

JUMO dTRON 316



JUMO dTRON 308



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JUMO dTRON 304

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Compact Controller
with program function

B 70.3041.2.3
Interface Description
PROFIBUS-DP

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1.1 Preface

These operating instructions are addressed to equipment manufacturers with appropriate technical training and PC knowledge.



Please read this Interface Description before starting to work with PROFIBUS-DP. Keep the interface description in a place which is accessible to all users at all times. Your comments will help us improve this interface description, where necessary.

Phone: +49 661 6003-0

Fax: +49 661 6003-607

e-mail: mail@jumo.net

Warranty



All necessary settings are described in this manual. If any difficulties should arise during commissioning, you are asked not to carry out any manipulations that are not described in these operating instructions. You could endanger your rights under the instrument warranty. Please contact the nearest subsidiary or the head office in such a case.

Electrostatic charge



When carrying out work inside the instrument, and when returning modules, assemblies or components, the regulations of EN 61340-5-1 and EN 61340-5-2 "Protection of electronic devices from electrostatic phenomena" must be observed. Only use **ESD** packaging for transport.

Please note that we cannot accept any liability for damage caused by ESD (electrostatic discharge).

1 Introduction

1.2 Typographical conventions

1.2.1 Warning signs

Danger



This sign is used when there may be **danger to personnel** if the instructions are ignored or not followed correctly!

Caution



This sign is used when there may be **damage to equipment or data** if the instructions are ignored or not followed correctly!

ESD



This sign is used where special care is required when handling **components liable to damage through electrostatic discharge**.

1.2.2 Note signs

Note



This sign is used when your **special attention** is drawn to a remark.

Reference



This sign refers to **further information** in other manuals, chapters or sections.

Footnote

abc¹

Footnotes are remarks that **refer to specific points** in the text. Footnotes consist of two parts: A marker in the text, and the footnote text itself. The markers in the text are arranged as continuous superscript numbers.

1.2.3 Performing an action

Action instruction

*

This sign indicates that an **action to be performed** is described. The individual steps are marked by this asterisk, e.g.

- * Start the PLC software
- * Click on hardware catalog

Vital text



This text contains important information, and it is vital that you read it before going any further.

Command sequence

File → Save as

Small arrows between the words indicate a **sequence of commands** which must be performed one after another.

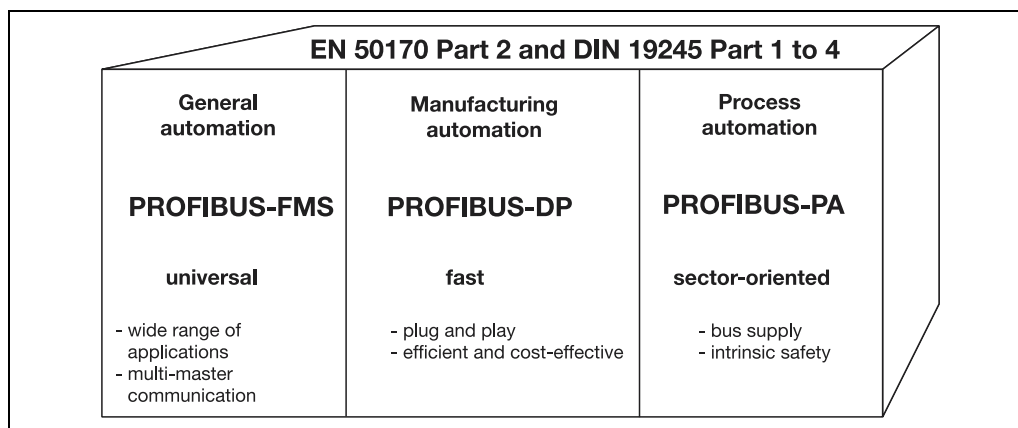
1 Introduction

2 PROFIBUS-DP description

PROFIBUS-DP is a manufacturer-independent, open fieldbus standard for a wide range of applications in manufacturing, process and building automation. Manufacturer independence and openness are ensured by the international standards IEC 61158 and IEC 61784.

Using PROFIBUS-DP, devices from different manufacturers can communicate without any special interface adjustments. PROFIBUS-DP can be employed for both high-speed time-critical data transmission and extensive, complex communications tasks. The PROFIBUS-DP family consists of three variants.

2.1 Profibus types



The PROFIBUS family

PROFIBUS-DP

This PROFIBUS variant, which is optimized for high speed and low connection costs, has been especially designed for communication between automation control systems (PLC) and distributed field devices (typical access time < 10msec). PROFIBUS-DP can be used to replace conventional, parallel signal transmission with 24V or 0/4 – 20mA.

DPV0: cyclic data transfer:
--> is supported by all JUMO instruments (devices).

DPV1: cyclic and acyclic data transfer:
--> is not supported by JUMO instruments (devices).

DPV2: slave-to-slave communication takes place in addition to cyclic and acyclic data transfer:
--> is not supported by JUMO instruments (devices).

PROFIBUS-PA

PROFIBUS-PA has been specifically designed for process engineering. It permits the linking of sensors and actuators to a common bus cable, even in hazardous areas. PROFIBUS-PA enables data communication and energy supply for devices in two-wire technology according to MBP (Manchester Bus Powering) specified in the international IEC 61158-2 standard.

PROFIBUS-FMS

This is the universal solution for communication tasks at cell level (typical access time: approx. 100msec). The powerful FMS services open up a wide range of applications and provide a high degree of flexibility. FMS is also suitable for extensive communication tasks.

2 PROFIBUS-DP description

2.2 RS485 transmission technology

Transmission takes place according to the RS485 standard. It covers all areas in which high transmission speed and simple, cost-effective installation are required. A shielded twisted copper cable with one conductor pair is used.

The bus structure permits addition and removal of stations or step-by-step commissioning of the system without affecting the other stations. Later expansions have no influence on the stations which are already in operation.

Transmission speeds between 9.6kbit/sec and 12Mbit/sec are available. One uniform transmission speed is selected for all devices on the bus when the system is commissioned.

Basic characteristics

Network topology	linear bus, active bus termination at both ends, stub cables are only permissible for baud rates <1.5 Mbit/sec.
Medium	shielded twisted-pair cable
Number of stations	32 stations in each segment without repeater (line amplifier). With repeaters, this can be expanded to 126 (a maximum of 9 repeaters is possible)
Connector	preferably 9-pin sub-D connector

Structure

All devices must be connected in a line structure (one after another). Up to 32 stations (master or slaves) can be linked up within one segment. If there are more than 32 stations, repeaters must be used to further increase the number of devices, for instance.

Cable length

The maximum cable length depends on the transmission speed. The cable length specified can be extended by using repeaters. It is recommended not to connect more than 3 repeaters in series.

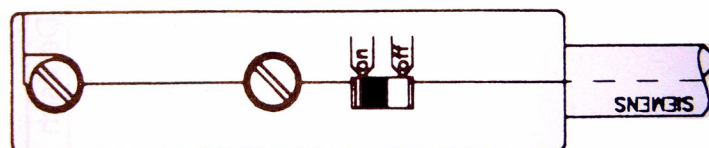
Baud rate (kbit/sec)	9.6	19.2	93.75	187.5	500	1500	12000
Range/segment	1200 m	1200 m	1200 m	1000 m	400 m	200 m	100 m

Range based on transmission speed

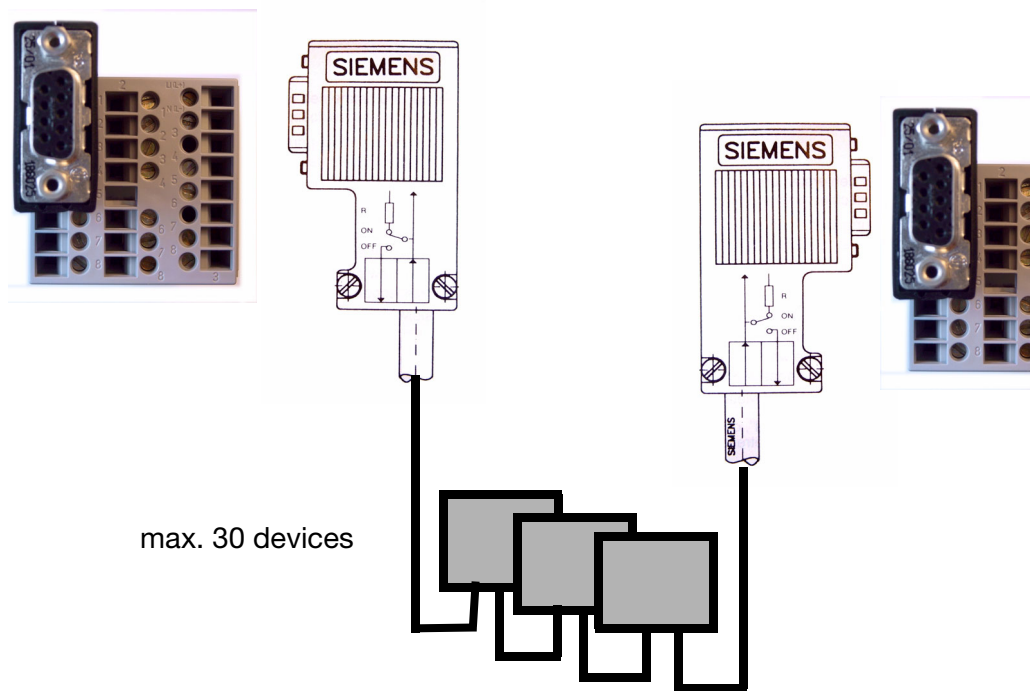
Bus termination

The bus is terminated by termination resistors at the start and end of each segment.

Both bus terminators must always be powered, to ensure fault-free operation. The termination resistors are located in the Profibus connectors and can be activated by setting the slide switch to ON.



2 PROFIBUS-DP description



Cable data

These cable length specifications refer to the cable type A described below:

Characteristic impedance:	135 — 165 Ω
Capacitance per unit length:	< 30 pf/m
Loop resistance:	110 Ω /km
Core dia.:	0.64 mm
Core cross-section:	> 0.34 mm ²

It is preferable to use a 9-pin sub-D connector for PROFIBUS networks incorporating RS485 transmission technology. The PIN assignment at the connector and the wiring are shown at the end of this chapter.

PROFIBUS-DP cables and connectors are supplied by several manufacturers. Please refer to the PROFIBUS product catalog (www.profibus.com) for types and addresses of suppliers.

When connecting up the devices, make sure that the data lines are not reversed. It is absolutely essential to use shielded data lines. The braided shield and the screen foil underneath (if present) should be connected to the protective earth on both sides, and with good conductivity. Furthermore, the data lines should be routed separately from all high-voltage cables, as far as this is possible.

As a suitable cable we recommend the following type from Siemens:

Simatic Net Profibus 6XV1

Order No. 830-0AH10

*** (UL) CMX 75 °C (Shielded) AWG 22 ***

2 PROFIBUS-DP description

Data rate

For installation, the use of stub cables must be avoided for data rates above 1.5 Mbit/sec.



For important notes on installation, please refer to the Installation Guidelines PROFIBUS-DP, Order No. 2.111 by the PNO (Profibus Nutzerorganisation).

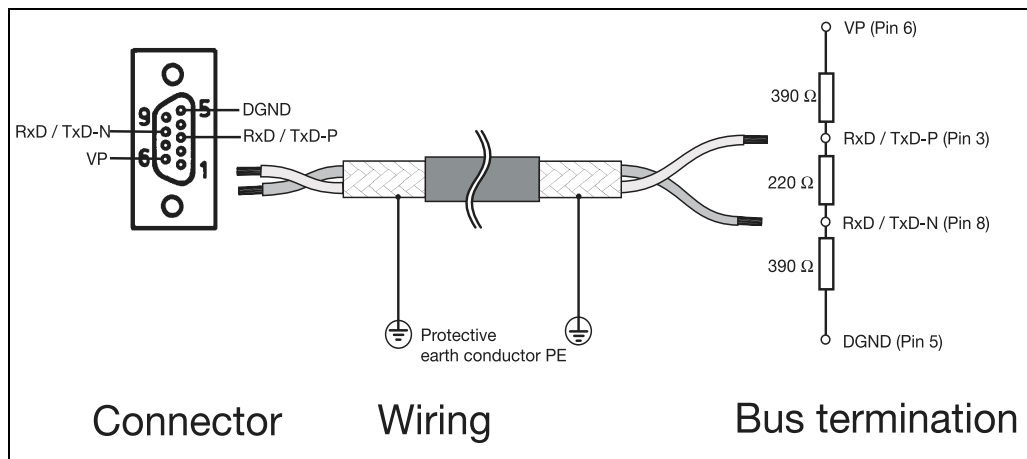
Address:
Profibus Nutzerorganisation e.V.
Haid- u. Neu-Straße 7
D-76131 Karlsruhe, Germany

Internet: www.profibus.com

Recommendation:

Please follow the installation recommendations made by the PNO, especially for the simultaneous use of frequency inverters.

Wiring and bus termination



2 PROFIBUS-DP description

2.3 PROFIBUS-DP

PROFIBUS-DP is designed for high-speed data exchange at the field level. The central control devices, PLC/PC for instance, communicate through a fast serial connection with distributed field devices such as I/O, paperless recorders and controllers. Data exchange with these distributed devices is mainly cyclic. The communication functions required for this are defined by the basic PROFIBUS-DP functions in accordance with IEC 61158 and IEC 61784.

Basic functions

The central controller (master) reads the input information cyclically from the slaves and writes the output information cyclically to the slaves. The bus cycle time must be shorter than the program cycle time of the central PLC. In addition to cyclic user data transmission, PROFIBUS-DP provides powerful functions for diagnostics and commissioning.

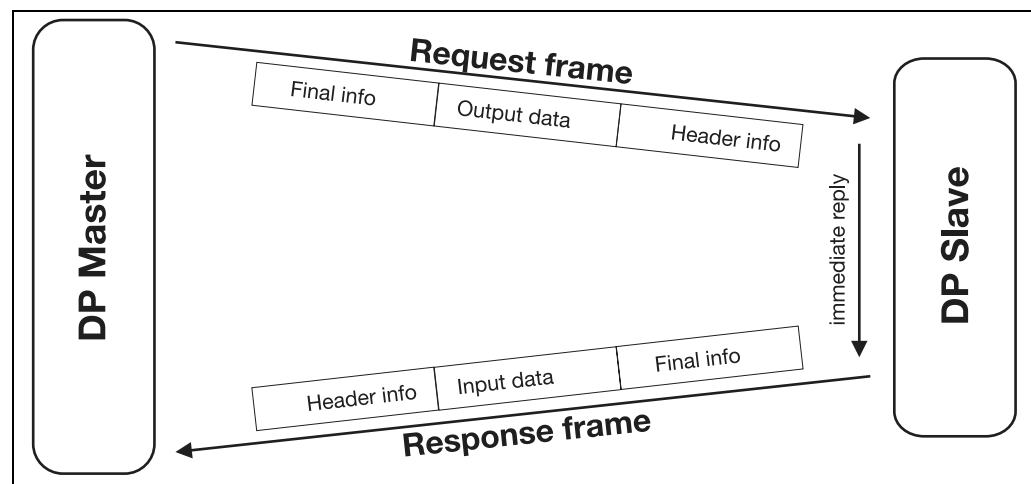
Transmission technology <ul style="list-style-type: none">• RS485 twisted pair• Baud rates of 9.6 kbit/sec up to 12 Mbit/sec
Bus access <ul style="list-style-type: none">• Master and slave devices, max. 126 stations on one bus
Communication <ul style="list-style-type: none">• Peer-to-peer (user data communication)• Cyclic master-slave user data communication
Operating states <ul style="list-style-type: none">• Operate: Cyclic transmission of input and output data• Clear: Inputs are read, outputs remain in secure state• Stop: Only master-master data transfer is possible
Synchronization <ul style="list-style-type: none">• Sync mode: not supported by JUMO devices• Freeze mode: not supported by JUMO devices
Functionality <ul style="list-style-type: none">• Cyclic user data transfer between DP master and DP slave(s)• Dynamic activation or deactivation of individual DP slaves• Checking the configuration of the DP slaves• Address assignment for the DP slaves via the bus• Configuration of the DP master via the bus• Maximum of 246 bytes input/output data for each DP slave
Protective functions <ul style="list-style-type: none">• Address monitoring for the DP slaves• Access protection for inputs/outputs of the DP slaves• Monitoring of user data communication with adjustable monitoring timer in the DP master
Device types <ul style="list-style-type: none">• DP master Class 2, e. g. programming/project design devices• DP master Class 1, e. g. central automation devices such as PLC, PC...• DP slave e. g. devices with binary or analog inputs/outputs, controllers, recorders...

2 PROFIBUS-DP description

Cyclic data transmission

The data transmission between the DP master and the DP slaves is carried out by the master in a defined, recurring order. When configuring the bus system, the user defines the assignment of a DP slaves to the master. It is also defined which DP slaves are to be included in, or excluded from, the cyclic user data communication.

Data transmission between the master and the DP slaves is divided into three phases: parameterization, configuration and data transfer. Before a DP slave enters the data transfer phase, the DP master checks in the parameterization and configuration phase whether the planned configuration matches the actual device configuration. In the course of this check, the device type, format and length information, as well as the number of inputs and outputs must agree. These checks provide the user with reliable protection against parameterization errors. In addition to the user data transfer, which is performed automatically by the DP master, new parameterization data can be sent to the DP slaves at the request of the user.



User data transmission in PROFIBUS-DP

3 Configuring a PROFIBUS-DP system

3.1 The GSD file

Device data (GSD) enable open project design.

PROFIBUS-DP devices have different performance features. They differ with respect to the available functionality (e. g. number of I/O signals, diagnostic messages) or possible bus parameters, such as baud rate and time monitoring. These parameters vary individually for each device type and manufacturer. In order to obtain simple Plug & Play configuration for PROFIBUS-DP, the characteristic device features are defined in an electronic data sheet (device data base file, GSD file). The standardized GSD files expand open communication up to the operator level. By means of the project design tool, which is based on the GSD files, devices from different manufacturers can be integrated into a bus system, simply and user-friendly. The GSD files provide a clear and comprehensive description of a device type in a precisely defined format. GSD files are prepared according to the application. The defined file format permits the project design system to simply read in the device data of any PROFIBUS-DP device and automatically use this information when configuring the bus system. Already during the project design phase, the project design system can automatically perform checks for input errors and the consistency of data entered in relation to the entire system.

The GSD files are divided into three sections.

- **General specifications**
This section contains information on manufacturer and device names, hardware and software release states and the baud rates supported.
- **DP master-related specifications**
This section contains all the parameters related to DP master devices only, such as the maximum number of DP slaves that can be connected, or upload and download options. This section is not available for slave devices.
- **DP slave-related specifications**
This section contains all slave-related specifications, such as the number and type of I/O channels, specifications of diagnostic texts and information on the consistency of I/O data.

The GSD file contains lists, such as the baud rates supported by the device, as well as the possibility of describing the modules available in a modular device.

3 Configuring a PROFIBUS-DP system

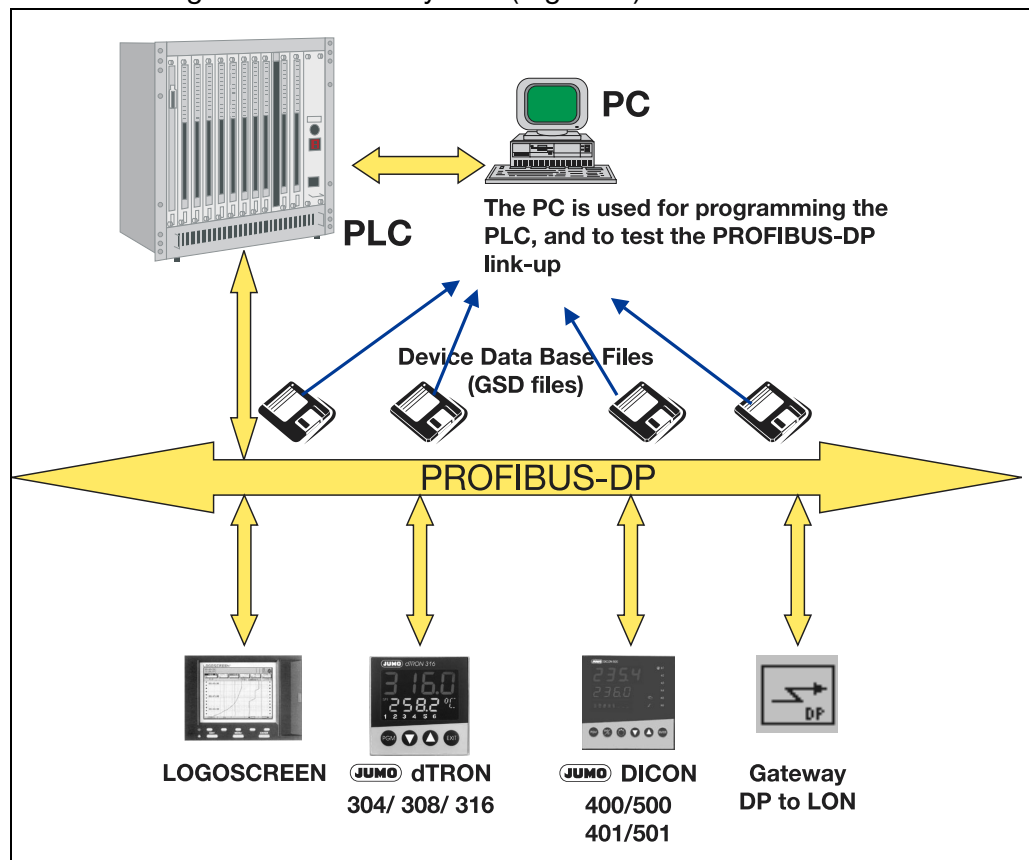
3.2 Configuration procedure

Plug & Play

To simplify the configuration of the PROFIBUS-DP system, the DP master (PLC) is configured using the PROFIBUS-DP configurator and the GSD files, or in the PLC through the hardware configurator.

Configuration steps:

- Create GSD file by using the GSD generator
- Load GSD files of the PROFIBUS-DP slaves into the PROFIBUS-DP network configuration software
- Perform configuration
- Load configuration into the system (e.g. PLC)



The GSD file

The characteristic device features of a DP slave are specified by the manufacturer, clearly and comprehensively in a precisely defined format, in the GSD file (Device Data Base File).

The PROFIBUS-DP configurator / hardware configurator (PLC)

This software can read in the GSD files from PROFIBUS-DP devices of any manufacturer and integrate them for the configuration of the bus system.

Already in the project design phase, the PROFIBUS-DP configurator automatically checks the files that have been entered for errors in system consistency.

The result of the configuration is read into the DP master (PLC).

3 Configuring a PROFIBUS-DP system

3.3 The GSD generator

3.3.1 General

GSD files for JUMO devices with a PROFIBUS-DP interface are generated by the user with the aid of the GSD generator. The devices with a PROFIBUS-DP interface that are available from JUMO can send or receive a large variety of variables (parameters). Since, however, in most applications, only a portion of these variables will be sent via PROFIBUS-DP, the GSD generator is used to make a selection of these variables.

After selection of the device, all available variables are shown in the “Parameters” window. Only after these have been copied to the “Input” or “Output” window will they later be contained in the GSD file for processing or preprocessing by the DP master (PLC).

3.3.2 Operation

The screenshot shows the 'Untitled - JUMO GSD Generator' window. On the left is a tree view of parameters under 'Parametrieren', including folders like 'Regler', 'Programm', 'Timer', and 'Binaer'. The 'Binaer' folder is expanded, showing items like 'Limitkomparatoren 0x0024' which is highlighted. On the right are two text boxes: 'Eingang SPS' containing 'Interface-Status', 'Binaer|Binärsignale 0x0026', and 'Binaer|Limitkomparatoren 0x0024'; and 'Ausgang SPS' which is empty. Between these boxes are two sets of left and right arrow buttons. At the bottom, there is a 'Gerät:' field with 'JUMO dTRON 304/308/316' and an 'Ende' button.

File menu

Window with available parameters

Input window (input for master/PLC)

Output window (output for master/PLC)

These addresses are described in the MODBUS interface description.
⇒ B 70.3041.2

Device name for hardware catalog
If different GSD files are required for devices of the same type, this standard name should be altered in such a way as to enable an unambiguous assignment of the Profibus master in the hardware configuration.

Delete entry from input window

Delete entry from output window

Close program

3 Configuring a PROFIBUS-DP system

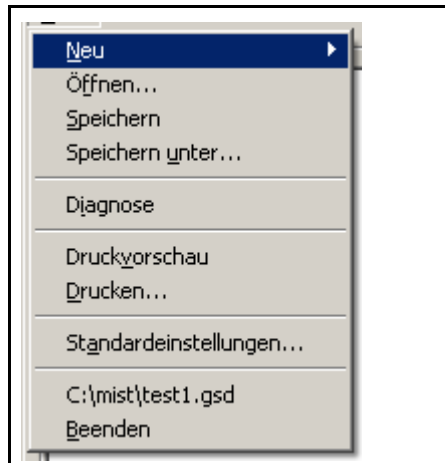


When using SIEMENS Simatic S7 for project design, the file names in the GSD file must not be longer than 8 characters.

GSD files with long file names cannot be entered into the hardware catalog of the PLC.

File menu

The file menu can be called up by using the Alt-D combination or the left mouse button. It provides the following options:



New	After calling up the function which creates a new GSD file, the available devices are selected. After selection of the required device, all available parameters are shown in the parameter window.
Open	This function opens an existing GSD file.
Save/ Save as	This function is available for saving the generated or altered GSD file.
Diagnosis	Using this function, the GSD file can be tested in conjunction with a PROFIBUS-DP master simulator from B+W and the Profibus slave.
Print preview	shows the preview of a report ¹ , that can be printed.
Print	prints a report ¹ .
Default settings	The language to be used at the next restart of the program can be selected here.
Exit	exits the program.



1. The report contains additional information for the PLC programmer (e.g. data type of the selected parameters).

⇒ Chapter 3.3.3 "Example report"

3 Configuring a PROFIBUS-DP system

3.3.3 Example report

I/O Report

Gerät: JUMO dTRON 304/308/316

Länge der Eingänge (Byte): 27

Länge der Ausgänge (Byte): 6

Eingänge

Byte	Beschreibung	Type
[0]	Interface-Status	BYTE
[1]	Regler\Istwert	REAL
[5]	Regler\Sollwert	REAL
[9]	Regler\Regelabweichung	REAL
[13]	Regler\Stellgradanzeige	REAL
[17]	Regler\1.Reglerausgang	REAL
[21]	Regler\Schaltstellung 2	INTEGER
[23]	Timer\Timerrestzeit1	LONG

Ausgänge

Byte	Beschreibung	Type
[0]	Sollwerte\Sollwert 1	REAL
[4]	Regler\Handstellgrad	INTEGER

3 Configuring a PROFIBUS-DP system

3.3.4 Arrangement of a GSD file

```
;; =====
; GSD file Gateway PROFIBUS-DP
; JUMO dTRON 300
; Release 08.07.2005
; =====
;
;
;
#Profibus_DP
GSD_Revision = 2 ;extended GSD file is supported
; ;according to PNO directive of 14.12.95
Vendor_Name = "JUMO" ;name of the manufacturer
Model_Name = "dTRON 3xx" ;name of the DP device
Revision = "revision level 2.0" ;actual edition of the DP device
Ident_Number = 0x09AB ;exact type designation of the DP device
Protocol_Ident = 0 ;protocol characteristics PROFIBUS-DP
Station_Type = 0 ;DP slave
FMS_supp = 0 ;DP device only
Hardware_Release = "1.00" ;actual edition of the hardware
Hardware_Release = "1.00" ;actual edition of the hardware
; ;the following baud rates are supported
9.6_supp = 1 ; 9.6 kbaud
19.2_supp = 1 ; 19.2 kbaud
; ; 31.25 kbaud (PA)
45.45_supp = 1 ; 45.45 kbaud
93.75_supp = 1 ; 93.75 kbaud
187.5_supp = 1 ; 187.5 kbaud
500_supp = 1 ; 500 kbaud
1.5M_supp = 1 ; 1.5 Mbaud
3M_supp = 1 ; 3 Mbaud
6M_supp = 1 ; 6 Mbaud
12M_supp = 1 ; 12 Mbaud
;
MaxTsd_r_9.6 = 60
MaxTsd_r_19.2 = 60
; ; 31.25 kbaud (PA)
MaxTsd_r_45.45 = 60
MaxTsd_r_93.75 = 60
MaxTsd_r_187.5 = 60
MaxTsd_r_500 = 100
MaxTsd_r_1.5M = 150
MaxTsd_r_3M = 250
MaxTsd_r_6M = 350
MaxTsd_r_12M = 800
;
Redundancy = 0 ;no redundant transmission
Repeater_Ctrl_Sig = 1 ;Plug signal CNTR-P TTI level
24V_Pins = 0 ;Plug signals M24V and P24 V not connected
Implementation_Type = "SPC3" ;Application of ASIC SPC3
;
;
```

3 Configuring a PROFIBUS-DP system

```
;
;
;      ,*** Slave specific values ***
Freeze_Mode_supp = 0      ;Freeze mode is not supported
Sync_Mode_supp = 0       ;Sync mode is not supported
Auto_Baud_supp = 1       ;Automatic recognition of baud rate
Set_Slave_Add_supp = 1   ;Set_Slave_Add is supported
Min_Slave_Interval = 6   ;Slave interval = 0.6 ms
Modular_Station = 1      ;Modular station
Max_Module = 4
Max_Diag_Data_Len = 6    ;
Slave_Family = 5        ;
;
;
;      ,*** Parameterization ***
;
;These lines are for locating PBC file, and initial data length.
;Do not disturb!!!
;atPBC_File = C:\PROGRAMS\JUMO\GSDGEN\14401XX\D\ju_d300.PBC
;atINIT_LEN = 2
;
;
User_Prm_Data_Len = 16
User_Prm_Data = 0x00, 0x03, 0x02, 0x01, 0x13, 0x00, 0x43, 0x04, 0x17, 0x20, \
0x10, 0x08, 0x27, 0x20, 0x00, 0x08
Max_Input_Len = 13
Max_Output_Len = 8
Max_Data_Len = 21
;===== Input Master =====
Module = "Interface Mode" 0x10
Preset = 1
Endmodule
Module = "Controller/Process value" 0x13
Preset = 1
Endmodule
Module = "acycl. Data/Block-Read" 0x17
Preset = 1
Endmodule
;===== Output Master =====
Module = "acycl. Data/Block-Write" 0x27
Preset = 1
Endmodule
```

The GSD file has been arranged for installation on the SIMATIC S7 (SIEMENS).

Should installation problems occur with other controls, all entries Preset=1 must be deleted.

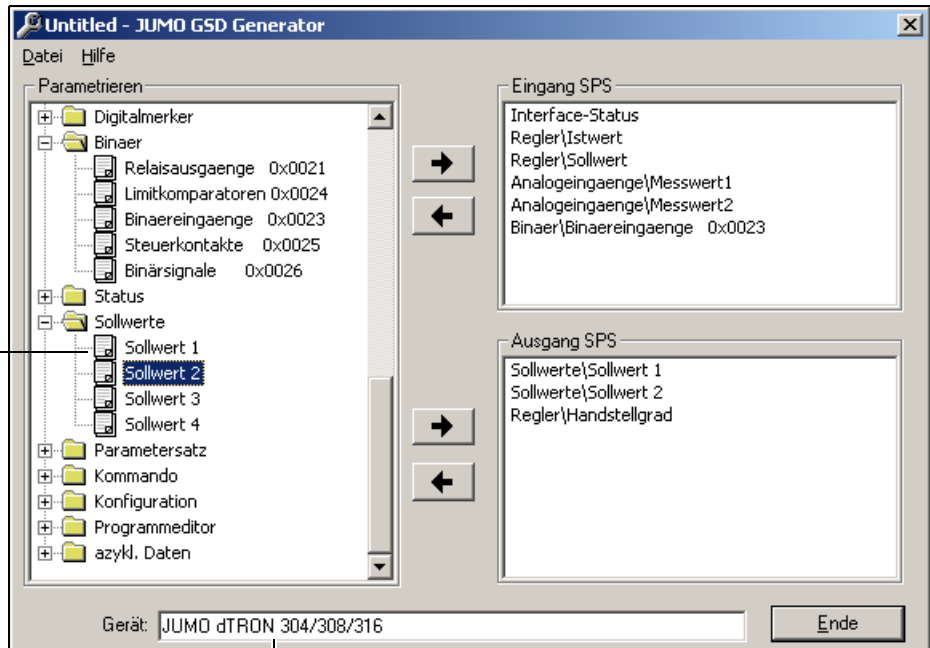
In this case, it is additionally necessary to set up the variables selected in the GSD generator in the correct sequence in the process image of the PLC.

3 Configuring a PROFIBUS-DP system

Select parameter

If an existing file has been opened, or a new one created, all available parameters are shown in the parameter window.

These addresses are described in the MODBUS interface description.
⇒ B 70.3041.2




Device name for hardware catalog

If different GSD files are required for devices of the same type, this standard name should be altered in such a way as to enable an unambiguous assignment of the Profibus master in the hardware configuration.

A click with the left mouse button on the “+” (⊕) (Regler) or “-” (⊖) (Sollwerte) symbol will extend the parameter list or reduce it.

Click on the parameter with the left mouse button, and, keeping it pressed, copy it to the input or output window by Drag & Drop.

Remove parameter

Parameters are deleted from the input or output window by using the left-pointing arrow  .



The parameter “Interface status” will automatically appear in the input window and cannot be deleted. It is used for diagnosis of the internal data transmission in the device and should be evaluated by the PLC program, to make sure the data are valid.

- 0 : internal communication in device is OK
- unequal 0 : faulty communication in device

3 Configuring a PROFIBUS-DP system

3.4 Connection example

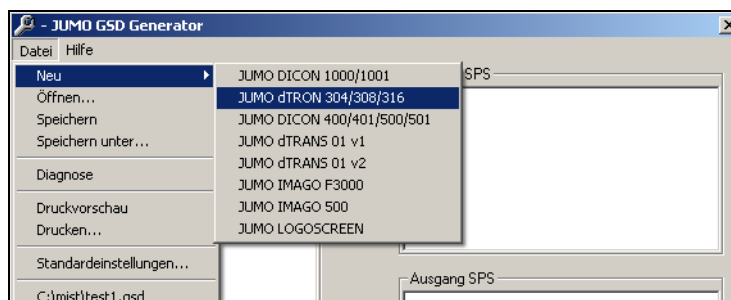
The example below shows the path for the connection of a JUMO controller (dTRON 3XX) to a SIMATIC S7.

3.4.1 dTRON 3XX

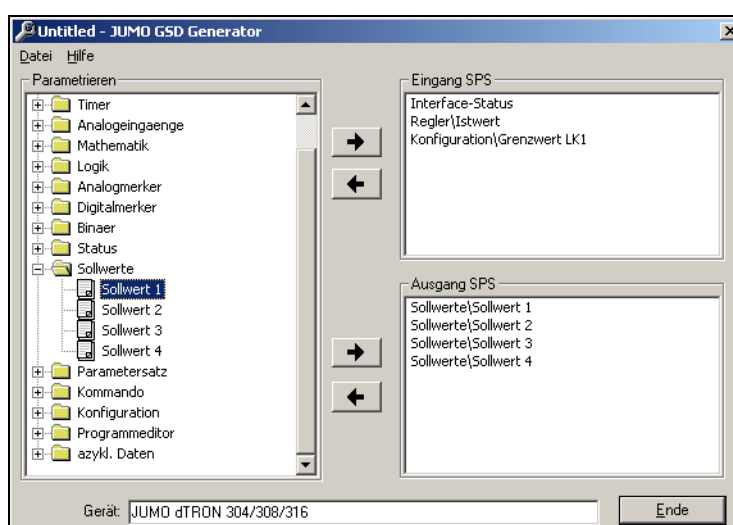
- * Connect the device to the PLC.
- * Set the device address.
The device address can be selected via the instrument keys or through the setup program.

3.4.2 JUMO GSD generator

- * Start up the GSD generator (Example: *Start* → *Programs* → *JUMO devices* → *PROFIBUS* → *JUMO GSD generator*).
- * First select the device.

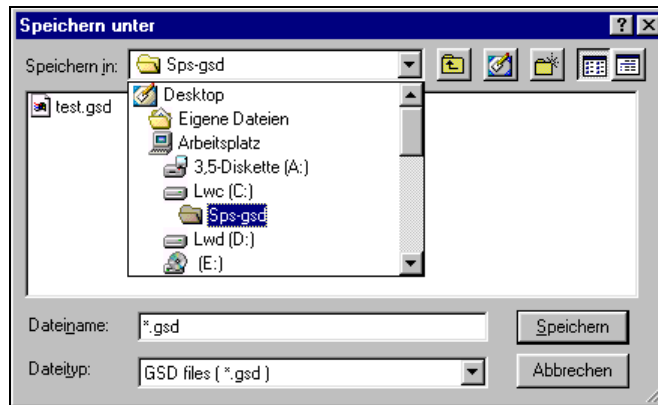


- * In the left window, select the variable that is to be transmitted to the DP master
- * Click on the direction arrow and the variable appears in the right window, or move to the right window by Drag&Drop.



3 Configuring a PROFIBUS-DP system

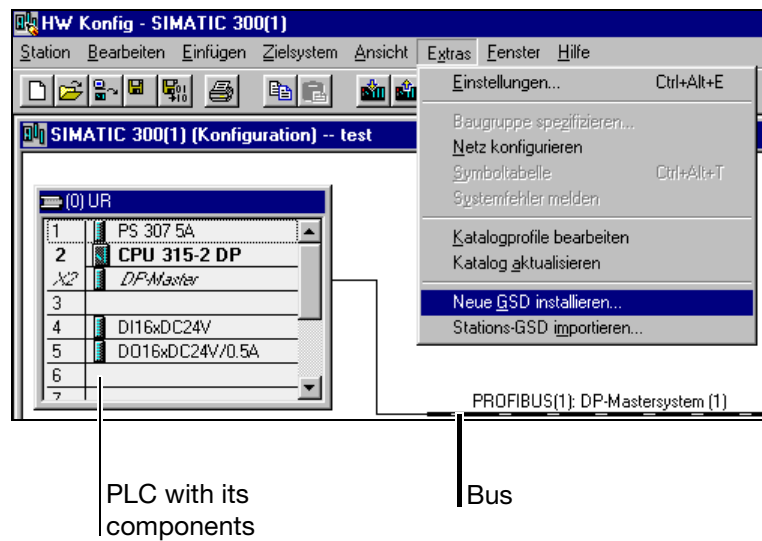
- * Save the GSD file in any folder.



When using SIEMENS Simatic S7 for project design, the file names in the GSD file must not be longer than 8 characters.

3.4.3 PLC configuration

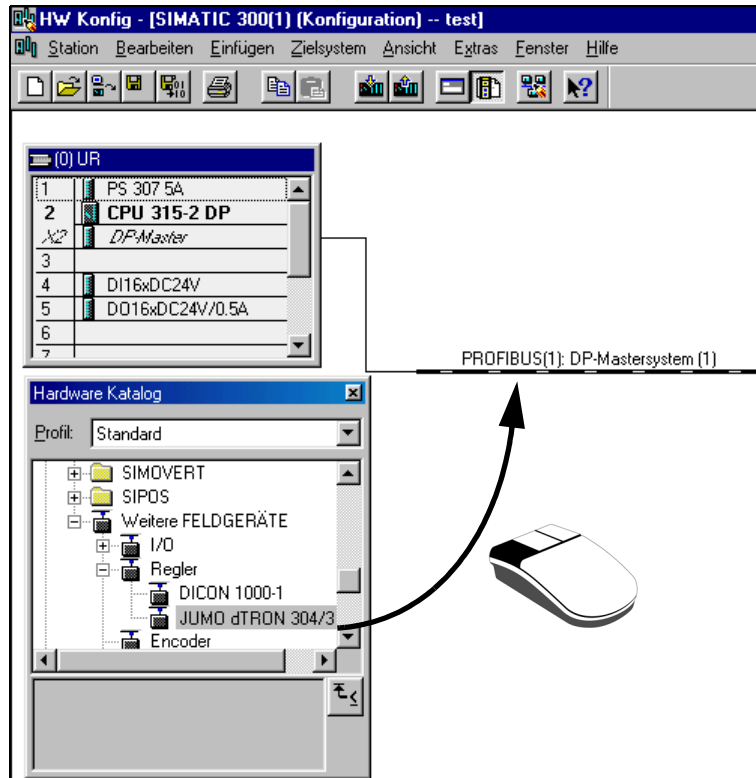
- * Start the PLC software.
- * Call up the hardware configuration and execute the menu command "Install new GSD".



The new GSD file is read in and processed, and the controller is inserted into the hardware catalog.

3 Configuring a PROFIBUS-DP system

- * Open the hardware catalog and place the new device in the working area.



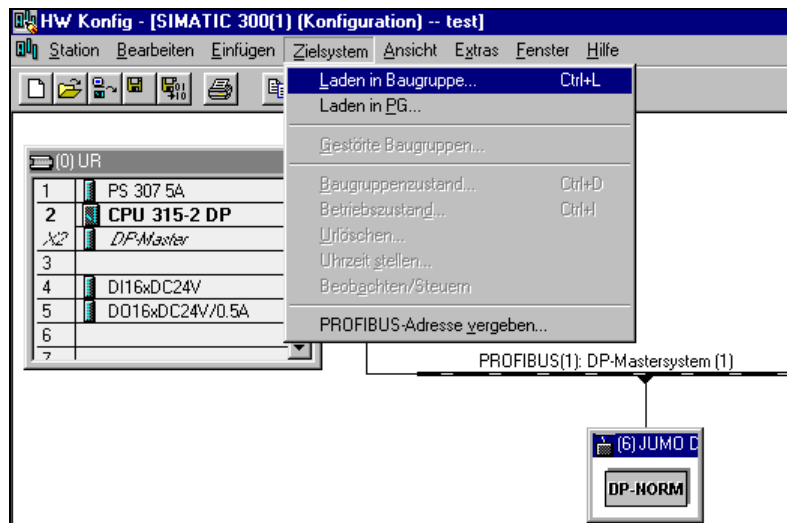
The controller is placed on the bus using the left mouse button. After releasing the mouse button, the controller address has to be assigned.



Via the GSD file of the slaves, the master receives information on which baud rates are supported.

3 Configuring a PROFIBUS-DP system

- * Finally, you have to load the configuration into the PLC (*Target system* → *Download to module*)



If a device with PROFIBUS-DP interface is operated on a master system (PLC), suitable error analysis routines should be provided on the master side.

In conjunction with a SIMATIC S7, the OB86 should be installed in the PLC, so that failure of a PROFIBUS-DP device can be detected, analyzed and registered for the specific plant.



The parameter "Interface status" will automatically appear in the input window and cannot be deleted. It is used for diagnosis of the internal data transmission in the device and should be evaluated by the PLC program, so that, for instance, a communication problem within the device can be detected by the PLC master.

- 0 : internal communication in device is OK
- unequal 0 : faulty communication in device

4 Data format of the JUMO devices

When using JUMO devices in a PROFIBUS-DP system, please take note of their data format.

Integer values

Integer values are transmitted in the following format:

- first the high byte,
- then the low byte.

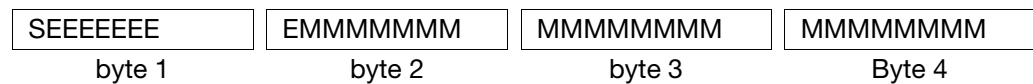
Float values/ real values

The float/real values of the cyclic data for the device are transmitted using the IEEE-754 standard format (32bits).

The float/real values for the controllers/generators and for the acyclic data of the device are transmitted in the MODbus format.

The IEEE-754 standard format and the MODbus format differ in the transmission sequence of the individual bytes. In the MODbus format bytes 1 and 2 are swapped with bytes 3 and 4 (first the high byte, then the low byte).

Single-float format (32bits) as per IEEE 754 standard



S - sign bit (bit31)

E - exponent in complement to base 2 (bit23 — bit30)

M - 23bit normalized mantissa (bit0 — bit22)

Example:

calculation of the real number from sign, exponent and mantissa.

byte1 = 40h, byte2 = F0, byte 3 = 0, byte 4 = 0

40F00000h = 0100 0000 1111 0000 0000 0000 0000 0000b

S = 0

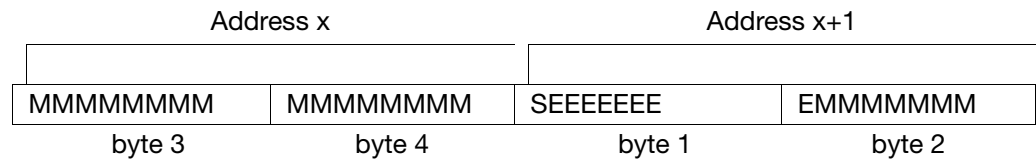
E = 100 0000 1

M = 111 0000 0000 0000 0000 0000

$$\text{Value} = -1^S \cdot 2^{\text{exponent}-127} \cdot (1 + M_{b22} \cdot 2^{-1} + M_{b21} \cdot 2^{-2} + M_{b20} \cdot 2^{-3} + M_{b19} \cdot 2^{-4} + \dots)$$
$$\text{Value} = -1^0 \cdot 2^{129-127} \cdot (1 + 1 \cdot 2^{-1} + 1 \cdot 2^{-2} + 1 \cdot 2^{-3} + 0 \cdot 2^{-4})$$
$$\text{Value} = 1 \cdot 2^2 \cdot (1 + 0.5 + 0.25 + 0.125 + 0)$$
$$\text{Value} = 1 \cdot 4 \cdot 1.875$$
$$\text{Value} = 7.5$$

4 Data format of the JUMO devices

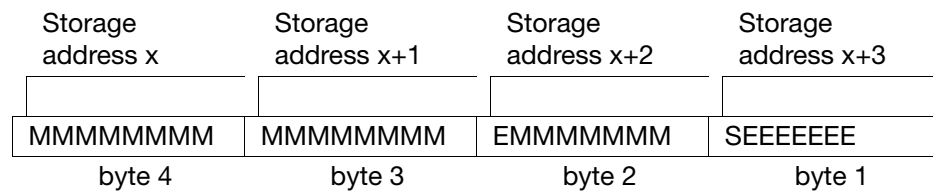
MODbus float format



After/before the transmission from/to the device, the bytes of the float value have to be swapped accordingly.

Many compilers (e. g. Microsoft C++, Turbo C++, Turbo Pascal, Keil C51) store the float values in the following order (Intel compatibility):

float value

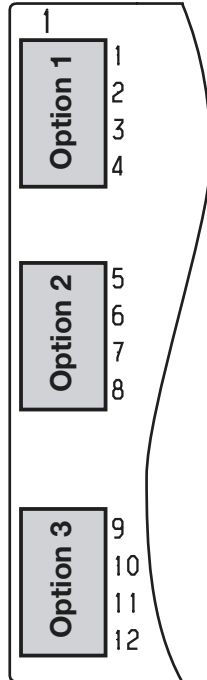


Please check how float values are stored in your application. If necessary, the bytes have to be swapped accordingly.

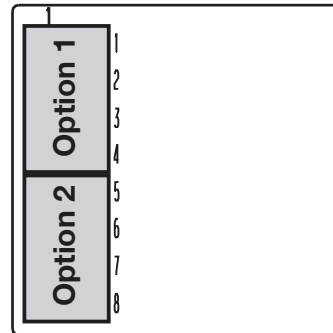
5.1 Connection for dTRON 3XX

Rear view

JUMO dTRON304/308



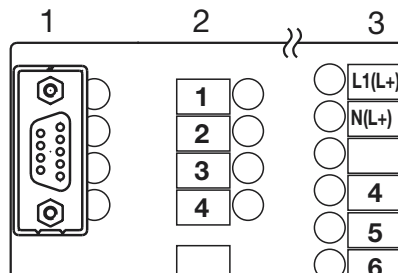
JUMO dTRON316



* Determine the position of the PROFIBUS-DP interface from the type code (see Operating Instructions B70.3041.0)

Adapter mounting

In this example, the PROFIBUS-DP interface is in option slot 1



Assignment of the 9-pole D-SUB socket

COM2 D-Sub socket		Pin: signal on device terminal strip 1	Designation
6		1: VP	Supply voltage positive
3		2: RxD/TxD-P	Receive/Transmit Data positive
8		3: RxD/TxD-N	Receive/Transmit Data negative
5		4: DGND	Ground

5 Device-specific data

5.2 Setting the slave address

The slave address is set at the configuration level:
Configuration level → *Interfaces* →

PROFIBUS-DP PrOF →

	Symbol	Value/selection	Description
Protocol type Protocol	Prot	0	Intel
		1	Motorola
		2	Intel integer
Device address	Adr	0 – 128 – 255	Address in data network
Analog marker	ANAP	-1999 to 0 to +9999	Analog value
Binary marker	binP	0 – 255	Binary value

Factory settings are shown **bold**.

Setting on the SIMATIC S7	Meaning
1 – 124	Slave address, as selected
125	The setting for the slave address can be defined by the bus master.

The baud rate is determined automatically (max. 12Mbps).

5.3 Diagnostic and status messages

If errors occur during communication with the device, the error message “ProF” appears in the display.

Please check the wiring and the master (PLC).
 It may be necessary to restart the system.

The error message can be suppressed by setting the slave address 0.

5.4 Acyclic data transmission

You can use acyclic data transmission to read and write a large number of the parameter/measurement and process data for the controller that are documented in the Interface Description B 70.3041.2



The acyclic data are also transmitted with the cyclic data transfer (DPV0).

In order to establish communication with the device, 4 info bytes and a maximum of 4 bytes of user data must be transmitted. Communication by means of acyclic data is mainly through the well-known MODbus communication, i.e. the mechanisms of MODbus communication, such as the function (CMD) and address are used in this case.

The advantage of the acyclic transmission method is that it is possible to break through the limits imposed by the PLC, such as a maximum of 128 bytes of input and output data in the process image of the SIMATIC S7-300, or

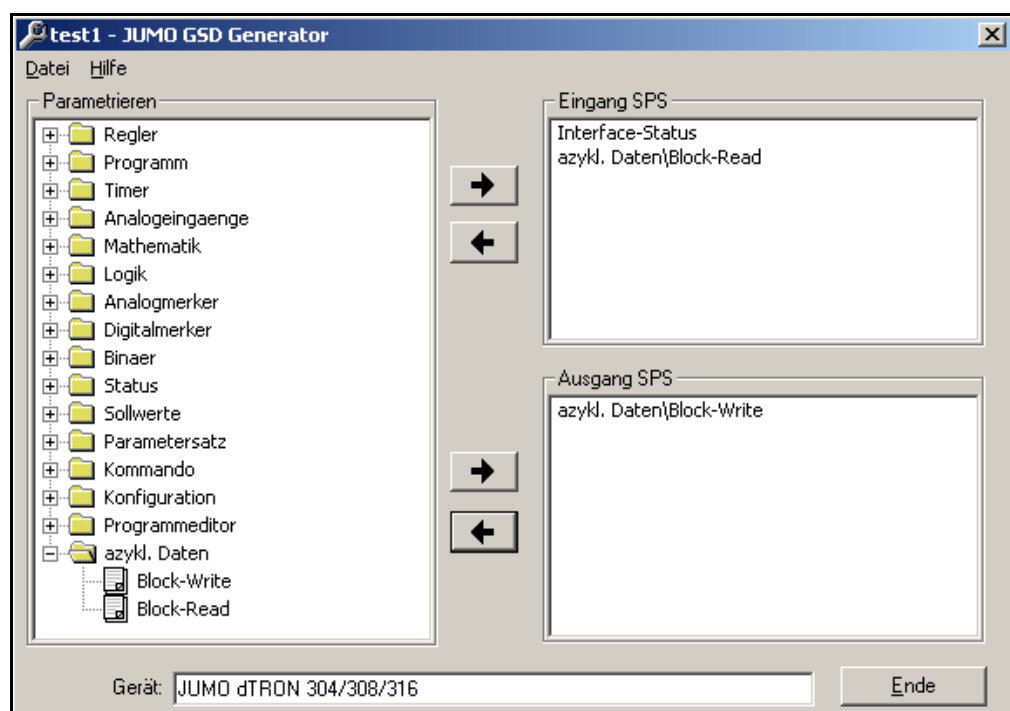
5 Device-specific data

a maximum of 31 module entries (number of cyclic parameters) in the GSD file. Any number of parameters can be transmitted one after another and then processed.

The disadvantage of acyclic transmission is that an additional interface must be integrated into the PLC, to ensure the operation of the transmission procedure described below.

On the installation CD supplied with the PROFIBUS interface, you will find a PLC demo program (Dtron3xx.zip) for the Siemens SIMATIC S7, using the widely-used CPU 315-2 DP. JUMO can only make this demo program available for the SIMATIC S7. JUMO does not provide any guarantee that the program, which is intended to facilitate the first commissioning of the acyclic transmission method, will function without errors in all applications.

Selecting the acyclic transmission method in the GSD generator:



Both entries for acyclic data transmission (Block Read and Block Write) lie within the consistent area of the process image of the PLC.

5 Device-specific data

5.4.1 Arrangement of the protocol

Byte no.	1 – 2	3 – 4	5 – 8
Field	Control word	MODbus address	Data
Contents	Control	Length	Function
	4-bit (bits 7 – 4)	4-bit (bits 3 – 0)	1 byte
	Job OK Job error Job Toggle 2 Job Toggle 1	no function	0x11 read INT 0x13 read FLOAT 0x21 write INT 0x23 write FLOAT

Control bits 4 – 5

Job Toggle 1, Job Toggle 2

These two bits are required to control the interaction between the PLC and the device. Control bits 4 and 5 may only be set after the transmit buffer has been completely filled up. In order to ensure that the correct data are evaluated and processed, the following procedure must be adhered to.

Bit 5	Bit 4	
0	0	Job 1 is mirrored by the device.
0	1	Bit 4 is set, job 1 is processed for the first time.
1	0	Bit 5 is set, job 1 is processed again.
0	0	Job 2 is mirrored by the device.
0	1	Bit 4 is set, job 2 is processed for the first time.
...

The internal design of the device means that it is mandatory to adhere to the procedure above. Control bits 6 – 7

Control bits 6 – 7

Job OK, job error

Bit 6 and Bit 7 are signals to the PLC, when the telegram has been evaluated by the device, and the PLC can generate and transmit the next command for the device.

5 Device-specific data

Sequence: Case 1, everything functioning OK

Bit 7	Bit 6	Bit 5	Bit 4	
0	0	0	0	No job-bit has been set, i.e. the device must mirror the job.
0	0	0	1	The PLC has set the job through Bit 4 = 1, i.e. the device evaluates the telegram.
1	0	0	1	Job with Bit 4 = 1 has been successfully processed, no errors appeared.
0	0	1	0	The PLC has set the job through Bit 5 = 1, i.e. the device evaluates the telegram again.
1	0	1	0	Job with Bit 5 = 1 has been successfully processed, no errors appeared. The processing of the job is thereby finished.

Sequence: Case 2, not everything functioning OK

Bit 7	Bit 6	Bit 5	Bit 4	
0	0	0	0	No job-bit has been set, i.e. the device must mirror the job.
0	0	0	1	The PLC has set the job through Bit 4 = 1, i.e. the device evaluates the telegram.
1	0	0	1	Job with Bit 4 = 1 has been successfully processed, no errors appeared.
0	0	1	0	The PLC has set the job through Bit 5 = 1, i.e. the device evaluates the telegram again.
0	1	1	0	Job with Bit 5 = 1 has not been successfully processed, an error appeared. The processing of the job is thereby canceled.

Sequence: Case 3, not everything functioning OK

Bit 7	Bit 6	Bit 5	Bit 4	
0	0	0	0	No job-bit has been set, i.e. the device must mirror the job.
0	0	0	1	The PLC has set the job through Bit 4 = 1, i.e. the device evaluates the telegram.
0	1	0	1	Job with Bit 4 = 1 has not been successfully processed, an error appeared. Processing can be canceled, since there is probably an error in the telegram layout.

Address

A large number of the addresses listed in the Interface Description B 70.3590.2 can be transmitted through the acyclic transmission procedure. The transmission follows the well-known MODbus communication very closely.

User data

A maximum of 4-bytes of user data can be transmitted. The quantity of user data used is stored in the function byte.

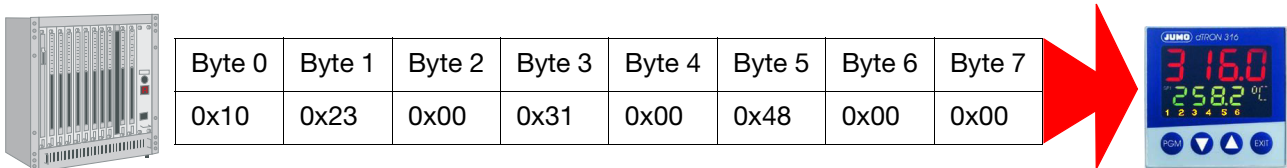
5 Device-specific data

Example

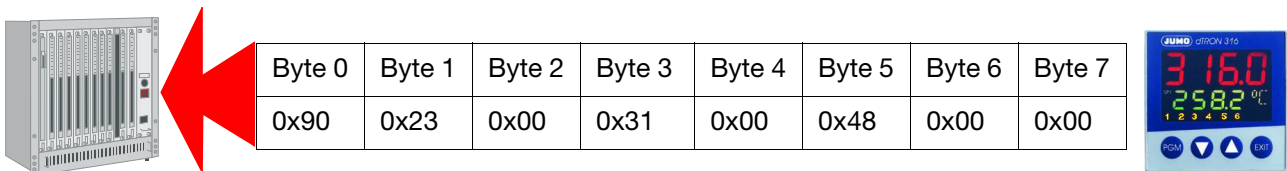
An example will clarify the basic sequence to be used for the data transmission between the PLC and the device. In this case, the controller setpoint = 50.0 is defined by the PLC for Controller 1.

Byte no.	1 – 2			3 – 4	5 – 8
Field	Control word			Modbus address	Data
Contents	Control	Length	Function		

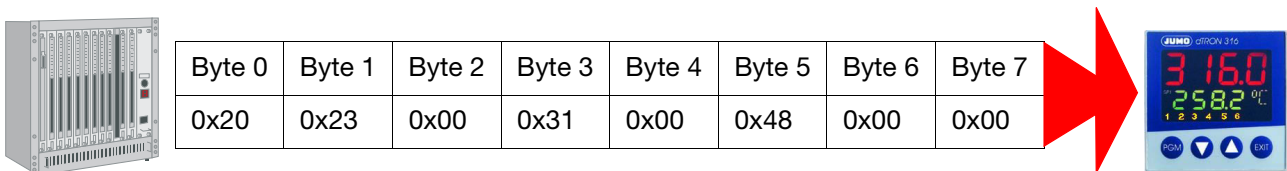
3.) PLC transmits telegram with the information Toggle 1.



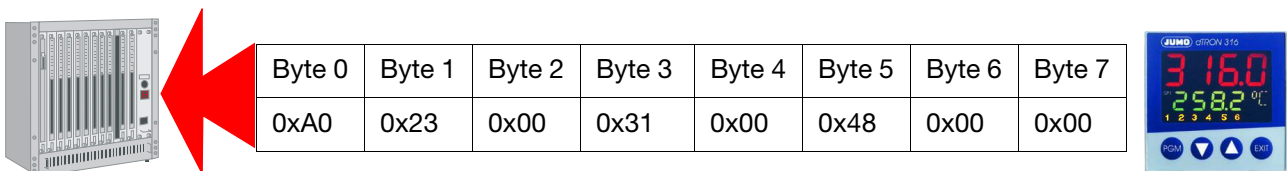
4.) Device evaluates the telegram, and sends back Job OK or Job error.



5.) If the PLC receives Job OK , the telegram is sent again to the device, with Toggle 2. If Job error is received, processing can be canceled immediately, since there is an error in the telegram layout.



6.) Device evaluates the telegram again, and sends back Job OK or Job error.



5.4.2 Demo program dTRON3xx.zip

The demo program for the controllers can be found on the installation CD. JUMO can only make it available for the SIMATIC S7. The CPU 315-2 DP is used.

You can find a program listing in PDF format on the installation CD, by first calling up the installation program, and then clicking on "Documentation → dTRON3xx_azyk.pdf" .

JUMO does not provide any guarantee that the program, which is intended to facilitate the first commissioning of the acyclic transmission method, will function without errors in all applications.

The procedure for data communication is controlled by markers. The demo program processes a total of 6 commands, in the course of which Controller/process value and Controller setpoint are read, and Setpoints/setpoint1 is written and transmitted to 2 dTRON3XX.

5 Device-specific data

- OB1** The operating system of the PLC processes OB1 cyclically. If the processing of OB1 is finished, then the operating system starts processing OB1 again. The cyclic processing of OB1 is started when the start-up has finished.
- OB86** The operating system of the PLC calls up OB86 if it detects the failure of an expansion device, a DP master system or a station in the decentralized periphery (both for incoming and outgoing events). If such an error occurs, and OB86 is not present, then the CPU goes to the STOP status. The demo program only evaluates the incoming events for error codes 0xC4 and 0xC5, by incrementing marker word 28.
- FC1 :** Function for reading 4 analog values and writing 2 analog values into the SIMATIC S7 - 300 (315 - 2 DP). The reading and writing of process values is carried out separately, and can be started separately. Reading is started once through the marker 30.3 StartTransferZyklisch, i.e. all 4 analog values are read, one after another, and then the procedure is terminated. The marker 30.1 StartTransferAzyklisch can be used to separately start the writing of the 2 analog values. The markers 30.0 SteuerFlagZyklisch and 30.2 SteuerFlagAzyklisch indicate the duration of the transmission separately for reading and writing.
- The command processing is set up in a sequential list, i.e. if one command has been processed, the next is started automatically.
- FC10 :** Operates the PROFIBUS-DP interface (driver). The function has some defined transfer parameters, which are explained in the following text.
- Addr :** Address for the acyclic data in the process image of the PLC. The addresses for the acyclic data in the input process image and the output process image must be identical. It is not possible to use different addresses. The address must be transferred to FC 10 in HEX format.

5 Device-specific data

Steckplatz	Baugruppe / DP-Kennung	Bestellnummer	E-Adresse	A-Adresse	Kommentar
0	8DE	Interface Module	2		
1	16DE	azykl. Daten/Lesen/Header	3..4		
2	16DE	azykl. Daten/Lesen/Adresse	5..6		
3	32DE	azykl. Daten/Lesen/Daten	7..10		
4	16DA	azykl. Daten/Schreiben/Header		3..4	
5	16DA	azykl. Daten/Schreiben/Adresse		5..6	
6	32DA	azykl. Daten/Schreiben/Daten		7..10	

- Command :** Command syntax that is to be sent to the device, e.g. Controller 1 set Setpoint = 50.0, ... The program is laid out so that a pool of possible commands is predefined in a data block (DB).
- Response:** The response that the device sends to the PLC is also saved in a data block, and can be interpreted and evaluated by other PLC program components.
- STRT :** Start pulse, i. e. the start of command processing. The telegram that is transferred under Command is sent to the device.
- RDY:** Command processing finished. The device has sent back a response to the PLC, after which the RDY flag is set by FC10 in order to indicate to the higher-level processing that the execution of the telegram has been concluded. The RDY flag will also be set after a time-out error.
- Toggle:** The Toggle flag is reset by FC10. The toggle flag that is to be transferred is interpreted and the toggle information is prepared for the device.
- DB10 :** The response from the device is placed in this data block. At present, 6 different response messages can be stored. The size of DB10 can be adjusted at any time. DB10 saves the complete response telegram from the controller, i. e. the user data as well as the control information and the address.
- DB20 :** Several predefined commands are stored in Data Block 20. These can be used individually in this demo program. For each command, there is a short description of the data that can be transferred. You can alter DB20 or add other commands at any time. The necessary information can be found in the Operating Instructions B 70.3590.2.

5 Device-specific data

Command 000:
Read Controller\process value

Command 001
Read Controller\setpoint

Command 002
Read Controller\controller output 1

Command 003
Read Controller\controller output 2

Command 004
Write Setpoints/setpoint1

Command 005
Write Controller>manual output

UDT10 : Universal Data Type. The organization of the input and output data channel for the device is defined in UDT10.

VAT1 : The variable table that is set up makes it possible to check the data communication or control the command processing.

	Operand	Symbol	Anzeigeform	Statuswert	Steuerwert
1	M 30.3	"StartTransferZyklisch"	BIN	2#0	2#1
2	M 30.0	"SteuerFlagZyklisch"	BOOL	false	
3	M 30.1	"StartTransferAzyklisch"	BIN	2#0	2#0
4	M 30.2	"SteuerFlagAzyklisch"	BOOL	false	
5					
6	DB10.DBD 4	"Read".Antwort000.ND00_03	GLEITPUNKT	23.0022	
7	DB10.DBD 12	"Read".Antwort001.ND00_03	GLEITPUNKT	48.00101	
8	DB10.DBD 20	"Read".Antwort002.ND00_03	GLEITPUNKT	12.125	
9	DB10.DBD 28	"Read".Antwort003.ND00_03	GLEITPUNKT	32.0	
10					
11	DB20.DBD 36	"Write".Befehl004.ND00_03	GLEITPUNKT	12.125	
12	DB20.DBD 44	"Write".Befehl005.ND00_03	GLEITPUNKT	32.0	
13					
14	MW 28	"AnzSlaveError"	DEZ	0	
15					

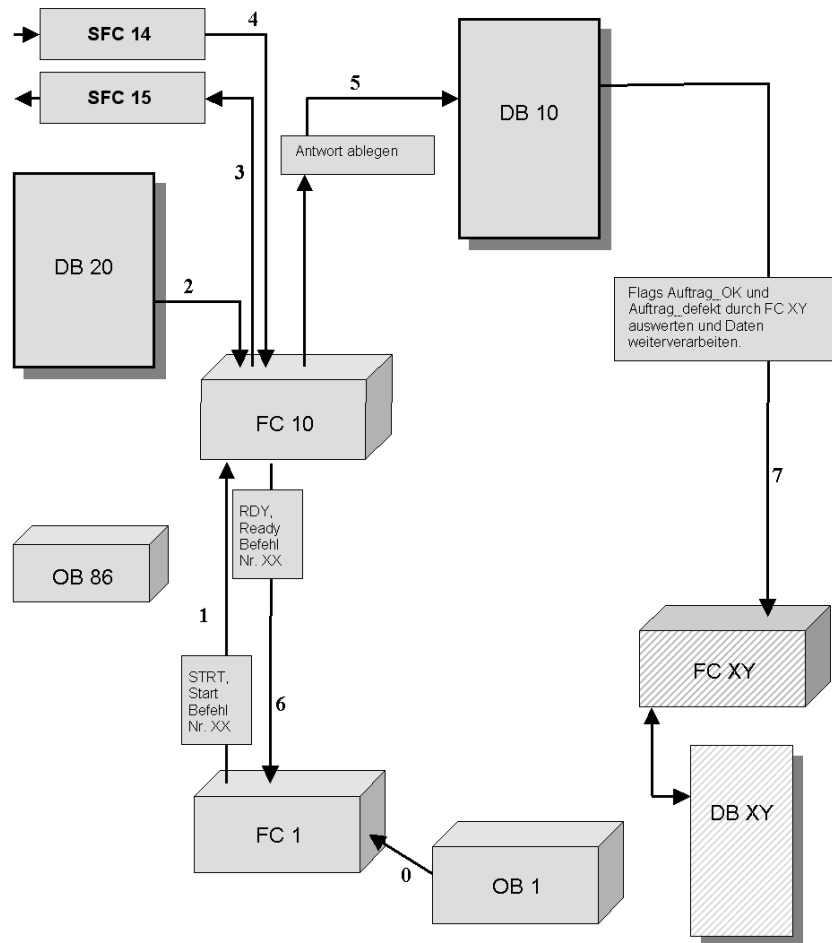
Start Lesen
Lesen Aktiv
Start Schreiben
Schreiben Aktiv

Werte die vom Gerät gelesen werden.
Regler\Regler1\Istwert
Regler\Regler2\Istwert
Regler\Regler1\Sollwert
Regler\Regler2\Sollwert

Werte die zum Gerät geschrieben werden.
Regler\Regler1\Sollwert
Regler\Regler2\Sollwert

Anzahl der aufgetretenen PROFIBUS - Fehler, ermittelt durch OB86.

5.4.3 Block diagram of the demo program



0:OB1 is automatically and cyclically executed by the CPU of the PLC.

1)	FC1 is also called up cyclically by the PLC. If the marker 30.3 StartTransferZyklisch is set, the result is that processing of the command starts in FC1, whereby the first command is prepared by FC10 and sent to the controller.
2)	FC10 loads the required command from DB20 and prepares the corresponding toggle information.
3)	The data telegram is entered into the process image of the PLC by FC10, and thus transmitted to the controller.
4)	The controller processes the data telegram that has been received, and makes a response message available for FC10 in the process image of the PLC.
5)	FC10 evaluates the response by comparing it with the transmitted telegram, and saving it in DB10 for the following PLC program.

5 Device-specific data

6)	FC1 receives a signal, through the RDY flag, that the processing of a command has been concluded. When this information reaches FC1, the next command is immediately dispatched to the JUMO dTRON 3XX.
7)	The data that is collected or is to be sent to the JUMO dTRON 3XX is, in practice, evaluated or handled by other PLC program functions. As a consequence, it is always necessary to check whether the data are correct before they can be interpreted. The two control flags in the telegram header (Job OK and Job error) must be checked.
1 – 8	Processing sequence



JUMO cannot provide any guarantee that the components or extensions listed above will ensure fault-free operation of the system, since any error handling must always be defined on a system-specific basis.

5.4.4 Timing of acyclic data

Acyclic data transmission enables universal access to a large number of the data and parameters that are accessible via MODbus (without alteration to the configuration or program). However, because of the larger number of processing steps, it requires a longer time to update.

5.4.5 Commands (GSD generator)



If you require additional information on the commands within the GSD generator, please refer to the Interface Description B 70.3041.2.

The GSD file has been laid out for installation on the SIMATIC S7. Should installation problems occur with other controls, all entries Preset=1 must be deleted.

⇒ Chapter 3.3.4

In this case it will also be necessary to set up the variables selected in the GSD generator in the correct sequence in the process image of the PLC.



JUMO GmbH & Co. KG

Street address:
Moltkestraße 13 - 31
36039 Fulda, Germany
Delivery address:
Mackenrodtstraße 14
36039 Fulda, Germany
Postal address:
36035 Fulda, Germany
Phone: +49 661 6003-0
Fax: +49 661 6003-607
E-mail: mail@jumo.net
Internet: www.jumo.net

JUMO Instrument Co. Ltd.

JUMO House
Temple Bank, Riverway
Harlow, Essex CM20 2TT, UK
Phone: +44 1279 635533
Fax: +44 1279 635262
E-mail: sales@jumo.co.uk
Internet: www.jumo.co.uk

JUMO Process Control, Inc.

8 Technology Boulevard
Canastota, NY 13032, USA
Phone: 315-697-JUMO
1-800-554-JUMO
Fax: 315-697-5867
E-mail: info@jumo.us
Internet: www.jumo.us