Danaher Controls

Your Dynapar brand A25/A58 encoder was designed for applications that require absolute position feedback. By providing a unique output for each shaft position you can detect machine position immediately on power-up, without having to perform a reference cycle. Available in single or multi-turn models, with resolution up to 26 bits, connection to the encoder has been greatly simplified by inclusion of a Profibus interface. With this version of the A25/A58 it is not necessary to run individual wires all the way back to a dedicated input card. Instead just plug in to the bus, and interface to the same card the rest of your Profibus compatible products are utilizing.

The A25/A58 comes with a variety of programmable features, such as count direction, measuring units, and offset value. This manual provides detailed information on these features, as well instructions on how to access them over the network. Also included are wiring/installation instructions, dimensional drawings and technical specifications

Should you require any additional assistance with the installation or operation of this product, please call our toll free application support line at 1-800-234-8731

Technical Manual #702258-0001

Dynapar brand

A25/A58 Absolute Encoder with Profibus Interface

PROFIBUS PROCESS FIELD BUS

Features

- Profibus interface for simplified installation and programming
- Multi-turn models available for applications that required extended travel or greater resolution: up to 26 bits
- Choice of standard U.S. (2.5") or European (58mm) package
- Integrated bus manifold connection
- Metal enclosure is rugged and provides noise immunity to IEC Level 3
- Frequency response up to 100 kHz
- Alarm flag communicates the encoder's health status over the network

Contents

1 Scope

This technical manual describes the software, parameter setting, and initial operation of the A25/A58 encoder.

Explanation of symbols

The caution symbol is located next to sections of the manual to which special attentioned should be paid in order to avoid potential safety hazards

i The information symbol indicates important directions for the **proper use** of the encoder. Observance of this information will assist you in quickly getting your unit on-line and properly functioning

⇒ This symbol indicates instructions for action.

Abbreviations used

ASIC	Application specific integrated circuit
DP	"Dezentrale Peripherie" (local I/O modules)
DPM1	DP master (Class 1) DPM1 is the central programmable controller for PROFIBUS DP
DPM2	DP master (Class 2) DPM2 is a project planning and configuration device for PROFIBUS DP
GSD	Device master data Electronic device data sheet
HMI	Human Machine Interface Operator panels and monitoring devices
KBL	"Kommunikationsbeziehungsliste" (list of communication relations) The KBL contains a list of all communication relations of a station.
KR	Local abbreviation for a communication relation
MAC	The MAC determines, when a device is granted the right to send data

OV	Object Directory The OV contains the description of all communication objects of a device
SAP	Service Access Point Service access point in the PROFIBUS layer 2
TSDI	Station Delay Time Initiator Call delay time of the initiators
TSDR	Station Delay Time Responder Response delay time of the responder
VFD	Virtual Field Device The VFD is the part of a real device which can be reached by communication

Miscellaneous:

Numerical data Unless indicated explicitly, decimal values are represented as figures without additional features (e.g. 1408), binary values are marked **b** (e.g. 1101b), hexadecimal values **h** (e.g. 680h) at the end of the figures.

2 Safety and Operating Instructions

The A25/A58 model series' absolute encoders are quality products which have been manufactured according to recognised electrical engineering regulations. The devices have left the manufacturing company's premises meeting all relevant safety requirements.
In order to preserve this condition and to ensure an interference-free operation of the encoders, the technical specifications presented in this documentation must be observed.

- Electrical devices should only be installed by skilled electricians!
- The devices may only be operated within the limits defined in the technical data.
- The maximum operating voltages must not be exceeded!The devices have been constructed according to DIN EN 61010 Part 1, protection class III.In order to avoid dangerous electric shocks, the devices have to be operated with safety extra-low voltage (SELV).
- For enhanced protection, use an external fuse (see Chapter 9, Technical Data).
- Field of application: industrial processes and control systems.Overvoltages at the connection terminals must be restricted to overvoltage category II values.
- Shock effects on the housing, especially on the encoder shaft, as well as axial and radial overloading of the encoder may greatly reduce the life of the device.
- To maximize the life of the encoder it is necessary to use an appropriate coupling.
- The neighbouring parts as well as the installation of the cable system have a significant influence on the electromagnetic compatibility of the shaft encoder. As a consequence, it is necessary to ensure the EMC of the entire device or system.
- In regions endangered by electrostatic discharges, ESD protection for the plugs and the cable to be connected should be provided when installing the shaft encoder.

3 Profibus DP

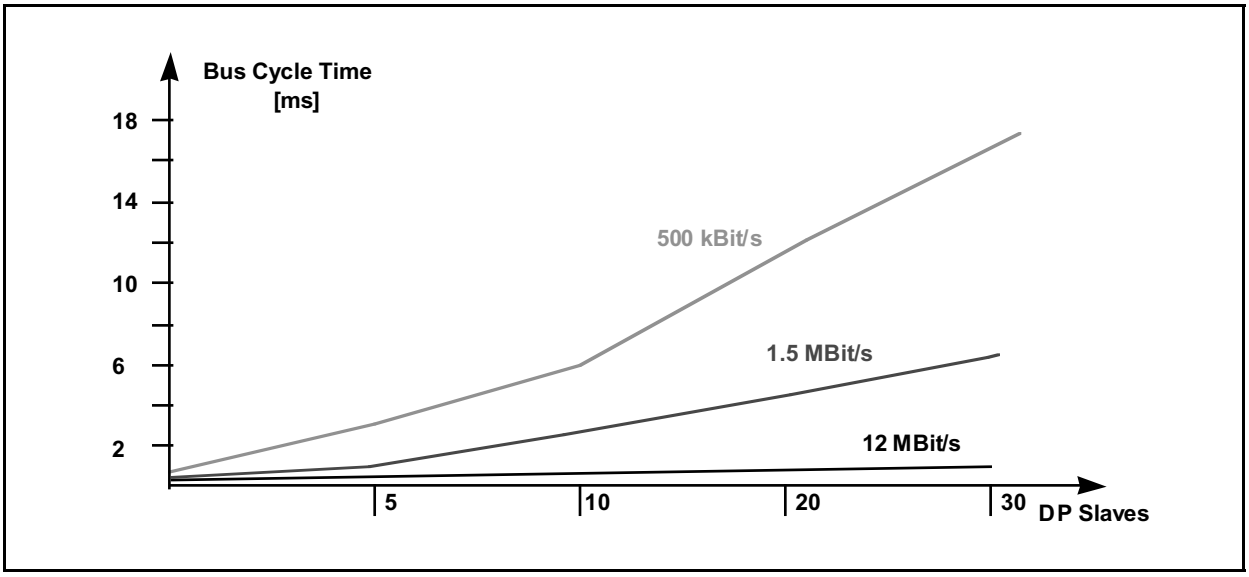
An open communication standard developed by the European Community, Profibus comes in several variations. Profibus DP, which is utilized for the A25/A58, is optimized for data transfer with local field devices like valves, drives and encoders. DP is well suited for applications that require high speed transmission of fairly large amounts of data (512 bits of input data and 512 bits of output data over 32 nodes in 1 ms)

3.1 Functional Overview

Transmission technology:	• RS-485 twisted pair line • Baud rates ranging from 9.6 kbit/s up to 12 Mbit/s
Bus access:	• Token passing procedure between the masters and master-slave procedures for slaves • Monomaster or multimaster systems possible • master and slave devices, max. of 126 stations at a single bus
Communication:	• Point-to-point (user data communication) or multicast (control commands) • cyclical master-slave user data communication and acyclical master-master data transfer
Operating state:	• Operate: cyclical transfer of input and output data • Clear: The input data are read, the output data remain in the safe status • Stop: only master-master data transfer is possible
Synchronisation:	• Control commands enable a synchronisation of the input and output data • Sync mode: Output data is synchronised
Functionality:	• Cyclical user data transfer between DP master and DP slave(s) • Single DP slaves are dynamically activated or deactivated • Control of the DP slave's configuration, 3 stepped diagnostic message levels. • Synchronisation of in- and/ or output • Address assignment for the DP slaves via the bus • Configuration of the DP masters (DPM1) via the bus • Maximum of 246 byte input and output data per DP slave possible
Protection functions:	• All messages are transferred with a hamming distance of HD=4 • Response control at the DP slaves • Access protection of the DP slaves' input/ output • Monitoring of the user data communication with adjustable control timer at the master
Device types:	• DP master class 2 (DPM2), e.g. programming/ project planning devices • DP master class 1 (DPM1), e.g. central automation devices like SPC, PC • DP slave e. g. devices with binary or analog input/ output, drives, valves

3.2 Communciation Speed

The PROFIBUS DP only requires approx. 1 ms at a speed of 12 Mbit/s in order to transfer 512 bit input and 512 bit output data by means of 32 stations.
The following diagram shows the usual PROFIBUS DP transfer time interval in relation to the number of stations as well as the transmission speed. The high speed can be above all explained by the fact that the input and output data within a message cycle are transferred by using the layer 2 SRD service (Send and Receive Data Service).



Bus cycle time of a PROFIBUS DP monomaster system
Boundary conditions : Each slave has 2 byte input and 2 byte output data; the minimum slave interval time amounts to 200 microseconds; TSDI = 37 bit times, TSDR = 11 bit times

3.3 Diagnostic Functions:

The comprehensive diagnostic functions of PROFIBUS DP enable a quick localisation of errors. The diagnostic messages are transferred by means of the bus and are assembled at the master. They are subdivided in three levels:

Station-related diagnostics
Messages on the general readiness for service of a station, such as, overtemperature or undervoltage.

Module-related diagnostics
Theses messages indicate that an error within a certain I/O part (e.g. 8 bit output module) has been detected.

Channel related diagnostics
The error cause in relation to a single input/output bit (channel) is indicated here, such as, a short-circuit at output line 7.

3.4 Configuration of the System and Device Types

Profibus DP supports both mono and multimaster systems, providing highly flexibly system configuration. A maximum of 126 devices (master or slaves) may be connected to a bus. The definitions for the system configuration contain the number of stations, the assignment of the station address to the I/O addresses, the data consistency of the I/O data, the format of the diagnostic messages and the bus parameters used. Each PROFIBUS DP system consists of different device types. There are three device types to be distinguished:

DP master class 1 (DPM1)

These devices are central control systems exchanging information with the local stations (DP slaves) during a fixed message cycle. Typical devices of this kind are stored-program controllers (SPC), PC or VME systems.

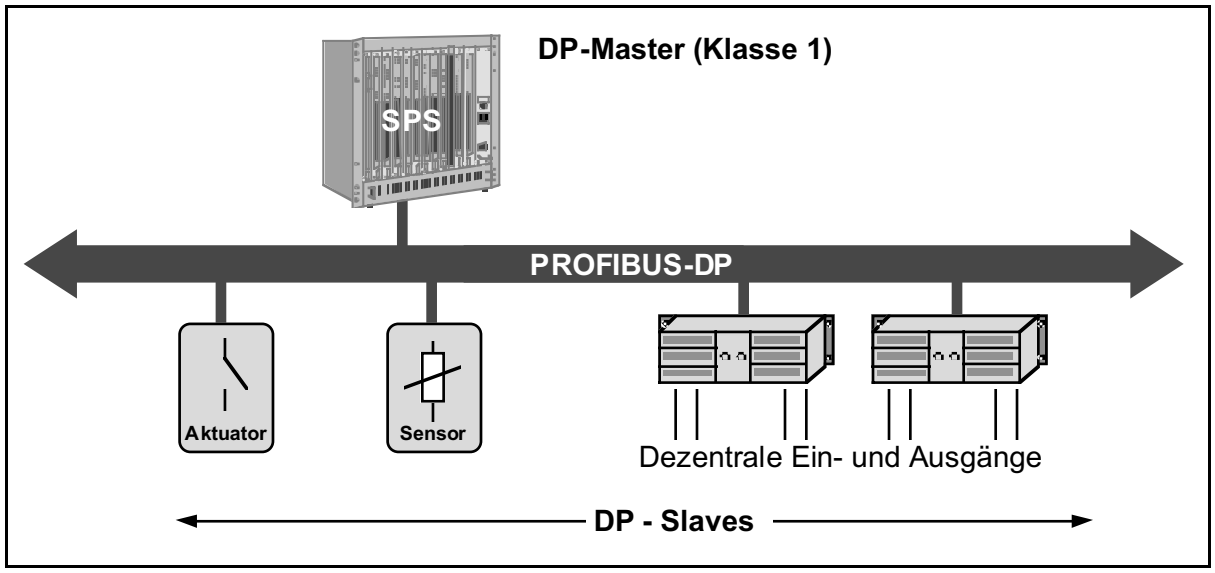
DP master class 2 (DPM2)

Programming, configuration devices, and operator panels belong to this category. They are used for the initial operation procedures in order to establish the configuration of the DP system.

DP slave

A DP slave is a peripheral I/O rack (I/O, drives, HMI, valves) that reads the input information and sends output information to the peripheral equipment. Devices which provide only input or only output information might also be used.

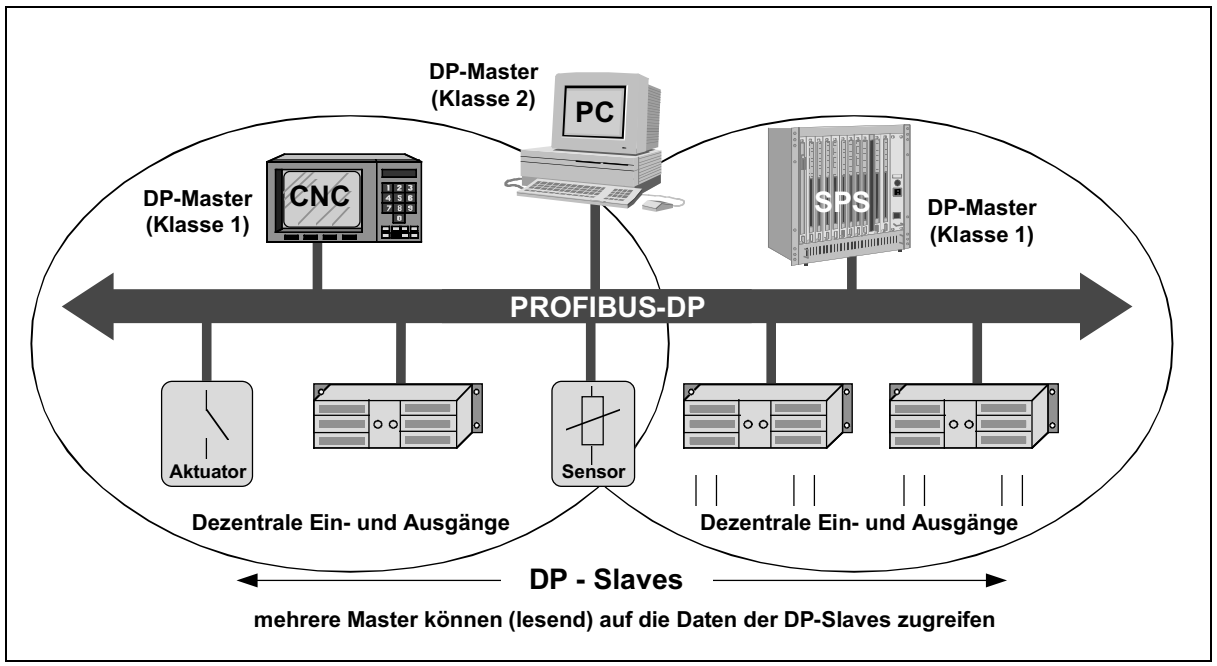
The amount of input and output informationis device sepecific and must not exceed 246 byte for the input 246 byte for the output data.



PROFIBUS DP monomaster system

In the case of monomaster bus systems, there is only one master active on the bus during the on-line phase of the bus system. The above diagram shows such a configuration. The SPC based control system is the central control element. By means of the transmission medium, the DP slaves are locally linked to the SPC control system. This configuration provides the shortest bus cycle times.

In the multimaster mode, several masters are linked to a single bus. They either form independent subsystems consisting of one DPM1 and its corresponding DP slaves each, or additional configuration and diagnostic devices (see diagram below). The I/O maps of the DP slaves can be read by all DP masters, but only one DP master, the one which has been assigned as DPM1 during bus configuration is able to write the output information. Multimaster systems provide a bus cycle time.



Multi-Master System

3.5 System Performance

In order to obtain a high level of exchangeability between the devices, the system performance of PROFIBUS DP has also been standardised. It is mainly determined by the operational status of the DPM1.

The DPM1 can either be controlled locally or via the bus by a supervisory computer. The following three main states can be distinguished:

Stop
There is no data traffic between DPM1 and the DP slaves.

Clear
The DPM1 reads the input information of the DP slaves and maintains the safe status of the DP slaves' output.

Operate
The DPM1 has entered the data transfer phase. In case of a cyclical data traffic, the input is read by the DP slaves while the output is transferred to the DP slaves.

By means of a multicast command, the DPM1 cyclically sends its local status to the assigned DP slaves within a configurable time interval.

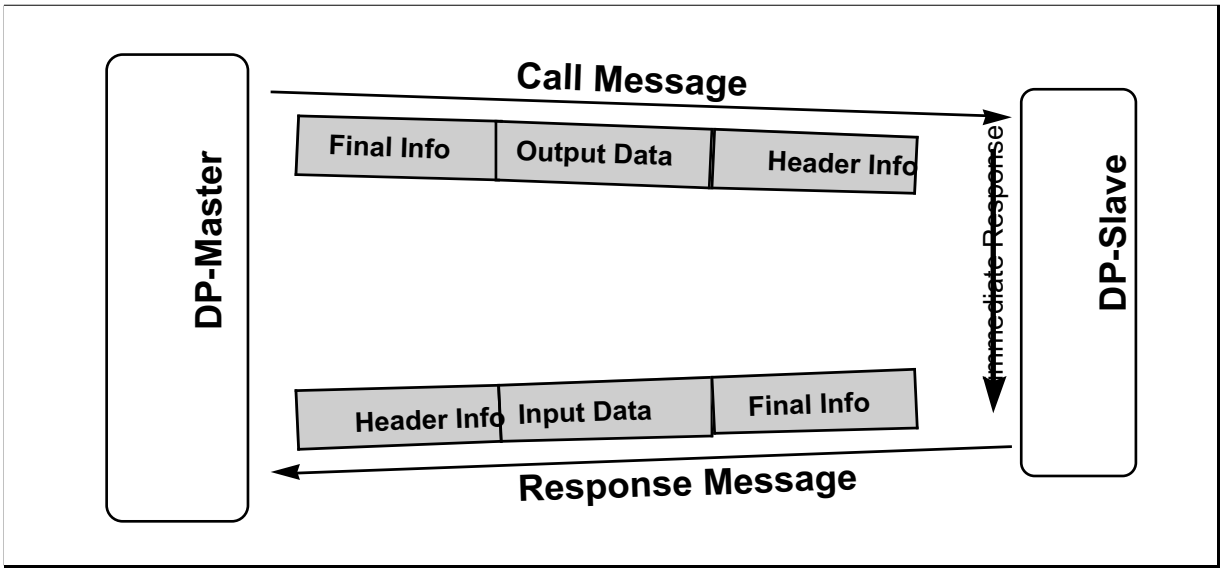
After an error has occurred during the data transfer phase of the DPM1, like for example, such as the failure of a DP slave, the response of the system is determined by the setting of the "Auto Clear" operating parameter.

If this parameter has been set to true, the DPM1 will set the output of all the respective DP slaves to the safe status, as soon as a DP slave is no longer available for user data communication. Afterwards, the DPM1 changes to the clear status.

If this parameter is = false, the DPM1 remains, even if an error occurs, in the operate status, and the user can determine the response of the system at his own discretion.

3.6 Cyclical Data Transfer between DPM1 and the DP Slaves

The data traffic between the DPM1 and the respective DP slaves is automatically handled by the DPM1 in a fixed, recurring order. When configuring the bus system, the user assigns a DP slave to the DPM1. In addition, the slaves to be included in-or excluded from the user data communication are defined. The data traffic between the DPM1 and the DP slaves is subdivided in parametrisation, configuration, and data transfer phases. Before including a DP slave in the data transfer phase, the DPM1 checks during the parametrisation and configuration phase, whether the planned set configuration corresponds to the actual configuration of the device. For this check, the device type, the information on the format and the length as well as the number of input and output lines have to be correct. The user thus obtains a reliable protection against parametrisation errors. In addition to the user communication, which is automatically executed by the DPM1, the user may request the new parametrisation data to be sent to the DP slaves.



3.7 Data Traffic between DPM1 and Supervisory Devices

In addition to the functions between DP master and DP slaves, master-master communication functions are available. They support the project planning and diagnostic devices in projecting the system via the bus. Besides the upload and download functions, the master-master functions offer the opportunity to switch the user data transfer between the DPM1 and the single DP slaves dynamically on or off as well as to modify the operating status of the

Function	Meaning	DPM1	DPM2
Get_master_Diag	reads the diagnostic data of the DPM1 or the collective diagnosis of the DP slaves.	M	O
Download / Upload Group (Start_Seq, Down- / Upload, End_Seq)	reads or writes the entire configuration data of a DPM1 and of the respective DP slaves.	O	O
Act_Para_Brct	activates the bus parameters for all operating DPM1 devices.	O	O
Act_Param	activates parameters or modifies the operating status of the operating DPM1 device.	O	O

M: Mandatory, O: optional

3.8 Sync Mode

In addition to the station-related user data communication being automatically handled by the DPM1, the masters may send control commands to a single slave, a group of slaves or all slaves at the same time. These control commands are transferred as a multicast. It is only by means of this multicast that the sync and freeze operating modes for the event-controlled synchronisation of the DP slaves can be enabled. The **sync mode** is started by the slaves, as soon as they receive a sync command form the respective master. The output lines of the addressed slaves will then be frozen in their current state. The output data will be stored at the slaves during the following user data transfers; the state of the output lines, however, will remain unchanged. Unless the next sync command has been received, the stored output data will not be connected to the output lines. By selecting unsync, the sync mode is terminated.

3.9 Protective Mechanisms

PROFIBUS DP offers protective functions against false parametrisation or failure of the transmission equipment. For this purpose, both the DP master and the DP slave have time -out circuits. The monitoring interval is determined during bus configuration.

At the DP master

The DPM1 controls the data traffic of the slaves by means of the Data_Control_Timer. For each slave, a special timer is used. The time-out circuit will respond, if no proper user data transfer occurs during a control interval. In this case, the user will be informed. If the automatic response to an error (Auto_Clear = True) has been set, the DPM1 will quit the operate status, switch the output lines of the respective slaves to the safe status and change to the clear status.

At the DP slave

In order to recognise errors by the master or transmission errors, the slave executes the response control. If there is no data traffic during the response control interval, the slave will automatically switch the output lines to the safe status.
When operating in multimaster systems, a supplementary access protection for the I/O lines of the slaves will be necessary. This is to make sure that direct access can only be gained by an authorised master. For all the other masters, the slaves will provide an I/O map which can be also be read without access authorisation.

3.10 Communication Interface

The communication interface corresponds to the PROFIBUS DP class 2 encoder profile.

Within this interface the class 1 functions are included. The manufacturer specific functions will be described separately in the following.

4 Overview Encoder Functions

Function	Octet no.	Data type	Designation	Class
Chk_Cfg	1	Octet string	Configuration data exchange	1
Set_Prm	1	Octet	Station status	1
Set_Prm	2 - 3	16 bit	Response check time (T_{WD})	1
Set_Prm	4	Octet	Min. Station Delay Responder (min. T_{SDR})	1
Set_Prm	5 - 6	16 bit	PNO identity number	1
Set_Prm	7	Octet	Group identity	1
Set_Prm	9	Octet string	Operating parameters	1
Set_Prm	10 - 13	32 bit	Measuring steps per revolution	2
Set_Prm	14 - 17	32 bit	Total number of measuring steps	2
Data_Exchange	1 - 8	16, 32 or 64 bit	Position value, preset	1/2
slave_Diag	1	Octet string	Station status 1	1
slave_Diag	2	Octet string	Station status 2	1
slave_Diag	3	Octet string	Stations status 3	1
slave_Diag	4	Octet string	Diagnosis master Add	1
slave_Diag	5 - 6	Octet string	PNO identity number	1
slave_Diag	7	Octet string	Extended diagnostic header	1
slave_Diag	8	Octet string	Alarm messages	1
slave_Diag	9	Octet string	Operating status	1
slave_Diag	10	Octet string	Encoder type	1
slave_Diag	11 - 14	32 bit	Single turn resolution	1
slave_Diag	15, 16	16 bit	Multi turn resolution	1
slave_Diag	17	Octet string	Additional alarm messages	2
slave_Diag	18, 19	Octet string	Supported alarm messages	2
slave_Diag	20, 21	Octet string	Warnings	2
slave_Diag	22, 23	Octet string	Supported warnings	2
slave_Diag	24, 25	Octet string	Profile version	2
slave_Diag	26, 27	Octet string	Software version	2
slave_Diag	28 - 31	32 bit	Operating time	2
slave_Diag	32 - 35	32 bit, signed	Offset value	2
slave_Diag	40 - 43	32 bit	Measuring steps per revolution	2
slave_Diag	44 - 47	32 bit	Total measuring range in measuring steps	2
slave_Diag	48 - 57	ASCII string	Serial number	2
RD_Inp	1 - 4	32 bit	Position value	1

5 Configuration (DDLM_Chk_Cfg)

By means of this routine, the DP master determines the number of bytes for the data exchange.

Octet	**1**
Bit	7 - 0
Data	D1h = 2 words of input data (standard configuration)
	F1h = 2 words of input data, output data (standard configuration)
	D0h = 1 word of input data (optional configuration)
	F0h = 1 word of input data, output data (optional configuration)
	D3h = 4 words of input data (manufacturer configuration)
	F3h = 4 words of input data, 4 words of output data (manufacturer specific configuration)

6 Operating parameters (DDLM_Set_Prm)

6.1 Overview

Parameter	**Data type**	**Parameter Octet number**	**Class**	**GSD file standard value**
Station status	Octet string	1	DIN 19245-3	88h
Response check time (T_{WD})	16 bit	2 - 3	DIN 19245-3	340 ms
Min. station delay responder (min. T_{SDR})	Octet string	4	DIN 19245-3	11
PNO identity number	16 bit	5 - 6	DIN 19245-3	00B7h
Group identity	Octet string	7	DIN 19245-3	0
Code sequence	Bit 0	9	1	0 = ascending for revolution cw
Class 2 functionality	Bit 1	9	2	1 = On
Maintenance diagnosis	Bit 2	9	Optional	0 = Off
Scaling function	Bit 3	9	2	1 = On
Sampling	Bit 7	9	2	1 ms
Measuring steps per revolution	32 bit	10 - 13	2	4096*
Total number of measuring steps	32 bit	14 - 17	2	2^{26}*

*Entry must be set to a value less than or equal to the maximum possible resolution of your device

6.2 Definition of the Operating Parameters

DDLM_Set_Prm

Octet	**9**
Bit	7 - 0
Data	2^7 - 2^0
	Operating parameters

Bit	Designation	= 0	= 1
0	Code sequence	ascending code sequence for clockwise revolution	ascending code sequence for counterclockwise revolution
1	Class 2 functionality	inactive	active
2	Maintenance diagnosis	inactive	active
3	Scaling function	inactive	active, sets scaling parameters to the transferred values
7	Sampling	1 ms	10 ms

6.2.1 Code Sequence

The code sequence defines the counter direction, in which the position code is issued in ascending order (clockwise (cw) or counterclockwise (ccw), viewed from the shaft). The Code sequence is determined by the code sequence bit in the operating parameters.

i Default Setting: bit = 0 - ascending code sequence for clockwise revolution

6.2.2 Class 2 Functionality

This bit activates the “class 2 functionality”.
The DP master has to set the bit to “1 = active“, in order to be able to use the “class 2 functionality“. If the “class 2 functionality” is inactive, the encoder operates like a class 1 encoder.

i Default setting: bit = 1 - Class 2 functionality is switched on.

6.2.3 Maintenance Diagnostics

The hardware of the encoder may be checked while at a standstill. The diagnosis is activated via the respective bit within the operating parameters. Occurring errors are indicated by the alarm bit of the diagnostic function (see Alarm functions 8.1.2).

i Default setting: bit = 0 - Diagnostics switched off.

6.2.4 Scaling Function Control

With the scaling function the encoder numerical value is converted in software to change the physical resolution of the encoder.
The parameters “Measuring units per revolution” and ”Total measuring range in measuring units” are the scaling parameters. If the scaling function bit is set to zero, the scaling function is disabled.

i Scaling function bit = 0 for not activated (default setting)
Scaling function bit = 1 for active

6.2.5 Sample Rate

This bit sets the time frame over which the enocdr data is updated

i bit=0 Encoder disk is sampled every 1 ms (Default setting)
bit=1: Encoder disk is sampled every 10 ms (will provide more stable readings for speed and acceleration at lower rotational speeds)

6.3 Measuring units per revolution

Enables the encoder output to be scaled by setting the desired number of output steps per revolution (to a number less than the encoders physical resolution)

i **The resulting scaling factor SCF (by which the physical value of position is multiplied) can be calculated according to the following equation:**

$$\frac{\textbf{Measuring units per revolution (octet 10 -13)}}{\textbf{Physical Single-turn resolution (octet 14 -17)}} = \textbf{SCF}$$

DDLM_Set_Prm

Octet	**10**	**11**	**12**	**13**
Bit	31 - 24	23 - 16	15 - 8	7 - 0
Data	2^{31} - 2^{24}	2^{23} - 2^{16}	2^{15} - 2^{8}	2^{7} - 2^{0}
	Measuring steps per revolution			

i Value range: 0 to max physical resolution of encoder
Default Setting: Physical resolution of the encoder

Example Setting for 13 bit resolution

Octet 10	Octet 11	Octet 12	Octet 13
00h	00h	20h	00

6.4 Total Measuring Range in Measuring Units

Sets the number of distinguishable steps over multiple revolutions of the encoder. i.e. the measuring units per revolution x the total number of revolutions required to represent the required system travel.5.6.7

The measuring units per revolution (resolution) are set by octet 10 - 13.

In case the encoder is used in continuous operation, the "Total Measuring range" must be divisible by the "Measuring Units per Revolution" setting

DDLM_Set_Prm

Octet	**14**	**15**	**16**	**17**
Bit	31 - 24	23 - 16	15 - 8	7 - 0
Data	2^{31} - 2^{24}	2^{23} - 2^{16}	2^{15} - 2^{8}	2^{7} - 2^{0}
	Total number of measuring steps			

Value range: 0 ... (max. physical total resolution)

Default value = Encoder Physical Resolution

Example: Setting for 25 bit resolution

Octet 14	Octet 15	Octet 16	Octet 17
02h	00h	00h	00h

7 Data exchange (DDLM_Data_Exchange)

The data exchange is configured by means of the DDLM_Chk_Cfg routine
(see Chapter 5 Configuration of the System and Device Types).

Position value

The encoder input data amounting to a length of 32 bit are used for the position value, the speed, and the acceleration. Optionally, the encoder also supports position values with a length of 16 bit. The value is positioned on the right side of the data field.

Preset function

The Preset function adapts the output of the encoder to correlate to the desired machine/system position reading. This parameter is then use in calculating the offset value.

i Ex: The output of the encoder is currently at 500, but the machine is actually at postion 400. Instead of physically rehoming the machine and the encoder, simply set the encoder's value to 400 (thereby creating an offset of -100)

The MSB of the preset value controls the preset function in the following way:

Normal operating status:	**MSB=0 (bit 31**, optionally bit 15 or bit 63 respectively) Preset value will **not** be utilized.
Preset-Mode:	**MSB=1 /bit 31** (optionally bit 15 or bit 63, respectively) With MSB=1 the encoder takes on the transferred value (bit 0 - 30) as preset value in the binary code.

i **In the encoder, the preset value will be converted into a respective offset value and will be added to the phsical position value (Offset = Preset - Physical Position).**

i The preset function may only be used if the encoder is at standstill. Scaling parameters should be set prior ot the preset value as modification to those parameters will cause the preset value to be deleted

7.1 Standard Configuration:

Configuration data:

- Class 1: D1h (2 words of input data)
- Class 2: F1h (2 words of input data, 2 words of output data for preset value)

Octet	**1**	**2**	**3**	**4**
Bit	31 - 24	23 - 16	15 - 8	7 - 0
Data	2^{31} - 2^{24}	2^{23} - 2^{16}	2^{15} - 2^{8}	2^{7} - 2^{0}
	Data_Exchange - 32 bits			

Format preset value

Octet	**1**		**2**	**3**	**4**
Bit	31	30 - 24	23 - 16	15 - 8	7 - 0
Data	0 / 1	2^{30} - 2^{24}	2^{23} - 2^{16}	2^{15} - 2^{8}	2^{7} - 2^{0}
	Preset control*	**Preset value - max. 31 bits**			

* The preset value will only be taken on if the bit 31 is set. If the encoder sends back the preset value, the master is able to reset the bit 31.

7.2 Optional Configuration

Configuration data:

- Class 1: D0h (1 word of input data)
- Class 2: F0h (1 word of input data, 1 word of output data for preset value)

Octet	**1**	**2**
Bit	15 - 8	7 - 0
Data	2^{15} - 2^{8}	2^{7} - 2^{0}
	Data_Exchange - 16 bits	

Format preset value

Octet	**1**		**2**
Bit	15	14 - 8	7 - 0
Data	0 / 1	2^{14} - 2^{8}	2^{7} - 2^{0}
	Preset control*	**Preset value - max. 15 bits**	

* The preset value will only be taken on if the bit 31 is set.

7.3 Manufacturer Specific Configuration with Speed and Acceleration

Configuration Data:
D3h (4 words of input data: 2 words for position, 1 word for speed, 1 word for acceleration)
F3h (4 words of input data: 2 words for position, 1 word for speed, 1 word for acceleration; 4 words of output data for preset value)

Octet	**1, 2**	**3, 4**	**5, 6**	**7, 8**
Bit	43 - 48	47 - 32	31 - 16	15 - 0
Data	$2^{63} - 2^{48}$	$2^{47} - 2^{32}$	$2^{31} - 2^{16}$	$2^{15} - 2^{0}$
	Position		**Speed**	**Acceleration**

Format preset value

Octet	**1, 2**		**3, 4**	**5, 6**	**7, 8**
Bit	63	62 - 48	47 - 32	31 - 16	15 - 0
Data	0/1	$2^{62} - 2^{48}$	$2^{47} - 2^{32}$	$2^{31} - 2^{16}$	$2^{15} - 2^{0}$
	Preset control*	**Preset value**		**-**	

* The preset value will only be taken on if the bit 31 is set. If the encoder sends back the preset value, the master is able to reset the bit 31.

The **speed** is indicated independently from the physical resolution in:

$$\frac{\mathbf{2^{14}}}{\mathbf{60000}} \langle T \langle \frac{U}{min}$$ with T=1 or 10 (Sampling; see Operating parameters Page **Error! Bookmark not defined.**).

Acceleration: The difference between 5 subsequent speed samples is calcualted.

8 Diagnostic Functions (DDLM_slave_Diag)

Diagnostic function	Data type	Diagnosis Octet number	Class
Station status 1	Octet string	1	DIN 19245-3
Station status 2	Octet string	2	DIN 19245-3
Station status 3	Octet string	3	DIN 19245-3
Diagnosis master Add	Octet string	4	DIN 19245-3
PNO identity number	Octet string	5 - 6	DIN 19245-3
Extended diagnostic header	Octet string	7	1
Alarm message	Octet string	8	1
Operating status	Octet string	9	1
Shaft encoder type	Octet string	10	1
Phys. resolution single turn	32 bit	11 - 14	1
Phys. resolution multi turn	16 bit	15, 16	1
Additional alarm messages	Octet string	17	2
Supported alarm messages	Octet string	18, 19	2
Warnings	Octet string	20, 21	2
Supported warnings	Octet string	22, 23	2
Profile version	Octet string	24, 25	2
Software version	Octet string	26, 27	2
Operating time	Octet string	28 - 31	2
Offset value	signed 32 bit	32 - 35	2
Measuring steps per revolution	32 bit	40 - 43	2
Total number of measuring steps	32 bit	44 - 47	2
Serial number	ASCII string	48 - 57	2

8.1 Diagnostic Functions Class 1

The octets 1 - 6 are specified in the DP standard DIN 19245.

The length of the diagnostic information class 1 is 16 byte, for Class 2, it is 57 byte.

8.1.1 Diagnostic Header

The header byte indicates the length of the diagnostic message including the header byte.
The format of the value is hexadecimal.

DDLM_slave_Diag

Octet	**7**		
Bit	7	6	5 - 0
Data	0	0	xxh
	Restricted to 00 for the display of device specific diagnostic messages		**Length including header**
	Extended diagnostic header		

8.1.2 Alarm Messages

In the case of a malfunction in the encoder that may lead to an incorrect position values, an alarm message will be sent. The alarm type is defined in Octet 8 of the diagnostic function within the DDLM_slave_Diag. dialog.
Additional class 2 alarm messages will be displayed in Octet 17 of the diagnostic function.
In the case of an alarm message the bits Ext_Diag and Stat_Diag are both set to 1 until

- the alarm message has been deleted and
- the encoder recognizes a precise position value.

Alarm messages will be deleted, if the functions have been restored according to the specifications and if the position value is correct.

The diagnostic function “supported alarm messages“ (Octet 18 - 19) provides the information on which alarm messages are supported by the encoder.

DDLM_slave_Diag

Octet	**8**
Bit	7 - 0
	Alarm messages

Bit	Designation	= 0	= 1
0	Position error	no	yes
1	Error voltage supply	no	yes
2	Current too high	no	yes
3	Maintenance diagnostics	OK	error
4	Storage error	no	yes

8.1.3 Operating Status

Octet 9 of the diagnostic functions provides information on internal parameters of the encoder.
The class 2 encoder sets the bit to “class 2 functionality“, in order to signal the DP master that the class 2 functions are entirely supported.
The DP master has to set the bit to “1 = active” in „DDLM_Set_Prm“, to make the „class 2 functionality available“.
The bit for the status of the scaling function will be set, if the scaling function is activated and the resolution is controlled by the scaling parameters.

DDLM_slave_Diag

Octet	9
Bit	7 - 0
	Operating status

Bit	Designation	= 0	= 1
0	Status code sequence	ascending code sequence for clockwise rotation	ascending sequence for counterclockwise rotation
1	Class 2 functionality	inactive	active
2	Maintenance diagnostics	not supported	supported
3	Scaling function	inactive	active
7	Sampling	1 ms	10 ms

8.1.4 Encoder Type

The encoder type is contained as hexadecimal code in Octet 10 of the diagnostic function.

DDLM_slave_Diag

Octet	**10**
Code	00/01
	Encoder type

Code	**Designation**
00	Absolute shaft encoder, single turn
01	Absolute shaft encoder, multi turn

8.1.5 Physical Single Turn Resolution

The diagnostic octets 11 through 14 contain the number of measuring steps per revolution.

DDLM_slave_Diag

Octet	**11**	**12**	**13**	**14**
Bit	31 - 24	23 - 16	15 - 8	7 - 0
Data	2^{31} - 2^{24}	2^{23} - 2^{16}	2^{15} - 2^{8}	2^{7} - 2^{0}
	Single turn resolution			

8.1.6 Physical Multi Turn Resolution

The diagnostic octets 15 and 16 contain the number of revolutions. For a multi turn shaft encoder, the measuring range results from the number of revolutions and the single turn resolution according to the equation:

Measuring range = Number of revolutions x single turn resolution.

DDLM_slave_Diag

Octet	**15**	**16**
Bit	15 - 8	7 - 0
	Number of revolutions	

8.2 Diagnostic Functions Class 2

The length of the class 2 diagnostic information including header amounts to 51 byte (33h).

8.2.1 Additional Alarm Messages

Diagnostic octet 17 is reserved for further alarm messages, which have, however, not yet been defined in the profile.

DDLM_slave_Diag

Octet	**17**
Bit	7 - 0
	Additional alarm messages (currently not assigned)

8.2.2 Supported Alarm messages

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

The alarm messages are displayed by means of octet 8.

DDLM_slave_Diag

Octet	**18**	**19**
Bit	15 - 8	7 - 0
	Supported alarm messages	

Bit	**Designation**	**= 0 (not supported)** **= 1 (supported)**
0	Position error	1
1	Error voltage supply	0
2	Current too high	0
3	Maintenance diagnosis	1
4	Memory error	0

8.2.3 Warnings

Warnings signal that some tolerances for certain internal parameters have been exceeded. In contrast to the alarm messages, they do not indicate false position values.
The diagnostic octets 20 and 21 contain the warnings.
In case of a warning, the EXT_Diag bit is set to 1, until the warning has been deleted.

Warnings are deleted after the diagnostic message has been read. If the tolerance is still being exceeded, the message will come up again.

The warning “operating time limit“ (bit 4) only turns up again after a restart.

The diagnostic function "supported warnings" (Octet 22-23) provides the information on which warnings are supported by the encoder.

DDLM_slave_Diag

Octet	**20**	**21**
Bit	15 - 8	7 - 0
	Warnings	

Bit	**Designation**	**0**	**1**
0	Frequency exceeded	no	yes
1	Temperature	no	yes
2	LED Reserve	not attained	attained
3	CPU Watchdog	OK	reset executed
4	Operating time warning (100,000 h)	not attained	attained
5	Battery charge	OK	too low
6	Point of reference	attained	not attained

8.2.4 Supported Warnings

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

The warnings are indicated via octet 20-21.

DDLM_slave_Diag

Octet	22	23
Bit	15 - 8	7 - 0
	Supported warnings	

Bit	Designation	= 0 (not supported) = 1 (supported)
0	Frequency	1
1	Temperature	0
2	LED Reserve	0
3	CPU Watchdog	1
4	Operating time warning (100.000 h)	1
5	Battery charge	0
6	Point of reference	0

8.2.5 Profile Version

The diagnostic octets 24 and 25 contain the DP encoder profile version. The octets are subdivided in a revision number and an index.

Example:

Profile version:	1.10	
Octet no.:	24	25
Binary code:	0000 0001	0001 0000
Hex.:	01	10

DDLM_slave_Diag

Octet	24	25
Bit	15 - 8	7 - 0
Data	2^7 - 2^0	2^7 - 2^0
	Revision number	Index
	Profile version	

8.2.6 Software Version

The diagnostic octets 26 and 27 contain information on the software version of the encoder. The octets are subdivided into a revision number and an index.
example:

Software version:	1.00	
Octet no.:	26	27
Binary code:	0000 0001	0000 0000
Hex.:	01	00

DDLM_slave_Diag

Octet	**26**	**27**
Bit	15 - 8	7 - 0
Data	2^7 - 2^0	2^7 - 2^0
	Revision number	**Index**
	Software version	

8.2.7 Operating Time

The encoder tracks the amount of time it has been in operation in 0.1 hr increments. The operating time is indicated as unsigned binary value, the unit being 0.1 hours. The fixed time limit is 100,000 hours.
In case the limit has been exceeded, the encoder issues the respective warning via bit 4, octet 21.

DDLM_slave_Diag

Octet	**28**	**29**	**30**	**31**
Bit	31 - 24	23 - 16	15 - 8	7 - 0
Data	2^{31} - 2^{24}	2^{23} - 2^{16}	2^{15} - 2^8	2^7 - 2^0
	Operating time			

8.2.8 Offset Value

Reads out the value that is offset between the output position and physical position of the encoder. This value is transmitted via diagnostic octets 32 to 35. The data type of the offset value is 32 bit signed in the binary code. The value range is valid for the set measuring range (total number of measuring steps).

DDLM_slave_Diag

Octet	**32**	**33**	**34**	**35**
Bit	31 - 24	23 - 16	15 - 8	7 - 0
Data	2^{31} - 2^{24}	2^{23} - 2^{16}	2^{15} - 2^8	2^7 - 2^0
	Offset Value			

8.2.9 Measuring Steps per Revolution

The scaling parameters are set in the DDLM_Set_Prm (Octet 9-17) dialog.
The parameters are stored and may be read out from the diagnostic octets 40 through 47.
The set resolution of the encoder is indicated by the parameters “measuring steps per revolution“ and “total number of measuring steps“.

The data type for both values is 32 bit, unsigned.

DDLM_slave_Diag

Octet	**40**	**41**	**42**	**43**
Bit	31 - 24	23 - 16	15 - 8	7 - 0
Data	2^{31} - 2^{24}	2^{23} - 2^{16}	2^{15} - 2^{8}	2^{7} - 2^{0}
	Measuring steps per revolution			

8.2.10 Total Number of Measuring Steps

The scaling parameters are set in the DDLM_Set_Prm (Octet 9-17) dialog.
The parameters are stored and may be read out from the diagnostic octets 40 through 47.
The set resolution of the encoder is indicated by the parameters „measuring steps per revolution“ and „total number of measuring steps“.

DDLM_slave_Diag

Octet	**44**	**45**	**46**	**47**
Bit	31 - 24	23 - 16	15 - 8	7 - 0
Data	2^{31} - 2^{24}	2^{23} - 2^{16}	2^{15} - 2^{8}	2^{7} - 2^{0}
	Total number of measuring steps			

8.2.11 Encoder Serial Number

The diagnostic octets 48 through 57 contain the serial number of the encoder as an ASCII string with 10 characters.

DDLM_slave_Diag

Octet	**48 - 57**
Bit	79 - 0
Data	ASCII
	Serial number

9 Bus Connection

9.1 Bus Connection of the Encoder

The data is transferred according to RS-485. A bus line system meeting the requirements of the line type A specification of the EN 50170 standard is used.

The line parameters are as follows

Parameter	Line type A
Surge impedance in Ω	135 ... 165 at a frequency of (3 ... 20 MHz)
Working capacitance (pF/m)	< 30
Loop resistance (Ω/km)	< 110
Core diameter (mm)	> 0.64
Core-cross section (mm^2)	> 0.34

By means of this cable the following linear expansions be obtained:

Transmission speed in kbit/s	9.6	19.2	45.45	93.75	187.5	500	1500	3000	6000	12000
Segment length in m	1200	1200	1200	1200	1000	400	200	100	100	100

The bus structure allows connection and disconnection of stations without requiring the bus to be reinitialized. The transmission speed can be selected for the range of 9.6 kbits/s through 12 Mbits/s. The speed selection applies to all devices on the bus.

At the beginning and at the end of each segment, the DP bus has to be terminated by an active bus termination!
For an interference-free operation, the voltage supply of both bus terminations has to be ensured.

The screen has to be connected on both sides with ground. The power supply lines should also be entirely screened. If this is impossible, appropriate filter methods should be applied

For data rates of more than 500 kbit/s spur lines should be avoided!

9.2 Connection Types

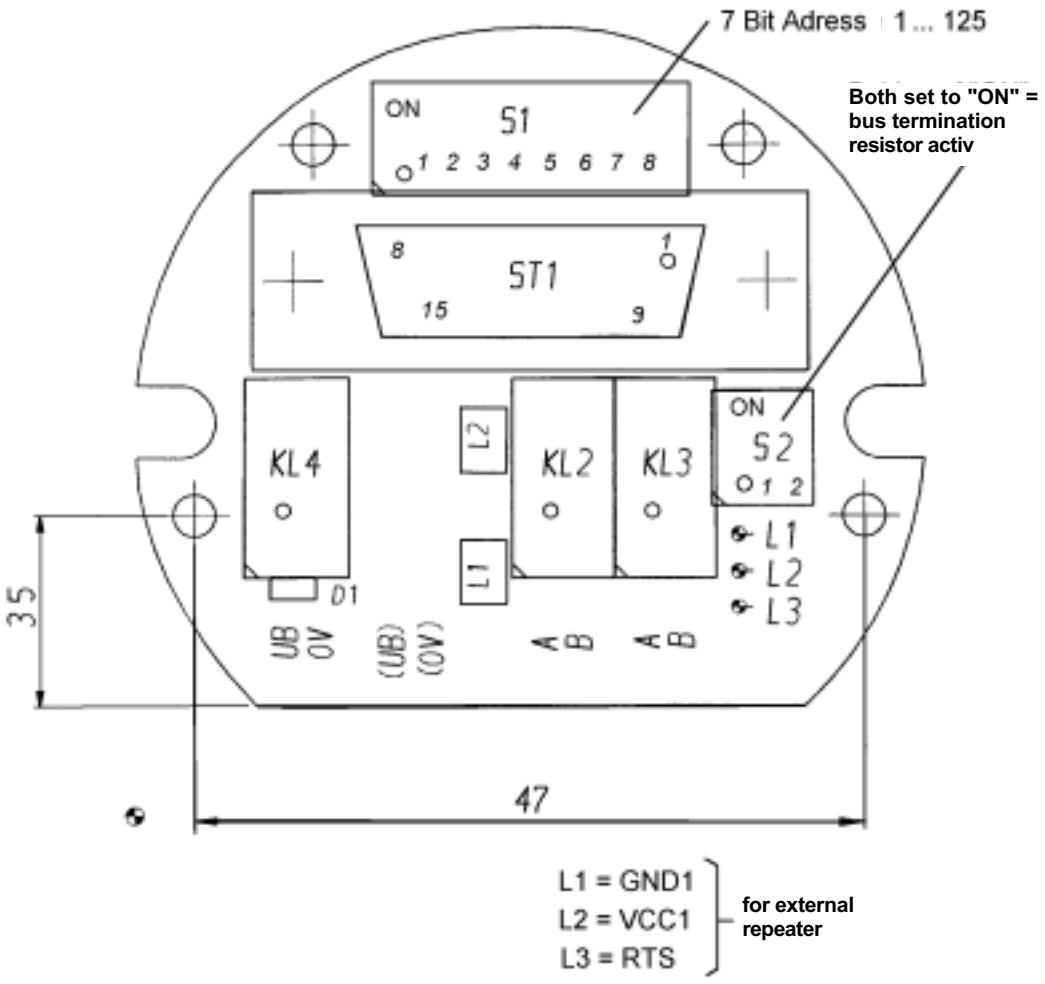
For DP encoders, there are two connection types available:
1. Bus terminal box
2. Connector 2-fold, 12 poles

The A25/A58 is offered with the bus terminal box

9.2.1 Connection Type BusTerminal Box

- Loosen the screws and draw off the bus terminal box from the encoder.
- Lead the incoming bus cables through the middle screw connection and connect it to the terminals A, B according to the inscription.
- In case there are no other devices following within the same bus phase: Activate the bus termination resistor in the bus terminal box (DIP switch 1 and 2 from S2 to „ON“)!
- In case there are other devices following within the same bus phase:
- Lead the continuing cable through the screw connection which is on your right when opening the bus terminal box and connect it to the terminals A, B according to the inscription.
- Lead the encoder voltage supply through the screw connection which is on your left when opening the bus terminal box and connect it to U_B and 0 V.
- Attach the bus terminal box to the encoder and tighten the screws.

Connection Diagram



10 Control Elements

10.1 Setting the device address

The device address is set via the 7 DIP switches on the PCB. The DIP switches will be accessible after the bus terminal box has been separated from the rest of the encoder.

> The encoder only scans the DIP switch positions upon initialization. A modification of the switch posi tion has no effect until the next Reset/ Power up
> The modification will only be accepted if the position of the DIP switches has been modified since the previous Reset. Otherwise the address which has been stored in the EEPROM and which has been possibly programmed with a DPM2 device (class 2 master) via the bus will be preserved.

Switch in ON position = 1

Only DIP switches 1 through 7 (8 has no function) are used. The address of the device may only be set within a range of 1 ... 125 (126 is reserved as default value for devices without DIP switches).

Default device address of 125 has been stored into EEPROM.
To set a new address, the DIP switches must be modified correspondingly and the encoder must be reinitialized (Reset or Power up).
The device address may also be reprogrammed by a DPM2 device (Class 2 master) via the bus.

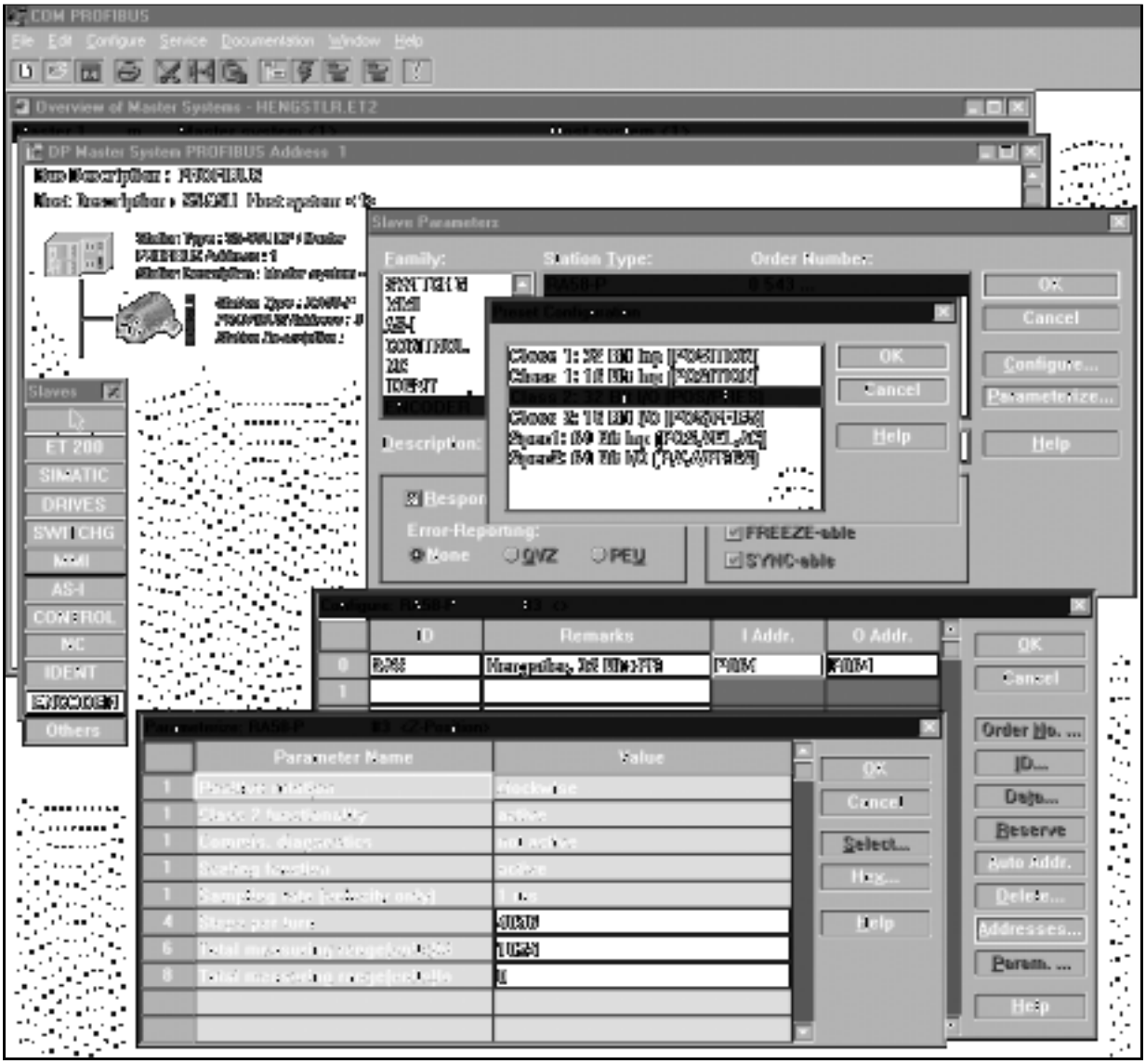
10.2 Activating the bus terminating resistor

:
Set both S2 DIP switches in “ON” position, if the encoder is the last device in line.
Terminator plugs can also be used to terminate the bus
(e. g. Siemens: item no. 6ES5 755-2CA11)

11 Start-up procedure

The A25/A58 can be programmed using standard Profibus-DP tools, by installing a "GSD" file onto the host system. This file can be ordered as a separate line item under part# A25/A58-GSD10, or can be downloaded from the Danaher Controls website at www. dancon.com/absdoc

Example of start-up procedure using Profibus-DP tools with the GSD file



11.1 Installing the GSD files

⇒ Copy the GSD file to your ..\GSD directory
⇒ Copy the bitmap files (RA58—N.BMP and RA58—S.BMP) to your ..\BITMAP directory
⇒ From the File menu, select the “Scan GSD Files” item

11.2 Configuring the master system

⇒ Load an existing program file (“File” menu - ”Open” item) or create a new one (choose from the “File” menu the ”New” item, selecting a corresponding master from the list).

11.3 Configuring the encoder and setting its parameters

⇒ First, from the “Slaves” button bar, choose the “ENCODER” family.
⇒ Then, in the “PROFIBUS Address” window, define the device address for the slave.
⇒ In the ”Slave Parameters” window, select the “RA58-P” station type
⇒ From the “Preset Configuration” list, choose the desired configuration (see table in chapter 5)
⇒ In the “Configure” window, complete the desired entries (Remarks, I Address, O Address)
⇒ Now, in the “Parameterize” window, you may modify the encoder parameters correspondingly (see figure above): Click on the respective field in the “Value” column and activate the “Select …” button.

Parameter indications:

Sampling rate (velocity only): By this bit, the internal encoder timer’s sampling rate will be set to 1 ms or 10 ms. (With 10 ms, the encoder provides larger speed and acceleration values at a low number of turns.)

Steps per turn: The number of measuring steps per turn (resolution) may be adjusted in a range from 1 up to the maximum possible physical resolution.

Total measuring range (units): As an upper limit, indicate the total number of measuring steps. Then, the encoder will stand at zero. The value’s four bytes are split into Low word and High word. (In the figure above, the total value of 67,108,864 [= 26 bit] results from the High word’s setting to 1,024 and the Low word’s setting to 0).
Example: As total measuring range the value 1,000,000 (dec.) shall be entered
Solution (decimal values): 1,000,000 / 2^{16}
= 15 remainder 16,960;

12 Technical Data

Mechanical:

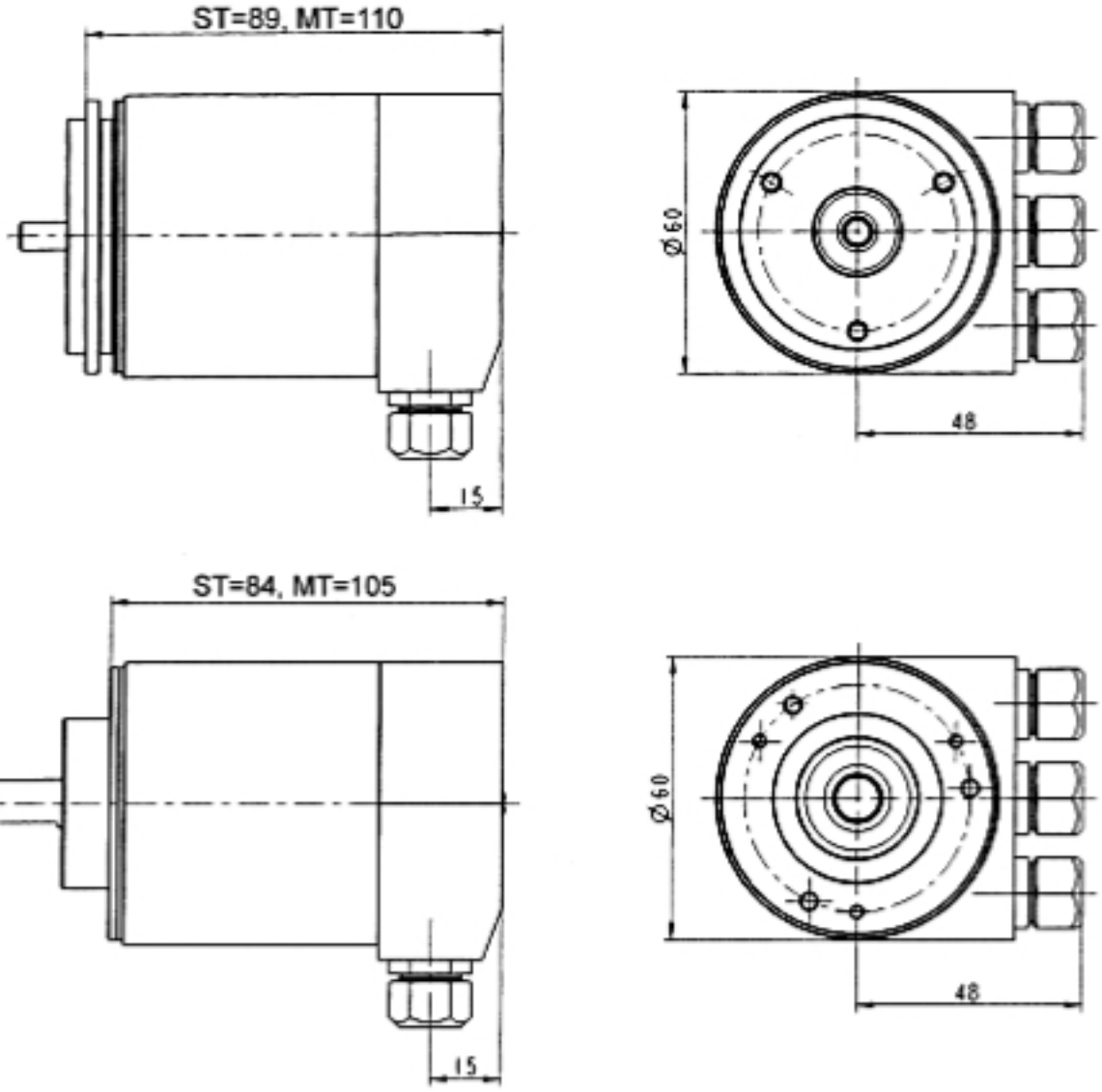
Shaft diameter	A25: 3/8“ A58: 6mm servo mount, 10mm face mount
Max. shaft load	3/8 & 10mm shaft: 24 lbs. Axial, 35 lbs. Radial 6mm shaft: 13 lbs. Axial, 24 lbs. Radial
Maximum speed	10000 rpm (short-time basis), 6000 rpm (continuous duty)
Torque	≤ 0.5 Ncm
Moment of inertia	Servo mount: 14 gcm^2; face & flange mount: 20 gcm^2
Protection class (EN 60529)	IP 65, bearing IP64
Operating temperature	-10 ... +60°C
Storage temperature	-25 ... +85°C
Vibration resistance (IEC 68-2-6)	100 m/s^2 (10 - 500 Hz)
Shock resistance (IEC 68-2-27)	1000 m/s^2 (6 ms)
Connections	Bus terminal box with integrated t-manifold
Housing	Aluminium
Weight	Multi turn 350 g approx., single turn 300 g approx.

Electrical:

General design	according to EN 61010-part 1, protection class III, contamination level 2, overvoltage category II
Supply voltage	10 ... 30 V DC (SELV)
Induced current absorption; Recommended external fuse	typ. 200 mA, max 230 mA T 0.25 A
Current fed-through supply voltage; recommended external fuse	max. 2 A via Pin 7 and 8 at connector 2-fold T 2 A
EMC	Interference emission according to EN 50081-2 Interference immunity according to EN 50082-2
Interface	RS 485
Protocol	Profibus DP with class 2 encoder profile C2 (programmable)
Physical resolution	1024 Increments (10 bit) single turn 4096 Increments (12 bit) single turn 8192 Increments (13 bit) single turn 16384 Increments (14 bit) single turn 4096 Increments/4096 revolutions (24 bit) multi turn 8192 Increments/4096 revolutions (25 bit) multi turn 16384 Increments/4096 revolutions (26 bit) multi turn
Linearity	± _ LSB (± 1 LSB at a resolution of 13, 14, 25, 26 bit)
Type of code	Binary
Baud rate	is automatically set within a range of 9.6 Kbit/s through 12 Mbit/s
Device address	can be set via DIP switches and bus
Programmable functions	Code sequence (direction), resolution per revolution, total resolution, preset, speed, acceleration

13 Dimensional Drawings

Bus terminal box



Explanation: ST = Single turn
MT = Multi turn

14 Ordering Information

Code 1: Model	Code 2: CPR	Code 3: Mechanical	Code 4: Interface	Code 5: Electrical	Code 6: Termination
A25	□□□□	□	□	□	□
Ordering Information					
A25 2.5" Absolute encoder	**1024** 1024 counts/ rev (10 bit) **4096** 4096 counts/ rev (12 bit) **8192** 8192 counts/ rev(13 bit) **0014** 16,398 counts/ rev (14 bit) **1212** 4096 counts/ rev, multiturn (24 bit) **1213** 8192 counts/ rev, multiturn (25 bit) **1214** 16,398 counts/ rev, multiturn (26 bit)	**0** 3/8" Shaft, flange mount	**0** Parallel-Binary (push-pull) **1** Parallel-Gray code (push-pull) **Multi-turn models* must use the following** **D** DeviceNet **P** Profibus **I** Interbus	**0** 5 VDC input power **1** 10 - 30 VDC input power (must be ordered for multi-turn models) **1** 10 - 30 VDC input power	**0** End mount 17 pin connector **1** Side Mount 19 pin connector **M** Integrated bus manifold **E** 5 pin Micro connector* *available only for DeviceNet models, code 4 = D

Code 1: Model	Code 2: CPR	Code 3: Mechanical	Code 4: Interface	Code 5: Electrical	Code 6: Termination
A58	□□□□	□	□	□	□
Ordering Information					
A58 58mm Absolute encoder	**0720** 720 counts/rev **1024** 1024 counts/ rev (10 bit) **4096** 4096 counts/ rev (12 bit) **8192** 8192 counts/ rev(13 bit) **0014** 16,398 counts/ rev (14 bit) **1212** 4096 counts/ rev, multiturn (24 bit) **1213** 8192 counts/ rev, multiturn (25 bit) **1214** 16,398 counts/ rev, multiturn (26 bit)	**0** Face mount 10mm shaft **1** Servo mount 6mm shaft	**0** Parallel-Binary (push-pull) **1** Parallel-Gray code (push-pull) **Industrial Bus Options (listed below)** **D** DeviceNet **P** Profibus **I** Interbus	**0** 5 VDC input power **1** 10 - 30 VDC input power (must be ordered for multi-turn models) **1** 10 - 30 VDC input power	**0** End Exit Cable **2** End exit cable w/ DB37 male connector (must be ordered for multi-turn models) **M** Integrated bus manifold **E** 5 pin Micro connector* *available only for DeviceNet models, code 4 = D

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