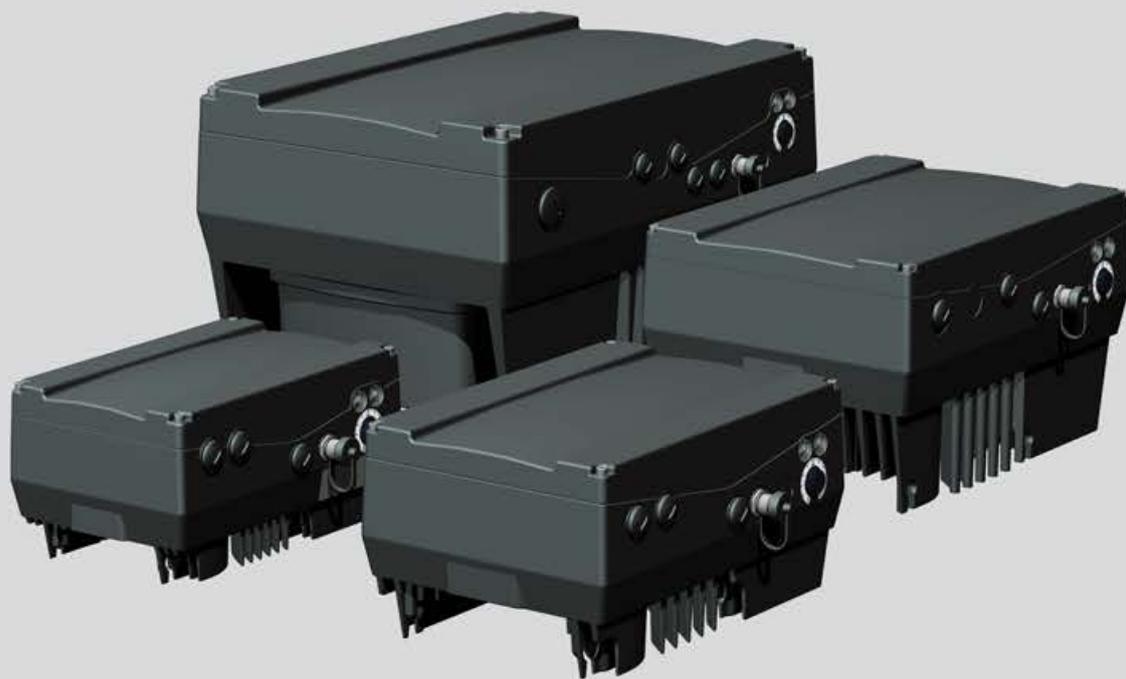


# Operating Instructions

Field Bus Profinet 2FC...-1PN



**G-Serie**  
**G-Series**

Seitenkanal  
Side Channel



**C-Serie**  
**C-Series**

Klaue  
Claw



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### 1.1 Storing the documentation

Store this manual and all other applicable documents safely so they are available as and when required.

Provide the operator of the system with this manual so it is available as and when required.

### 1.2 Explanation of the terms and symbols

In these instructions symbols and terms will be used to mean the following.

Symbol	Explanation
!	Requirement, pre-requisite
①	One-step handling instructions
1 2 3	Multi-step handling instructions
✓	Result
[→ 54]	Cross reference with page reference
	Additional information, tips
	General warning sign (warns of risk of injury)
	Electrical voltage warning
	Observe the instructions

Term	Explanation
Plant	Part provided by the user in which the vacuum pump/compressor is installed.
Vacuum pump/compressor	Ready to connect machine for the generation of a vacuum and/or overpressure. The vacuum pump/compressor consists of a compressor part and motor, as well as other accessories where applicable.
Motor	Asynchronous motor for driving the vacuum pump/compressor.
Compressor	Mechanical part of the vacuum pump/compressor without motor.
Assembly environment	Space in which the vacuum pump/compressor is set up and operated (this may differ from the suction environment).
Drive control	Device for rotation speed control of the vacuum pump/compressor. The drive control can be mounted close to the motor (wall assembly) or integrated into the vacuum pump/compressor

### 1.3 Changes in comparison to the previous version

This document is the first edition.

## 1.4 Other valid documents

All instructions that describe the use of the drive control and if applicable, further instructions of all accessory parts used, e.g.

<b>Document number</b>	<b>Purpose</b>
—	Vacuum pump/compressor operating manual
610.00260.02.000	Operating instructions 2FC4...-1ST/PB/PN/SC/CB
610.00260.40.010 *	Operating manual 2FC4...-1PB <b>OR</b>
610.00260.40.030 *	Operating manual 2FC4...-1SC <b>OR</b>
610.00260.40.040 *	Operating manual 2FC4...-1CB
610.00260.40.600 *	Operating manual of manual control unit MMI

\*according to the model option or accessories

Download of 3D files (.stp) for drive control and adapter plates under [www.gd-elmorietschle.com](http://www.gd-elmorietschle.com).

To parameterize the drive control, the parameter description is ready to be downloaded ([www.gd-elmorietschle.com](http://www.gd-elmorietschle.com)). The download contains all necessary information for correct parameterization.

The manufacturer is not liable for damage caused by the failure to observe these instructions and the related documents [→ 4].

## 2.1 Explanation of warning signs

Warning sign	Explanation
⚠ DANGER	Danger that failure to observe the measures could lead to death or serious physical injuries.
⚠ WARNING	Danger that failure to observe the measures could lead to death or serious physical injuries.
⚠ CAUTION	Danger that failure to observe the measures could lead to minor physical injuries.
NOTICE	Danger that failure to observe the measures could lead to material damage.

## 2.2 Safety instructions

The following warnings, precautionary measures and comments are provided for your safety and serve to prevent damage to the drive control and the components connected to it. This chapter contains warnings and information that are generally applicable when handling drive controls. They are split into general information, transport and storage, start-up, operation, repairs and dismantling & disposal.

Specific warnings and comments that apply to specific activities can be found at the start of the appropriate chapters and are repeated and added to at various critical points in these chapters.

Please read this information carefully as it is provided for your personal safety and will also prolong the life of the drive control and connected devices.

### 2.2.1 General information



#### ⚠ WARNING

**This drive controller carries dangerous voltages and controls rotating mechanical parts which may be dangerous!**

**Disregarding the warnings or failure to follow the instructions contained in this manual may lead to death, serious bodily injury or substantial property damage.**

- ① Only qualified personnel should work on this drive controller. These personnel must be thoroughly familiar with all safety instructions, installation, operation and maintenance procedures contained in this manual. The smooth and safe operation of the drive controller depends on proper handling, installation, operation and maintenance.



#### ⚠ WARNING

**Risk of fire or electric shock!**

**Improper use, modifications and the use of spare parts and accessories that are not sold or recommended by the manufacturer of the drive controller can cause fire, electric shock and bodily injury.**

- ① The cooling element of the drive controller and motor can reach temperatures of above **70°C** [158 °F]. During installation, sufficient spacing between adjacent components should be maintained. Before working on the drive controller or motor, required cooling time must be ensured. If necessary, a protection against accidental contact should be installed.

**NOTICE**

The drive controller may be operated safely only if the required ambient conditions are met, see Suitable ambient conditions.

**NOTICE**

This operating manual must be kept in the vicinity of the equipment, so as to be readily accessible to all users.

**NOTICE**

Please read these safety instructions and warnings carefully and all the warning labels attached to the equipment before installing and commissioning. Make sure that the warning labels are kept in a legible condition and replace missing or damaged labels.

### 2.2.2 Transport and Storage

**NOTICE**

**Risk of damage to the drive controller!**

**The drive controller can be damaged in the case of non-compliance with the instructions and destroyed during subsequent handling.**

- ① The smooth and safe operation of this drive controller requires proper mounting, installation and assembly as well as careful operation and maintenance. The drive controller must be protected during transport and storage against mechanical shocks and vibration. The protection against excessive temperatures (see Technical data) must be guaranteed.

### 2.2.3 Commissioning



 **DANGER**

**Risk of injury due to electric shock!**

**The non-observance of warnings can result in severe bodily injury or substantial property damage.**

1. Only hard-wired grid connections are permitted. The device must be earthed (DIN EN 61140; VDE 0140-1).
  2. The drive controls may have contact currents > 3.5mA. According to DIN EN 61800-5-1 chapter 4.3.5.5.2, an additional protective earth conductor with the same cross section as the original earth conductor must be attached. The possibility of connecting a second protective earth conductor is located underneath the power supply (with marked ground symbol) on the outside of the device. For the connection, a suitable M6x15 screw (torque: **4.0 Nm** [2.95 ft lbs]) is included in the scope of delivery of the adapter plates.
  3. When using alternating current drive controls, conventional FI circuit breakers of type A, also known as RCDs (residual current-operated protective devices) are not permitted for the protection of direct or indirect contact! As per DIN VDE 0160, section 5.5.2 and EN 50178, section 5.2.11.1, the FI circuit breaker (RCD type B) must be suitable for all types of current.
  4. The following terminals can also lead to dangerous voltages when the engine is at a standstill:
    - ✓ the mains connection terminals X1: L1, L2, L3
    - ✓ the motor connection terminals X2: U, V, W
    - ✓ the connection terminals X6, X7: Relay contacts relays 1 and 2
    - ✓ the PTC connection terminals T1/T2
  5. When using different voltage levels (e.g. +24V/230V), always ensure that lines do not cross! Furthermore, the operator must ensure that the applicable regulations are adhered to (e.g. doubled or reinforced insulation according to DIN EN 61800-5-1).
  6. The drive control contains electrostatically sensitive assemblies. These assemblies can be destroyed due to improper handling, therefore safety measures against electrostatic loading must be adhered to when work must be done on these assemblies.
-

### 2.2.4 Operation



#### DANGER

**Risk of injury from electric shock or restarting motors!**

**The non-observance of warnings can result in severe bodily injury or substantial property damage.**

① Observe the following instructions during operation:

- ✓ The drive controller operates at high voltages.
- ✓ When operating electrical equipment, certain parts of the equipment carry dangerous voltage.
- ✓ Emergency stop devices according to EN 60204-1:2006 must remain operative in all operating modes of the control unit. Resetting the emergency stop device must not lead to uncontrolled or undefined restart.
- ✓ Safe disconnection from the mains requires synchronous and all-pole disconnection of the mains supply line to the drive controller.
- ✓ For devices with single-phase supply and for the BG D (11 to 22 kW), at least 1 to 2 min break should be kept between successive connections to the mains.
- ✓ Certain parameter settings may cause the drive controller to restart automatically after a power failure.

#### *NOTICE*

**Risk of damage to the drive controller!**

**The drive controller can be damaged in the case of non-compliance with the instructions and destroyed during subsequent handling.**

1. Observe the following instructions during operation:
2. For a functioning motor overload protection, the motor parameters must be configured correctly.
3. Ensure the motor overload protection via a PTC. In addition, the drive control provides an internal motor protection. See also parameter 33.100 and 33.101. According to the presetting, the I<sup>2</sup>T is OFF and must be activated during operation without PTC.
4. The drive controller must not be used as an 'emergency stop device' (see EN 60204-1:2006).

### 2.2.5 Maintenance and inspection

Maintenance and inspection of the drive controllers must be performed only by electrically certified, qualified person. Changes in hardware and software, unless explicitly described in this manual, may only be performed by the manufacturer.

#### **Cleaning the drive controllers**

The drive controllers are maintenance-free when operated properly. In a dusty environment, the cooling ribs on the motor and the drive controller must be cleaned regularly. For equipment that are equipped with integrated fans, option for BG C, series in BG D, cleaning with compressed air is recommended.

#### **Measurement of insulation resistance on the control unit**

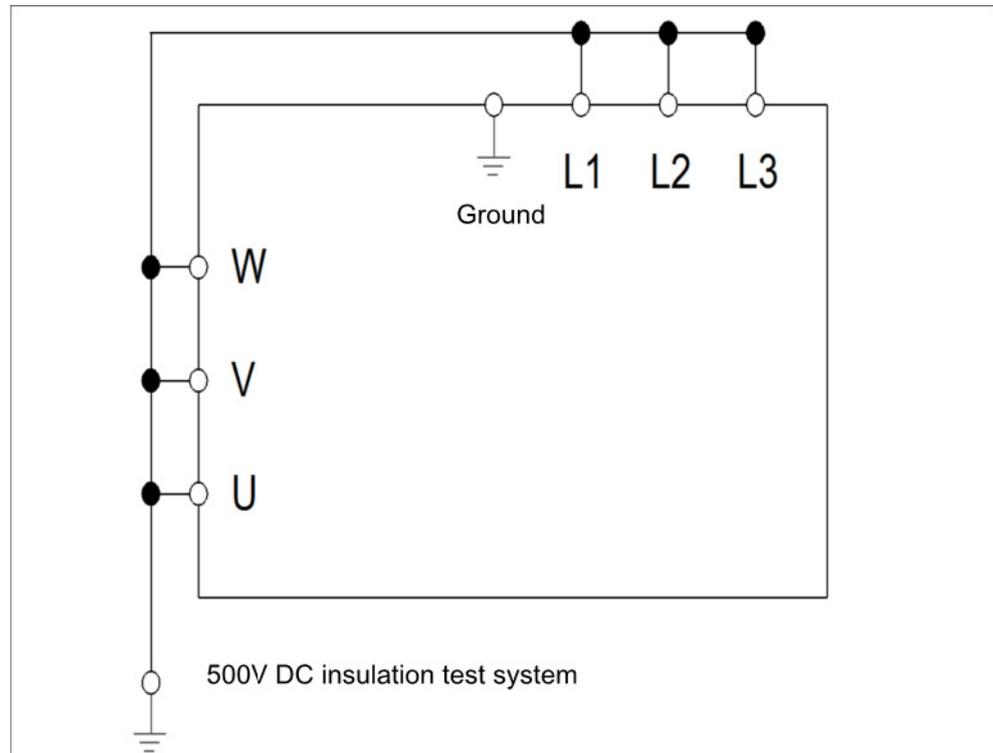
Insulation test at the input terminals of the control card is not permitted.

#### **Measurement of insulation resistance on the power unit**

In the course of the series testing, the power unit of the drive controller is tested by applying 1.9 kV.

Should the measurement of insulation resistance be necessary in a system check, then this can be carried out under the following conditions:

- an insulation test can be performed only for the power unit,
- to avoid impermissible high voltages, all connecting cables of the drive controller must be disconnected prior to the test,
- a 500 V DC insulation tester is used.



*Insulation test on the power unit*

### Pressure test on a DRIVE CONTROLLER

A pressure test of the drive controller is not allowed.

### 2.2.6 Repairs



#### **⚠ DANGER**

**Danger of injury through electric shock!**

**Non-observance of warnings may result in serious injury or damage.**

- ① When the drive control is disconnected from the mains voltage, live device parts and connections may not be touched immediately in case the condensers are still live.

#### **NOTICE**

**Risk of damage to the drive control!**

**If the information is not observed, the drive control could be damaged and destroyed during subsequent start-up.**

- ① Repairs to the drive control may only be performed by the manufacturer.

### 2.2.7 Disassembly and Disposal

**Screw and snap-on connections are easy to release and allow the drive control to be dismantled into its individual parts. These parts can be sorted for recycling. Please comply with local regulations during disposal.**

**Components with electronic parts may not be disposed of along with normal household waste. They have to be collected separately with used electrical and electronic equipment in accordance with applicable legislation.**

### 2.3 Correct use of the equipment

During installation in machinery, commissioning of the drive controller (i.e. starting of intended operation) is prohibited until it is proven that the machine complies with the regulations of the EC Directive 2006/42/EC (Machinery Directive); EN 60204-1:2006 is to be observed.

Commissioning (i.e. starting of intended operation) is only permitted if the EC Directive 2004/108/EC (EMC Directive) allows it.

The harmonised standards of the series EN 50178:1997 in conjunction with EN 60439-1/A1:2004 shall be applied to this drive controller.

This drive controller is not approved for operation in potentially explosive areas!

Repairs may only be carried out by authorised repair workshops. Unauthorised interventions can lead to death, bodily injury and property damage. The warranty provided by the manufacturer expires in this case.

External mechanical loads, such as stepping on the casing are not allowed!

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**The use of the drive units in non-stationary equipment is considered as unusual environmental conditions, and is permitted only in accordance with the locally applicable standards and guidelines.**

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### 2.4 Staff qualifications and training



All those who will work with the 2FC4 must have read and understood these instructions and the related documents [→ 4].

Personnel in training may only work with the 2FC4 under supervision of personnel who have the **required knowledge**.

Only personnel with the following knowledge may carry out the work described in these instructions:

Qualified personnel, as understood in these operating instructions and product labels, are qualified electricians who are familiar with the installation, assembly, commissioning and operation of the drive controller, as well as the risks associated therewith and have the respective skills on account of their professional training and knowledge of the relevant standards.

## 2.5 Requirements of the operator

As a basic principle, electronic devices are not fail-proof. The operator and/or the contractor setting up the machine or system is responsible for ensuring that the drive switches to a safe state if the device fails.

The “Electrical equipment of machines” section in EN 60204-1, “Safety of machinery” describes the safety requirements for electrical control units. These are provided for the safety of people and machines and must be observed in order to retain the functional capability of the machine or system.

An emergency stop feature does not have to result in the power supply to the drive being switched off. To avoid dangerous situations, it may be useful for individual drives to remain operational or for specific safety procedures to be initiated. The effectiveness of emergency stop measures is evaluated by means of a risk assessment for the machine or system and its electrical equipment, and is determined by selecting a circuit category according to EN 13849 “Safety of machinery – Safety-related parts of control systems”.

The operator ensures that:

- All work on the 2FC4 is carried out by:
  - personnel that have the necessary Staff qualifications and training [→ 10]
  - personnel that have been sufficiently informed of these instructions and all related documents [→ 4]
- Assignment, responsibility and supervision of personnel is regulated.
- The content of these and locally applicable instructions are always available to personnel.
- All local and plant-specific safety measures are adhered to, such as:
  - Prevention of accidents
  - safety and operating regulations
  - Utility company regulations
  - Standards and laws
- Dangers due to electrical energy are not possible.

## 3.1 Model description

<b>2FC</b>	<b>4</b>	<b>152</b>	<b>-</b>	<b>1</b>	<b>ST</b>	<b>0</b>
1	2	3		4	5	6

*Item designation*

- |   |  |
|---|--|
| <p>1 <b>2FC</b> = drive control</p> <p>2 Connection voltage:<br/> <b>4</b> = 400 V -15% — 480 V +10%</p> <p>3 Performance:<br/> <b>152</b> = 1.5 kW<br/>                 222 = 2.2 kW<br/>                 302 = 3.0 kW<br/>                 402 = 4.0 kW<br/>                 552 = 5.5 kW<br/>                 752 = 7.5 kW</p> | <p>4 Type of assembly:<br/> <b>1</b> = integrated drive control</p> <p>5 Version:<br/> <b>ST</b> = Standard<br/>                 PB = Profibus<br/>                 PB = Profinet<br/>                 SC = Sercos III<br/>                 CB = CANopen</p> <p>6 reserved:<br/> <b>0</b> = Standard</p> |
|---|--|

## 3.2 Description of the drive control

The drive control is a device for speed control in three-phase AC motors.

The drive control can be integrated in the motor (with the standard adapter plate) or fitted close to the motor (with the wall installation adapter plate).

The permitted ambient temperatures specified in the technical data refer to operation at nominal load. In many cases, higher temperatures may be permitted after a detailed technical analysis. These have to be approved by manufacturer on a case-by-case basis.

## 3.3 CE marking

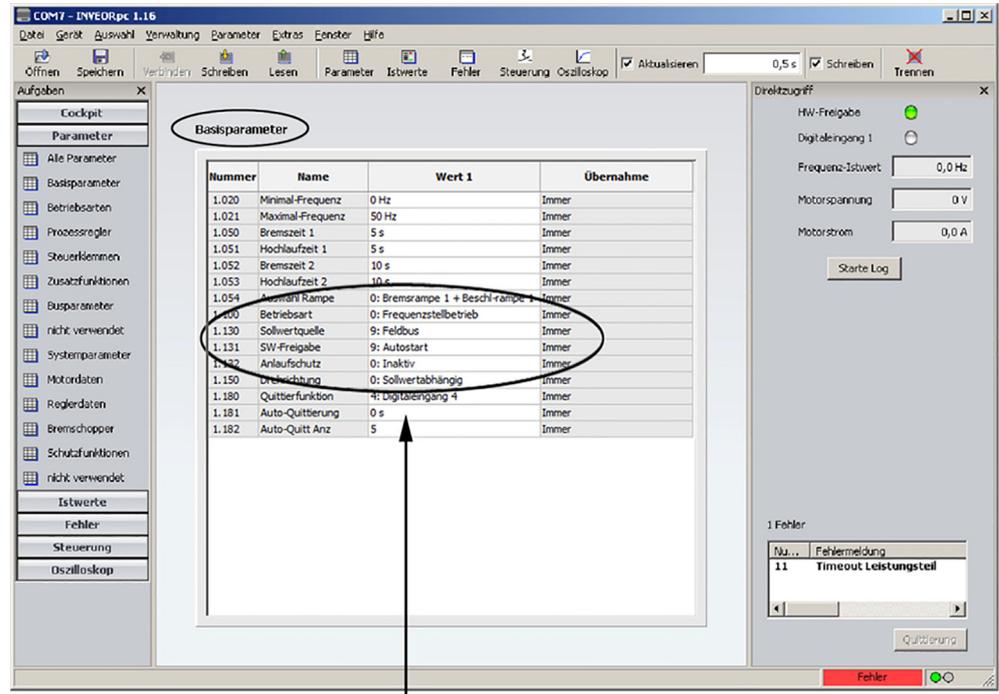
With the CE marking, we, as the manufacturer of the device, confirm that the drive control meets the basic requirements of the following guidelines:

- Directive on Electromagnetic Compatibility (Directive 2004/108/EC)
- Low Voltage Directive (Directive 2006/95/EC)

You can download the declaration of conformity from [www.gd-elmorietschle.com](http://www.gd-elmorietschle.com).

\* Profinet compliant

In order to control the drive controller through the field bus, the following default parameters must be set with the help of the INVERTER PC - Tools.



In order for the drive controller to use the setpoint of the "field bus", the parameter 1.130 (setpoint source) must be set to field bus "9". To control the software release through the field bus, the parameter 1.131 (setpoint release) must be set to field bus.

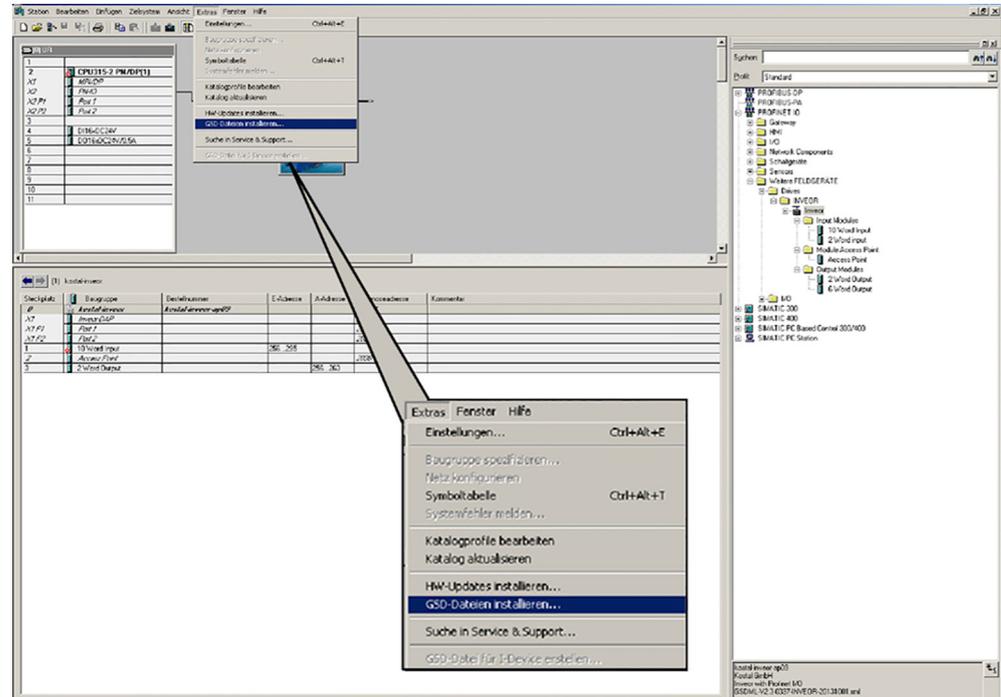
In the example shown above, the software release was set to "auto start" and the "start-up protection" to "inactive". The setpoint specification is operated through the field bus.

The aforementioned settings ("auto start" resp. "inactive") were selected at random and only serve for exemplary clarification.

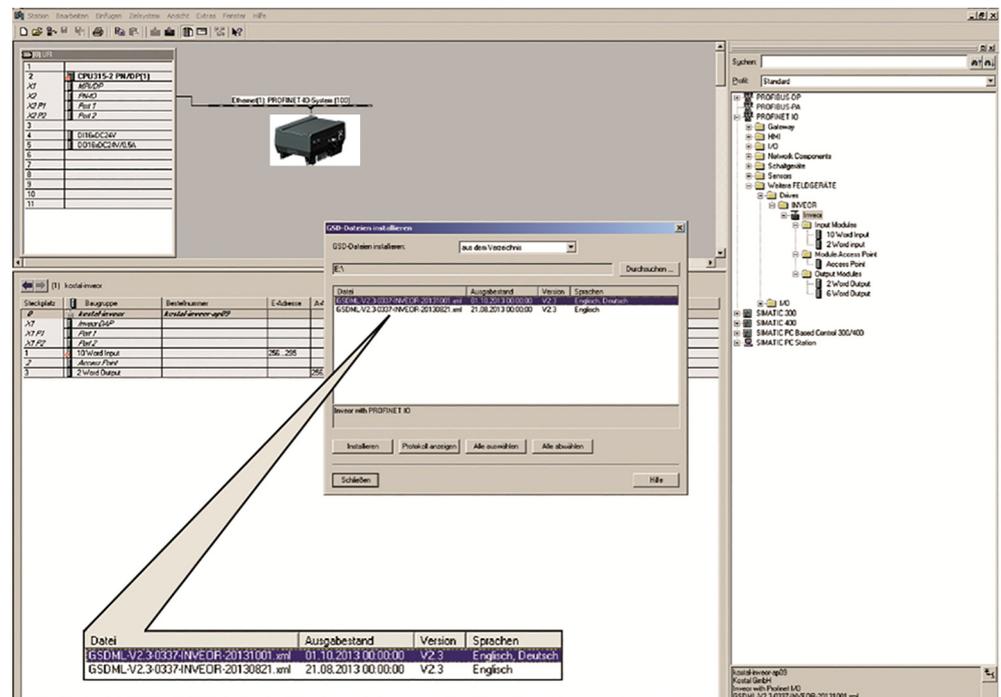
The following file must be available for the commissioning of the drive controller:  
GardnerDenver\_GSDML\_2FC4\_\_\_-1PN.zip (Deutsch)

This file contains, on the one hand, the corresponding GSD file and, on the other hand, a bitmap with the symbol of the drive controller under Profinet.

Unzip the ZIP file in an appropriate directory and embed as follows under the HW config in Siemens Simatic S7 Manager:



The menu item "install GSD file" is located under "extras". After selecting this item, the following menu appears:



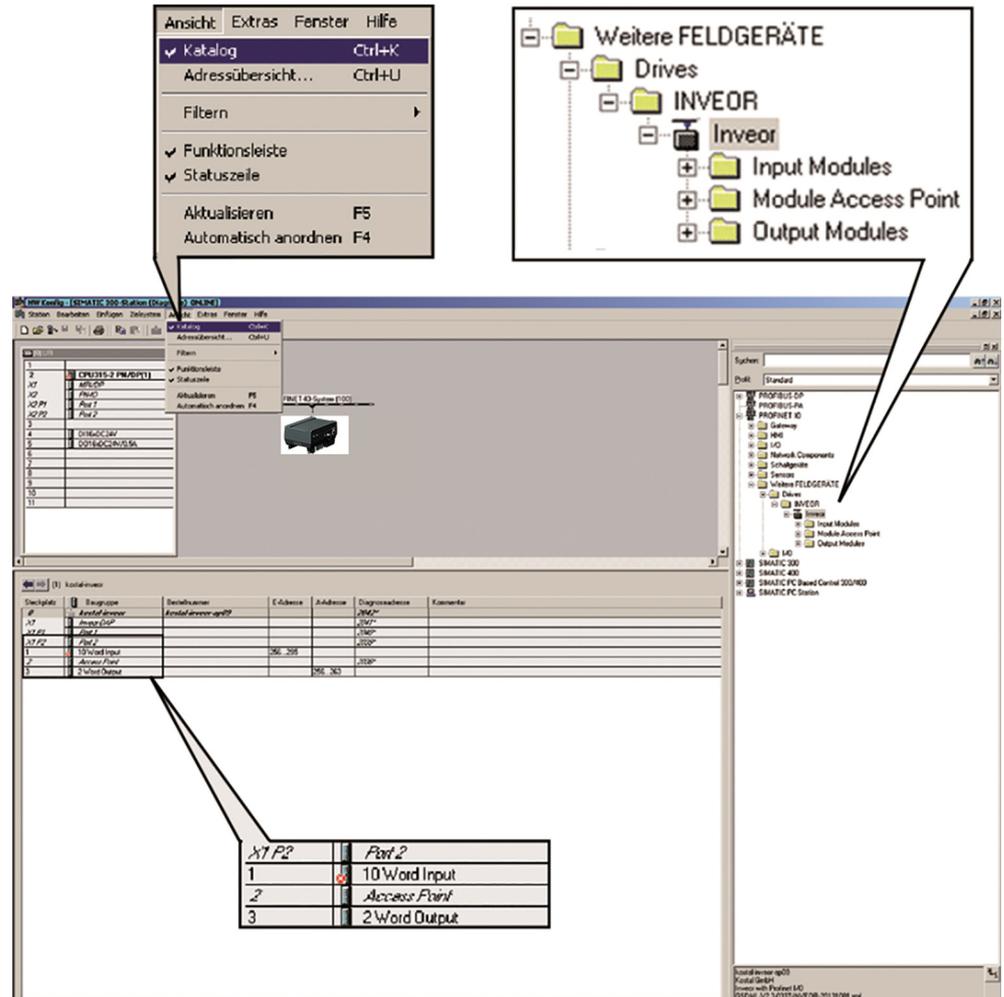
After selecting the appropriate directory (prior to unpacking the content of the ZIP file) mark the

GardnerDenver\_GSDML\_2FC4\_\_\_-1PN.zip (Deutsch) file and select "install".

The name of the file varies from example to example.

The overall name of the file can also change from delivery to delivery. The valid file can be downloaded from the Gardner Denver Homepage.

The setting "catalogue" should be selected in the HW config window in Siemens Simatic S7 Manager.



The slots for the "input module", "output module" and "module access point" are predefined.

The "input-" and "output module" serve the cyclic data traffic and the "module access point" the acyclic data traffic/the alert messages.

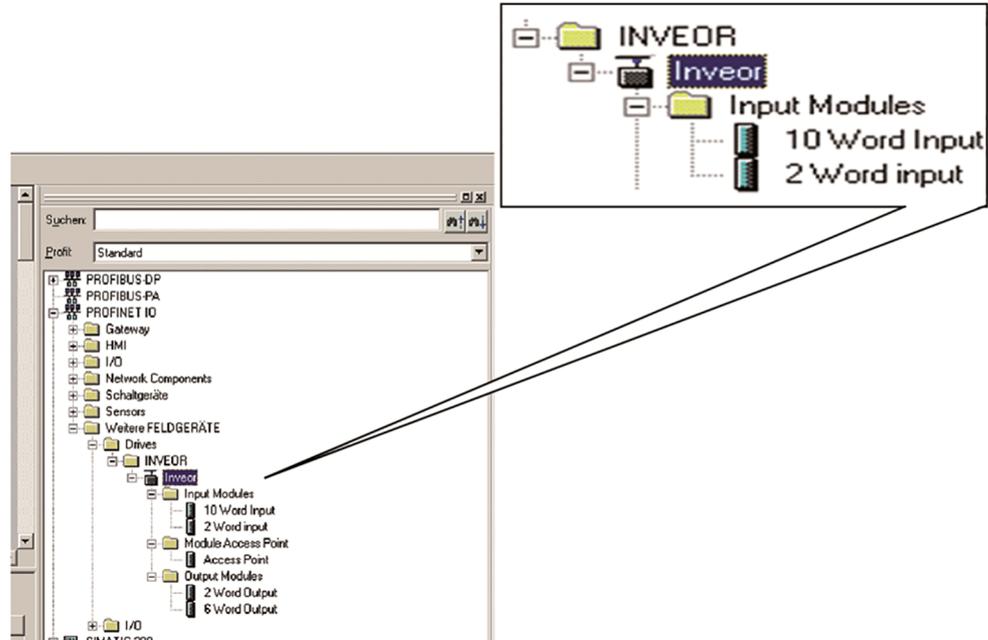
The various functions are described in more detail below.

### 6.1 Input modules

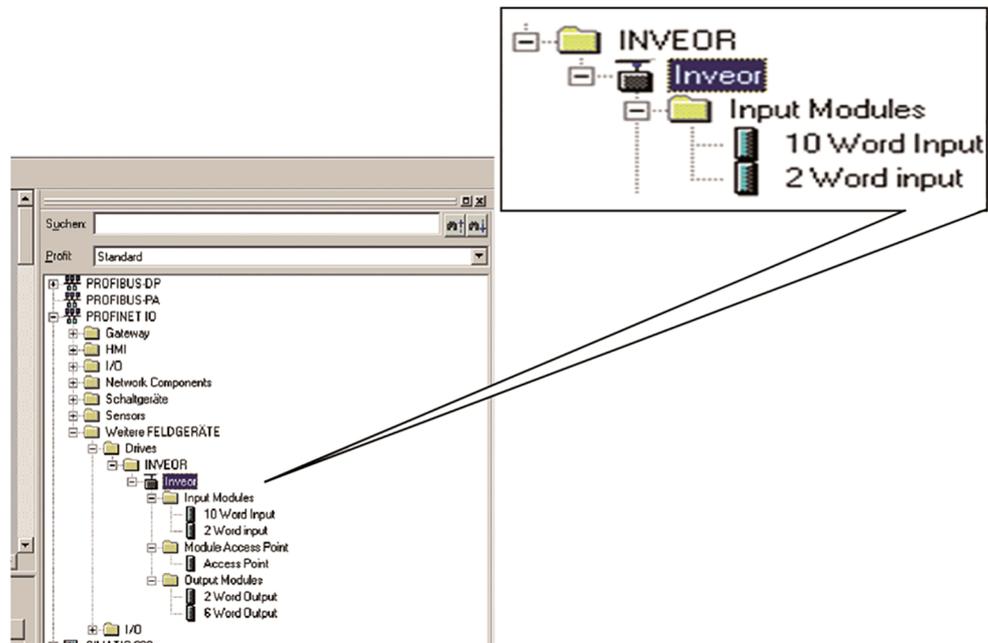
The choices of the input module for the drive controller are located in the window "catalogue" after installation of the GSD file.

The folder "input module" (from Siemens' S7 side, the OUT data of the drive controller are the IN data of Siemens) contains two possible configurations for this area.

It thereby concerns data sent from the drive controller **TO** S7. Both configurations can **ONLY** be "inserted" in slot 1. This is done by "Dragging & Dropping" the respective selection.



The size of the data to be sent can be limited to 2 words (8 bytes) for fast and streamlined data traffic. Then, this concerns the "status word" and "actual frequency".



If more information should be read, the second configuration can be selected with a size of 10 words (40 bytes). The possible configurations are listed in the following "process data OUT" table. The data to be additionally sent to the status word and actual frequency can be set through the INVERTER PC. The possibilities are shown in the "parametrizable process data Out" table.

**The 32-bit data (error status, DigOuts, DigIns) have been broken down into 16-bit data, because part of the data width of the field buses is limited to 16-bit. If the 32-bit data access is possible then, regardless of whether the Low- or High Word is accessed, the 32-bit is used!**

### 6.1.1 Drive controller process data Out

Address	Data type	Designation	Unit	Description
0x0000	WORD*	Status word	—	not parameterizable
0x0004	REAL	Actual frequency	—	not parameterizable
0x0008	REAL	Process data Out 3 (motor voltage)	V	parameterizable through PC Tool
0x000C	REAL	Process data Out 4 (motor current)	A	parameterizable through PC Tool
0x0010	REAL	Process data Out 5 (mains voltage)	V	parameterizable through PC Tool
0x0014	REAL	Process data Out 6 (frequency setpoint)	Hz	parameterizable through PC Tool
0x0018	DWORD*	Process data Out 7 (digital inputs bit coded)	—	parameterizable through PC Tool
0x001C	REAL	Process data Out 8 (analogue inputs 1)	V	parameterizable through PC Tool
0x0020	DWORD*	Process data Out 9 (error word 1)	—	parameterizable through PC Tool
0x0024	DWORD*	Process data Out 10 (error word 2)	—	parameterizable through PC Tool

\*Data type WORD corresponds to UNIT16

\*Data type DWORD corresponds to UNIT32

### 6.1.2 Parametrizable process data Out

Serial number	Data type	Available in SW version	Designation	Unit	Description
0	REAL	—	mechanical speed	Hz	regardless of the pole pairs
1	REAL	—	issued voltage	V	Motor voltage
2	REAL	—	Motor current	A	—
3	REAL	—	IGBT temperature	° C	—
4	REAL	—	Intermediate circuit voltage	V	—
5	REAL	—	Frequency setpoint	Hz	—
6	REAL	—	Mains voltage	V	Input voltage
7	REAL	—	DC intermediate circuit	A	—
8	REAL	—	Internal temperature	° C	FU internal temperature
9	REAL	—	Speed incremental encoder	Hz	only with encoder option
10	t.b.d.	—	Position incremental encoder	-	only with encoder option
11	DWORD*	—	Error application	1	Bit coded
13	DWORD*	—	Error performance	1	Bit coded

## 6 Cyclic data

Serial number	Data type	Available in SW version	Designation	Unit	Description
15	DWORD*	—	Digital inputs (1..4+Output stage release)	1	Bit coded
16	REAL	—	Analogue In 1	V	Analogue input 1 application
17	REAL	—	Analogue In 2	V	Analogue input 2 application
18	REAL	—	F_Target ramp	Hz	Frequency setpoint behind ramp
19	REAL	—	F_Target	Hz	Frequency setpoint of the setpoint source
20	REAL	—	PID actual value	%	Actual value of the PID process controller
21	REAL	—	PID setpoint	%	Setpoint of the PID process controller
22	REAL	—	Analogue Out 1	V	Analogue Out 1
23	REAL	—	DC intermediate circuit performance	W	DC intermediate circuit performance
24	REAL	—	Reserved	—	Reserved
25	REAL	—	Reserved	—	Reserved
26	REAL	—	Reserved	—	Reserved
27	REAL	—	Reserved	—	Reserved
28	REAL	—	Reserved	—	Reserved
29	DWORD*	—	Status word BUS/Soft PLC	1	Status word BUS/Soft PLC
30	REAL	03.02	Revolutions	U/min	Motor shaft speed
31	REAL	03.02	Torque	Nm	Torque
32	REAL	03.02	Electrical motor power	W	Electrical motor power
33	DWORD*	03.04	Virtual DigOuts (lowWord)	1	Virtual DigOuts of the SoftPLC
35	REAL	03.04	Customer-spec. Output quantity 1	1	Customer-spec. Output quantity SoftPLC
36	REAL	03.04	Customer-spec. Output quantity 2	1	Customer-spec. Output quantity SoftPLC
37	REAL	03.04	Customer-spec. Output quantity 3	1	Customer-spec. Output quantity SoftPLC
38	DWORD*	03.05	Operating time in seconds	1	Operating time in seconds
39	DWORD*	03.05	Power On cycles	1	Power On cycles
40	REAL	03.05	Electrical energy	Wh	Added up electrical energy
41	DWORD*	03.05	Condition of the outputs (DigOuts +2, relay 1+2)	—	Condition of the outputs

\*Data type DWORD corresponds to UNIT32

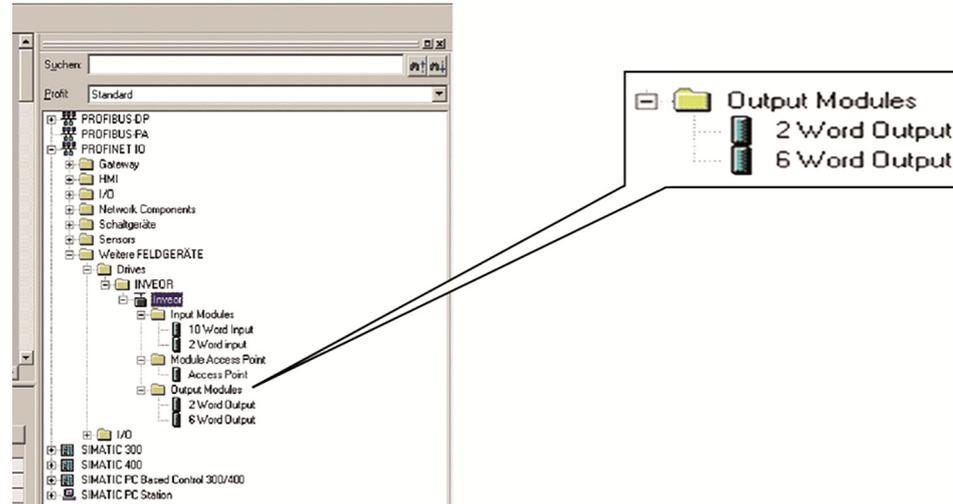
## 6.2 Structure of the drive controller status word

The following table describes the importance of the individual bits of the status word of the drive controller.

Bit	Who	Importance	Description
0	1	Ready to switch on	Mains contactor on, power supply switched on, no disturbance
	0	Not ready to be switched on	—
1	1	Ready for operation	See control word Bit 0 (main contactor on, mains voltage is connected to FU and HW release), no malfunction
	0	Not ready for operation	—
2	1	Operation/impulse release	See control word Bit 3
	0	Operation blocked	—
3	1	Error active	There is a malfunction
	0	Failure-free	—
4	1	electrical stop active (OFF 2)	OFF 2 command is present
	0	No OFF 2	—
5	1	Emergency stop active (OFF 3)	OFF 3 command is present
	0	No OFF 3	—
6	1	Lock-out active	1 Operation blocked
	0	No lock-out	1 Operation released
7	1	Warning active	2 Drive still in operation, no acknowledgement
	0	No warning	2 No warning is present resp. warning has disappeared again
8	1	Deviation of setpoint-/actual value within range of tolerance	Actual value within a tolerance margin: dynamic upper- or lower deviations for $t < t_{max}$ admissible e.g. $f = f_{tgt} \pm f$ , etc. $t_{max}$ is parameterizable
	0	Deviation of setpoint-/actual value not within range of tolerance	—
9	1	Control of AG	The automation system is requested to assume control.
	0	No Control of AG	Guidance only possible on the device
10	1	Nominal frequency reached	Actual frequency $\geq$ reference value (setpoint) that can be set through parameter number
	0	Nominal frequency not reached	Actual frequency $<$ reference value
11	1	Device-specific	Importance not specified
	0	—	—
12	1	Device-specific	Importance not specified
	0	—	—
13	1	Device-specific	Importance not specified
	0	—	—
14	1	Device-specific	Importance not specified
	0	—	—
15	1	Device-specific	Importance not specified
	0	—	—

### 6.3 Output modules

There are also two possibilities under the item "output module". A variant with only 2 words (control word and setpoint, a total of 8 bytes) is available for fast data transfer. The second option offers a total of 6 words. The INVERTER PC - TOOL can parameterize the way the drive controller interprets the data sent by the S7.



It thereby concerns data sent from the S7 **TO** the drive controller. Both configurations can **ONLY** be "inserted" in slot 3.

The various possible data for the output module, which can be parameterized with the INVERTER PC TOOL, are summarized in the tables (Drive controller In [→ 20]).

### 6.4 Drive controller In

**The 32-bit data (error status, DigOuts, DigIns) have been broken down into 16-bit data, because part of the data width of the field buses is limited to 16-bit. If the 32-bit data access is possible then, regardless of whether the Low- or High Word is accessed, the 32-bit is used!**

#### 6.4.1 Process data In

Address	Data type	Designation	Unit	Description
0x0000	WORD*	Control word	—	not parameterizable
0x0004	REAL	Setpoint	%	not parameterizable
0x0008	DWORD*	Process data In 3 (digital output 1 – relay)	—	parameterizable through PC Tool
0x000C	REAL	Process data Out 4 (analogue output 1)	V	parameterizable through PC Tool
0x0010	—	Process data In 5 (reserved)	—	parameterizable through PC Tool
0x0014	—	Process data In 6 (reserved)	—	parameterizable through PC Tool

\*Data type WORD corresponds to UNIT16

\*Data type DWORD corresponds to UNIT32

### 6.4.2 Parametrizable process data In

Serial number	Data type	SW-Vers.	Designation	Unit	Description
0	DWORD*	03.02	Digital relais - outputs	1	Control of the digital- and relay outputs
1	REAL	03.02	Analogue Out 1	V	Control of analogue output
2	DWORD*	03.04	Virtual DigIn	1	Virtual DigIn of the Soft PLC
4	REAL	03.04	Customer-spec. Input variable 1	1	Customer-spec. Input variable SoftPLC
5	REAL	03.04	Customer-spec. Input variable 2	1	Customer-spec. Input variable SoftPLC
6	REAL	03.04	Customer-spec. Input variable 3	1	Customer-spec. Input variable SoftPLC

\*Data type DWORD corresponds to UNIT32

### 6.4.3 Structure of the drive controller control word

Bit	Who	Meaning	Description
0	1*	ON	Ready for operation, i.e. main contactor on, mains voltage is connected to FU and HW release
	0	OFF 1	Stop through ramp
1	1*	Operating condition	OFF 2 conditions lifted
	0	electrical stop (OFF 2)	PWM switched off, free outlet
2	1*	Operating condition	Operating condition
	0	Emergency stop (OFF 3)	Stop through the fastest possible ramp
3	1*	Impulse release	Operation released, PWM switched on
	0	Block impulse	Block operation, free outlet, PWM switched off
4	1*	Operating condition	Operating condition
	0	Block HLG	<sup>1</sup> OFF3 Stop through the fastest possible ramp
5	1	Release HLG	<sup>1</sup> Not implemented
	0	Stop HLG	<sup>1</sup> Not implemented
6	1*	Release setpoint	Selected value at the RFG input is switched on
	0	Block setpoint	Selected value at the HLG input is used at 0
7	1	Error acknowledgement (0 - > 1)	Collection acknowledgement on slope pos.
	0*	—	—
8	1	JOG (right)	<sup>1</sup> Not implemented
	0		<sup>1</sup> Not implemented
9	1	JOG (left)	<sup>1</sup> Not implemented
	0		<sup>1</sup> Not implemented
10	1*	Control of AG	Guidance through interface, process data valid
	0		No guidance through interface, process data invalid
11	1	Device-specific	—
12	1	Device-specific	—
	0		
13	1	Device-specific	—

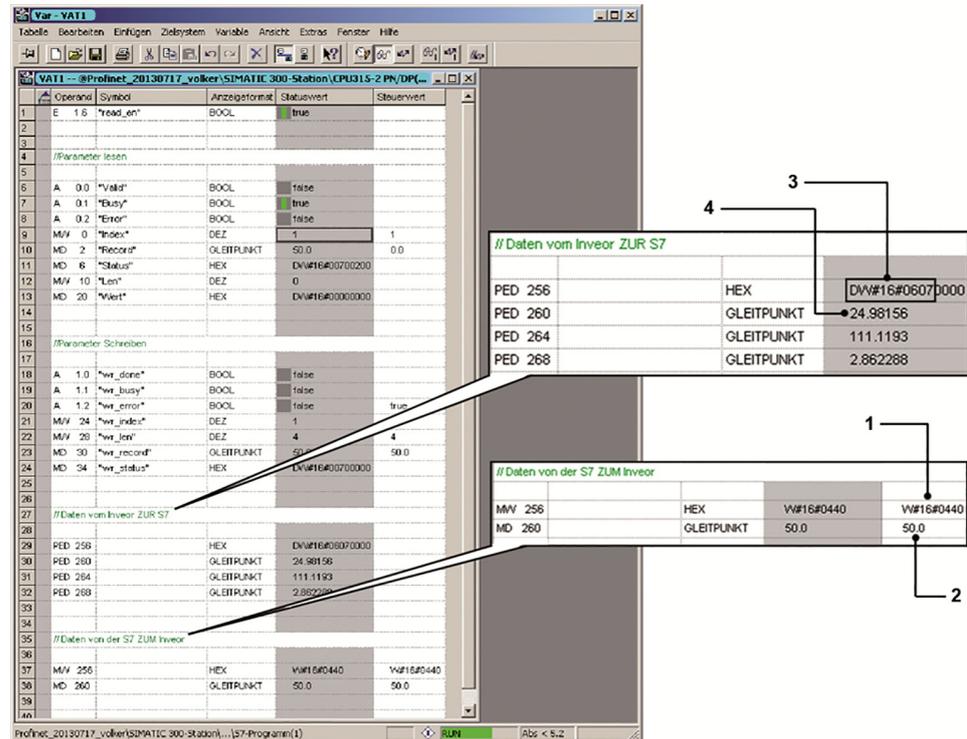
## 6 Cyclic data

Bit	Who	Meaning	Description
	0		
14	1	Device-specific	—
15	1	Device-specific	—
	0		

HLG: Ramp-function generator

\* Operating condition

The following figure shows the Siemens VAT table as required for the operation of the drive controller.



The screenshot shows the Siemens VAT table with the following data points highlighted by callouts:

- Callout 1:** Points to the status word (PED 256) in the table, which is set to 0x0440.
- Callout 2:** Points to the setpoint (MD 260) in the table, which is set to 50.0.
- Callout 3:** Points to the actual frequency (MD 260) in the table, which is set to 50.0.
- Callout 4:** Points to the actual frequency (MD 260) in the table, which is set to 50.0.

Control word (1): 0x0440 = Bits 6 and 10 set, which corresponds to "release setpoint" and "control of AG, process data valid".

Setpoint (2): 50.0 % of the setpoint speed.

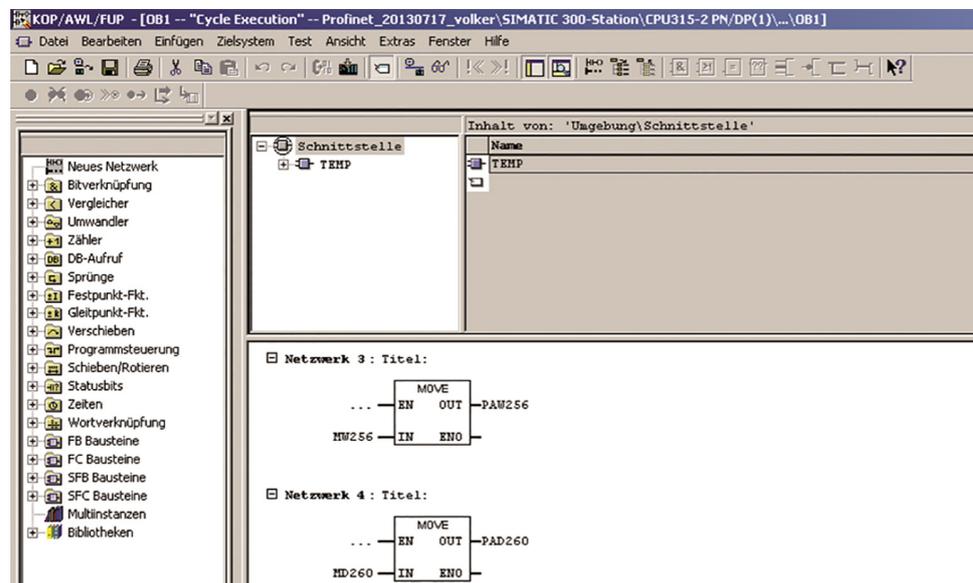
Status word (3): Bits 0,1,2,9,10 set.

Actual frequency (4): 24,98 Hz.

It should be noted here that the status word only assigns 16 bits, which are stored in the upper 16 bits of the 32 bits wide PED 256.

The bits set in the status word mean: "Ready to be switched on", "ready for operation", "operation", "control of AG" and "setpoint frequency reached".

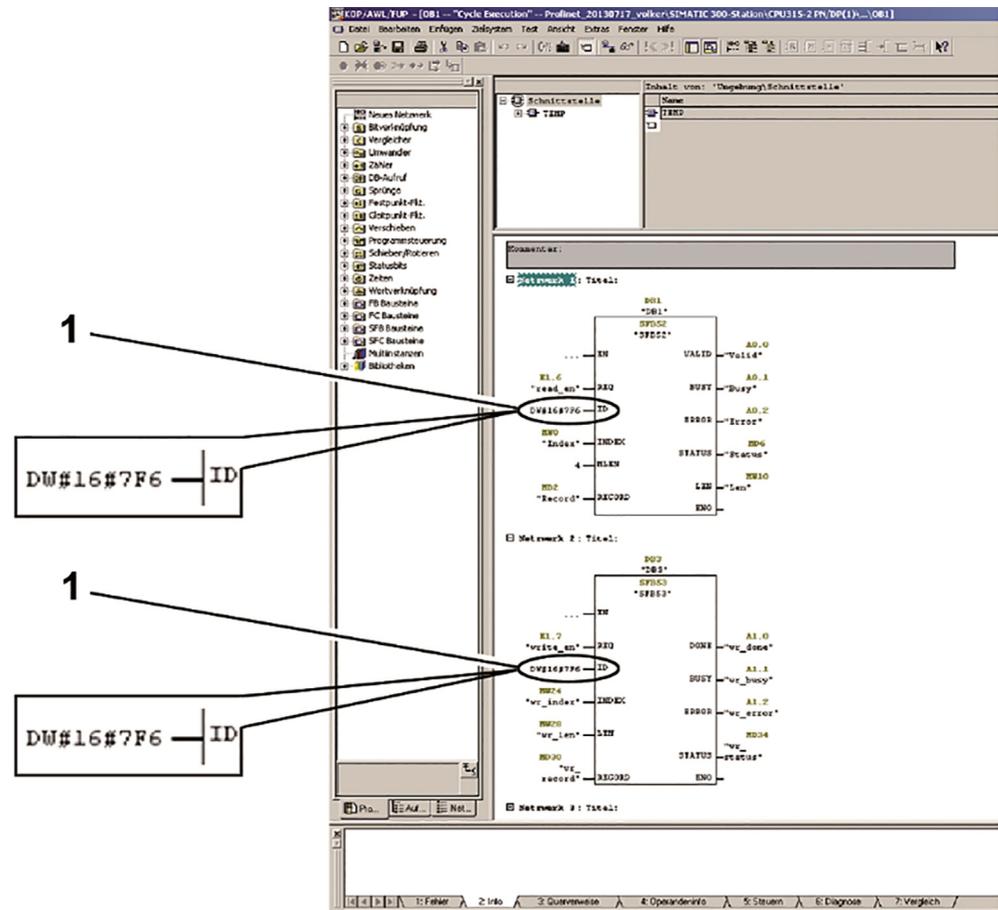
The date sent from the S7 to the drive controller cannot be written directly into the process register, but must be copied therein by using the following functional modules.



The screenshot shows the Siemens LAD editor with the following functional modules:

- Netzwerk 3:** A MOVE instruction with EN (IN) and ENO (OUT) connected to PAM256.
- Netzwerk 4:** A MOVE instruction with EN (IN) and ENO (OUT) connected to PAD260.

The acyclic communication includes two sections. On the one hand, access to parameters seldom used or only when needed and, on the other hand, the error/alarm - mechanism. First, the "access point", in folder "module access point", must be "inserted" in slot 2 for both cases.

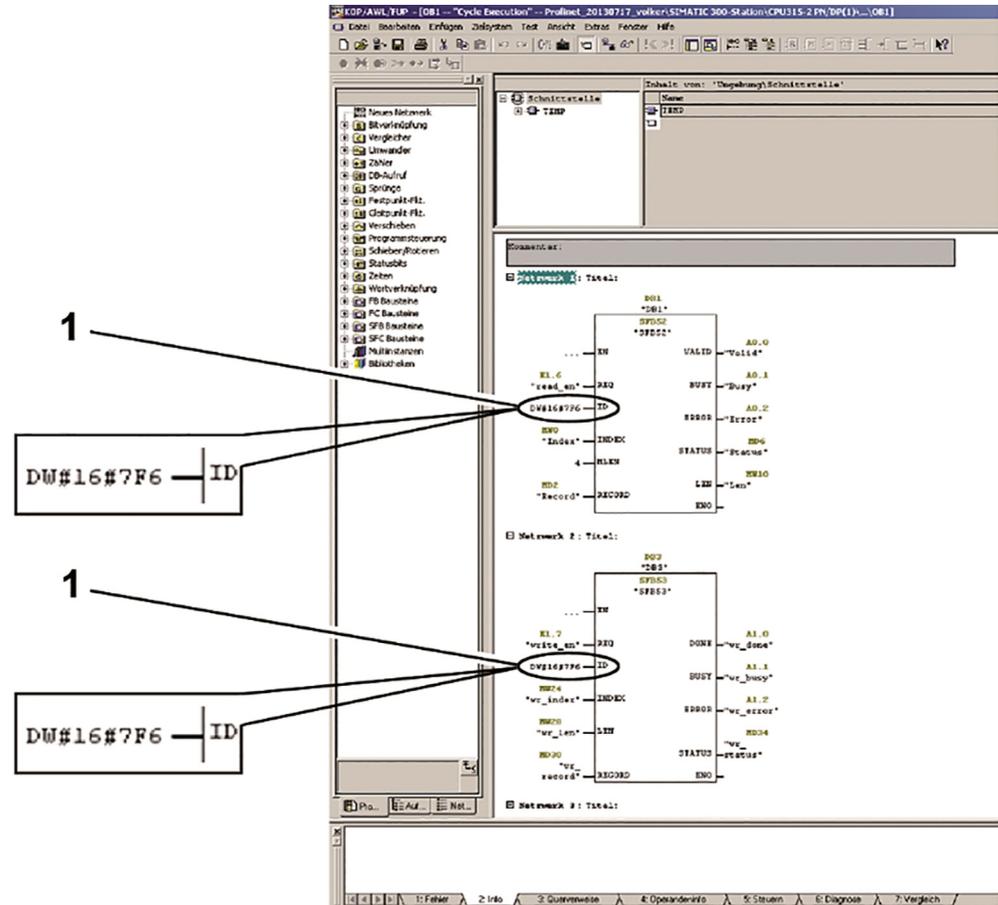


After "inserting" the module access point, a diagnostics address will be displayed for such (in the above example 2038 or 0x7F6 ). This address is required if the parameters of the drive controller should be accessed with the Siemens function modules SFB 52 and SFB 53.

## 8.1 Access to parameters of the drive controller with a Siemens S7

Parameters can be read with the SFB52 and parameters can be rewritten with the SFB53. The possible parameters of the drive controller (importance and numbering) are described in the operating instructions of the drive controller.

Use the diagnostic address (1) of the access point at the ID input for both function blocks.



The desired parameter can be selected from the list of the drive controller parameters through the input "INDEX" of the SFBs.

The representation in the VAT table is as follows:

#Parameter lesen				
A	0.0	"Valid"	BOOL	false
A	0.1	"Busy"	BOOL	true
A	0.2	"Error"	BOOL	false
MW	0	"Index"	DEZ	1 1
MD	2	"Record"	OLEITPUNKT	50.0 0.0
MD	6	"Status"	HEX	DW#16#00700000
MW	10	"Len"	DEZ	0
MD	20	"Wert"	HEX	DW#16#00000000

1

#Parameter Schreiben				
A	1.0	"wr_done"	BOOL	false
A	1.1	"wr_busy"	BOOL	false
A	1.2	"wr_error"	BOOL	false true
MW	24	"wr_index"	DEZ	1 1
MW	28	"wr_len"	DEZ	4 4
MD	30	"wr_record"	OLEITPUNKT	50.0 50.0
MD	34	"wr_status"	HEX	DW#16#00700000

2

The screenshot shows the SIMATIC Manager interface with a variable declaration table and a ladder logic network. The variable declaration table is as follows:

#Parameter lesen				
A	0.0	"Valid"	BOOL	false
A	0.1	"Busy"	BOOL	true
A	0.2	"Error"	BOOL	false
MW	0	"Index"	DEZ	1 1
MD	2	"Record"	OLEITPUNKT	50.0 0.0
MD	6	"Status"	HEX	DW#16#00700000
MW	10	"Len"	DEZ	0
MD	20	"Wert"	HEX	DW#16#00000000

#Parameter Schreiben				
A	1.0	"wr_done"	BOOL	false
A	1.1	"wr_busy"	BOOL	false
A	1.2	"wr_error"	BOOL	false true
MW	24	"wr_index"	DEZ	1 1
MW	28	"wr_len"	DEZ	4 4
MD	30	"wr_record"	OLEITPUNKT	50.0 50.0
MD	34	"wr_status"	HEX	DW#16#00700000

The SFB52 (1) reads in the above example the parameter with the index 1. This is the maximum frequency having the value 50.0 (record).

The SFB53 (2) has written the value 50.0 (wr\_record) to parameter 1 (wr\_index) with a length of 4 bytes (wr\_len).

## 8.2 Alarms and error handling with a Siemens S7

To process errors/alarms with the S7, the building blocks SFB54 and OB82 must be registered.

A detailed description of the current error is obtained in the diagnostic buffer of the drive controller available through the hardware setting in the Simatic Manager. If the error on the drive controller is rectified and acknowledged, the diagnostic buffers in the PLC are also adjusted.

The screenshot shows the SIMATIC Manager interface with a diagnostic buffer window open. The diagnostic buffer window displays the following information:

- Platz:** Profnet\_20130717\_voller/S7-Programme/S7-Programme
- Status:** Fehler
- Bezeichnung:** knot@invo
- Name:** knot@invo
- Systemkennung:** PROFNET ID
- Version:**

Bezeichnung / Bereich	Komponente	Anzahl
knot@invo-ap09	Hardware	3
...	Firmware	V 3.70.0
- ID-System:** 100
- Gatewaynummer:** 1
- Adresse:** E 2042
- Anlagenkennzeichen:**
- Objektbezeichnung:**
- Status:** Baugruppe positiv (Diagnosealarm erkannt) Fehler beheben

But if you want to read the error for further processing, you can proceed as follows.

The following building blocks should be created in the Simatic Manager first:

OB82 I/O\_FLT

The OB82 is an error OB of the PLC which is called up automatically with diagnostic errors. In general, the absence of such error OBs in the building block directory of the project induces a change into the STOP operating condition of the PLC.

The OB82 interrupts the current function sequence in the PLC and executes its programmed program code. The SFB54 is called up here to read the error.

OB86 RACK\_FLT

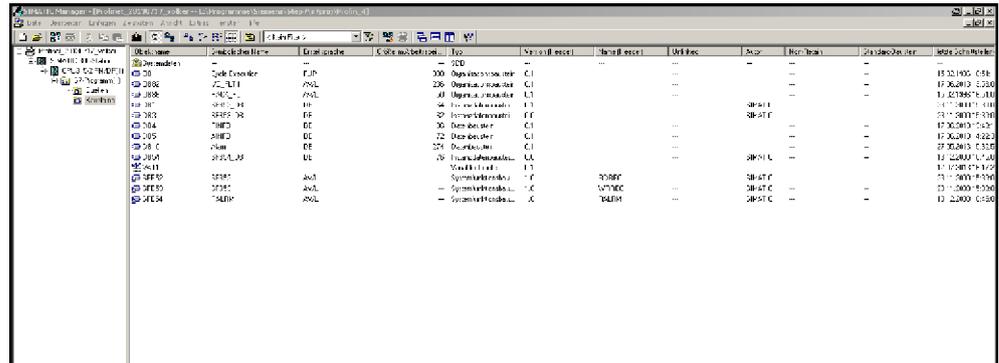
Triggering the alert message through the drive controller causes an assembly carrier failure from the PLC's perspective. Without creating the OB86 in the project directory, the PLC will go into the STOP mode, as already described. The content of the OB86 can be left blank.

Data blocks for the SFB54 (here DB54), AINFO and TINFO of the outputs of the SFB54 (here DB4, DB5)

Each function block requires a data block to manage its own variables which is referred to in the example project DB54.

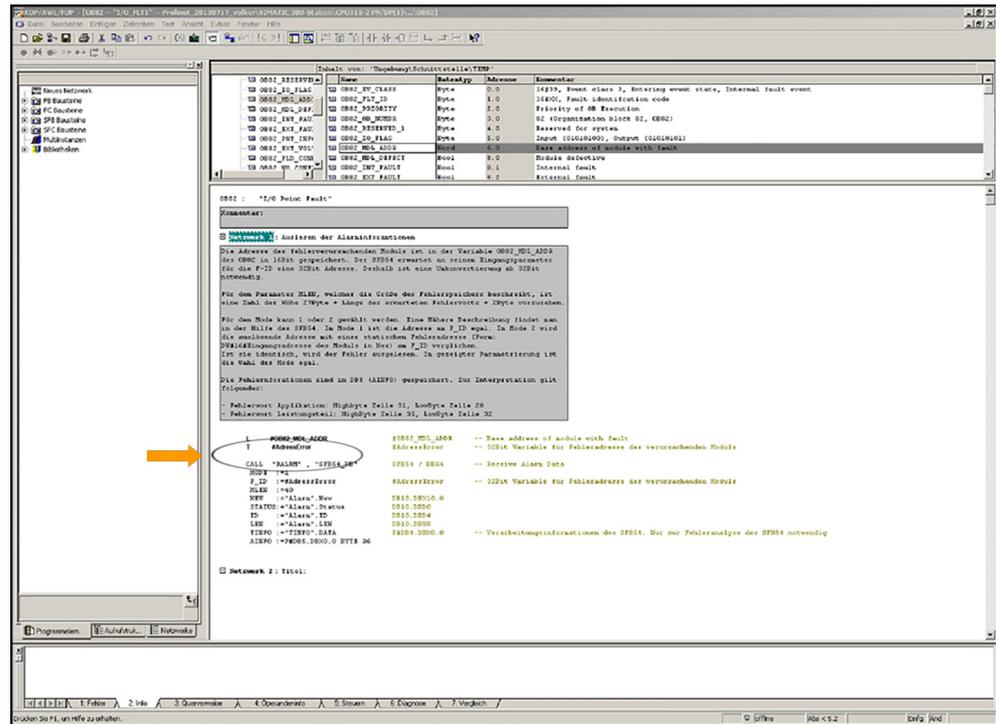
TINFO - "Target for OB start information and management information": Unimportant for the actual failure analysis, but must be provided for error-free use of the SFB54.

AINFO - "Target for header information and additional alarm management information": Memory area for the error reading.



Objektname	Symbolischer Name	Erstellungsdatum	Code modifiziert	Typ	Startzeitpunkt							
OB82	I/O_FLT	...	...	OB	...	...	...	...	...	...	...	...
SFB54	SFB54	...	...	SFB	...	...	...	...	...	...	...	...
DB54	DB54	...	...	DB	...	...	...	...	...	...	...	...
DB4	DB4	...	...	DB	...	...	...	...	...	...	...	...
DB5	DB5	...	...	DB	...	...	...	...	...	...	...	...

The SFB54 should be called up in the OB82 as shown in figure "OB82" (see pictorial representation on the following page).



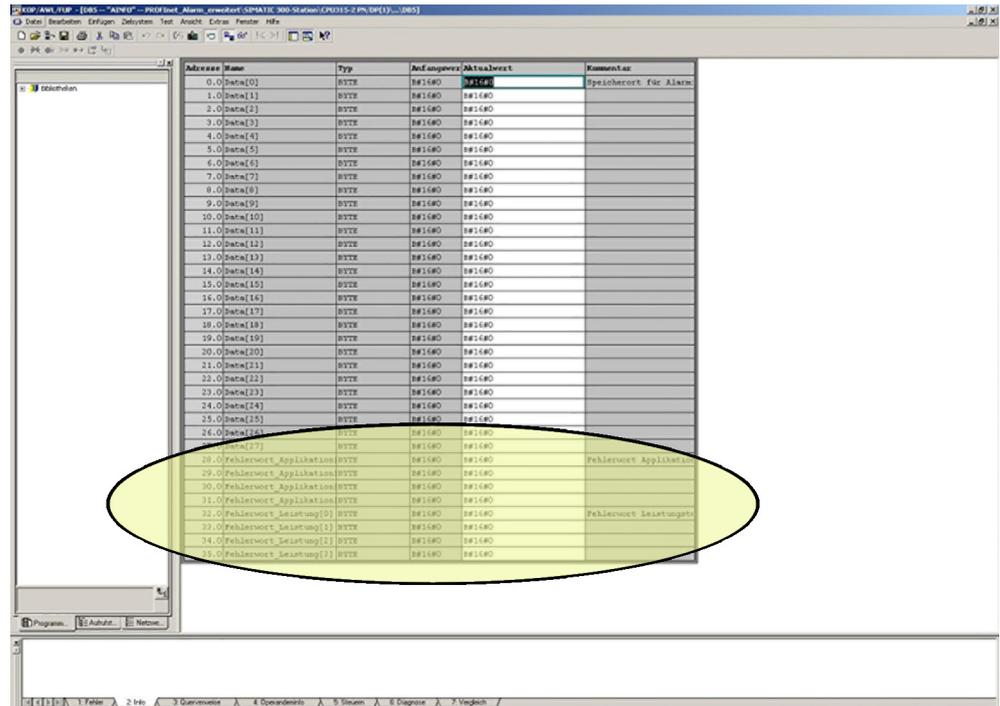
The address of the components causing the error is read using the OB82. It is saved in the „OB82\_MDL\_ADDR“ variable. The address can be used to be applied at the F\_ID input of the SFB54. Since the SFB54 expects a 32-bit variable as an input address, a type adjustment from 16 bits to 32 bits should be implemented beforehand "(arrow on the load- and transfer command)". Depending on the mode selection, as explained later, however, this step can be omitted.

The SFB54 is very extensive. The exact description of the SFB54 can be found in help in step 7. For the parameterization of the building block, a few things should be considered that are briefly listed as follows:

Either mode 1 or 2 can be selected. The address at the F\_ID input in mode 1 does not matter. In mode 2, the triggering address is compared with a static error address on F-ID. The error is read, if identical.

The selection in the parameterization according to figure „OB82“ (see pictorial representation on the following page) does not matter. The error is always read since the comparison address is dynamically generated to F\_ID in mode 2 by reading the variable „OB82\_MDL\_ADDR“ of the OB82, as described above. However, if only errors of a particular component should be read, a static address should be entered at this point in 32-bit format.

Another important value for the input is MLEN which describes the size of the error memory (AINFO) in bytes. It is calculated according to: 27 bytes + length of the expected error word + 2 bytes. The first 27 bytes are general information. The manufacturer-specific alarms follow as of byte 28, followed by an empty 2-byte buffer. This rule is not a specification by Siemens, but has been appropriately determined using its own experience with the SFB54. If the size is too small, the error cannot be read, since the registration of the manufacturer-specific error only starts as of byte 28.



Adresse	Name	Typ	Anfangsadresse	Aktualisierungszeit	Kommentar
0.0	Data[0]	BYTE	#B16#0	#B16#0	
1.0	Data[1]	BYTE	#B16#0	#B16#0	
2.0	Data[2]	BYTE	#B16#0	#B16#0	Speicherort für Alarm
3.0	Data[3]	BYTE	#B16#0	#B16#0	
4.0	Data[4]	BYTE	#B16#0	#B16#0	
5.0	Data[5]	BYTE	#B16#0	#B16#0	
6.0	Data[6]	BYTE	#B16#0	#B16#0	
7.0	Data[7]	BYTE	#B16#0	#B16#0	
8.0	Data[8]	BYTE	#B16#0	#B16#0	
9.0	Data[9]	BYTE	#B16#0	#B16#0	
10.0	Data[10]	BYTE	#B16#0	#B16#0	
11.0	Data[11]	BYTE	#B16#0	#B16#0	
12.0	Data[12]	BYTE	#B16#0	#B16#0	
13.0	Data[13]	BYTE	#B16#0	#B16#0	
14.0	Data[14]	BYTE	#B16#0	#B16#0	
15.0	Data[15]	BYTE	#B16#0	#B16#0	
16.0	Data[16]	BYTE	#B16#0	#B16#0	
17.0	Data[17]	BYTE	#B16#0	#B16#0	
18.0	Data[18]	BYTE	#B16#0	#B16#0	
19.0	Data[19]	BYTE	#B16#0	#B16#0	
20.0	Data[20]	BYTE	#B16#0	#B16#0	
21.0	Data[21]	BYTE	#B16#0	#B16#0	
22.0	Data[22]	BYTE	#B16#0	#B16#0	
23.0	Data[23]	BYTE	#B16#0	#B16#0	
24.0	Data[24]	BYTE	#B16#0	#B16#0	
25.0	Data[25]	BYTE	#B16#0	#B16#0	
26.0	Data[26]	BYTE	#B16#0	#B16#0	
27.0	Data[27]	BYTE	#B16#0	#B16#0	
28.0	Fehlerwert_Applikation	BYTE	#B16#0	#B16#0	Fehlerwert Applikation
29.0	Fehlerwert_Applikation	BYTE	#B16#0	#B16#0	
30.0	Fehlerwert_Applikation	BYTE	#B16#0	#B16#0	
31.0	Fehlerwert_Applikation	BYTE	#B16#0	#B16#0	
32.0	Fehlerwert_Leistung[0]	BYTE	#B16#0	#B16#0	Fehlerwert Leistung
33.0	Fehlerwert_Leistung[1]	BYTE	#B16#0	#B16#0	
34.0	Fehlerwert_Leistung[2]	BYTE	#B16#0	#B16#0	
35.0	Fehlerwert_Leistung[3]	BYTE	#B16#0	#B16#0	

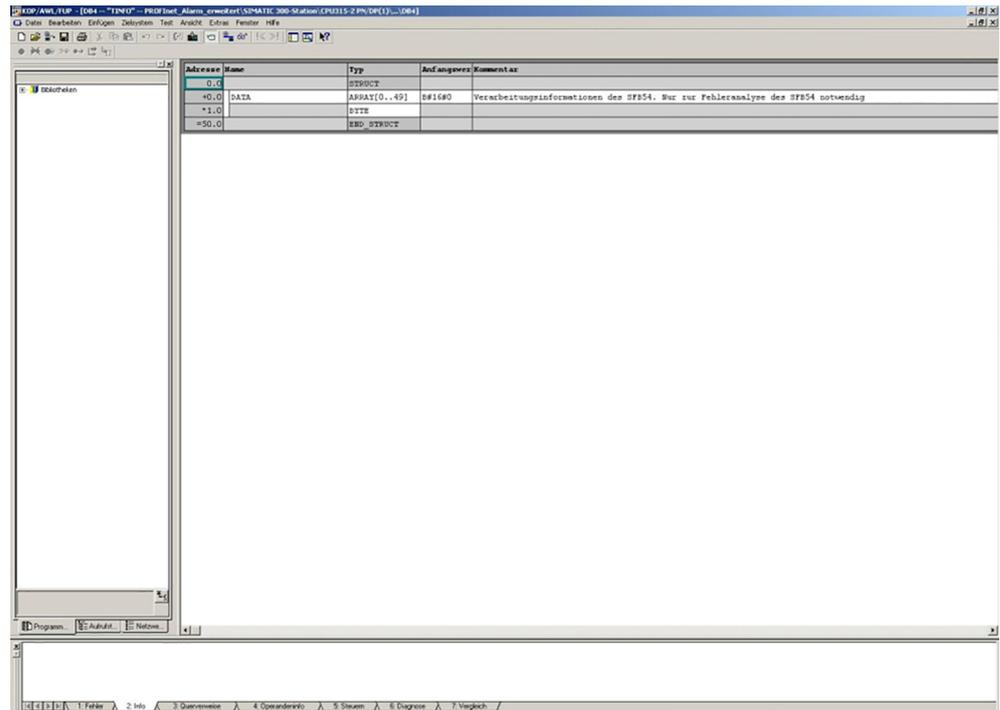
The output of the error takes place in DB\_AINFO (memory dump is shown in the figure above, the area in which the error is saved, is marked).

The memory areas for the output information should be communicated to the function block SFB54 using pointers. Therefore, the following syntax sets such a pointer to the beginning of the memory area:

P#DBY.DBX0.0 BYTE Z

- Y is the number of the data block for AINFO and TINFO.
- Z is any natural number. The selection should not be too small (e.g. 40) for TINFO and the size of MLEN for AINFO. If errors occur, the memory areas should be increased in the first step.

The building block TINFO is used for error analysis of the SFB and can be neglected, however, should be created in the project. The selection of the size should not be too small.



Adresse	Name	Typ	Anfangswert	Kommentar
Q.0		STRUCT		
*Q.0	DATA	ARRAY[0..49]	SFB54	Verschleißzustandsinformationen des SFB54. Nur zur Fehleranalyse des SFB54 notwendig
*I.0		BOOL		
*S0.0		BOOL_STRUCT		

The rest consists of SFB54 outputs. These can be saved or outputted arbitrarily. STATUS is suitable for error diagnosis, because a description of the status code is in the help text for the SFB54. NEW marks the input of an error. The output only becomes TRUE in mode 2 when the address of the error-causing assembly and F\_ID coincide. A TRUE always appears in mode 1 when an error is triggered regardless of the F\_ID. ID shows the address from whom the diagnostic alarm was received. The address of the module access point in HEX appears here if the drive controller reports an error. LEN indicates the length of the error word received.





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