Standard Industrial Types Absolute

HENGSTLER ACURO industry

HENGSTLER OPTOASIC inside

Absolute shaft encoders, also known as shaft-angle encoders, are by no means used only to detect angular positions. They are also suitable for linear movements that can be converted into rotary movements by a toothed belt, drive pinion, or wire winch.

The special feature of absolute shaft encoders is that they assign a unique, digitally encoded signal to each individual measured increment. The method of transducing prevents erroneous readings, whether by a power failure, or by a transient malfunction. After the encoder is switched on again, or power is restored, the position can be read out. It is not necessary to move to a reference position, as it is for shaft encoders of the incremental type.

Examples of application for absolute encoders

- overhead support robots
- ventilation flaps
- spinning machines
- conveyor belts
- cam controllers
- injection moulding machines
- packaging machinery
- extruders
- folding machines
- printing machines
- high lift storage systems
- stamping machines

ABSOLUTE ENCODERS FOLLOW THE LATEST TREND: CHANGE EASILY TO ACURO

Absolute encoders save costs and provide enhanced safety - facts that are obviously important in complex installations and multi-axis machinery: Time-consuming reference runs after powering-up the supply voltage have become a thing of the past for absolute encoders. Hazardous conditions caused by reference runs (which are always necessary with incremental encoders) can be prevented right from the start. Absolute encoders - too large, too expensive?

A prejudice that is cleared up by ACURO. Even the multi turn version of ACURO is no larger than most incremental encoders and costs less than you would expect. And how about reliability? Due to their complexity, absolute encoders seem to be susceptible to faults. No problem with ACURO: once installed they will not cause trouble, due to the highest integration density and use of extremely reliable technologies to ensure safe and reliable long-term operation.

Hengstler's new ACURO absolute encoders feature innovative technology, simple operational and optimal functional safety. Their platform concept also allows especially compact dimensions with a modular design, which always ensures the right version for each individual application in the field of motor feedback and automation engineering. Equipped with the new open BiSS interface these encoders are a good and future oriented investment.

The mechanical construction of ACURO is rugged and precise. Double high-precision ball bearings guarantee reliable long-term operation even at speeds of up to 12000 rpm. ACURO is equipped with the commercially available mechanical interfaces, including solid shaft or hub shaft, synchro-flange or clamping flange.

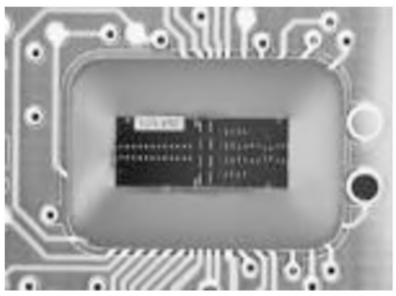
ABSOLUTE ENCODERS ARE DIFFERENTIATED ACCORDING TO:

1 revolution (= 360 °) is coded in n steps. After a rotation of over 360 ° the code is repeated.

Apart from measuring 360 ° (1 revolution) further coded revolutions can be recorded e.g for applications in combination with lead srews or timing belts. Hengstler is using the principle of a mechanical memory (gearbox, which is unmatched in reliability and EMC).

High-Tech Features in a Modular System

INNOVATIVE TECHNOLOGY



Hengstler's ACURO series comprises a complete range of absolute encoders, all in OPTOASIC technology. OPTOASIC units combine all required optical and electronic components in only one silicon chip.

This new technology is tailored to the user's needs and offers advantages previously unknown in the field:

- **High degree of reliability** due to differential scanning and single-step Gray code.
- **Fail-safe** due to the elimination of more than a hundred components
- **Long serviceable lifetime** due to state-of-the-art semiconductor technology-
- High degree of **electromagnetic compatibility** due to elimination of macroscopic low-current paths.

Our new absolute shaft encoders have an excellent price/performance ratio. As a further feature the encoders are fully backward compatible due to identical mounting flanges and electrical interfaces.

This makes it easy for the user to switch from incremental to absolute shaft encoders.

PROGRAMMABLE ABSOLUTE SHAFT ENCODERS

All essential parameters are userprogrammable.
Additional advantages are uncomplicated subsequent data processing, electronic adjustment and add-on optimization of mechanical systems which are subject to tolerances.

Furthermore, storage and maintenance are more cost-efficient: the same encoder may be used for a variety of applications and assigned to its task at the place of installation.

APPLICATIONS

The new encoders are, for example, perfectly suited to determine angular positions in automated systems with reliable and precise operation.
Absolute encoding eliminates the need for a reference run after interruptions (such as power failures).

ACURO is the right match for a wide range of applications - from medical technology, elevators, all printing, paper processing or metal-processing machinery, such as presses and saws, right through to highly-dynamic drives.

INTERFACES

Of course, the user has a selection of the most advanced interface technology available:

- Tristate parallel drivers
  The symmetrical push-pull drivers are fully short circuit proof, overload protected and polarity protected in a range from 10 to 30 V.
  Parallel bus systems are easy to realize. So you save in cabling expenses.

- CAN
  Bus specifications according to CAN High-Speed ISO/DIS 11898 for transfer rates up to 1 MBaud.

- Suconet K1
  Klöckner-Moeller 2 wire fieldbus

- DeviceNet
  - Based on CAN layer 2 (data link layer)
  - Up to 64 nodes and 500 KBaud speed
  - Configuration via network

- INTERBUS
  Interface including the potential-free power supply is already integrated in the housing with a diameter of only 58 mm.

- SSI
  The encoders can also be supplied with synchronous-serial interface (SSI) which is available worldwide.
  This allows trouble-free connection to commercial processing components.

- Profibus DP
  Protocol according to encoder profile class C2 (programmable)

- BiSS
  - bidirectional and fully digital
  - synchronous serial data
  - licence-free
  - up to 8 slaves per master

Profibus-DP

GENERAL INFORMATION

The basic functions of the PROFIBUS DP are here only described in extracts. For additional information, please refer to the standards on PROFIBUS DP, i.e. DIN 19245-3 and EN 50170 respectively.

INTRODUCTION

The AC 58 is an absolute shaft encoder (encoder, angle encoder). The version described in this manual sends its current position to another station via the transmission medium "PROFIBUS DP" (physically: screened and twisted pair line). The AC 58 supports all class 1 and 2 functions listed in the encoder profile.

PROFIBUS-DP is manufacturer independent, open field bus standard for a variety of applications in the field of production, process and building services automation. The requirements of openness and independence from the manufacturer are stipulated in the European standard EN 50 170.

PROFIBUS-DP permits the communication of devices produced by different manufacturers without any particular adaptations of the interfaces.
PROFIBUS DP is a special standard version for a quick data exchange within the field level which has been optimised in terms of speed and low connection costs. Central control systems like, for example SPC/ PC communicate via a quick, serial connection with local field devices like drives, valves, or encoders. The data exchange between these devices is predominantly cyclical. The communication functions required for this exchange are determined by the basic functions of the PROFIBUS DP according to the EN 50 170 European standard.

FIELD OF APPLICATION

In systems, where the position of a drive or of any other part of a machine has to be recorded and signalled to the control system, the AC 58 can assume this function.

The AC 58 can resolve, for instance, positioning tasks by sending the checkback signal concerning the present drive position via the PROFIBUS DP to the positioning unit.

BASIC FUNCTIONS OF THE PROFIBUS-DP

The central control system (master) cyclically reads out the input information from the slaves and writes the output information to the slaves. For this purpose, the bus cycle time has to be shorter than the program cycle time of the central SPC, which amounts to approx. 10 ms for various applications.

Apart from the cyclical user data transfer, the PROFIBUS DP version also disposes of powerful functions for diagnosis and initial operation procedures. The data traffic is controlled by watchdog functions on both the slave and the master side. The following table summarises the basic functions of the PROFIBUS DP.

Profibus-DP

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 are being 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. Powerful diagnostic functions, 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 analogue input/ output, drives, valves

ESSENTIAL FEATURES/ 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 bythe factthatthe input and output data within a message cycle are transferred by using the layer 2 SRD service (Send and Receive Data Service).

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

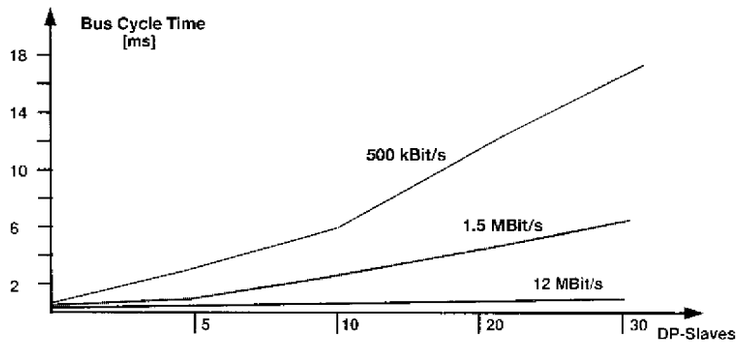
Profibus-DP

BASIC FEATURES/SPEED

Station-related diagnosis
Messages on the general readiness for service of a station, like for example, overtemperature or undervoltage.

Module-related diagnosis
Theses messages indicate that a diagnosis within a certain I/O part (e.g. 8 Bit output module) of a station is in hand.

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



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

CONFIGURATION OF THE SYSTEM AND DEVICE TYPES

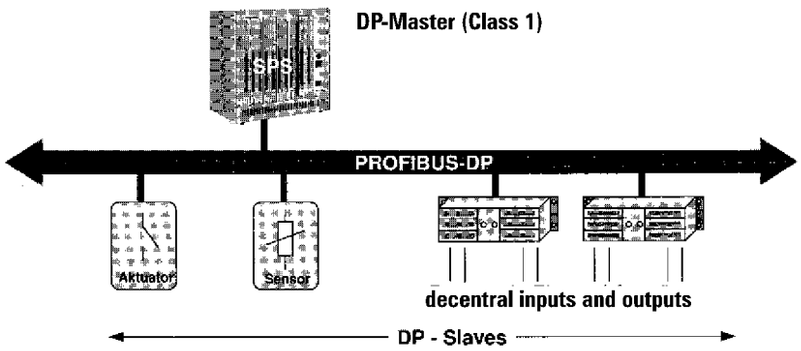
By means of PROFIBUS DP, mono- and mulitmaster systems can be realised. For this reason, a high level of flexibility in terms of the system configuration can be achieved. A maximum of 126 devices (master or slaves) may be connected to a bus. The definitions for the system configuration contain the number 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, or to operate the plants in the course of operation.

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 information is device specific and must not exceed 246 byte for the input and 246 byte for the output data.

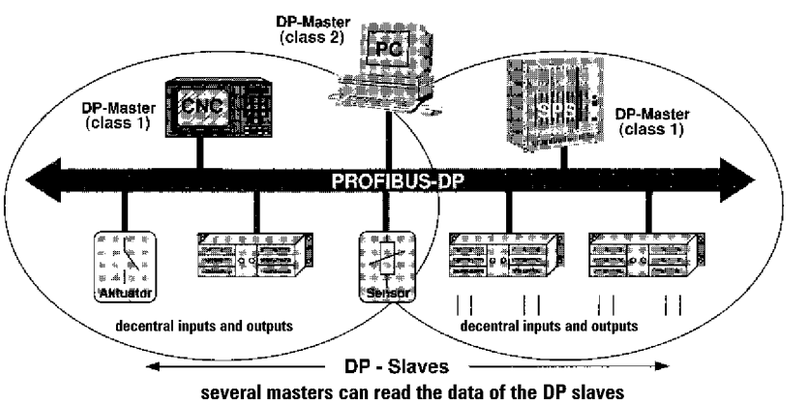
Profibus-DP



PROFIBUS DP monomaster system

In the case of monomaster bus systems, there is only one master active at bus during the on-line phase of the bus system. The above diagram shows the system configuration of a monomaster system.
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. By using this system configuration, the shortest bus cycle time can be obtained.

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 DPM1 during project planning, is able to write the output information. Multimaster systems attain a medium bus cycle time.



PROFIBUS-DP Multi-Master System

Profibus-DP

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 the project planning device. 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.

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

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.

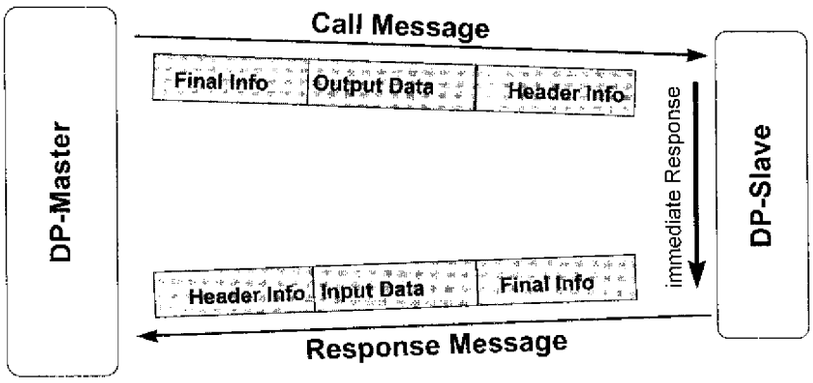
CYCLICAL DATA TRANSFER BETWEEN DPM1 AND THE DP SLAVES

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.

Profibus-DP



User data communication for PROFIBUS-DP

DATA TRAFFIC BETWEEN DPM1 AND PROJECT PLANNING DEVICES

In addition to the functions between DP master and DP slaves, master-master communication functions are available, see table. 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 DPM1.

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
Functional overview for the master-master functions for PROFIBUS DP

Profibus-DP

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 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 have been 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.

PROTECTIVE MECHANISMS

For reasons of safety, it is necessary to equip PROFIBUS DP with powerful protective functions against false parametrisation or failure of the transmission equipment. For this purpose, control mechanisms at the DP master and the DP slave have been realised, taking the form of time-out circuits. The monitoring interval is determined during project planning.

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 released, 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.

COMMUNICATION INTERFACE

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

Within this interface the class 1 functions are included.

For further information see:
www.profibus.de