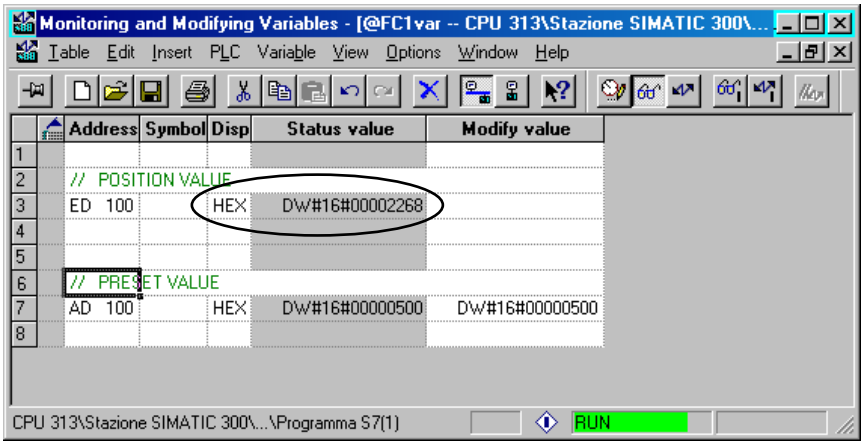


Byte	Description
0	status 1
1	status 2
2	status 3
3	Master ID
4	manufacturer ID
5	

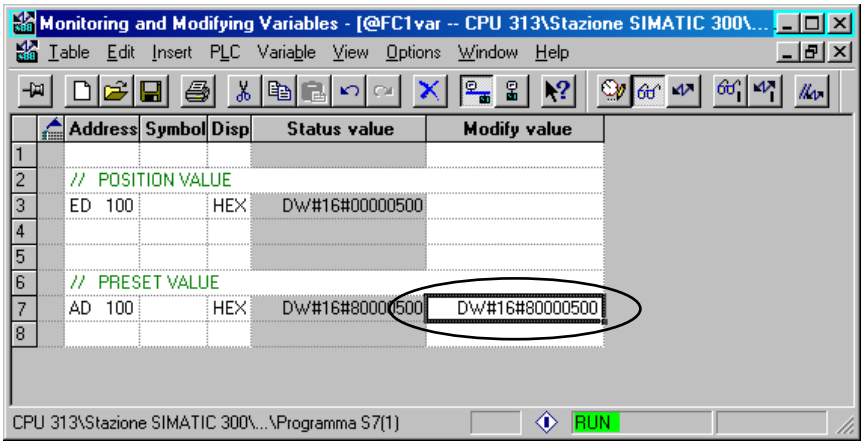
3.3 Setting the Preset value

Example:

The encoder with device address 1 transmits the position value to the Master.
The position value is loaded into variables ED 100...103 (4 byets).
The Preset is transmitted using variables AD 100...103 (4 bytes).



- Encoder actual position is 0000 2268hex



- to set Preset value = 0000 0500hex
- Set bit 31 of variable AD 100 = "1" (8000 0500hex)
- click "Command" button: 

Now the position value is 0000 0500hex.

To close Preset procedure
- set bit 31 of variable 100 back to "0"
- click "command" button

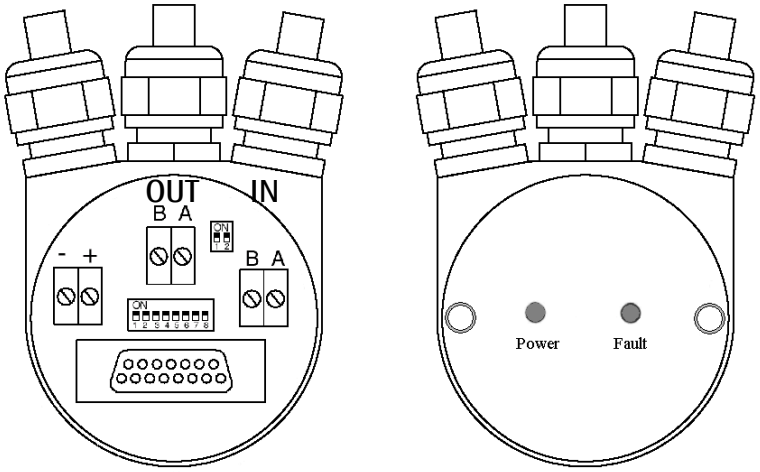
NOTE:
Some releases of STEP7 may not work properly with Data variables having index higher than 127. We recommend to use "MD" reference operators (pointers) for encoder position, velocity and Preset.

4 - Electrical connections

ATTENTION: do not remove or mount the connection cap with power supply switched ON. Damage may be caused to internal components. Make sure that the encoder body and connection cap are at the same potential.

Minimize noise by connecting shield or connector housing to ground (GND). Make sure that ground (GND) is not affected by noise. It's recommended to provide the ground connection as close as possible to the encoder.

4.1 Connection cap with PGs (CC-PB)



The CC-PB connection cap has 3 cable gland PG9 for bus-IN, bus-OUT connections and for power supply connection. The bus cables can be connected directly to the clamps placed in front of each cable gland.
It's recommended to use Profibus-DP certificated cables. Core diameter should not exceed Ø1,5mm (0.06inch).

Clamp	Description
-	0 Vdc Supply voltage
+	+10Vdc +30Vdc Supply voltage
B	Profibus B (Red)
A	Profibus A (Green)
PG	Shield [1]

[1]: connected cable shield to cable gland.

4.2 Conn. cap with M12 connectors (CC-PB-C)

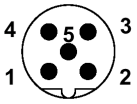
The CC-PB-C connection cap has three M12 connectors with pin-out according to the Profibus standard. Users can directly connect Profibus cables for commerce.

Power supply:
connector: M12
coding: A
(frontal side)

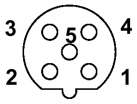
male

Pin	Function
1	+10Vdc +30Vdc
3	0 Vdc GND
4	Shield

Profibus signals:
connector: M12
coding: B
(frontal side)



male
(BUS IN)



female
(BUS OUT)

Pin	Function
2	Profibus A (Green)
4	Profibus B (Red)

4.3 Bus termination

A bus termination resistance is provided in the connection cap. This has to be activated as line termination on the last device.
Use RT Switch activated or deactivate the bus termination.

RT	Description
1 = 2 = ON	Activated: if the encoder is the last device
1 = 2 = OFF	Deactivated: if the encoder is not the last device

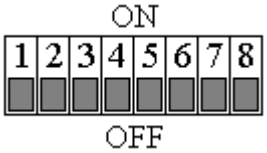
4.4 Baud rate

The baud rate can be set by the Master via software during configuration of the node (slave).
Supported baud rates are listed in the .GSD file.

4.5 Node number: DIP A

The node number must be set via hardware using dip-switches DIP A.
Permissible addresses are from 0 to 125.
Power supply must be switched off during this operation.

DIP A:



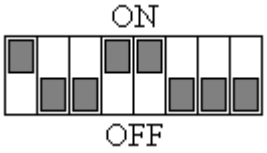
Set the node number in binary value: ON=1, OFF=0

bit	1 LSB	2	3	4	5	6	7 MSB	8 not used
	2^0	2^1	2^2	2^3	2^4	2^5	2^6	

Example:

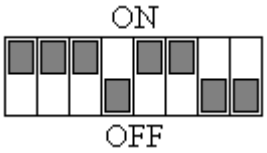
Set node number = 25:
25_{10} = 0001 1001$_2$ (binary value)

bit	1	2	3	4	5	6	7	8
	2^0	2^1	2^2	2^3	2^4	2^5	2^6	
	ON	OFF	OFF	ON	ON	OFF	OFF	OFF



Set node number = 55:
55_{10} = 0011 0111$_2$ (binary value)

bit	1	2	3	4	5	6	7	8
	2^0	2^1	2^2	2^3	2^4	2^5	2^6	
	ON	ON	ON	OFF	ON	ON	OFF	OFF



4.6 LED diagnostics

Two LEDs on the rear of the connection cap show the status of the Profibus-DP interface.

Fault (red)	Power (green)	Event
OFF	OFF	No power supply or hardware malfunction
OFF	ON	Correct function (correct communications)
OFF	Flashing	Dead Zone, see chap. 5.8
ON	Flashing	Configuration parameter not valid
ON	OFF	Transmission time-out error
Flashing	ON	Bus communication failure
Flashing	Flashing	Flash memory error

5 - Profibus interface

The unit is a slave device according to "Profibus-DP Profile for Encoders" and it can be set as Class 1 or Class 2 device (see chapter 5.2).
Refer to the official Profibus website for all information not listed in this manual (www.profibus.com).

5.1 GSD file

Profibus encoder is supplied with GSE file **LIKA1655.GSE** (see enclosed support or **www.lika.biz > PRODUCTS > ROTACOD > Ax58x PB**). Install GSE file on Profibus master device.

5.2 Classes of the Device profile

Encoder class must be set during configuration of the device. Class 1 allows basic functions of the device and should be used for:

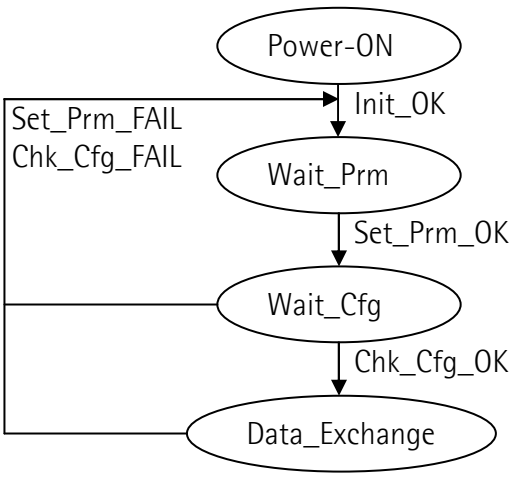
- transmission of position value
- change of counting direction
- Preset value

Class 2 allows to use Class 1 functions and extended function such as:

- scaling function

5.3 Modes of operation

Profibus-DP devices allow operation using different communication modes (see figure below):



NOTE:
All parameters except Preset value are transmitted in Set_Prm mode.
Preset value is transmitted only in Data_Exchange mode.

Types of communication

Transmission of data between Master and Slave takes place using the following 3 types of messages:

- **DDLM_Set_Prm:**
  Used for configuration of the slave. This mode is active immediately after power ON and used to transmit parameters from the Master to the Slave (see chapter 5.4).

- **DDLM_Chk_Cfg:**
  Defines the number of bytes used for data transmission in Data_Exchange mode (see chapter 5.5).

- **DDLM_Data_Exchange:**
  Used as "standard operation mode".
  Used by the Master to send the Preset value and used by the Slave to transmit position value (see chapter 5.6).

- **DDLM_Slave_Diag:**
  Used during power on and whenever the Master wants to know diagnostic information from the Slave device (see chapter 5.7).

5.4 DDLM_Set_Prm

It is possible to choose between different encoder configurations. Functionality and parameters depend on the selected configuration and are stored in the Master.
At start-up the Profibus network transmits all data to the Slave (DDLM_Set_Prm mode).
The following tables shows the structure of parameters according to the encoder Profile.

DDLM_Set_Prm with Class 2:

Byte	Parameter	
0...9	reserved for PROFIBUS	
10	operating parameters	
	bit 0	code sequence
	bit 1	class 2 functionality
	bit 2	reserved
	bit 3	scaling function control
	bits 4...7	reserved
11...12	counts per revolution	
13...16	total resolution	
17...20	reserved	

5.4.1 Byte 10 - Operating parameters

Bit	Function	bit = 0	bit = 1
0	code sequence	CW	CCW
1	class 2 functionality	disabled	enabled
2	reserved		
3	scaling function control	disabled	enabled
4, 5, 6, 7	reserved		

Code sequence
The code sequence defines whether increasing or decreasing position values are output when the encoder shaft rotates clockwise (CW) or counterclockwise (CCW) as seen from the shaft side.
The code sequence is set with the code sequence bit in the operating parameters.

Class 2 functionality
Disabled = Encoder Class 1 is set.
Enabled = Encoder Class 2 is set.

Scaling function control
If disabled the device uses the hardware resolution, if enabled the device uses the resolution transmitted in bytes 11...16 (Counts per revolution and Total resolution).
For a correct use of this function see chapter 5.4.2 and 5.4.3.

5.4.2 Bytes 11...12 - Counts per revolution

The "Counts per revolution" parameter can be used to program a user specific resolution each turn (single turn resolution).
The function is active if :
bit 1 and bit3 of byte 10 are ="1"

Byte	11	12
Bits	15-8	7-0
Data	2^{15} to 2^{8}	2^{7} to 2^{0}

Possible values are equal or less than "hardware counts per revolution".
Setting a value greater than possible, the resolution will be forced to "hardware counts per revolution".

5.4.3 Bytes 13...16 - Total resolution

This parameter is used to adapt the measuring range of encoder to a different measuring range required by the application.
The function is active if :
bit 1 and bit3 of byte 10 are ="1"

Byte	13	14	15	16
Bit	31-24	23-16	15-8	7-0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}

Possible values are equal or less than "hardware total resolution".
Setting a value greater than possible, the resolution will be forced to "hardware total resolution".

$$\text{"Number of rev."} = \frac{\text{"total resolution"}}{\text{"counts per revolution"}}$$

It's recommended to set "Number of revolution" to a value which is power of 2. This avoids problems when using the device in endless operation (when passing the physical zero) and entering the "Dead Zone" (see chapter 5.8).

Example

"AS58**13**/PB-xx": singleturn encoder
- "Hardware counts per revolution" = **13** bit/turn (8192 cpr)
- "Hardware number of turns" = 1
- "Hardware total resolution" = 13 bit (8192 * 1 = 8192)

"AM58**12/4096**PB-xx": multiturn encoder
- "Hardware counts per revolution" = **12** bit/turn (4096 cpr)
- "Hardware number of turns" = 12 bit (**4096** turn)
- "Hardware total resolution" = 24 bit (4096 * 4096 = 16777216)

Example

Multiturn encoder "AM58**12/4096**PB-6" with connection cap "CC-PB-C".

Resolution is:
- "Hardware counts per revolution" = 4096 (2^12)
- "Hardware number of turns" = 4096 (2^12)
- "Hardware total resolution" = 16777216 (2^24)

2048 steps per revolution * 1024 turns are required:
- Enable "scaling function": byte 10 = 0A hex (bit 1 = bit 3 = "1")
- "Counts per revolution" = 2048: byte 11...12 = 0800 hex
- "Total resolution" = 2048 * 1024 = 2097152: byte 13...16 = 0020 0000 hex.

NOTE:
If "counts per revolution" and/or "total resolution" are changed, the Preset value should be adapted to the new resolution. A new setting to the Preset value is also required.

5.5 DDLM_Chk_Cfg

The configuration function allows the Master to send configuration data to the Slave for checking. The main purpose of this function is to define number of bytes used for the Data_Exchange as seen from the Master side.

Chk_Cfg message structure (1 byte):

bit 7 = Concistency (="1")
bit 6 = Word format ("0"=byte,"1"=word=4byte)
bit 5...4 = In/out data ("01"=Input, "10"=output)
bit 3...0 = Length code

Example:

bit	7	6	5	4	3	2	1	0	
Data	1	1	0	1	0	0	0	1	D1h
	1	1	1	0	0	0	0	1	E1h

D1hex = 4 byte input
E1hex = 4 byte output

5.6 DDLM_Data_Exchange

This is the normal operation status of the system. The Slave can transmit the position value and receive the Preset value from the Master (both Class 1 and Class 2).

Position value (Encoder → Master)

Byte	1	2	3	4
Bit	31-24	23-16	15-8	7-0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}

Preset (Master → Slave)

Byte	1	2	3	4
Bit	31-24	23-16	15-8	7-0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}

The preset value is the process actual value, which should then be output when the axis is in a certain physical position. Using the preset value parameter, the value output from the angular encoder, is defined at a specific angular position.
- If "scaling function control" = disable
  "Preset" < "hardware total resolution".
- If "scaling function control" = enable
  "Preset" < "total resolution".

The preset value is transferred in the Data_Exchange mode (from Master to Slave) by setting bit 31 = "1" at last 3 cycles .

Example:

Preset to set = 0000 1000hex
actual position = 0005 5000hex

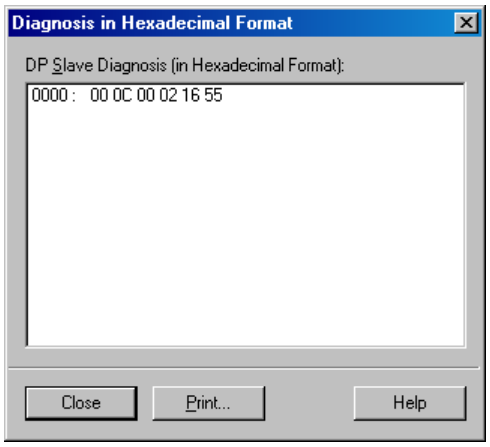
	Byte	1	2	3	4
Cycle	Bit	31-24	23-16	15-8	7-0
1°	M→S	80	00	10	00
	S→M	00	05	50	00
2°	M→S	80	00	10	00
	S→M	00	05	50	00
3°	M→S	80	00	10	00
	S→M	00	00	10	00

We suggest to set preset with stationary shaft.
The new preset value is stored immediately after reception.

5.7 DDLM_Slave_Diag

The Master device can request diagnostic information at any time to the Slave device.

6 bytes Diagnostic:



Byte	Description
0	status 1
1	status 2
2	status 3
3	Master ID
4	manufacturer ID
5	

5.8 "Dead Zone"

The "Dead Zone" occurs when

$$\text{"Number of revolution"} = \frac{\text{"total resolution"}}{\text{"counts per revolution"}}$$ is not a power of 2.

The device operates in the "Dead Zone" for the remaining positions to complete the difference between "hardware total resolution" and "total resolution" when this difference is less than "total resolution".

Example:

"AM58**13/4096**PB-xx": multiturn encoder

- "hardware counts per revolution" = 8192 (2^13)
- "hardware number of turns" = 4096 (2^12)
- "hardware total resolution" = 33554432 (2^25)

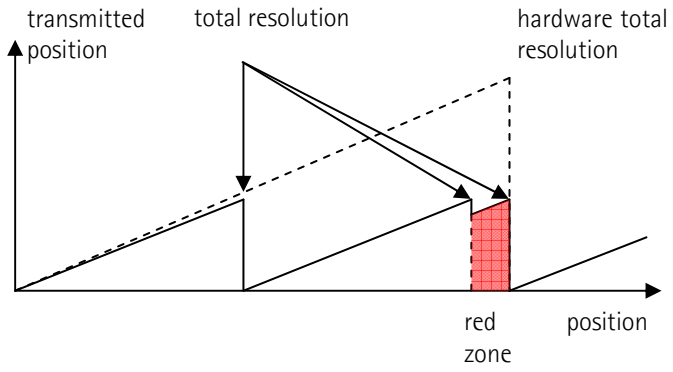
set parameters value:

- "Counts per revolution" = 5 000
- "Number of revolution" = 2 000
- "Total resolution" = 10 000 000

$$\frac{\text{"hardware number of revolution"}}{\text{"number of revolution"}} = \frac{4096}{2000} = 2.048$$

hence, for 96 revolutions (4096 - 2 * 2000 = 96) the encoder will work inside the "Dead Zone".

It can be explain graphically:



NOTE:

- The Dead Zone status is indicated with green LED flashing and red LED OFF.
- In Dead Zone, the transmitted position is coherent with setting resolution: it is calculating so that the last position before zero position is "Total resolution -1".
- Make attention using encoder position if it work in Dead Zone. In passage from normal status to Dead Zone status (and vice versa) a jump of position occurs.

Man.Vers.	Description
1.0	1st issue
2.0	General revision
2.1	Chapter 4 update

c UL us	This device is to be supplied by a Class 2 Circuit or Low-Voltage Limited Energy or Energy Source not exceeding 30 Vdc. Refer to the product datasheet for supply voltage rate.

lika

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