VIPA System 300S

VIPA

A YASKAWA COMPANY

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Contents

About this Manual

This manual describes the operation of the System 300S and the according available interface modules IM 353-1DP01. You'll find here a detailed description of the module. You will get information for connecting and operating the module.

Overview   **Chapter 1:   Installation and assembly guide lines**

In this chapter you will find all information, required for the installation and the cabling of a process control with the components of the System 300S.

Besides the dimensions the general technical data of the System 300S will be found.

Chapter 2:   Hardware description

Here the hardware components of the IM 353-1DP01 are described. The technical data are at the end of the chapter.

Chapter 3:   Deployment IM 353-1DP01

This chapter describes the usage of the IM 353-1DP01 at the System 300S.

You may find here all information about project engineering, commissioning and diagnostic.

Objective and contents

This manual describes the interface module IM 353-1DP01 which can be used at the System 300S. It contains a description of the construction, project implementation and usage. This manual is relevant for:

Product	Order number	as of state: HW	FW
IM 353	VIPA 353-1DP01	01	V1.1.6

Target audience

The manual is targeted at users who have a background in automation technology.

Structure of the manual

The manual consists of chapters. Every chapter provides a self-contained description of a specific topic.

Guide to the document

The following guides are available in the manual:
- an overall table of contents at the beginning of the manual
- an overview of the topics for every chapter

Availability

The manual is available in:
- printed form, on paper
- in electronic form as PDF-file (Adobe Acrobat Reader)

Icons Headings

Important passages in the text are highlighted by following icons and headings:

Danger!
Immediate or likely danger.
Personal injury is possible.

Attention!
Damages to property is likely if these warnings are not heeded.

Note!
Supplementary information and useful tips.

Safety information

Applications conforming with specifications

The interface modules are constructed and manufactured for:
- all VIPA System 300S components
- communication and process control
- general control and automation applications
- industrial applications
- operation within the environmental conditions specified in the technical data
- installation into a cubicle

Danger!
This device is not certified for applications in
- in explosive environments (EX-zone)

Documentation

The manual must be available to all personnel in the
- project design department
- installation department
- commissioning
- operation

The following conditions must be met before using or commissioning the components described in this manual:

- Hardware modifications to the process control system should only be carried out when the system has been disconnected from power!

- Installation and hardware modifications only by properly trained personnel.

- The national rules and regulations of the respective country must be satisfied (installation, safety, EMC ...)

Disposal

National rules and regulations apply to the disposal of the unit!

Chapter 1   Assembly and installation guidelines

Overview   In this chapter you will find all information, required for the installation and the cabling of a process control with the components of the System 300S.

Besides the dimensions the general technical data of the System 300S will be found.

Safety Information for Users

Handling of electrostatic sensitive modules

VIPA modules make use of highly integrated components in MOS-Technology. These components are extremely sensitive to over-voltages that can occur during electrostatic discharges.

The following symbol is attached to modules that can be destroyed by electrostatic discharges.

The Symbol is located on the module, the module rack or on packing material and it indicates the presence of electrostatic sensitive equipment.

It is possible that electrostatic sensitive equipment is destroyed by energies and voltages that are far less than the human threshold of perception. These voltages can occur where persons do not discharge themselves before handling electrostatic sensitive modules and they can damage components thereby, causing the module to become inoperable or unusable.

Modules that have been damaged by electrostatic discharges can fail after a temperature change, mechanical shock or changes in the electrical load.

Only the consequent implementation of protection devices and meticulous attention to the applicable rules and regulations for handling the respective equipment can prevent failures of electrostatic sensitive modules.

Shipping of modules

Modules must be shipped in the original packing material.

Measurements and alterations on electrostatic sensitive modules

When you are conducting measurements on electrostatic sensitive modules you should take the following precautions:

• Floating instruments must be discharged before use.

• Instruments must be grounded.

Modifying electrostatic sensitive modules you should only use soldering irons with grounded tips.

Attention!

Personnel and instruments should be grounded when working on electrostatic sensitive modules.

Installation dimensions

Dimensions   1tier width (WxHxD) in mm: 40 x 125 x 120
Basic enclosure

Dimensions
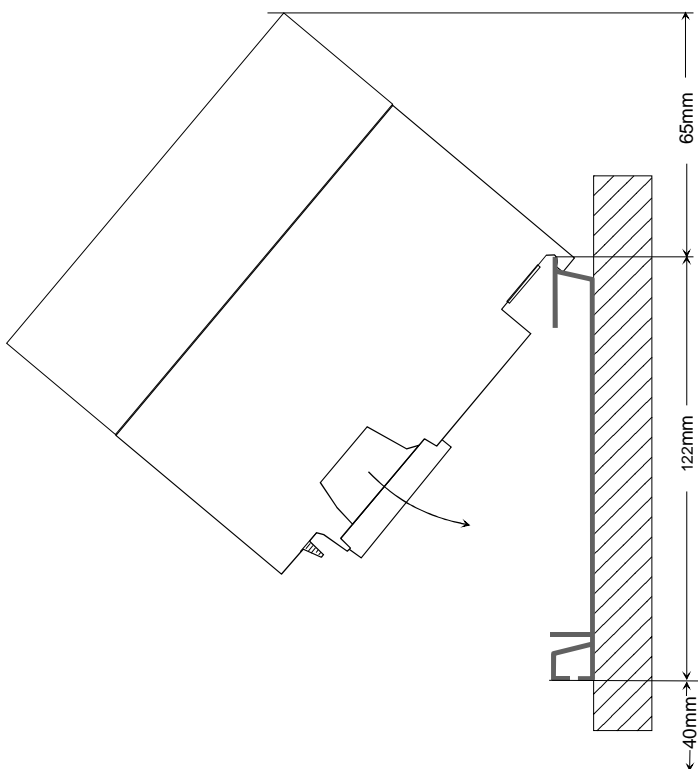
**Installation dimensions**
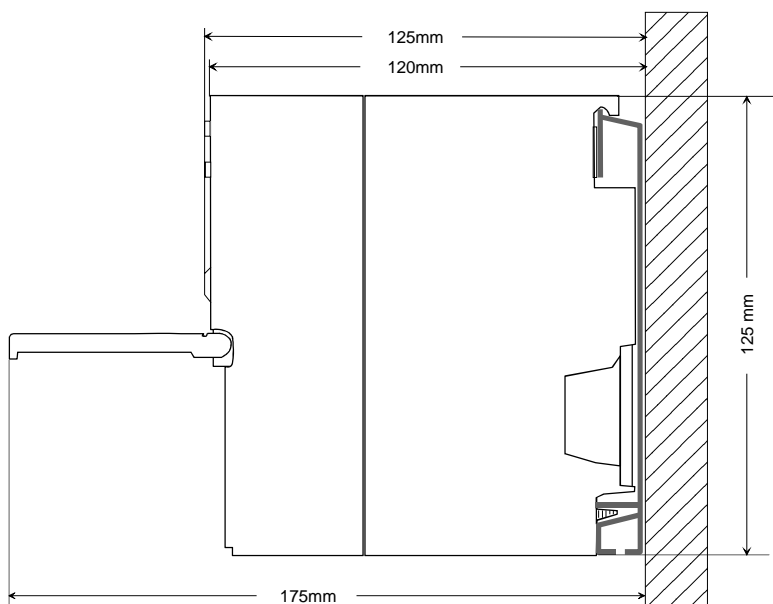
Assembly standard bus

General

The single modules are directly installed on a profile rail and connected via the backplane bus connector. Before installing the modules you have to clip the backplane bus connector to the module from the backside.

The backplane bus connector is delivered together with the peripheral modules.

Profile rail

| Order number	A	B	C
VIPA 390-1AB60	160	140	10
VIPA 390-1AE80	482	466	8.3
VIPA 390-1AF30	530	500	15
VIPA 390-1AJ30	830	800	15
VIPA 390-9BC00*	2000	Drillings only left	15

* Unit pack: 10 pieces

Measures in mm
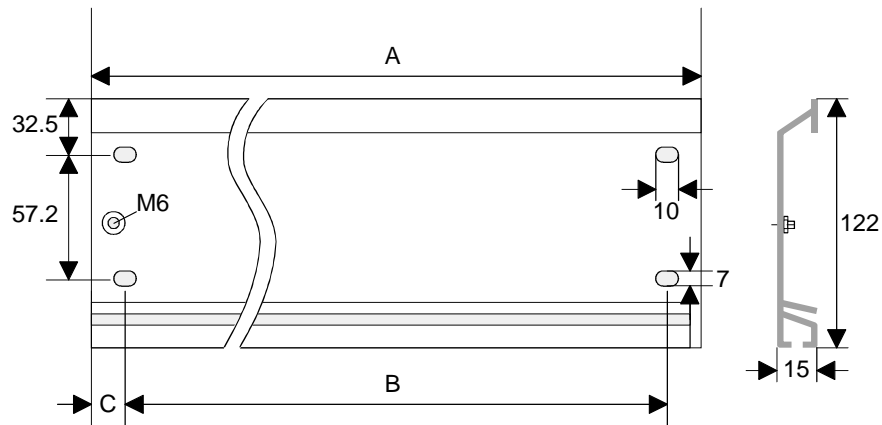
Bus connector

For the communication between the modules the System 300S uses a backplane bus connector. Backplane bus connectors are included in the delivering of the peripheral modules and are clipped at the module from the backside before installing it to the profile rail.
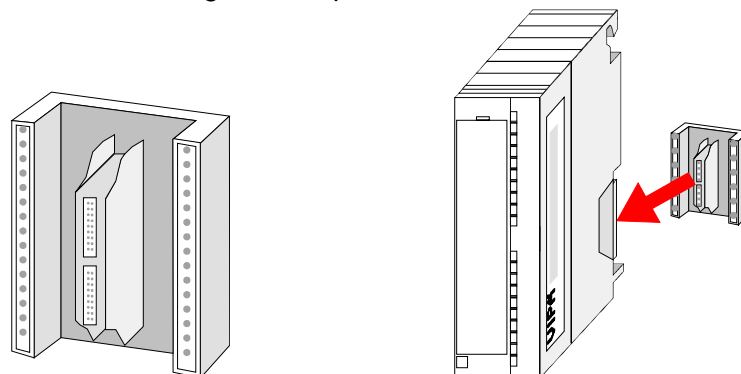
Assembly possibilities

horizontal assembly
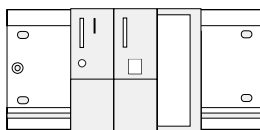
vertical assembly

lying assembly
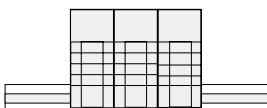
Please regard the allowed environment temperatures:

- horizontal assembly: from 0 to 60°C
- vertical assembly: from 0 to 40°C
- lying assembly: from 0 to 40°C

Approach
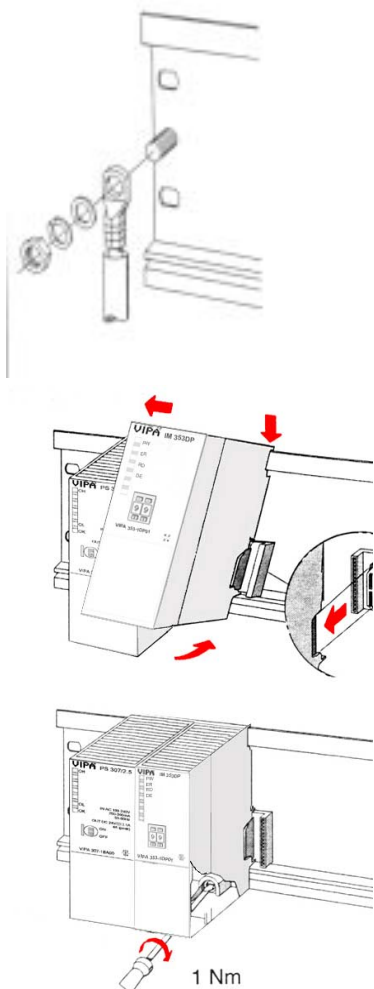
- Bolt the profile rail with the background (screw size: M6), so that you still have minimum 65mm space above and 40mm below the profile rail.

- If the background is a grounded metal or device plate, please look for a low-impedance connection between profile rail and background.

- Connect the profile rail with the protected earth conductor. For this purpose there is a bolt with M6-thread.

- The minimum cross-section of the cable to the protected earth conductor has to be 10mm^2.

- Stick the power supply to the profile rail and pull it to the left side to the grounding bolt of the profile rail.

- Fix the power supply by screwing.

- Take a backplane bus connector and click it at the CPU from the backside like shown in the picture.

- Stick the CPU to the profile rail right from the power supply and pull it to the power supply.

- Click the CPU downwards and bolt it like shown.

- Repeat this procedure with the peripheral modules, by clicking a backplane bus connector, stick the module right from the modules you've already fixed, click it downwards and connect it with the backplane bus connector of the last module and bolt it.

1 Nm

Danger!

- The power supplies must be released before installation and repair tasks, i.e. before handling with the power supply or with the cabling you must disconnect current/voltage (pull plug, at fixed connection switch off the concerning fuse)!

- Installation and modifications only by properly trained personnel!

Cabling

Overview

The power supplies and CPUs are exclusively delivered with CageClamp contacts. For the signal modules the front connectors are available from VIPA with screw contacts. In the following all connecting types of the power supplies, CPUs and input/output modules are described.

Danger!

- Before installation or overhauling, the power supplies must be disconnected from voltage (pull the plug or remove the fuse)!

- Installation and modifications only by properly trained personnel!

CageClamp technology (gray)

For the cabling of power supplies, bus couplers and parts of the CPU, gray connectors with CageClamp technology are used.
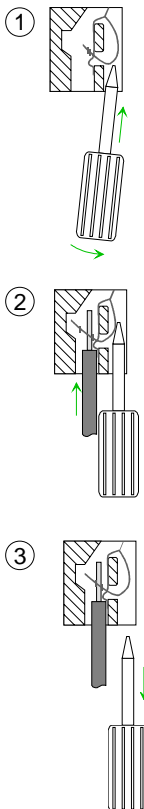
You may connect wires with a cross-section of 0.08mm^2 to 2.5mm^2. You can use flexible wires without end case as well as stiff wires.
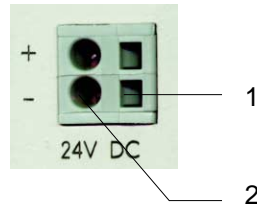
[1]   Rectangular opening for screwdriver
[2]   Round opening for wires

The picture on the left side shows the cabling step by step from top view.

- To conduct a wire you plug a fitting screwdriver obliquely into the rectangular opening like shown in the picture.
- To open the contact spring you have to push the screwdriver in the opposite direction and hold it.
- Insert the insulation striped wire into the round opening. You may use wires with a cross-section from 0.08mm^2 to 2.5mm^2.
- By removing the screwdriver the wire is connected safely with the plug connector via a spring.

Installation guidelines

General   The installation guidelines contain information about the interference free deployment of System 300S systems. There is the description of the ways, interference may occur in your control, how you can make sure the electromagnetic digestibility (EMC), and how you manage the isolation.

What means EMC?   Electromagnetic digestibility (EMC) means the ability of an electrical device, to function error free in an electromagnetic environment without being interferenced res. without interferencing the environment.

All System 300S components are developed for the deployment in hard industrial environments and fulfill high demands on the EMC. Nevertheless you should project an EMC planning before installing the components and take conceivable interference causes into account.

Possible interference causes   Electromagnetic interferences may interfere your control via different ways:
- Fields
- I/O signal conductors
- Bus system
- Current supply
- Protected earth conductor

Depending on the spreading medium (lead bound or lead free) and the distance to the interference cause, interferences to your control occur by means of different coupling mechanisms.

One differs:
- galvanic coupling
- capacitive coupling
- inductive coupling
- radiant coupling

Basic rules for EMC

In the most times it is enough to take care of some elementary rules to guarantee the EMC. Please regard the following basic rules when installing your PLC.

- Take care of a correct area-wide grounding of the inactive metal parts when installing your components.
  - Install a central connection between the ground and the protected earth conductor system.
  - Connect all inactive metal extensive and impedance-low.
  - Please try not to use aluminum parts. Aluminum is easily oxidizing and is therefore less suitable for grounding.

- When cabling, take care of the correct line routing.
  - Organize your cabling in line groups (high voltage, current supply, signal and data lines).
  - Always lay your high voltage lines and signal res. data lines in separate channels or bundles.
  - Route the signal and data lines as near as possible beside ground areas (e.g. suspension bars, metal rails, tin cabinet).

- Proof the correct fixing of the lead isolation.
  - Data lines must be laid isolated.
  - Analog lines must be laid isolated. When transmitting signals with small amplitudes the one sided laying of the isolation may be favorable.
  - Lay the line isolation extensively on an isolation/protected earth con-ductor rail directly after the cabinet entry and fix the isolation with cable clamps.
  - Make sure that the isolation/protected earth conductor rail is connected impedance-low with the cabinet.
  - Use metallic or metalized plug cases for isolated data lines.

- In special use cases you should appoint special EMC actions.
  - Wire all inductivities with erase links.
  - Please consider luminescent lamps can influence signal lines.

- Create a homogeneous reference potential and ground all electrical operating supplies when possible.
  - Please take care for the targeted employment of the grounding actions. The grounding of the PLC is a protection and functionality activity.
  - Connect installation parts and cabinets with the System 300S in star topology with the isolation/protected earth conductor system. So you avoid ground loops.
  - If potential differences between installation parts and cabinets occur, lay sufficiently dimensioned potential compensation lines.

Isolation of conductors

Electrical, magnetically and electromagnetic interference fields are weakened by means of an isolation, one talks of absorption.

Via the isolation rail, that is connected conductive with the rack, interference currents are shunt via cable isolation to the ground. Hereby you have to make sure, that the connection to the protected earth conductor is impedance-low, because otherwise the interference currents may appear as interference cause.

When isolating cables you have to regard the following:

- If possible, use only cables with isolation tangle.
- The hiding power of the isolation should be higher than 80%.
- Normally you should always lay the isolation of cables on both sides. Only by means of the both-sided connection of the isolation you achieve high quality interference suppression in the higher frequency area.

  Only as exception you may also lay the isolation one-sided. Then you only achieve the absorption of the lower frequencies. A one-sided isolation connection may be convenient, if:
  - the conduction of a potential compensating line is not possible
  - analog signals (some mV res. µA) are transferred
  - foil isolations (static isolations) are used.

- With data lines always use metallic or metalized plugs for serial couplings. Fix the isolation of the data line at the plug rack. Do not lay the isolation on the PIN 1 of the plug bar!

- At stationary operation it is convenient to strip the insulated cable interruption free and lay it on the isolation/protected earth conductor line.

- To fix the isolation tangles use cable clamps out of metal. The clamps must clasp the isolation extensively and have well contact.

- Lay the isolation on an isolation rail directly after the entry of the cable in the cabinet. Lead the isolation further on to the System 300S module and **don't** lay it on there again!

Please regard at installation!

At potential differences between the grounding points, there may be a compensation current via the isolation connected at both sides.

Remedy: Potential compensation line

General data

Structure/ dimensions

- Profile rail 530mm

- Peripheral modules with recessed labeling

- Dimensions of the basic enclosure:
  1tier width: (WxHxD) in mm: 40x125x120
  2tier width: (WxHxD) in mm: 80x125x120
  3tier width: (WxHxD) in mm: 120x125x120

Reliability

- Wiring by means of spring pressure connections (CageClamps) at the front connector

- Core cross-section 0.08...2.5mm^2 or 1.5 mm^2

- Total isolation of the wiring at module change

- Potential separation of all modules to the backplane bus

- Burst/ESD acc. IEC 61000-4-2/IEC 61000-4-4 (up to level 3)

- Shock resistance acc. IEC 60068-2-6 / IEC 60068-2-27 (1G/12G)

Environmental conditions

- Operating temperature: 0 ... +60°C

- Storage temperature: -25 ... +70°C

- Relative humidity: 5 ... 95% without condensation

- Ventilation by means of a fan is not required

Chapter 2   Hardware description

Overview   Here the hardware components of the IM 353-1DP01 are described. The
   technical data are at the end of the chapter.

Properties

IM 353
353-1DP01

- PROFIBUS (DP-V0, DP-V1)
- PROFIBUS DP slave for max. 29 peripheral modules
  (max. 16 analog modules)
- Max. 244Byte input data and 244Byte output data
- Internal diagnostic protocol
- Integrated DC 24V power supply for the peripheral modules (3.5A max.)
- Supports all PROFIBUS data transfer rates
- 1 MSAC_C1 connection (Read, Write) with 244Byte data
  (4Byte DP-V1-Header + 240Byte user data)
- 3 MSAC_C2 connections (Initiale, Read, Write, DataTransport,
  Initiate Abort) with each 244Byte data
  (4Byte DP-V1-Header + 240Byte user data)
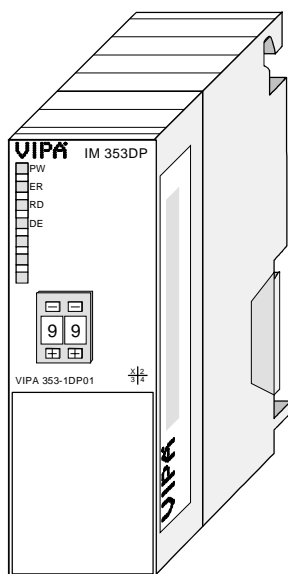
Ordering data

Type	Order number	Description
IM 353DP	VIPA 353-1DP01	PROFIBUS DP-V0/V1 slave

Structure

IM 353
353-1DP01
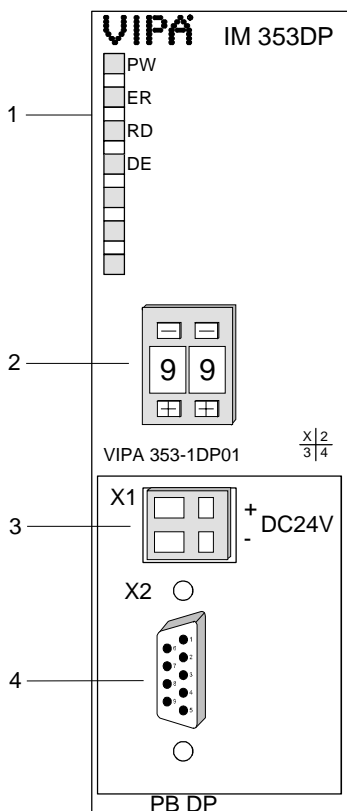
[1]   LED Status indicators
[2]   Address selector

The following components are beneath a flap

[3]   DC 24V voltage supply
[4]   RS485 interface

Interfaces

PB DP
X2

① n. c.
② n. c.
③ RxD/TxD-P (line B)
④ RTS
⑤ M5V
⑥ P5V
⑦ n. c.
⑧ RxD/TxD-N (line A)
⑨ n.c.

X1

+ ① + DC 24 V
- ② 0 V
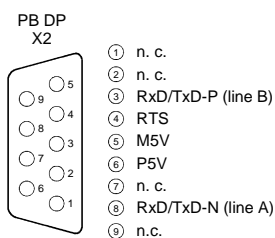
Components

LEDs

The module carries a number of LEDs that are available for diagnostic purposes on the bus and for displaying the local status. The following table explains the different colors of the diagnostic LEDs.

Label	Color	Description
PW	Yellow	Signalizes applying operation voltage (Power).
ER	Red	Short flash at reboot.
		On at internal error.
		Blinks at initialization error.
		Blinks alternately with RD at wrong configuration of the master (project engineering error).
		Blinks simultaneously with RD at wrong parameterization.
RD	Green	On at "Data exchange" if Bus cycle is faster than PROFIBUS cycle.
		Off at "Data exchange" if Bus cycle is slower than PROFIBUS cycle.
		Blinks at positive self test (READY) and successful initialization.
		Blinks alternately with ER at wrong configuration of the master (project engineering error).
		Blinks simultaneously with ER at wrong parameterization.
DE	Yellow	DE (Data exchange) indicates PROFIBUS communication

Address selector
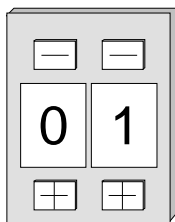
The address selector allows you to set the PROFIBUS address of the PROFIBUS slave. Permissible addresses are 1 to 99. Every address must be unique at the bus.

The slave address has to be set before turning on the bus coupler.

When you set the address 00 during operation, the diagnostic data is saved in the Flash-ROM one time. Please take care to reset the original PROFIBUS address afterwards, so that the correct address is used at next start-up.

Note!

Please regard that the PROFIBUS address assigned at project engineering and the address at the address selector have to be identical to assure an unambiguous identification of the PROFIBUS slave.

Power supply   The PROFIBUS slave has an internal power supply. This power supply requires DC 24V. In addition to the electronics on the bus coupler, the supply voltage is also used to power any modules connected to the backplane bus. Please note that the maximum current that the integrated power supply can deliver to the backplane bus is 3.5A.

The power supply is protected against reverse polarity.

PROFIBUS and backplane bus are galvanically isolated from each other.

Attention!
Please ensure that the polarity is correct when connecting the power supply!

RS485 interface   Via a 9pin RS485 interface, you connect the PROFIBUS slave with your PROFIBUS network.

The pin assignment of this interface is as follows:

Pin	Assignment	Bus termination
1	n.c	
2	n.c.	
3	RxD/TxD-P (Line B)	
4	RTS	
5	M5V	
6	P5V	
7	n.c.	
8	RxD/TxD-N (Line A)	
9	n.c.	

Note!
The PROFIBUS line has to be terminated with its ripple resistor. Please make sure to terminate the last participants on the bus at both ends by activating the terminating resistor.

Technical Data

Order no.	353-1DP01
Type	IM 353DP
SPEED-Bus	-
Technical data power supply	
Power supply (rated value)	DC 24 V
Power supply (permitted range)	DC 20.4...28.8 V
Reverse polarity protection	✓
Current consumption (no-load operation)	70 mA
Current consumption (rated value)	1 A
Inrush current	60 A
I²t	0.45 A²s
Max. current drain at backplane bus	3.5 A
Max. current drain load supply	-
Power loss	2.5 W
Status information, alarms, diagnostics	
Status display	yes
Interrupts	yes, parameterizable
Process alarm	yes, parameterizable
Diagnostic interrupt	yes, parameterizable
Diagnostic functions	yes, parameterizable
Diagnostics information read-out	possible
Supply voltage display	green LED
Service Indicator	-
Group error display	red LED
Channel error display	none
Hardware configuration	
Racks, max.	1
Modules per rack, max.	29
Number of digital modules, max.	29
Number of analog modules, max.	16
Communication	
Fieldbus	PROFIBUS-DP to EN 50170
Type of interface	RS485
Connector	Sub-D, 9-pin, female
Topology	Linear bus with bus termination at both ends
Electrically isolated	✓
Number of participants, max.	125
Node addresses	1 - 99
Transmission speed, min.	9.6 kbit/s
Transmission speed, max.	12 Mbit/s
Address range inputs, max.	244 Byte
Address range outputs, max.	244 Byte
Number of TxPDOs, max.	-
Number of RxPDOs, max.	-
Housing	
Material	PPE
Mounting	Rail System 300
Mechanical data	
Dimensions (WxHxD)	40 x 125 x 120 mm
Weight	170 g
Environmental conditions	
Operating temperature	0 °C to 60 °C
Storage temperature	-25 °C to 70 °C
Certifications	
UL508 certification	yes

Chapter 3   Deployment

Overview   This chapter describes the usage of the IM 353-1DP01 at the System 300.
You may find here all information about project engineering, commissioning
and diagnostic.

Basics

General

PROFIBUS is an international standard applicable to an open fieldbus for building, manufacturing and process automation. PROFIBUS defines the technical and functional characteristics of a serial fieldbus system that can be used to create a low (sensor-/actuator level) or medium (process level) performance network of programmable logic controllers.

Together with other fieldbus systems, Profibus has been standardized in **IEC 61158** since 1999. *IEC 61158* bears the title "Digital data communication for measurement and control - Fieldbus for use in industrial control systems".

PROFIBUS comprises an assortment of compatible versions. The following details refer to PROFIBUS DP.

PROFIBUS DP-V0

PROFIBUS DP-V0 *(Decentralized Peripherals)* provides the basic functionality of DP, including cycle data exchange as well as station diagnostic, module diagnostic and channel-related diagnostic.

PROFIBUS DP is a special protocol intended mainly for automation tasks in a manufacturing environment. DP is very fast, offers Plug'n'Play facilities and provides a cost-effective alternative to parallel cabling between PLC and remote I/O. PROFIBUS DP was designed for high-speed data communication on the sensor-actuator level.

PROFIBUS DP-V1

The original version, designed DP-V0, has been expanded to include version DP-V1, offering acyclic data exchange between master and slave.

DP-V1 contains enhancements geared towards process automation, in particular acyclic data communication for parameter assignment, operation, visualization and interrupt handling of intelligent field devices, parallel to cycle user data communication. This permits online access to station using engineering tools. In addition, DP-V1 defines interrupts. Examples for different types of interrupts are status interrupt, update interrupt and a manufacturer-specific interrupt.

If you'd like to use the DP-V1 functionality you have to make sure your DP master also supports DP-V1. More detailed information about this is to be found in the documentation of your DP master.

Master and slaves   PROFIBUS distinguishes between active stations (master) and passive stations (slave).

Master devices

Master devices control the data traffic at the bus. It is also possible to operate with multiple masters on a PROFIBUS. This is referred to as multi-master operation. The protocol on the bus establishes a logical token ring between intelligent devices connected to the bus. Only the master that has the token, can communicate with its slaves.

A master is able to issue unsolicited messages if it is in possession of the access key (token). The PROFIBUS protocol also refers to masters as active participants.

Slave devices

A PROFIBUS slave acquires data from peripheral equipment, sensors, actuators and transducers. The VIPA PROFIBUS couplers are modular slave devices that transfer data between the System 300V periphery and the high-level master.

In accordance with the PROFIBUS standards these devices have no bus-access rights. They are only allowed to acknowledge messages or return messages to a master when this has issued a request. Slaves are also referred to as passive participants.

Master class 1 MSAC_C1   The master of the class 1 is a central control that exchanges cyclically information with the decentral stations (slaves) in a defined message cycle. Typical MSAC_C1 devices are controls (PLC) or PCs. MSAC_C1 devices gain active bus access which allows them to read the measuring values (inputs) of the field devices and to write the set points (outputs) of the actuators at a fixed time.

Master class 2 MSAC_C2   MSAC_C2 are employed for service and diagnostic. Here connected devices may be configured, measuring values and parameters are evaluated and device states can be requested. MSAC_C2 devices don't need to be connected to the bus system permanently. These also have active bus access.

Typical MSAC_C2 devices are engineering, project engineering or operator devices.

Communication

The bus transfer protocol provides two alternatives for the access to the bus:

Master with master

Master communication is also referred to as token-passing procedure. The token-passing procedure guarantees the accessibility of the bus. The permission to access the bus is transferred between individual devices in the form of a "token". The token is a special message that is transferred via the bus.

When a master is in possession of the token it has the permission to access the bus and it can communicate with any active or passive device. The token retention time is defined when the system is configured. Once the token retention time has expired, the token is passed to the following master which now has permission to access the bus and may therefore communicate with any other device.

Master-slave procedure

Data communication between a master and the slaves assigned to it, is conducted automatically in a predefined and repetitive cycle by the master. You assign a slave to a specific master when you define the project. You can also define which DP slaves are included and which are excluded from the cyclic exchange of data.

Data communication between master and slave can be divided into a parameterization, a configuration and a data transfer phase. Before a DP slave is included in the data transfer phase the master checks whether the defined configuration corresponds with the actual configuration. This check is performed during the definition and configuration phase. The verification includes the device type, format and length information as well as the number of inputs and outputs. In this way a reliable protection from configuration errors is achieved.

The master handles the transfer of application related data independently and automatically. You can, however, also send new configuration settings to a bus coupler.

When the status of the master is DE "Data Exchange" it transmits a new series of output data to the slave and the reply from the slave contains the

Function cyclic data communication (DP-V0)	*DP-V0* provides the basic functionality of DP, including cycle data exchange as well as station diagnostic, module diagnostic and channel-related diagnostic.
	Data is transferred cyclically between the DP master and the DP slave by means of transmit and receive buffers.

PII: process image of the inputs
PIQ: process image of the outputs
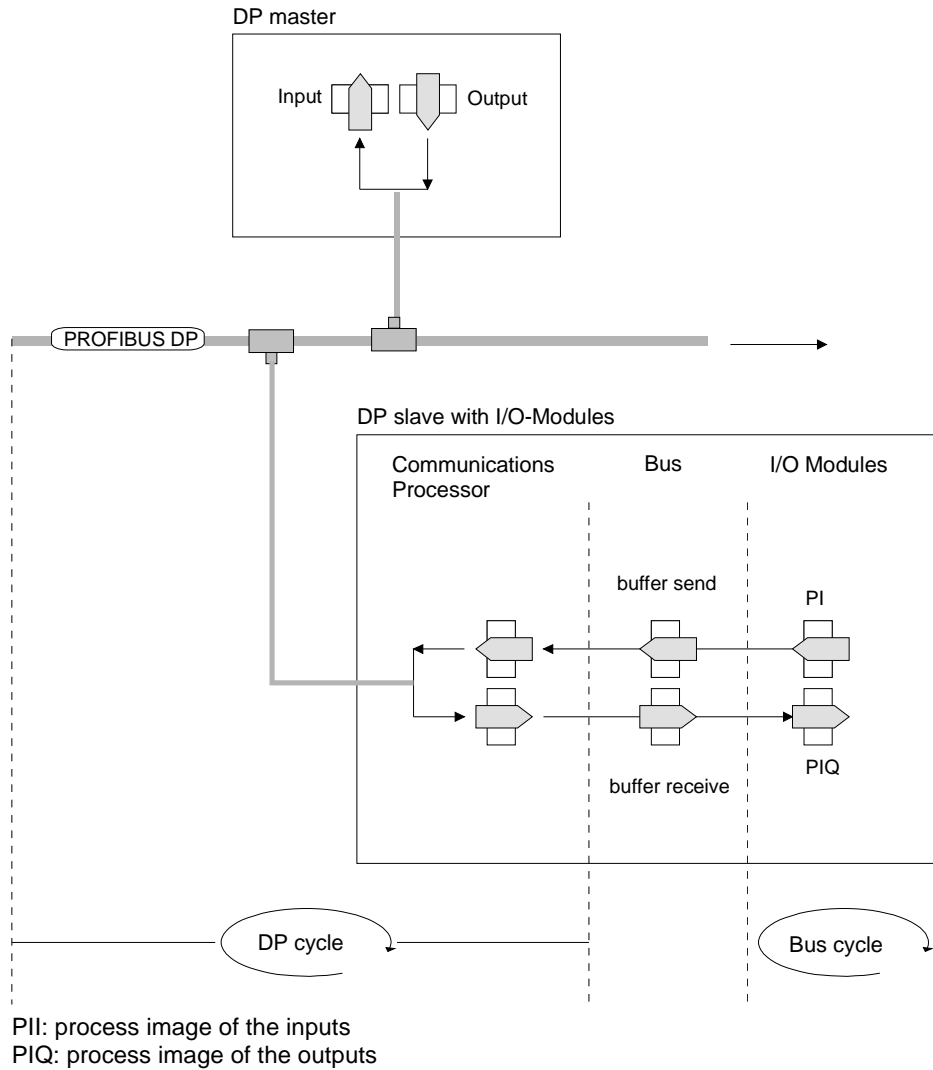
Bus cycle	A bus cycle saves all the input data from the modules in the PII and all the output data from the PIQ in the output modules. When the data has been saved the PII is transferred into the "send buffer" and the contents of the "receive buffer" is transferred into PIQ.
DP cycle	During a PROFIBUS cycle the master addresses all its slaves according to the sequence defined in the data exchange. The data exchange reads and writes data from/into the memory areas assigned to the PROFIBUS.
	The contents of the PROFIBUS input area is entered into the "receive buffer" and the data in the "send buffer" is transferred into the PROFIBUS output area.
	The exchange of data between DP master and DP slave is completed cyclically and it is independent from the bus cycle.

Bus cycle ≤ DP cycle

To ensure that the data transfer is synchronized the bus cycle time should always be less than or equal to the DP cycle time.

The parameter **min_slave_interval = 3ms** is located in the GSD-file.

In an average system it is guaranteed that the PROFIBUS data on the bus is updated after a max. time of 3ms. You can therefore exchange data with the slave at intervals of 3ms.

Note!

Starting with release version 6, the RUN-LED of a DP-V0 slave extinguishes as soon as the Bus cycle lasts longer than the DP cycle. This function is de-activated at the employment of a DP-V1 slave as DP-V0.

Function Acyclic data communication (DP-V1)

The key feature of version DP-V1 is the extended function for acyclic data communication. This forms the requirement for parameterization and calibration of the field devices over the bus during runtime and for the introduction of confirmed interrupt messages.

Transmission of acyclic data is executed parallel to cycle data communication, but with lower priority.
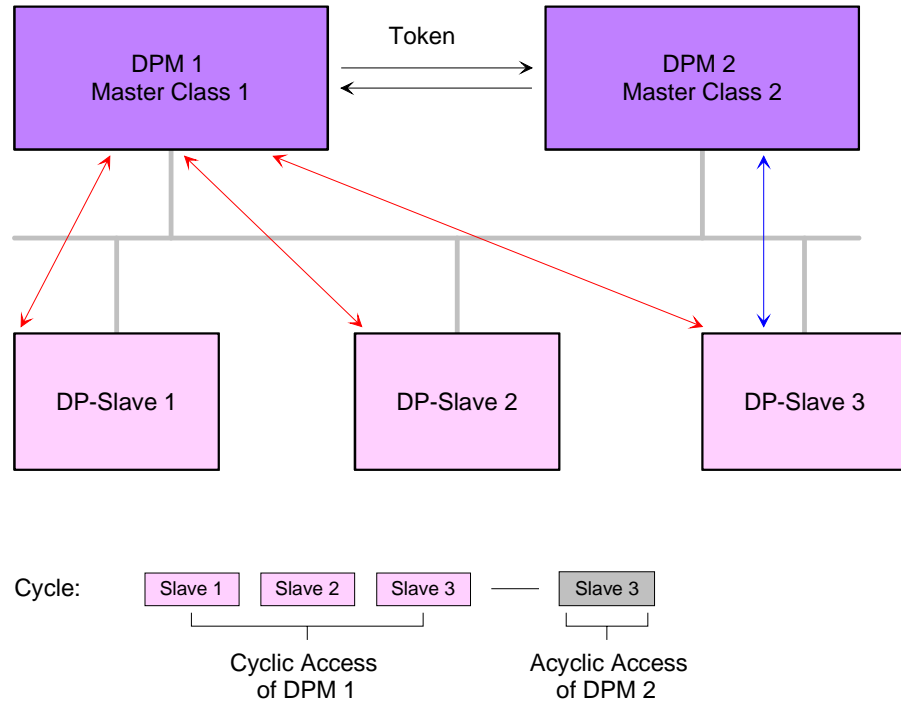
The DPM 1 (Master Class 1) has the token and is able to send messages to or retrieve them from slave 1, then slave 2, etc. in a fixed sequence until it reaches the last slave of the current list (MS0 channel); it then passes on the token to the DPM 2 (Master Class 2). This master can then use the remaining available time ("gap") of the programmed cycle to set up an acyclic connection to *any* slave (e.g. slave 3) to exchange records (MS2 channel); at the end of the current cycle time it returns the token to the DPM1.

The acyclic exchange of records can last for several scan cycles on their "gaps"; at the end, the DPM 2 uses the gap to clear the connection. Similarly as well as the DPM 2, the DPM 1 can also execute acyclic data exchange with slaves (MS1 channel).

Addressing with Slot and Index

When addressing data, PROFIBUS assumes that the physical structure of the slaves is *modular* or it can be structured internally in logical functional units, so-called *modules*. This model is also used in the basic DP functions for cyclic data communication where each module has a constant number of input-/output bytes that are transmitted in a fixed position in the user data telegram. The addressing procedure is based on identifiers, which characterize a module type as input, output or a combination of both. All identifiers combined produce the configuration of the slave, which is also checked by the DPM when the system starts up.

The acyclic data communication is also based on this model. All data blocks enabled for read/write access are also regarded as assigned to the modules and can be addressed using slot number and index.

The *Slot_Number* addresses the module and the *index* addresses the data blocks of a module. The Slot_Number = 0 addresses data of the PROFIBUS coupler, Slot_Number > 0 addresses the data of the function modules.
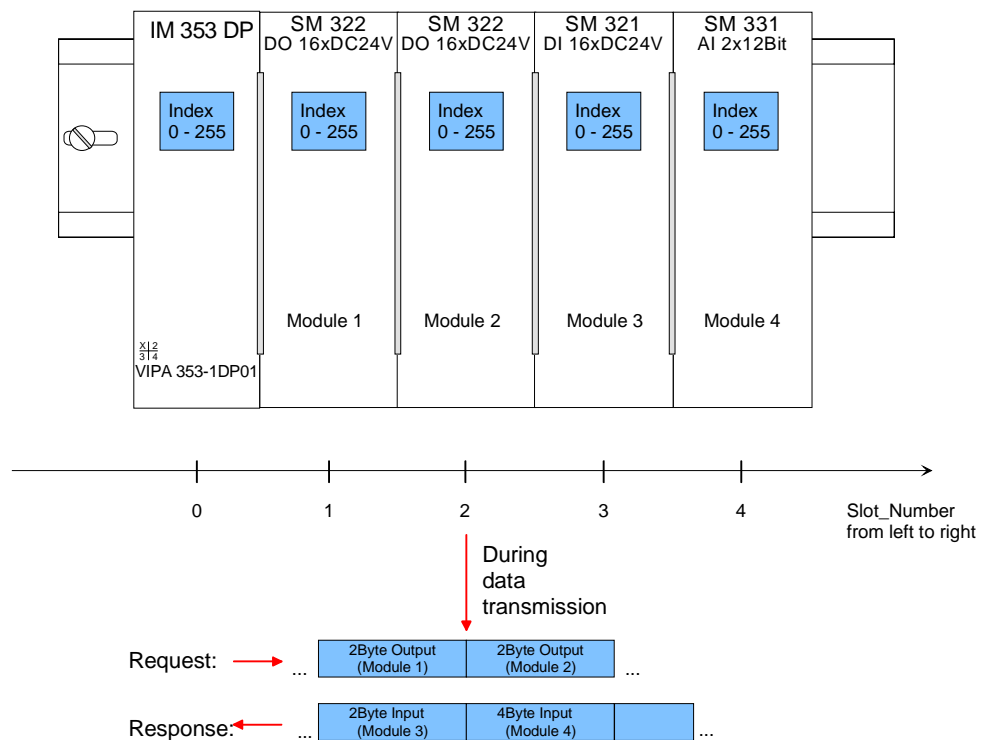
Each data block can be up to 244Bytes. In the case of modular devices, the slot number is assigned to the modules. Compact devices are regarded as a unit of virtual modules. These can also be addressed whit slot number and index. Through the length specification in the read/write request, it is also possible to read/write parts of a data block.

Note!

For the addressing at the deployment of the Siemens SIMATIC manager the following conventions are valid:

DP slave coupler: Setting of the *diagnostic address* as ID

Modules of the DP slave coupler: Setting of the *module address* as ID. For an output module you have to set additionally Bit 15 of the module address (e.g. address 0004h becomes 8004h). With a combination module you have to set the lower one of the two addresses.

**Services
Acyclic data
communication**

For the deployment of the DP-V1 services you have to take care that your CPU supports DP-V1 communication. More detailed information about this is to be found in the description of your CPU. The following system function blocks are available for this:

SFB 52   Read record set from a DP slave

SFB 53   Write record set to a DP slave

SFB 54   Receive interrupt from a DP slave

The following text shows the services for the acyclic data transfer that are using that function blocks.

More detailed information about the services and the DP-V0/V1 communication principles are to be found in the PROFIBUS norm IEC 61158.

DPM 1
(Master class 1)

Services for Acyclic data transfer between DPM 1 and slaves	
Read	The master reads a data block from the slave.
Write	The master writes a data block to the slave.
Interrupt	An interrupt is transmitted from the slave to the master, which explicitly acknowledges receipt. The slave can only send a new interrupt message after it has received this acknowledgement; this prevents any interrupts being overwritten.
Interrupt_ Acknowledge	The master acknowledges receipt of an interrupt to the slave.
Status	A status message is transmitted from the slave to the master. There is no acknowledgment.
Data transmission is connection-oriented over a MS1 connection. This is set up by the DPM 1 and is closely linked to the connection for cyclic data communication. It can be used by the master that has parameterized and configured the respective slave.	

DPM 2
(Master class 2)

Services for Acyclic data transfer between DPM 2 and slaves	
Initiate Abort	Setup and termination of a connection for acyclic data communication between the DPM 2 and the slave
Read	The master reads a data block from the slave.
Write	The master writes a data block to the slave.
Data_ Transport	The master can write application-specific data (specified in profiles) acyclically to the slave and if required, read data from the slave in the same cycle.
Data transmission is connection-oriented over a MS2 connection. This is set up before the start of the acyclic data communication by the DPM 2 using the Initiate service. The connection is then available for Read, Write and Data_Transport services. The connection is terminated correspondingly. A slave can maintain several active MS2 connections simultaneously. A limitation is given by the resources of the slave.	

Data transfer medium as RS485 interface

PROFIBUS employs screened twisted pair cable on the basis of the RS485 interface. The data transfer rate of the system is limited to a max. of 12MBaud.

The RS485 interface uses differential voltages. For this reason this kind of interface is less susceptible to interference than a plain voltage or current based interface. The network may be configured as linear or as tree structure. Your PROFIBUS coupler carries a 9pin socket. This socket is used to connect the PROFIBUS coupler to the PROFIBUS network as a slave.

Due to the bus structure of RS485, any station may be connected or disconnected without interruptions and a system can be commissioned in different stages. Extensions to the system do not affect stations that have already been commissioned. Any failures of stations or new devices are detected automatically.

Addressing

Every device on the PROFIBUS is identified by an address. This address must be an unique number in the bus system between 1 and 99. The address of the VIPA PROFIBUS coupler is set by the addressing switch located on the front of the module.

GSD- file

The GSD files may be found at www.vipa.com at the "Service" part.

The assignment of the GSD-file to your slave is shown in the following table:

Order number	GSD-file
VIPA 353-1DP01(DP-V0)	VI0009AF.gsd [*]
VIPA 353-1DP01(DP-V1)	VI0109AF.gsd

[*]   This GSD-file is used for PROFIBUS master that don't support DP-V1.

Please install the required files from your disc into your configuration tool. Details on the installation of the GSD and/or type files are available from the manual supplied with your configuration tool.

After the installation of the GSD-file you will find this entry e.g. in the hardware catalog under:

PROFIBUS DP>Additional field devices>I/O>VIPA_System_300V>
VIPA 353-1DP01.

Project engineering

General

For project engineering a DP master engineering tool can be used like the Siemens SIMATIC manager. Here you assign the according PROFIBUS DP slave modules to the DP master.

A direct assignment takes place via the PROFIBUS address that you set at the DP slave address selector.

By installing the corresponding GSD file the IM 353-1DP01 is listed at the hardware catalog as "VIPA_353-1DP01 (DP-V0 or DP-V1)".

You'll find this at:

PROFIBUS DP > Additional Field devices> I/O > VIPA_System_300V

DP-V0/DP-V1 functionality by GSD file

The GSD files may be found at www.vipa.com at the "Service" part.

Depending on the installed GSD file the following modules are listed at the hardware catalog:

Module	GSD file
VIPA 353-1DP01 (DP-V0)	VI0009AF.gsd
VIPA 353-1DP01 (DP-V1)	VI0109AF.gsd

Install the appropriate GSD file in your engineering tool. For more information see manual of you engineering tool.

Project engineering

- Mount your PROFIBUS system.
- Start your project engineering tool with a new project.
- Configure a master system and create a new PROFIBUS subnet.
- For the project engineering of the IM 353-1DP01 take the "VIPA 353-1DP01 (DPV0)" or "VIPA 353-1DP01 (DPV1)" for each functionality from the hardware catalog and drag it to the DP master subnet.
- Enter a PROFIBUS address between 1 and 99 into the properties of the DP slave and set the same address at the address lever.
- Parameterize the DP slave (see parameters).
- Transfer your project to the PLC.

Note

Please note to place the following modules during hardware configuration to the first three slots:

Config for Slot1
Config for Slot2
Config for Slot3

These modules are automatically placed using the Siemens SIMATIC Manager:

Parameter data IM 353-1DP01 DP-V0

At usage of the IM 353-1DP01 (DP-V0) you have the following parameter data:

Byte	Bit 7 ... Bit 0	Default
0	Bit 2 ... 0: 0 (fix) Bit 3: 0 = WD-Timebase 10ms 1 = WD-Timebase 1ms Bit 4: 0 (fix) Bit 5: 0 = Publisher-Mode not available 1 = Publisher-Mode available	00h[1]
1	00h (fix)	00h
2	08h (fix)	08h
3	0Ah (fix)	0Ah
4	81h (fix)	81h
5	00h (fix)	00h
6	00h (fix)	00h
7	Bit 0: 0 = Identifier-related diagnostic enable 1 = Identifier-related diagnostic disable Bit 1: 0 = Module status enable 1 = Module status disable Bit 2: 0 = Channel-related diagnostic enable 1 = Channel-related diagnostic disable Bit 3: 0 (fix) bit 4: 0 (fix) Bit 5: 0 = V0: Diagnostic interrupt not available 1 = V0: Diagnostic interrupt available Bit 6: 0 = V0: Hardware interrupt not available 1 = V0: Hardware interrupt available Bit 7: 0 (fix)	70h
8	Bit 7 ... 0: 0 (fix)	00h
9 ... 12	00h (fix)	00h

[1] Using the Siemens SIMATIC Manager this value is automatically set and can not be changed.

**Parameter data
IM 353-1DP01
DP-V1**

At usage of the IM 353-1DP01 (DP-V1) you have the following parameter data:

Byte	Bit 7 ... Bit 0	Default

0	Bit 2 ... 0: 0 (fix)
	Bit 3: 0 = WD-Timebase 10ms
	     1 = WD-Timebase 1ms
	Bit 4: 0 (fix)
	Bit 5: 0 = Publisher-Mode not available
	     1 = Publisher-Mode available
	Bit 6: 0 = Fail-Safe-Mode not available
	     1 = Fail-Safe-Mode available
	Bit 7: 0 = DP-V1 mode disable
	     1 = DP-V1 mode enable
		C0h[1]

1	Bit 0: Startup when expected/actual config. differ
	     (must always be 0 else a parameterization error
	     occures)
	Bit 3 ... 1: 0 (fix)
	Bit 4: 0 = V1: Vendor-specific interrupt not available
	     1 = V1: Vendor-specific interrupt available
	Bit 5: 0 = V1: Diagnostic interrupt not available
	     1 = V1: Diagnostic interrupt available
	Bit 6: 0 = V1: Hardware interrupt not available
	     1 = V1: Hardware interrupt available
	Bit 7: 0 (fix)
		70h

2	08h (fix)	08h
3	0Ah (fix)	0Ah
4	81h (fix)	81h
5	00h (fix)	00h
6	00h (fix)	00h

7	Bit 0: 0 = Identifier-related diagnostic enable
	     1 = Identifier-related diagnostic disable
	Bit 1: 0 = Module status enable
	     1 = Module status disable
	Bit 2: 0 = Channel-related diagnostic enable
	     1 = Channel-related diagnostic disable
	Bit 7 ... 3: 0 (fix)
		00h

8	Bit 7 ... 0: 0 (fix)	00h
9 ... 12	00h (fix)	00h

[1] Using the Siemens SIMATIC Manager this value is automatically set and can not be changed.

DP-V1 Services

Overview

For the deployment of the DP-V1 services you have to take care that your CPU supports DP-V1 communication. More detailed information about this is to be found in the description of your CPU. The following system function blocks are available for this:

SFB 52   Read record set from a DP slave

SFB 53   Write record set to a DP slave

SFB 54   Receive interrupt from a DP slave

Per default, one class-1 master and max 3 class-2 master connection with 244Byte data (4Byte DP-V1 header plus 240Byte user data) are supported. The class-1 master connection is established together with the cyclic connection and is activated via the parameterization. The class-2 master connection can be used by a C2 master that then communicates with the slave only acyclical and provides an own connection establishment.

Data from DP-V1 slave

To access the DP-V1 slave with the Siemens SIMATIC Manager the *diagnostic address*, which can be set by properties, is used as *ID*.

Using the following record set no. as *Index* you get access for reading (R) res. writing (W) to the listed DP slave elements:

Index	Access	Description
A0h	R	Device name as ASCII code (VIPA 353-1DP01)
A1h	R	Hardware Version as ASCII code (V1.00)
A2h	R	Software Version as ASCII code (V1.00)
A3h	R	Serial number of the device as ASCII code (e.g. 000347 = 30h, 30h, 30h, 33h, 34h, 37h)
A4h	R	Device configuration (see table next page with module identification assigned to module type)
D0h	R	Number of stored diagnostic
D0h	W	Any write instruction deletes every diagnostic entries
D1h	R	Read diagnostic entries in sequence
D1h	W	Any write instruction stores diagnostic entries permanently in the FLASH memory

Structure stored diagnostic entry

With every D1h call a stored diagnostic entry with max. 26Byte is displayed starting with the newest one.

Basically every stored diagnostic entry has the following structure:

Label	Type	Description
Length	Word	Length of the diagnostic data
Time stamp	Double word	Internal time stamp
Diagnostic (max. 20Byte)	Byte	Diagnostic entry (interrupt) that is stored internal

Device configuration

Via the index A4h, the module configuration of DP slave can be monitored. The assignment *identification* to *module type* can be found at the following table:

Module type	Identification	Input byte	Output byte
DI 8	9FC1h	1	-
DI 8 - Alarm	1FC1h	1	-
DI 16	9FC2h	2	-
DI 14 / 2C	08C0h	6	6
DI 32	9FC3h	4	-
DO 8	AFC8h	-	1
DO 16	AFD0h	-	2
DO 32	AFD8h	-	4
DIO 8	BFC9h	1	1
DIO 16	BFD2h	2	2
AI2	15C3h	4	-
AI4	15C4h	8	-
AI4 - fast	11C4h	8	-
AI8	15C5h	16	-
AO2	25D8h	-	4
AO4	25E0h	-	8
AO8	25E8h	-	16
AI2 / AO2	45DBh	4	4
AI4 / AO2	45DCh	8	4

Data of the function modules

To access the function modules with the Siemens SIMATIC Manager the *module address*, which can be set by properties, is used as *ID*.

Using the following record set no. as *Index* you get access for reading (R) res. writing (W) to the listed function module elements:

Index	Access	Description
00h	R	Diagnostic – record set 0
	W	Write Module parameters
01h	R	Diagnostic – record set 1

DP-V1 - I&M data

Overview
Identification and maintenance data (I&M) are stored information in a module which support you at:

- check of the system configuration
- discover of hardware changes
- remove errors in a system

Identification data (I data) are information of the module e.g. order number, serial number, which can be found printed at the module.
I data are manufacturer information and can only be read.

Maintenance data (M data) are information like location and date of installation. M data were produced and stored during project engineering

By means of I&M data the modules can online be identified.

Note!
Only one DP master may access at one time the I&M data.

Structure
The data structure of the I&M data corresponds to the specifications of PROFIBUS guideline - order no. 3.502, version 1.1 from May 2003.

I&M data	Access	Preset	Explanation
Identification data 0: IM_INDEX: 65000			
MANUFACTURER_ID	read (2byte)	022Bh (555)	Name of the manufacturer (555 = VIPA GmbH)
ORDER_ID	read (20byte)	depends on the module	Order number of the module VIPA 053-1DP00
SERIAL_NUMBER	read (16byte)	depends on the module	Serial number of the module for clear identification.
HARDWARE_REVISION	read (2byte)	depends on the module	Hardware revision of the module which is incremented on changes at the firmware.

continued ...

... continue

I&M data	Access	Preset	Explanation
SOFTWARE_REVISION	read (4byte)	Firmware version Vxyz	Firmware version of the module. An increase of the firmware version also increases the hardware revision
REVISION_COUNTER	read (2byte)	0000h	reserved
PROFILE_ID	read (2byte)	F600h	Generic Device
PROFILE_SPECIFIC_TYPE	read (2byte)	0003h 0004h 0005h	I/O modules Communication modules Interface modules
IM_VERSION	read (2byte)	0101h	Information about the version of the I&M data. (0101h = version 1.1)
IM_SUPPORTED	read (2byte)	001Fh	Information about available I&M-Data (IM_INDEX: 650000 ...65004)
Maintenance data 1: IM_INDEX: 65001			
TAG_FUNCTION	read/write (32byte)	_	Clear module ID inside the system
TAG_LOCATION	read/write (22byte)	_	Location of installation of the module
Maintenance data 2: IM_INDEX: 65002			
INSTALLATION_DATE	read/write (16byte)	_	Date and if applicable time of installation of the module
RESERVED	read/write (38byte)	_	reserved
Maintenance data 3: IM_INDEX: 65003			
DESCRIPTOR	read/write (54byte)	_	Commentary to the module
Maintenance data 4: IM_INDEX: 65004			
SIGNATURE	read/write (54byte)	_	Commentary to the module

PROFIBUS installation guidelines

PROFIBUS in
general

- A PROFIBUS DP network may only be built up in linear structure.
- PROFIBUS DP consists of minimum one segment with at least one master and one slave.
- A master has always been deployed together with a CPU.
- PROFIBUS supports max. 126 participants.
- Per segment a max. of 32 participants is permitted.
- The max. segment length depends on the baud rate:

9.6 ... 187.5kbaud	$\rightarrow$	1000m
500kbaud	$\rightarrow$	400m
1.5Mbaud	$\rightarrow$	200m
3 ... 12Mbaud	$\rightarrow$	100m

- Max. 10 segments may be built up. The segments are connected via repeaters. Every repeater counts for one participant.
- The bus respectively a segment is to be terminated at both ends.
- All participants are communicating with the same baud rate. The slaves adjust themselves automatically on the baud rate.

Transfer medium   As transfer medium PROFIBUS uses an isolated twisted-pair cable based upon the RS485 interface.

The RS485 interface is working with voltage differences. Though it is less irritable from influences than a voltage or a current interface. You are able to configure the network as well linear as in a tree structure.

Max. 32 participants per segment are permitted. Within a segment the members are linear connected. The segments are connected via repeaters. The maximum segment length depends on the transfer rate.

PROFIBUS DP uses a transfer rate between 9.6kbaud and 12Mbaud, the slaves are following automatically. All participants are communicating with the same transfer rate.

The bus structure under RS485 allows an easy connection res. disconnection of stations as well as starting the system step by step. Later expansions don't have any influence on stations that are already integrated. The system realizes automatically if one partner had a fail down or is new in the network.

Bus connection   The following picture illustrates the terminating resistors of the respective start and end station.
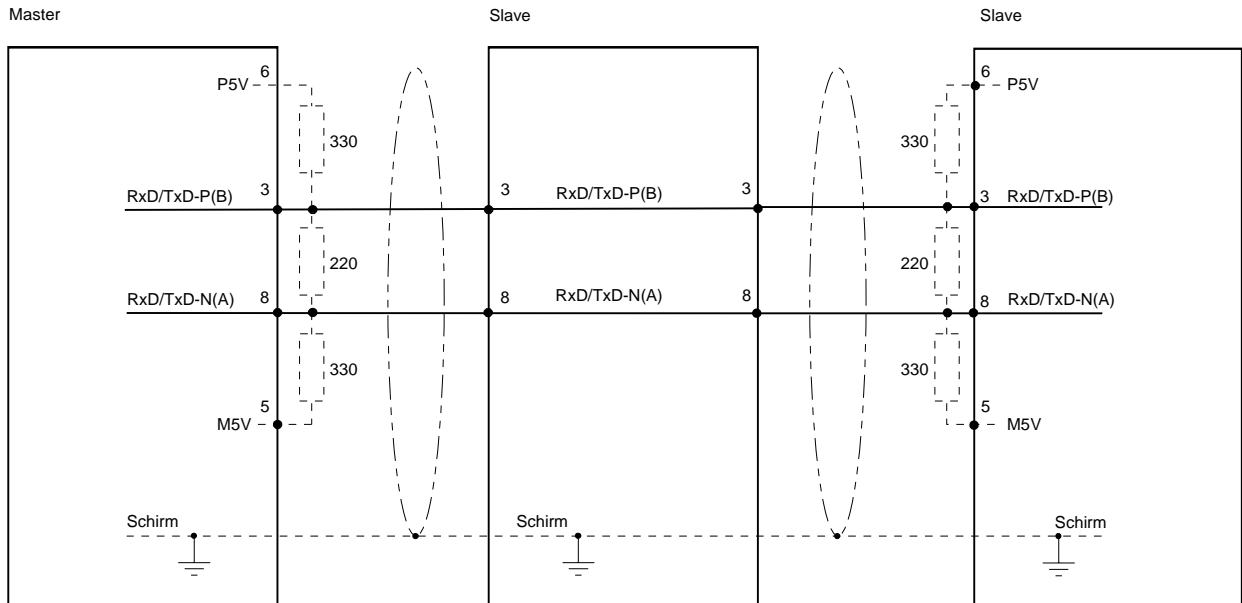
Note!

The PROFIBUS line has to be terminated with its ripple resistor. Please make sure to terminate the last participants on the bus at both ends by activating the terminating resistor.

EasyConn
bus connector

In PROFIBUS all participants are wired parallel. For that purpose, the bus cable must be feed-through.

Via the order number VIPA 972-0DP10 you may order the bus connector "EasyConn". This is a bus connector with switchable terminating resistor and integrated bus diagnostic.
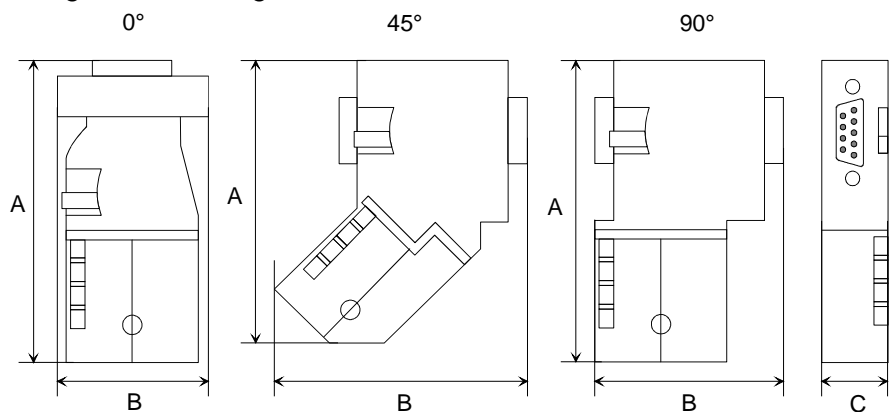
	0°	45°	90°
A	64	61	66
B	34	53	40
C	15.8	15.8	15.8

all in mm

Note!

To connect this EasyConn plug, please use the standard PROFIBUS cable type A (EN50170). Starting with release 5 you also can use highly flexible bus cable: Lapp Kabel order no.: 2170222, 2170822, 2170322.
With the order no. 905-6AA00 VIPA offers the "EasyStrip" de-isolating tool that makes the connection of the EasyConn much easier.

Dimensions in mm

Termination with "EasyConn"

The "EasyConn" bus connector is provided with a switch that is used to activate a terminating resistor.

Wiring

1./last
bus participant
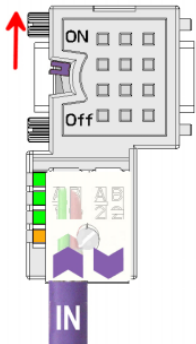
further
participants
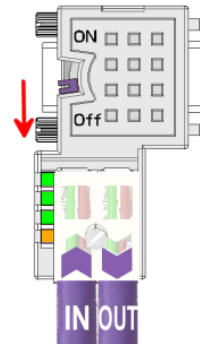
Attention!

The terminating resistor is only effective, if the connector is installed at a bus participant and the bus participant is connected to a power supply.

Note!

A complete description of installation and deployment of the terminating resistors is delivered with the connector.

Assembly
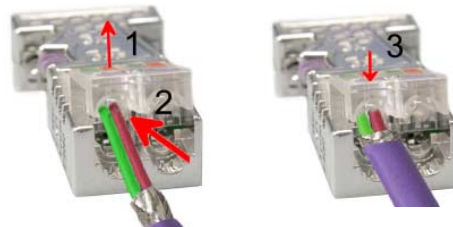
- Loosen the screw.
- Lift contact-cover.
- Insert both wires into the ducts provided (watch for the correct line color as below!)
- Please take care not to cause a short circuit between screen and data lines!
- Close the contact cover.
- Tighten screw
  (max. tightening torque 4Nm).

Please note: The green line must be connected to A, the red line to B!

Commissioning

Overview
- Assemble your PROFIBUS system.
- Configure your master system.
- Adjust a valid address of the PROFIBUS.
- Transfer the configuration into your master.
- Connect the master and slave modules with the PROFIBUS.
- Turn the power supply on.

Installation

Assemble your PROFIBUS system with the wanted peripheral modules. Every PROFIBUS slave coupler has an integrated power supply that has to be provided with DC 24V. Via the power supply not only the bus coupler is provided but also the modules connected via backplane bus. Please regard that the integrated power supply can provide the backplane bus with a max. of 3.5A.

PROFIBUS and backplane bus are galvanically separated from each other.

Configuration in the master system

Configure your PROFIBUS master in your master system. You can use the WinNCS of VIPA for this purpose ore the Siemens hardware configurator.

Addressing

At the PROFIBUS slave modules, you set the PROFIBUS address that you assigned at project engineering.

Transferring your project

Depending on the deployed master, there are different possibilities to transfer your project to the DP master.

Connecting a system by means of PROFIBUS

In a system with more than one station all stations are wired in parallel. For this reason the bus cable must be feed-through uninterrupted.
You should always keep an eye on the correct polarity!

Note!

To prevent reflections and associated communication problems the bus cable has always to be terminated with its ripple resistor!

**Start-up
behavior IM
353DP slave**

After power on, the DP slave executes a self test. It controls its internal functions and the communication via the backplane bus. After the error free start-up, the bus coupler switches into the state "ready". In this state, the DP slave gets its parameters from the DP master and, at valid parameters, switches into the state "DataExchange" DE (DE is permanently on).

At communication errors at the backplane bus, the PROFIBUS slave switches into STOP and boots again after app. 2 seconds. As soon as the test has been completed positive, the RD-LED blinks.

```
                    ┌─────────────────┐
                    │    Power On      │
                    └─────────────────┘
                             │
                             ▼
                    ┌─────────────────┐
                    │    ER-LED on     │
                    │    PW-LED on     │
                    └─────────────────┘
                             │
                             ▼
                    ┌─────────────────┐
                    │  Initialization  │
                    └─────────────────┘
                             │
                             ▼
                  ┌───────────────────────┐
                  │  DP slave sets outputs │
                  │  to "0" and takes over │
                  │  the defined Profibus  │
                  │        address         │
                  └───────────────────────┘
                             │
                             ▼
                    ┌─────────────────┐
                    │   ER-LED off     │
                    │  RD-LED blinks   │
                    └─────────────────┘
                             │
                             ▼
                  ┌───────────────────────┐
                  │   DP slave receives    │
                  │  project data from DP  │
                  │        master          │
                  └───────────────────────┘
                             │
                             ▼
              ◇ Project data conform ◇ ──no──> ◇ Para-       ◇ ──y──> ┌──────────────┐
              ◇ with real build-up?  ◇          ◇ meterization◇        │  ER-LED and   │
                             │                  ◇ error?      ◇        │  RD-LED blinking│
                            yes                      │                 │ simultaneously │
                             │                      no                 └──────────────┘
                             ▼                       │
                    ┌─────────────────┐       ◇ Configuration◇ ──y──> ┌──────────────┐
                    │    RD-LED on     │       ◇ error?       ◇        │  ER-LED and   │
                    │    DE-LED on     │            │ no               │  RD-LED blinking│
                    └─────────────────┘                               │ simultaneously │
                             │                                        └──────────────┘
                             ▼
                    ┌─────────────────┐
                    │ Release in-/outputs│
                    └─────────────────┘
                             │
                             ▼
                    ┌─────────────────┐
                    │  Data exchange   │
                    └─────────────────┘
```

Diagnostic functions

Overview

PROFIBUS DP provides an extensive set of diagnostic functions for quick error localization. Diagnostic messages are transferred via the bus and collected by the master.

At the DP-V1 the device related diagnostic has been improved as further function and is subdivided into the categories interrupts and status messages.

Additionally in the DP-V1 slave from VIPA the last 100 interrupt messages are stored in a RAM res. in the flash with a time stamp and may be evaluated with a software.

For this, please call the VIPA hotline!

In addition you can access diagnostic data using the DP-V1 services.

Difference diagnostic DP-V0 and DP-V1

At DP-V0 and DP-V1 there are identical diagnostic structure and behavior. The only difference consists of the fact that with employment in a system 300 with a hardware interrupt at DP-V0 the OB 82 and with DP-V1 the OB 40 is called.

Internal diagnostic system messages

The system also stores diagnostic messages like the states "Ready" res. "DataExchange" that are not passed on to the master.

With every status change between "Ready" and "DataExchange" the PROFIBUS slave stores the diagnostic-RAM content in a Flash-ROM and writes it back to the RAM at every reboot.

Manual storage of diagnostic data

With the short setting of 00 at the address lever you may save the diagnostic data in the Flash-ROM during "DataExchange".

Diagnostic messages at voltage failure

At voltage failure res. decreasing voltage a time stamp is stored in the EEPROM. If enough voltage is still left, a diagnostic output to the master occurs.

At the next reboot an undervoltage/shut-down diagnostic message is generated from the time stamp of the EEPROMs and is stored in the Diagnostic-RAM.

Structure of the 353-1DP01 diagnostic data

The diagnostic messages that are created by the PROFIBUS slave have, depending on the parameterization, a length of 58Byte.

As soon as the PROFIBUS slave sends a diagnostic to the master, the max. of 58Byte diagnostic data are prepended by 6Byte standard diagnostic data:

Byte 0 ... Byte 5	Standard diagnostic data	Is only prepended at transfer to the master via PROFIBUS	
x ... x+4	Identifier-related diagnostic		Can be enabled or disabled via parameterization
x ... x+11	Module state		
max. 9·(x ... x+2)	Channel-related diagnostic		
x ... x+19	Interrupt	Internal stored diagnostic	

Standard diagnostic data

At the transfer of a diagnostic to the master the slave standard diagnostic data are prepended to the diagnostic bytes. More detailed information to the structure of the slave standard diagnostic data is to find in the standard papers of the PROFIBUS User Organization.

The slave standard diagnostic data have the following structure:

Standard diagnostic

Byte	Bit 7 ... Bit 0
0	Bit 0: Bit is always at 0 Bit 1: slave is not yet ready for exchange data Bit 2: Configuration data does not correspond to actual configuration Bit 3: External slave diagnostic available Bit 4: Request function is not supported by slave Bit 5: 0 (fix) Bit 6: Wrong parameterization Bit 7: 0 (fix)
1	Bit 0: New parameters have to be assigned to slave Bit 1: Statistic Diagnostic Bit 2: 1 (fix) Bit 3: Response monitoring has been enabled Bit 4: "FREEZE" control command received Bit 5: "SYNC" control command received Bit 6: reserved Bit 7: 0 (fix)
2	Bit 6 ... 0: reserved Bit 7: Diagnostic data overflow
3	Master address after parameterizing FFh: Slave has not been parameterized
4	Ident number High Byte
5	Ident number Low Byte

Identifier-related diagnostic

Via the Identifier-related diagnostic you gain information at which plug-in location (module) an error has occurred.

More detailed information about the error is available via the *Module state* and the *channel-related diagnostic.*

The identifier-related diagnostic can be activated via the parameterization and has the following structure:

Identifier-related diagnostic

Byte	Bit 7 ... Bit 0
X	Bit 5 ... 0: 000101 (fix) Length of the Identifier-related diagnostic Bit 7 ... 6: 01 (fix) Code for Identifier-related diagnostic
X+1	The bit is set if one of the following occurs: - a module is removed - an unconfigured module is inserted - an inserted module cannot be accessed - a module reports a diagnostic interrupt Bit 0: Entry for module on slot 1* Bit 1: Entry for module on slot 2* Bit 2: Entry for module on slot 3* Bit 3: Entry for module on slot 4 Bit 4: Entry for module on slot 5 Bit 5: Entry for module on slot 6 Bit 6: Entry for module on slot 7 Bit 7: Entry for module on slot 8
X+2	Bit 0: Entry for module on slot 9 Bit 1: Entry for module on slot 10 Bit 2: Entry for module on slot 11 Bit 3: Entry for module on slot 12 Bit 4: Entry for module on slot 13 Bit 5: Entry for module on slot 14 Bit 6: Entry for module on slot 15 Bit 7: Entry for module on slot 16
X+3	Bit 0: Entry for module on slot 17 Bit 1: Entry for module on slot 18 Bit 2: Entry for module on slot 19 Bit 3: Entry for module on slot 20 Bit 4: Entry for module on slot 21 Bit 5: Entry for module on slot 22 Bit 6: Entry for module on slot 23 Bit 7: Entry for module on slot 24
X+4	Bit 0: Entry for module on slot 25 Bit 1: Entry for module on slot 26 Bit 2: Entry for module on slot 27 Bit 3: Entry for module on slot 28 Bit 4: Entry for module on slot 29 Bit 5: Entry for module on slot 30 Bit 6: Entry for module on slot 31 Bit 7: Entry for module on slot 32

*) This slot is occupied by a virtual module.

Module status   The module status gives you detailed information about the error that occurred at a module.

The module status can be activated via the parameterization and has the following structure:

Module status

Byte	Bit 7 ... Bit 0
X	Bit 5 ... 0: 001100 (fix) Length of the Module status Bit 7 ... 6: 00 (fix) Code for Module status
X+1	82h (fix) Status type Module status
X+2	00h (fix)
X+3	00h (fix)
X+4	Follow bits indicates the status of the modules from slot 1 ... 32 00: Module ok - valid Data 01: Module error - invalid Data (Module defective) 10: Incorrect module - invalid Data 11: No Module - invalid Data Bit 1, 0: Module status module slot 1* Bit 3, 2: Module status module slot 2* Bit 5, 4: Module status module slot 3* Bit 7, 6: Module status module slot 4
X+5	Bit 1, 0: Module status module slot 5 Bit 3, 2: Module status module slot 6 Bit 5, 4: Module status module slot 7 Bit 7, 6: Module status module slot 8
X+6	Bit 1, 0: Module status module slot 9 Bit 3, 2: Module status module slot 10 Bit 5, 4: Module status module slot 11 Bit 7, 6: Module status module slot 12
X+7	Bit 1, 0: Module status module slot 13 Bit 3, 2: Module status module slot 14 Bit 5, 4: Module status module slot 15 Bit 7, 6: Module status module slot 16
X+8	Bit 1, 0: Module status module slot 17 Bit 3, 2: Module status module slot 18 Bit 5, 4: Module status module slot 19 Bit 7, 6: Module status module slot 20
X+9	Bit 1, 0: Module status module slot 21 Bit 3, 2: Module status module slot 22 Bit 5, 4: Module status module slot 23 Bit 7, 6: Module status module slot 24
X+10	Bit 1, 0: Module status module slot 25 Bit 3, 2: Module status module slot 26 Bit 5, 4: Module status module slot 27 Bit 7, 6: Module status module slot 28
X+11	Bit 1, 0: Module status module slot 29 Bit 3, 2: Module status module slot 30 Bit 5, 4: Module status module slot 31 Bit 7, 6: Module status module slot 32

*) This slot is occupied by a virtual module.

Channel-related Diagnostic

With the channel-related diagnostic you gain detailed information about the channel error within a module. For the usage of the channel-related diagnostic you have to release the diagnostic interrupt for every module via the parameterization. The channel-related diagnostic can be activated via the parameterization and has the following structure:

Channel-related diagnostic

Byte	Bit 7 ... Bit 0
X	Bit 5 ... 0: ID number of the module that delivers the channel-specific diagnostic (000001 ... 011111) e.g.: Slot 1 has ID no. 0 Slot 32 has ID no. 31 Bit 7, 6: 10 (fix) Code for channel-related diagnostic
X+1	Bit 5 ... 0: Number of the channel or the channel group that delivers the diagnostic (00000 .... 11111) Bit 7 ... 6: 01=Input Module 10=Output Module 11=In-/Output Module
X+2	Bit 4 ... 0: *Error messages to PROFIBUS standard* 00001: Short circuit 00010: Undervoltage (Supply voltage) 00011: Overvoltage (Supply voltage) 00100: Output Module is overloaded 00101: Temperature rise output Module 00110: Open circuit sensors or actors 00111: Upper limit violation 01000: Lower limit violation 01001: Error - Load voltage at the output - Sensor supply - Hardware error in the Module *Error messages - manufacturer-specific* 10000: Parameter assignment error 10001: Sensor or load voltage missing 10010: Fuse defect 10100: Ground fault 10101: Reference channel error 10110: Hardware interruptlost 11001: Safety-related shutdown 11010: External fault 11010: Indefinable error - not specified Bit 7 ... 5: Channel type 001: Bit 010: 2 Bit 011: 4 Bit 100: Byte 101: Word 110: 2 Words

The maximum number of channel-related diagnostic is limited by the total length of 58Byte for diagnostic. By de-activating of other diagnostic ranges you may release these areas for further channel-related diagnostic. For each channel always 3Byte are used.

Interrupts   The interrupt section of the slave diagnostic shows informations about interrupt type and cause. It consists of max. 20Byte. For every slave diagnostic max. 1 interrupt can be send. The interrupt section is always the last part of the diagnostic telegram if activated it in the parameterization.

Structure   Depending on the interrupt type, the interrupt section has the following structure:

Byte	Element	Description
x...x+3	Interrupt status	Contains information about the interrupt type
x+4...x+19	Diagnostic interrupt	The 16Byte correspond to the record set 1 of the CPU diagnostic
x+4...x+7	Hardware interrupt	The 4Byte are module specific and are described with the according module.

Interrupt status   If there is a diagnostic event for channel/group 0 of a module, there may be a module error as well as a channel error. The entry is made in this case even if you have not enabled the diagnostic for channel (/channel group) 0 of a module.

The interrupt section is structured as follows:

Interrupt status Byte x ... x+3

Byte	Bit 7 ... Bit 0
x	Bit 5 ... 0: 010100: Length of the interrupt section incl. Byte x Bit 7 ... 6: 00 (fix) Code for Module-Related diagnostic
x+1	Bit 6 ... 0: Type of interrupt 0000001: Diagnostic interrupt 0000010: Hardware interrupt Bit 7: Code for interrupt
x+2	Bit 7 ... 0: Slot of the module that is producing interrupt 1 ... 32
x+3	Bit 1, 0: 00: Hardware interrupt 01: Diagnostic interrupt $_{incoming}$ 10: Diagnostic interrupt $_{outgoing}$ 11: reserved Bit 2: 0 (fix) Bit 7 ... 3: interrupt sequence number 1 …32

Interrupt status at diagnostic interrupt Bytes x+4 to x+7
(corresponds CPU diagnostic record set 0)

Byte	Bit 7 ... Bit 0
x+4	Bit 0: Module malfunction, i.e. a problem has been detected
	Bit 1: Internal error in the module
	Bit 2: External error - module no longer addressable
	Bit 3: Channel error in the module
	Bit 4: Load power supply is missing
	Bit 5: Front connector is missing
	Bit 6: Module is not parameterized
	Bit 7: Parameter assignment error
x+5	Bit 3 ... 0: Module class
	1111: Digital module
	0101: Analog module
	1000: FM
	1100: CP
	Bit 4: Channel information available
	Bit 5: User information available
	Bit 6: 0 (fix)
	Bit 7: 0 (fix)
x+6	Bit 0: Memory or coding key analog module is missing
	Bit 1: Communication error
	Bit 2: Operating mode
	0: RUN
	1: STOP
	Bit 3: Cycle time monitoring addressed
	Bit 4: Module power supply failure
	Bit 5: Empty battery
	Bit 6: Complete backup failure
	Bit 7: 0 (fix)
x+7	Bit 0: reserved
	Bit 1: reserved
	Bit 2: reserved
	Bit 3: reserved
	Bit 4: reserved
	Bit 5: reserved
	Bit 6: Hardware interrupt lost
	Bit 7: reserved

… continue

Interrupt status at diagnostic interrupt Bytes x+8 to x+19
(corresponds to CPU diagnostic record set 1)

Byte	Bit 7 ... Bit 0
x+8	70h: Module with digital inputs
	71h: Module with analog inputs
	72h: Module with digital outputs
	73h: Module with analog outputs
	74h: Module with analog in-/-outputs
	76h: Counter
x+9	Length of the channel-related diagnostic
x+10	Number of channels per module
x+11	Position (channel) with diagnostic event
x+12	Diagnostic event on the channel/channel group 0
	Assignment see module description
x+13	Diagnostic event on the channel/channel group 1
	Assignment see module description
.	.
.	.
.	.
x+19	Diagnostic event on the channel/channel group 7
	Assignment see module description

Interrupt status at hardware interrupt Bytes x+4 to x+7

More detailed information to the diagnostic data is to find in the concerning module descriptions.