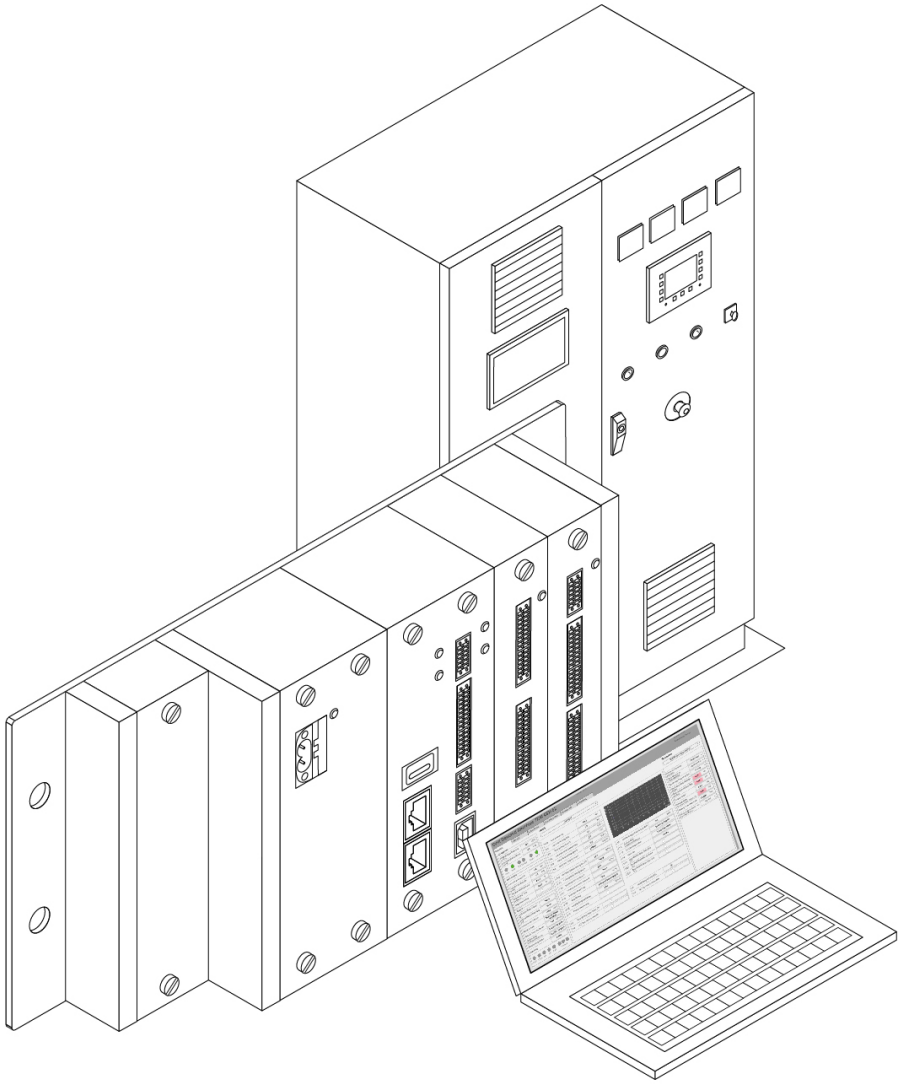
Grid Demand Interface (TEM-GDI-02)

Operating manual
12524308 for TEM EN
2023-11
Competence level SL or
Competence level CL 2



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This is a translation of the German original. All translations are based on the German original.

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The document contains information that is necessary for maintenance and repair work on the product. When carrying out the work listed in the maintenance schedule, only original parts or parts and operating media approved by the manufacturer may be used.

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Table of contents

1 Information about this manual 5

1.1 Introduction 6
1.2 Legal notes 8
1.3 Feedback on documentation 9

2 Safety 11

2.1 Safety regulations 12

3 Technical data and rating plates 13

3.1 Grid Demand Interface 14

4 Structure and function 19

4.1 Functionality of the interface 20
4.2 Technology of the interface 34
4.3 User interface 39
4.4 Integration in an energy supply plant 49
4.5 Configuration specifications 59

5 Preservation, packaging, transport and storage 109

5.1 Symbols on the packaging 110
5.2 Removing from transport 111
5.3 Information on packaging 112

6 Assembly 113

6.1 Safety notes 114
6.2 General 115
6.3 Scope of delivery 116
6.4 Own share 117
6.5 Preparation 118
6.6 Assembly 119
6.7 Cable routing and connection 122

7 Commissioning 135

7.1 Safety notes 136
7.2 Preparation 137
7.3 On-site checks 138
7.4 Connecting the service computer 139
7.5 Configuring the service computer for the interface application 140
7.6 Launching the user interface 141
7.7 Read mode (no login) 142
7.8 Edit mode (with login) 143
7.9 Managing configurations 145
7.10 Software update 146
7.11 Editing entries 157
7.12 Procedure for initial commissioning 159

8 Operation 167

8.1 Safety notes 168
8.2 Operating locations 169

9 Troubleshooting 171

9.1 Safety notes 172

10 Maintenance 173

10.1 Safety notes 174
10.2 Grid Demand Interface maintenance schedule 175
10.3 Work instructions 176

11 Dismantling and disposal 179

11.1 Safety notes 180
11.2 Disposing of components 181

12 Appendix 183

12.1 Copy template GDI 02: Digital module assignment (DIO6-1) 184
12.2 Copy template GDI 02: Analog module assignment (AIO6-1) 185

1 Information about this manual

Table of contents

1.1 Introduction 6
1.1.1 Target audience 6
1.1.2 Validity 6
1.1.3 Storage 6
1.1.4 Other applicable documents 6
1.1.5 Handling 7
1.1.6 Operator obligations 7
1.1.7 Symbols used 7
1.2 Legal notes 8
1.2.1 Limitations of liability 8
1.2.2 Copyright 8
1.3 Feedback on documentation 9

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1.1 Introduction

1.1.1 Target audience

This document is intended for personnel who fulfil at least the following requirements:

- Working as Qualified specialist personnel
- Possess knowledge and skills corresponding to Service Level (SL)

For further information on the knowledge and skills required of personnel, see

- Operating Manual ⇒ General ⇒ Safety regulations
  - Safety and Product Information Specification ⇒ Tasks, personnel and competencies

1.1.2 Validity

The document is valid for the Grid Demand Interface (TEM-GDI-02).

The document is drafted in German. In other languages, the document is a translation of the original manual.

1.1.3 Storage

This document is a component of the product. Keep the document in the immediate vicinity of the product. The document must be accessible at any time.

1.1.4 Other applicable documents

The end customer documentation supplied includes a large number of documents. This document is a component of the end customer documentation and describes the product.

The end customer documentation includes the following documents:

- Power plants layout - Planning notes and assembly notes
- Safety regulations
- Operating media specifications
- Protocols, specifications, certificates
- Technical drawings
- Wiring diagrams and circuit diagrams
- P&I diagram
- Component documentation
  - Assembly notes
  - Operating Manual
  - Maintenance information
  - Work instructions
- Spare parts catalog

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1.1.5 Handling

The notes and descriptions given in the document enable safe and efficient handling of the product. Observe and comply with all warnings, safety notes and instructions for handling in order to work safely on the product.

In the document, illustrations assist in basic understanding and may deviate from the actual design.

1.1.6 Operator obligations

The operator must observe and ensure the following points so that the product functions without impairment:

- Have all activities on the product performed in accordance with the applicable standards and specifications
- Determine the responsibilities for operation, servicing and troubleshooting
- Inform the authorized specialist personnel of possible dangers that may arise from handling the product
- Ensure that the authorized specialist personnel have read and understood the operating manual

1.1.7 Symbols used

Symbols are used in this document so that the authorized specialist personnel can quickly recognize issues and clearly categorize them. Warnings are marked with symbols.

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1.2 Legal notes

1.2.1 Limitations of liability

In this document, all information and notes have been compiled taking the relevant standards and specifications for the product and the state of the art technology into account.

The manufacturer assumes no liability for damage resulting from the following causes:

- Non-observance of the operating manual
- Non-intended use
- Deployment of unauthorized specialist personnel
- Unauthorized conversions
- Technical alterations
- Use of unapproved spare parts or attachments
- Use of unapproved operating media

The actual scope of delivery may differ under the following conditions:

- Special versions
- Utilization of additional order options
- Due to the latest technical modifications

The regulations apply in the following order:

1. Obligations agreed in the delivery agreement
2. Terms and conditions of the manufacturer for the sales and delivery of new engines, new plants and original parts in the current version
3. Legal provisions valid when the contract was concluded

The right for the manufacturer to undertake technical alterations to improve the performance characteristics and further development is reserved.

1.2.2 Copyright

The document is protected by copyright and exclusively designed for in-house purposes.

Unless for in-house purposes, the following measures are not permitted:

- Transferring the document to third parties
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Do you have any praise, criticism or suggestions for improvement for this document?

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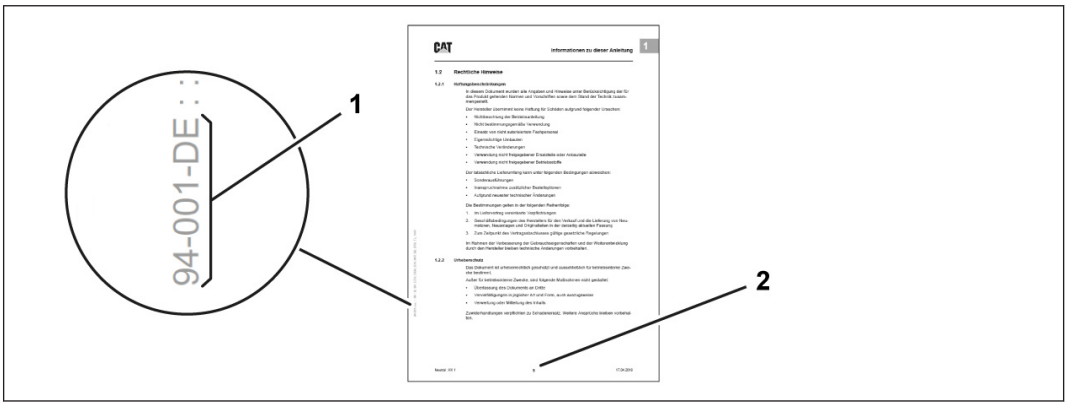
Describe your request as precisely as possible.

So that we can allocate your feedback, please also provide the following information:

- Document number (1)
- Page number (2)
- Contact data (name, email) for potential further enquiries



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Thank you for your support. We read all feedback carefully.

We look forward to hearing from you!

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2 Safety

Table of contents

2.1 Safety regulations..... 12

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2.1 Safety regulations

Observe the applicable safety regulations for operation, maintenance and servicing. Observe and comply with all instructions for handling and safety notes given in this document. Otherwise, substantial hazards may arise.

The product is used in the commercial sector. The operator is subject to the legal obligations for health and safety at work.

The operator must comply with the following for the product's and overall plant's area of application:

- Safety notes in this document
- Safety regulations
- Accident prevention regulations
- Environmental protection specifications
- General rules on health and safety at work
- Risk assessment of the operator
- Directives and ordinances on operational safety

Directives, ordinances and regulations are available from trade associations or specialist dealers.

For necessary information on the safety regulations, see

- Operating Manual ⇒ General ⇒ Safety regulations
  - Safety and Product Information Specification

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3 Technical data and rating plates

Table of contents

3.1 Grid Demand Interface 14
3.1.1 Hardware setup 14
3.1.2 System requirements 14
3.1.3 Ambient conditions 14
3.1.4 Safety 15
3.1.5 Power supply and connections 15
3.1.6 Approvals and guidelines 15
3.1.7 Housing 16
3.1.8 Rating plate 16

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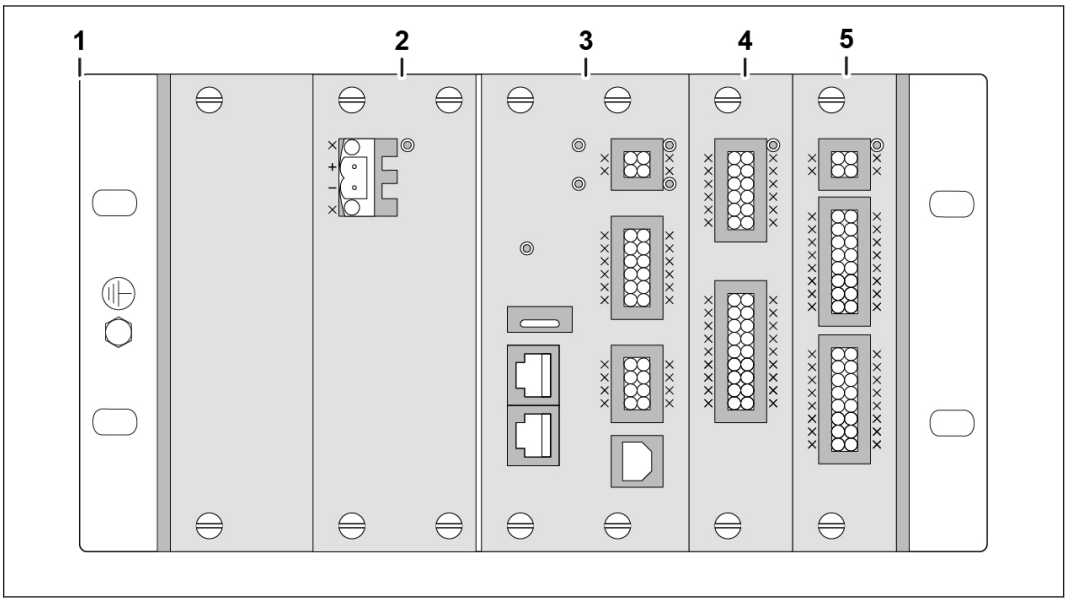
3.1 Grid Demand Interface

3.1.1 Hardware setup



75750-001 Front view

1 Rack (support plate)
2 Voltage supply
3 Computer unit with C/C++ and CODESYS application
4 Digital input and digital output module
5 Analog input and analog output module

3.1.2 System requirements

Description	Value
Available control system	TEM system

3.1.3 Ambient conditions

Description	Value
Installation site	Internal room, fixed location
Height above sea level	max. 4000 m
Operating temperature	-40°C to 60°C
Vibrations	Inspection in accordance with: DNV-GL A/B IEC 60255-21-1/2/3 IEC 60068-2-27

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3.1.4 Safety

Description	Value
Protection class	IP 30
Installation and protection	Installation (overvoltage) category III, 600 V, degree of soiling 2 as per EN 61010-1
Electromagnetic compatibility	Inspection in accordance with: IEC 61000-6-2/4 IEC 61000-4-3/4/5/6/8

3.1.5 Power supply and connections

Description	Value
Voltage supply	24 V_{DC} (+18 - 32 V_{DC}) 5 A PELV
Digital outputs current load	maximum per channel 0.25 A maximum for all outputs 2 A
Digital inputs voltage signal	high: 13 - 30 V_{DC} low: 0 - 5 V_{DC}
Analog signals current	0 - 20 mA / 4 - 20 mA
Analog signal voltage	0 - 10 V_{DC}
Buffer battery	CR2430 3 V
Connections	Connections for: • Ethernet • Power supply • Digital signals • Analog signals • Equipotential bonding

3.1.6 Approvals and guidelines

Description	Value
Certifications[1]	• European Union (CE) • UK Conformity Assessed (UKCA) • Underwriters Laboratories (UL/ULC)

[1] For current information, see labeling on the device or contact the responsible dealer or service partner

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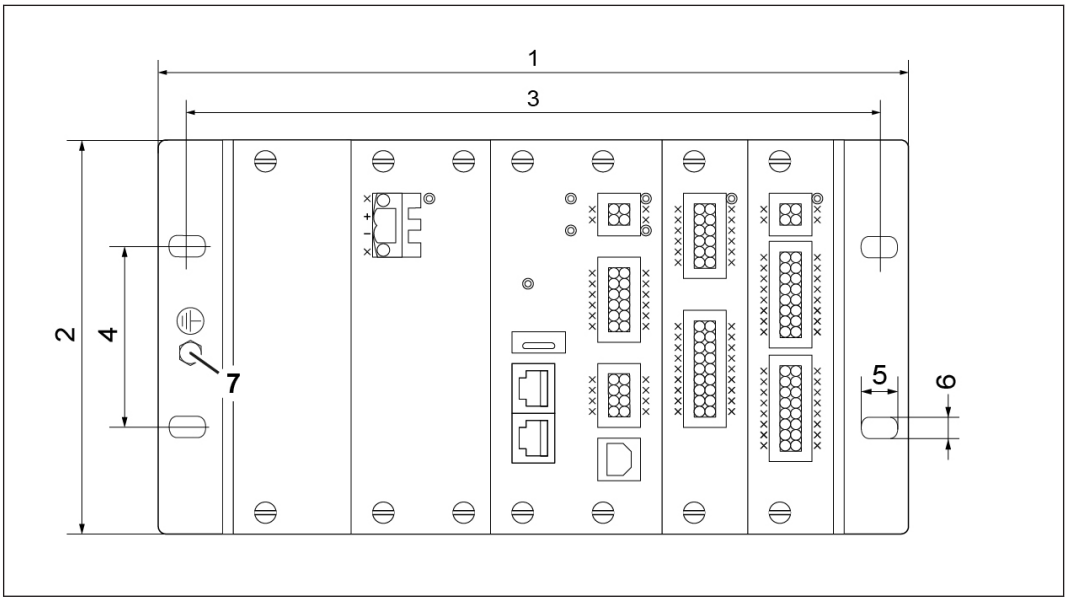
3.1.7 Housing

Description	Value
Type	Rack: Aluminium
Dimensions (W × H × D) in mm	233.2 × 122.0 × 113.9
Fastening	4× M6
Equipotential bonding	1× M5
Weight	870 g



75773-001 Rack dimensions

1 Width: 233.2 mm

2 Height: 122.0 mm

3 Mounting bores, horizontal: 217.2 mm

4 Mounting bores, vertical: 56 mm

5 Elongated hole, width: 10.5 mm

6 Elongated hole, height: 7.5 mm. mounting rack: 4x M6. Tightening torque: 5 Nm (depending on mounting type)

7 Equipotential bonding connection (PE): M5. Tightening torque: 3 Nm

3.1.8 Rating plate

The rating plate in on the Grid Demand Interface. The information must be observed.

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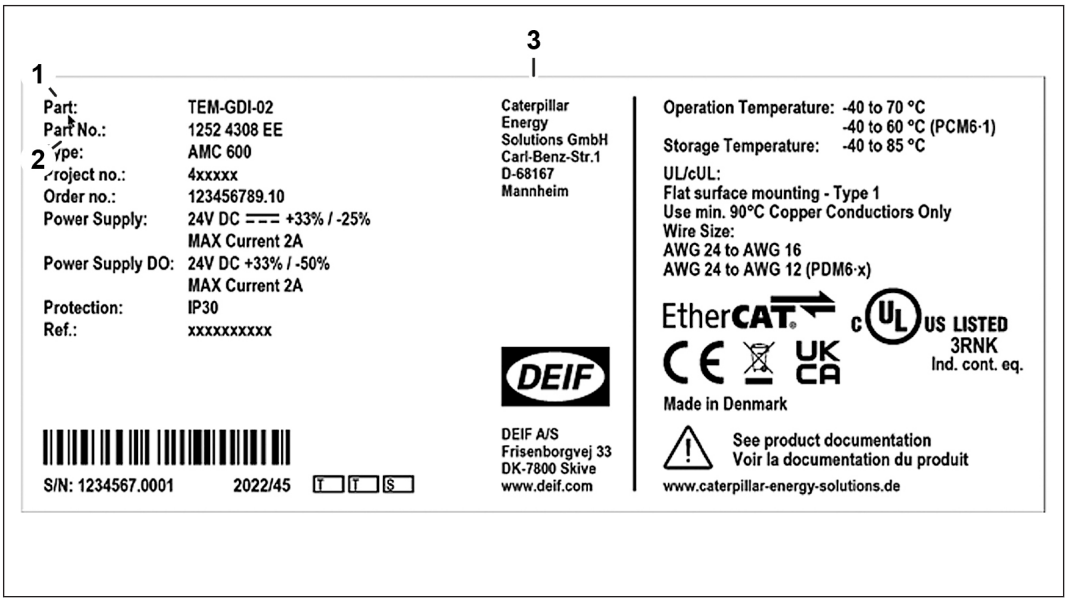
For questions to the manufacturer, the information presented is important.



75774-001 Rating plate

1 Part

2 Part number

3 Address of manufacturer

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4 Structure and function

Table of contents

4.1 Functionality of the interface ... 20
4.1.1 Purpose and functionality overview ... 20
4.1.2 Control concept ... 22
4.1.3 Genset and TEM system configuration ... 24
4.1.4 Power demand and coupling ... 24
4.1.5 Active power control ... 25
4.1.6 Reactive power control ... 29
4.2 Technology of the interface ... 34
4.2.1 Overview ... 34
4.2.2 Hardware ... 34
4.2.3 Firmware ... 36
4.2.4 Application software ... 36
4.2.5 Operating locations, signals, messages ... 37
4.2.6 Test modes ... 38
4.3 User interface ... 39
4.3.1 Conception ... 39
4.3.2 Overview tab ... 39
4.3.3 Data A-Z tab ... 41
4.3.4 Logging tab ... 43
4.3.5 I/O configuration tab ... 44
4.3.6 Raw I/O data tab ... 45
4.3.7 Login tab ... 47
4.4 Integration in an energy supply plant ... 49
4.4.1 Connection to an energy supply plant ... 49
4.4.2 Notes concerning IT security ... 49
4.4.3 Modbus Input Register ... 50
4.4.4 Modbus holding register ... 57
4.5 Configuration specifications ... 59
4.5.1 Sorted parameter list ... 59
4.5.2 Inputs and outputs ... 102

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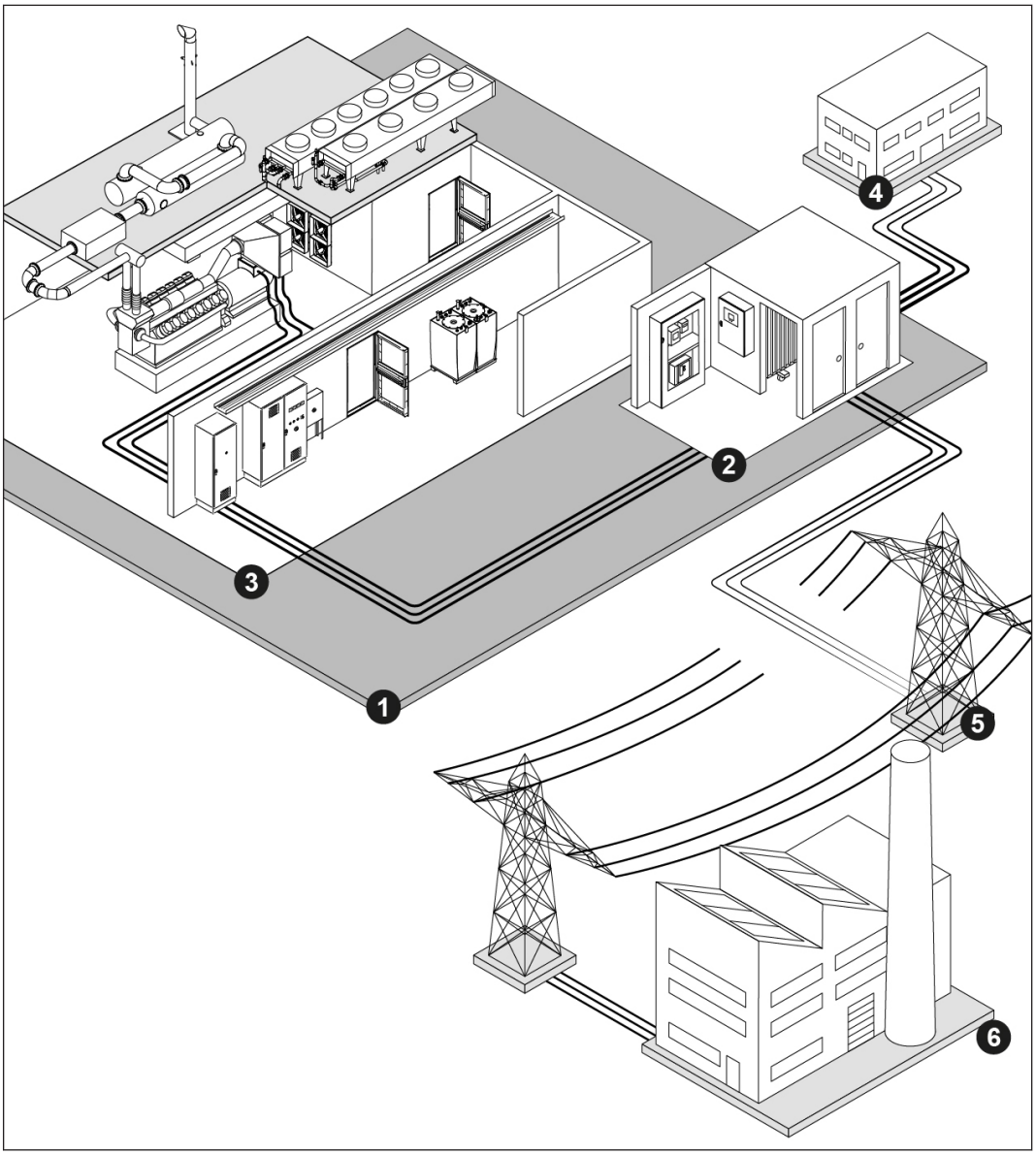
4.1 Functionality of the interface

4.1.1 Purpose and functionality overview

Purpose

The Grid Demand Interface implements many of the functions stipulated in the Grid code requirements regarding active power, reactive power and connection for TEM systems at the energy supply unit level (genset) (3). It provides the required interfaces between the energy supply unit (3) and the operator's open-loop and closed-loop control devices (2) of the energy supply plant (1).



75801-001 Schematic example illustration

1 Energy supply plant such as a combined heat and power station

2 Operator grid infeed with transformer, mains circuit breaker, EZA controller, counter, communication interface to external and EZE etc.

3 Energy supply unit such as an individual module with TEM system and switchgear

4 Local current consumer

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5 Data exchange with the mains operator control centre

6 Large power station of an electricity supply company

Function overview

The most important functions for fulfilling the grid connection regulations comprise:

- Checking the connection conditions for voltage and frequency in the normal state
- Checking the connection conditions for voltage and frequency after mains decoupling
- Active power limitation by mains operator via external digital and analog specifications (as part of the grid safety management)
- Frequency-dependent active power adjustment at overfrequency and underfrequency (Limited Frequency Sensitive Mode – underfrequency and overfrequency, LFSM-U and -O)
- Selection of required active power ramps at various grid conditions (normal operation, setpoint specification by third party (direct sales), active power limitation by mains operator, LFSM, according to LFSM) and others
- Operating modes for the provision of reactive power
  - Q(U) + UQ0 characteristic curve
  - Q(P) characteristic curve
  - Q(U) + Qref characteristic curve
  - PF demand
  - Q setpoint mode
  - PF (U) characteristic curve
  - PF (P) characteristic curve
  - U setpoint mode
- Parameterizable switchover of the reactive power mode or relevant setpoint as reaction upon failure of the telecontrol connection to the mains operator

Note

The fulfillment of the intended Grid code is only possible with the specifications for assembly and commissioning.

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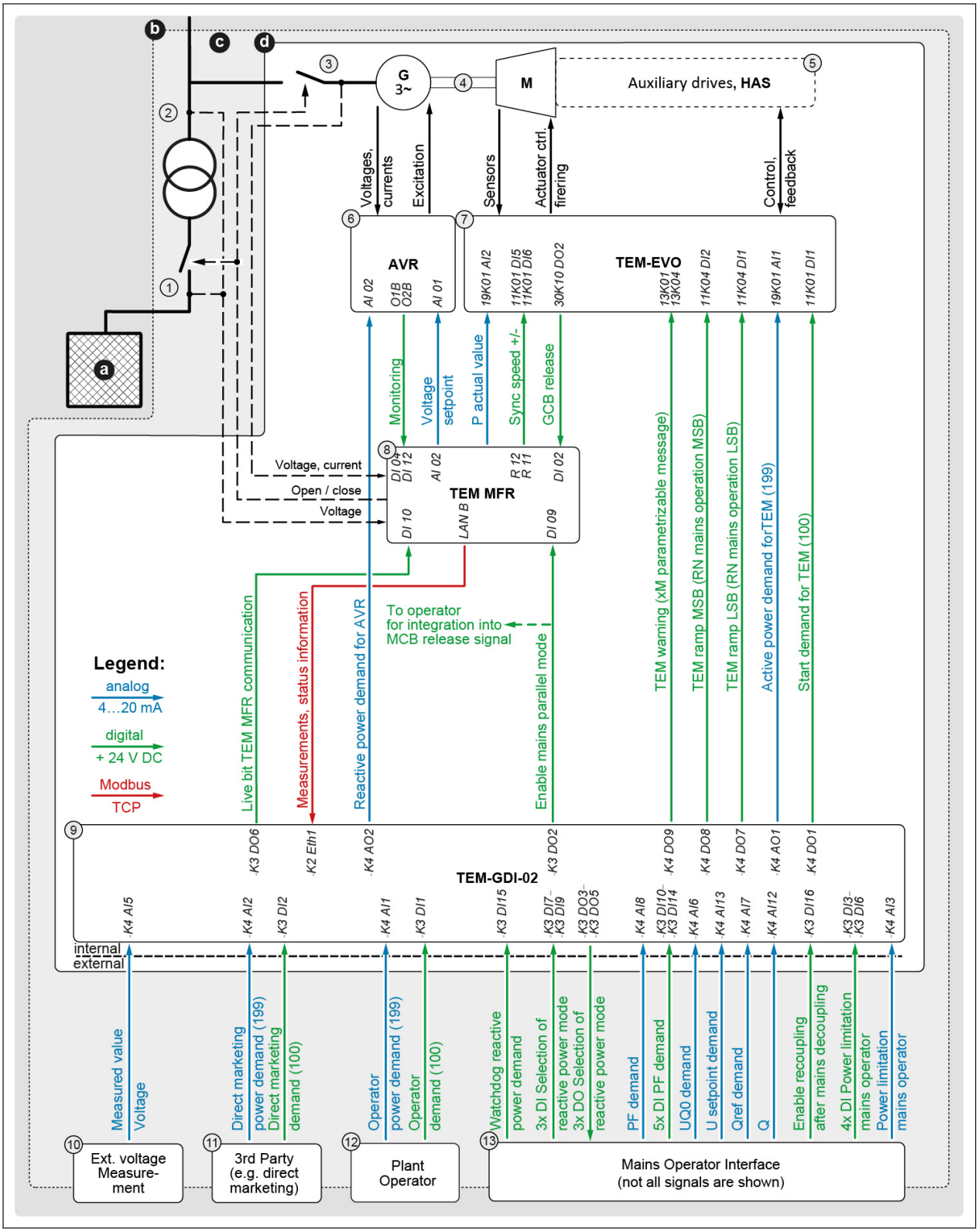
4.1.2 Control concept

Grid-parallel operation

The Grid Demand Interface (GDI) is only active in grid-parallel operation.



76137-001 Control concept and signal exchange

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Item	Area	Remark
a	Interconnected grid of a mains operator (NB)	Larger power grid with various consumers and producers.
b	Energy supply plant (EZA) of a plant operator with at least one power station (EZE)	EZA with higher-level control system, EZA controller, automatic and manual control commands to the EZE, the power section of the energy supply plant, supply facilities, etc.
c	Central switchgear in a energy supply plant (EZA)	Power cable or busbar, transformer, mains circuit breaker, coupling switch, etc. for coupling the EZE power and the grid feed-in of the EZA.
d	Power station (EZE) in an energy supply plant (EZA)	Genset with internal control system and auxiliary drives, mains circuit breakers, etc.

Item	Component / function	Remark
1	Grid connection point (NAP) with mains circuit breaker (MCB) and measuring connection	In relation to the grid connection point (NAP) of the energy supply plant (EZA): • Measured values for voltage and current • MCB status
2	Busbar with measuring connection	In relation to the energy supply plant (EZA): • Measured values for voltage and current
3	Generator circuit breaker (GLS) with measuring connection	In relation to the power station (EZE): • Measured values for voltage and current • GLS status
4	Genset with generator (G) and gas engine (M)	Power-generating part of the power station (EZE).
5	Auxiliary cabinet (HAS) for the open- and closed-loop control of auxiliary systems	Sending control signals for various actuators and receiving measurement signals or status messages from the sensors.
6	Generator controller (AVR)	Current for the field windings and measured values from the main machine.
7	TEM Evo system (TEM-EVO)	Base system with genset control cabinet (AGS), input/output controller TEM I/O and operating computer for controlling and regulating the gas engine and various auxiliary drives.
8	TEM Multi Function Relay (TEM MFR)	Controlling, synchronizing and monitoring the generator and the generator circuit breaker (GLF).
9	Grid Demand Interface (TEM-GDI-02)	Provides various interfaces between the energy supply unit (EZE) and the operator's control and regulation equipment of the energy supply plant (EZA).
10	External voltage measurement	Connection for an optional voltage measurement within the energy supply plant (EZA).
11	Third parties	Connections for third-party participants, for example for direct sales.

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Item	Component / function	Remark
12	Plant operator	Connections for direct access by the plant operator and their control system.
13	Mains operator (NB) interface	Active and reactive power demands of the mains operator (NB) via the control system of the energy supply plant (EZA), for example to an EZA controller.

4.1.3 Genset and TEM system configuration

Genset power

For internal calculations, the Grid Demand Interface requires information on the electrical performance of the genset.

Further information on the parameters

- For genset output parameters, see chapter 4.5.1.1 Genset 60

For required information on genset performance, see

- Operating Manual ⇒ General ⇒ Specifications
  - Genset data sheet

Multifunction relay (TEM MFR) and Modbus TCP

The Grid Demand Interface communicates with the TEM MFR via Modbus TCP to record measurement and status values.

Further information on the parameters

- For TEM MFR parameters, see chapter 4.5.1.24 TEM MFR configuration and Modbus communication 101

4.1.4 Power demand and coupling

Power demand and power demand

Power demand is specified via a digital demand signal and the specification of a power setpoint.

Further information on the parameters

- For parameters pertaining to operator and direct sales, see chapter 4.5.1.5 Operators and direct sellers 68
- For mains operator parameters, see chapter 4.5.1.6 Mains operator 68

Enablement conditions for grid-parallel operation

The enabling for grid-parallel operation differentiates between connection in normal operation and connection after a mains decoupling.

For these two cases, parameters P012 to P019 can be used to define a voltage band and a frequency band within which connection is permitted.

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Further information on the parameters

- For parameters for connection conditions, see chapter 4.5.1.3 Activation conditions 62

Observation time before coupling

Optionally, an observation time can be set in which the voltage and frequency must be permanently within the permissible range before a connection can be made.

A separate power gradient can be set for the power increase after connection.

Further information on the parameters

- For parameters for connection conditions, see chapter 4.5.1.3 Activation conditions 62

Enablement after mains decoupling

A time period can be set for the connection after a mains decoupling, in which the voltage and frequency have to be permanently in the permissible range before a connection can be made.

Optionally, the enabling can also be forced via a digital input for the connection after a mains decoupling. The set timing device only becomes active in this case if the enable signal is present and the voltage conditions and frequency conditions are fulfilled. The optional enable signal is activated/deactivated via a parameter.

If required, a temporary synchronization authorization can be defined, during which the genset can be switched on again even without an enable signal being present.

Further information on the parameters

- For parameters for connection conditions, see chapter 4.5.1.3 Activation conditions 62

Feeding in active power

The path to approaching feed-in specification values for active power can be parameterized.

Further information on the parameters

- For parameters pertaining to priorities and ramps, see chapter 4.5.1.4 Active power priorities and ramps 64

4.1.5 Active power control

Active power demand

The transmission of an active power demand from the control system of the energy supply plant to the Grid Demand Interface is possible via:

- Signal lines
- Modbus TCP

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Active power demand via signal lines

The following analog inputs are available on the analog module of the Grid Demand Interface for transmitting the active power demand:

- Active power requirement from the operator of the energy supply plant
- Active power demand by the mains operator
- Active power demand of a third party, for example a direct seller

Active power demand via Modbus TCP

Alternatively, the active power can be specified via the Modbus TCP server of the Grid Demand Interface.

Activation

Digital request signals are used to determine which active power demand is active. If several demand signals are set simultaneously, the system operator's active power demand always has the lowest priority. The priority of the other active power demands can be parameterized.

Depending on the input used, a separate active power gradient is active.

Further information on configuration

- For analog inputs for the active power demand, see chapter 4.5.2.2 Analog inputs (default assignment) 103
- For digital inputs for the type of active power demand, see chapter 4.5.2.3 Digital inputs (default assignment) 107

Further information on the parameters

- For parameters pertaining to operator and direct sales, see chapter 4.5.1.5 Operators and direct sellers 68
- For mains operator parameters, see chapter 4.5.1.6 Mains operator 68

Active power limitation by the mains operator

The active power limitation by the mains operator occurs either via an analog input, four digital inputs or Modbus TCP.

The switchover between the preset options is effected via parameter P037.

Further information on the parameters

- For active power limitation parameters, see chapter 4.5.1.6 Mains operator 68

Frequency Sensitive Mode (FSM)

Frequency sensitive mode (FSM) is used to adjust the active power according to a parameterized characteristic curve in case of smaller frequency deviations. The active power offset resulting from the FSM function is added to the active power demand that is active.

If a dead band is set for the FSM function, the two options shown below are available for adjusting the characteristic curve. Either the FSM characteristic is shifted by the amount of the dead band (black characteristic curve) or the FSM characteristic always runs through the zero point at the rated frequency, whereby the FSM active power offset within the dead band is set to zero (blue characteristic curve).

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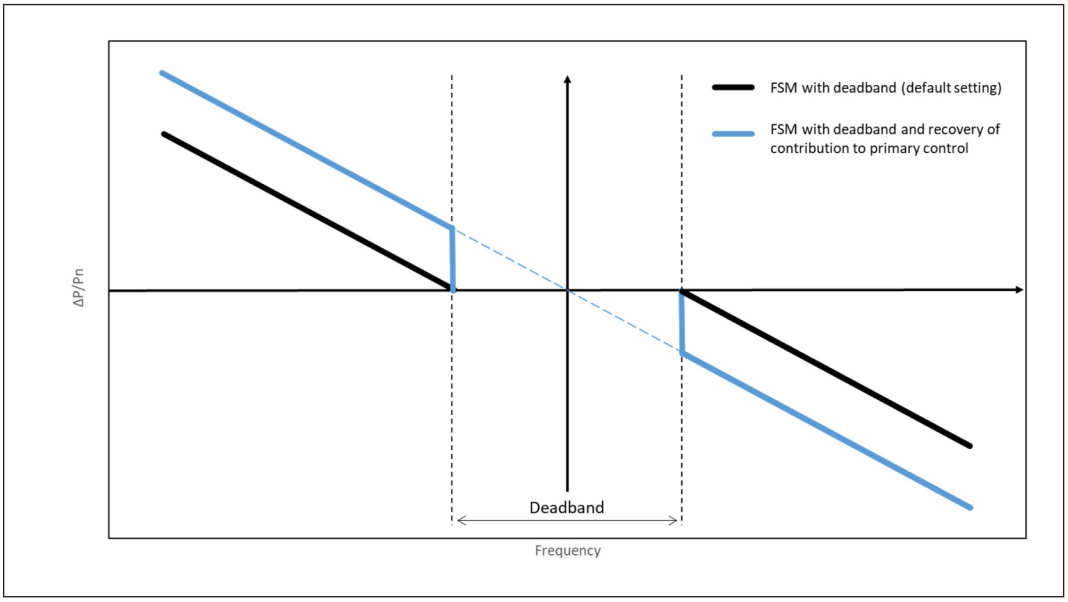

75023-001 FSM characteristic curve

Limited Frequency Sensitive Mode (LFSM)

The Limited Frequency Sensitive Mode is used to adjust the active power for larger frequency deviations.

The characteristic curve can be activated and parameterized separately for overfrequencies (LFSM-O) and underfrequencies (LFSM-U).

Optionally an activation delay can be set for LFSM-O and -U by which the adjustment of the active power setpoint is delayed if the mains frequency reaches one of the limit values.

To prevent the genset from switching off at low active power setpoints due to overfrequency, the active power output during LFSM is limited to the minimum power of 30 % P_n to the downside.

The following figure shows the LFSM characteristic curve at the frequency thresholds 49.8 Hz and 50.2 Hz and a power gradient of 40 % P_n/Hz.

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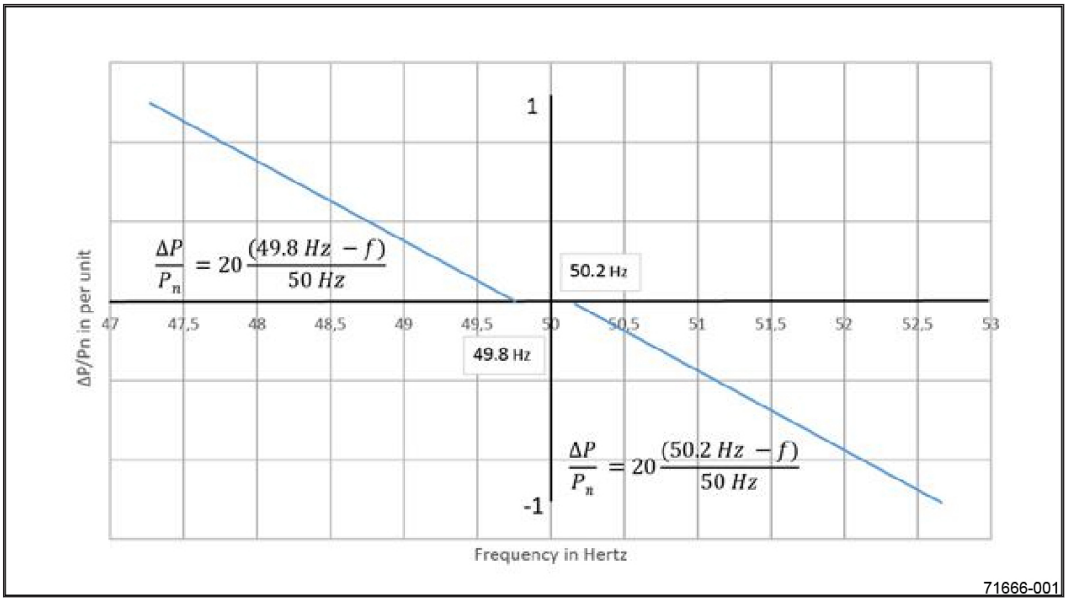


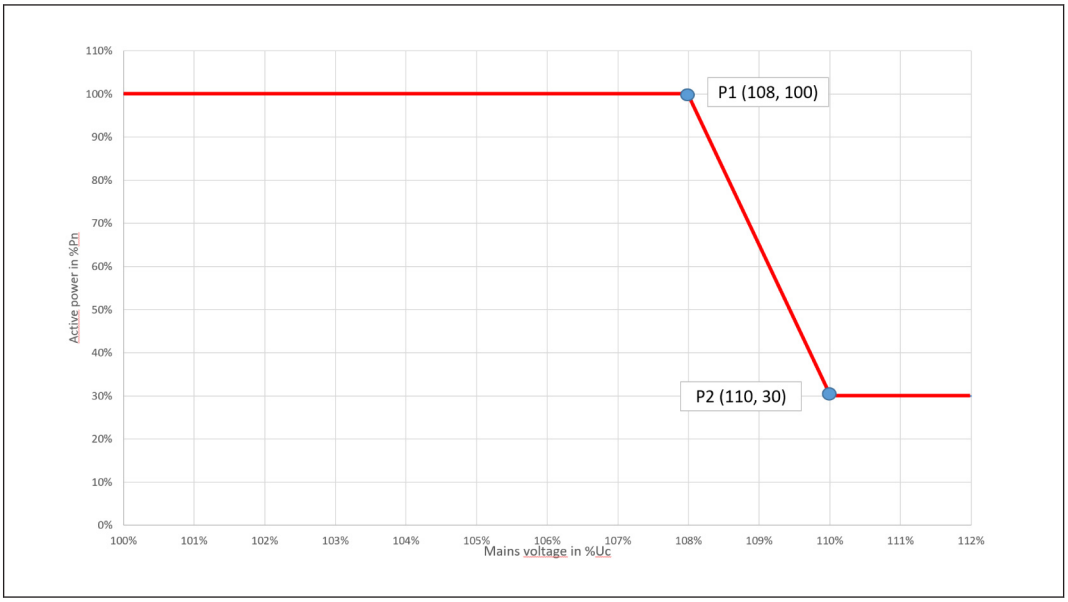
71666-003 LFSM characteristic curve

Further information on the parameters

- For Limited Frequency Sensitive Mode (LFSM) parameters, see chapter 4.5.1.9 Limited Frequency Sensitive Mode (LFSM) 72

Voltage dependent active power decrease P(U)

The voltage dependent active power decrease serves to limit the active power output at high voltages. With the P(U) function, two sampling points are used to set a limit curve that serves as the limit for the active power, as shown in the graphic below.



75024-001 Voltage dependent active power decrease P(U)

Further information on the parameters

- For parameters pertaining to voltage-dependent active power decrease, see chapter 4.5.1.10 Voltage-dependent active power decrease (P(U)) 74

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

4.1.6 Reactive power control

Reactive power mode specifications

Eight reactive power modes are available. The selection is made either via digital inputs, Modbus TCP or the GDI web server.

All values for parameterization of the reactive power modes must be indicated in the generator sign convention.

Further information on the parameters

- For reactive power mode settings parameters, see chapter 4.5.1.13 Reactive power mode specifications 79
- For digital inputs for specifying reactive power modes, see chapter 4.5.2.3 Digital inputs (default assignment) 107

Reactive power mode Q(U) + UQ0 characteristic curve

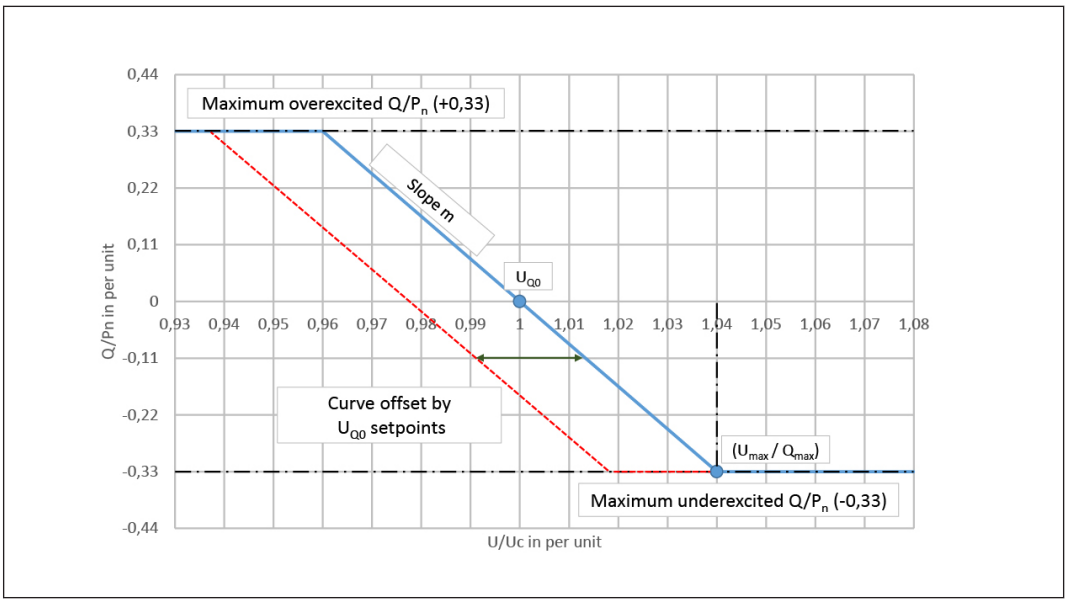
The Q(U) + UQ0 characteristic curve can be set via the values Q_{max}, U_{max} and U_{Q0} (parameters P048, P049 and P051). Parameter P050 can be used to activate the curve shift. The shift along the voltage axis occurs via an analog input (see description of the input and output signals). This input is parameterized via parameters P052 and P053.

In addition, a dead band can be set with parameter P054.

If the switchover is carried out to a fixed value for U_{Q0} in the event of a fault (failure of the telecontrol connection to the mains operator), a separate fixed value (parameter P110) is used.

The reactive power exhibits a PT_1 behavior qualitatively at setpoint increments. The time constant 3T, or the time until 95 % of the setpoint is attained, is defined via parameter P044.

The following figure shows the Q(U) + UQ0 characteristic curve for the values U_{Q0} = 1; U_{max} = 1.04; Q_{max} = -0.33 (generator sign convention).



71424-003 Q(U) + UQ0 characteristic curve

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Further information on the parameters

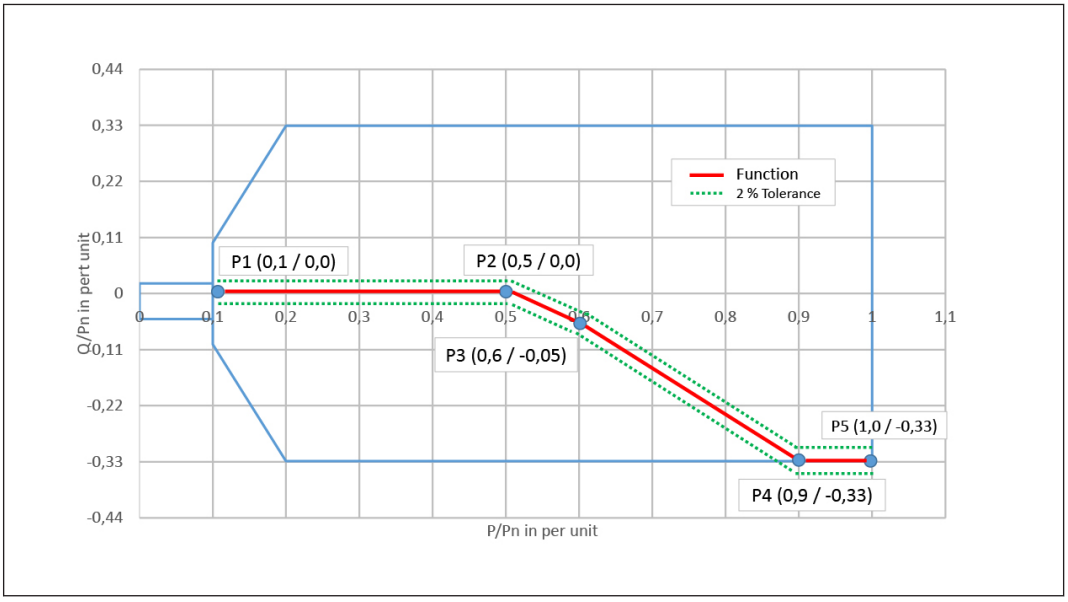
- For parameters pertaining to reactive power mode Q(U) characteristic curve, see chapter 4.5.1.14 Reactive power mode Q(U) + Qref 80

Reactive power mode Q(P) characteristic curve

The Q(P) characteristic curve is defined based on ten sampling points. The ten value pairs from active and reactive power are set via parameters P055 through P074.

The reactive power exhibits a PT_1 behavior qualitatively at setpoint increments. The time constant 3τ, or the time until 95 % of the setpoint is attained, is defined via parameter P045.

The following figure shows the Q(P) characteristic curve. Sampling points P_6 to P_{10} are assigned the values P = 1.0 and Q = −0.33 in this example similar to P_5. (Generator sign convention).



71423-003 Q(P) characteristic curve

Further information on the parameters

- For parameters pertaining to the reactive power mode Q(P) characteristic curve, see chapter 4.5.1.16 Reactive power mode Q(P) 83

Reactive power mode Q(U) + Qref

The Q(U) + Qref characteristic curve is defined using four sampling points (parameters P075 – P082). A characteristic curve shift is possible by specifying a value for Q_{ref} via an analog input, Modbus TCP or a fixed value (parameter P108). The analog input is parameterized via parameters P083 and P084. Switching between the analog input, Modbus TCP and the fixed value is possible using parameter P109.

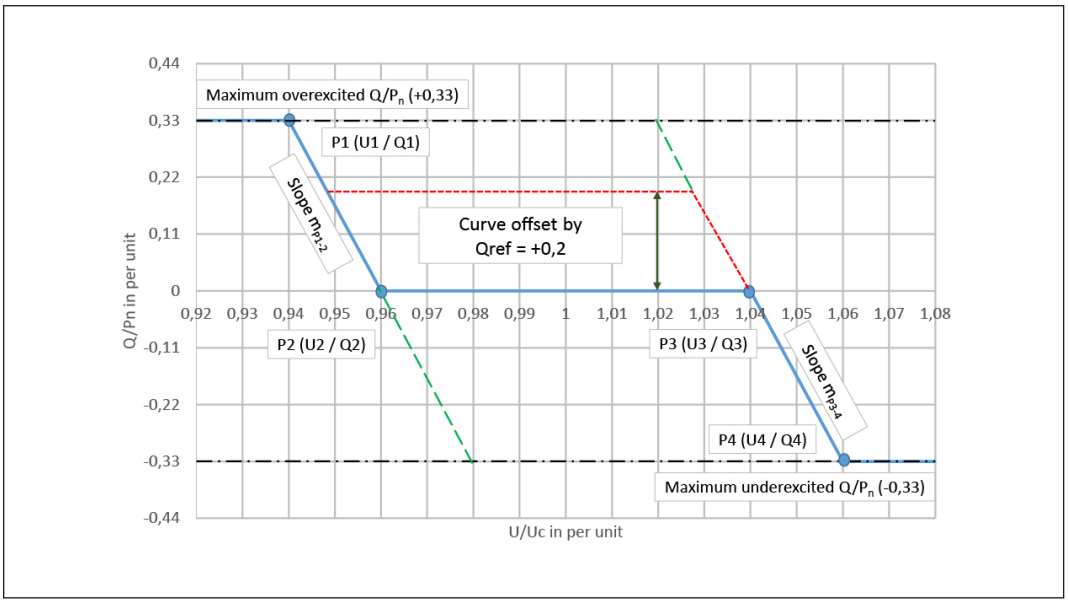
Optionally the reactive power supply can be limited by a minimum PF value (parameter P141). Depending on the active power, the reactive power supply can be set to zero or occur based on the characteristic curve of Q(U) + Qref. This occurs in each case via the parameterization of the active power threshold values (parameters P142 and P143). If the reactive power values of sampling points 2 and 3 are identical as in the figure below, an activation delay can be set (parameter P158). If the voltage falls below U_2 or exceeds U_3, the modification of the reactive power setpoint is delayed by the set period of time.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

If the switchover is carried out to a fixed value for Q_{ref} in the event of a fault (failure of the telecontrol connection to the mains operator), a separate fixed value (parameter P111) is used.

The reactive power exhibits a PT_1 behavior qualitatively at setpoint increments. The time constant 3T, or the time until 95 % of the setpoint is attained, is defined via parameter P046.

The following figure shows the Q demand with voltage limitation function for values P_1(0.94/0.33), P_2(0.96/0), P_3(1.04/0) and P_4(1.06/-0.33). (Generator sign convention)



71421-003 Q specification with voltage limiting function

Further information on the parameters

- For reactive power mode parameters Q(U) + Qref, see chapter 4.5.1.14 Reactive power mode Q(U) + Qref 80

Reactive power mode PF specification

The displacement PF can be specified via an analog input, via five digital inputs, Modbus TCP or via a fixed value (parameter P107). The analog input is parameterized via parameters P085 and P086. The digital inputs are parameterized via parameters P087 through P091. Switching between the analog input, the digital inputs and the fixed value is possible using parameter P092.

If the switchover is carried out to a fixed PF value in the event of a fault (failure of the telecontrol connection to the mains operator), a separate fixed value (parameter P093) is used.

The reactive power exhibits a PT1 behavior qualitatively at setpoint increments. The time constant 3T, or the time until 95 % of the setpoint is attained, is defined via parameter P047.

Further information on the parameters

- For reactive power mode PF specification parameter, see chapter 4.5.1.18 PF displacement factor 87

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Reactive power mode Q setpoint mode

Specification of the reactive power via an analog input, Modbus TCP or via a fixed value (parameter P135). The analog input is parameterized via parameters P083 and P084. Switching between the analog input, Modbus TCP and the fixed value is possible using parameter P134.

If the switchover is carried out to a fixed reactive power setpoint in the event of a fault (failure of the telecontrol connection to the mains operator), the fixed replacement value (parameter P136) is always used.

The reactive power exhibits a PT_1 behavior qualitatively at setpoint increments. The time constant 3T, or the time until 95 % of the setpoint is attained, is defined via parameter P137.

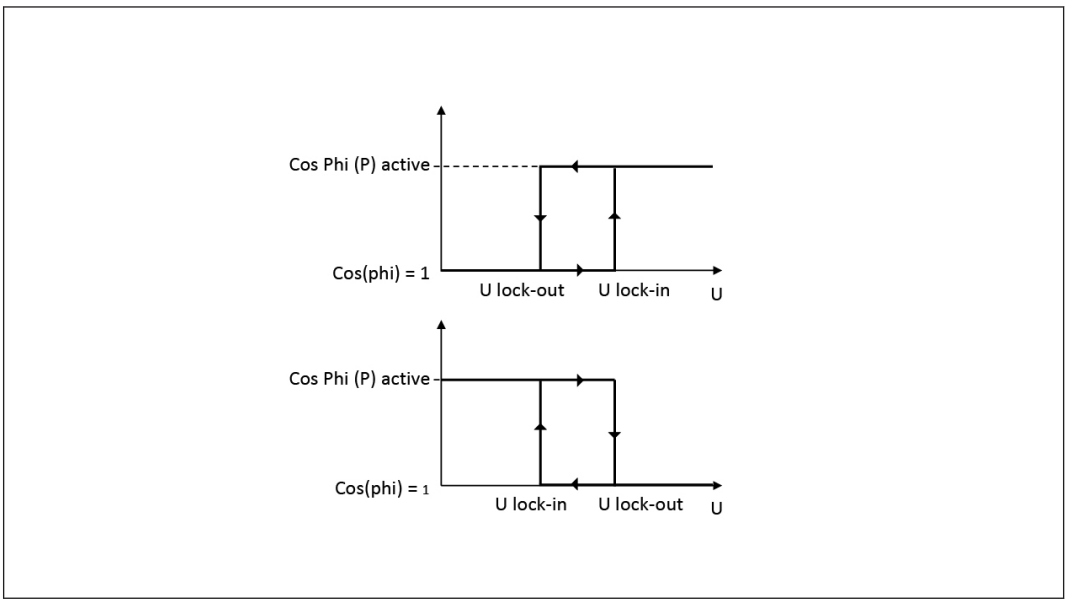
Further information on the parameters

- For parameters pertaining to reactive power mode Q setpoint mode, see chapter 4.5.1.15 Reactive power mode Q setpoint 82

Reactive power mode PF (P) characteristic curve

The PF (P) characteristic curve is defined based on ten sampling points (parameters P145 to P152). Optionally the PF (P) characteristic curve can be activated or deactivated depending on the voltage (parameters P154 and P155). If the characteristic curve is deactivated, the reactive power supply is set to zero. Depending on whether the activation threshold value (lock-in) is selected greater or lower than the deactivation threshold value (lock-out), PF (P) is active at high or low voltages.

The following figure shows the activation of PF (P) depending on the voltage.

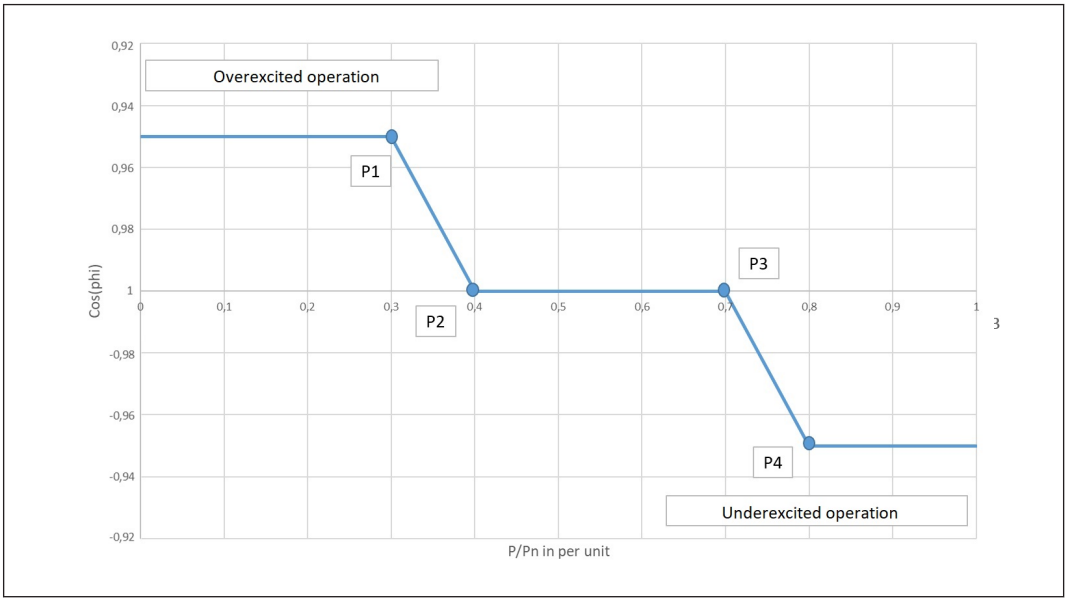


71425-003 Voltage-dependent activation of PF (P)

The reactive power exhibits a PT1 behavior qualitatively at setpoint increments. The time constant 3T, or the time until 95 % of the setpoint is attained, is defined via parameter P153.

The following figure shows the PF (P) characteristic curve for the values P_1(0.3/0.95), P_2(0.4/1), P_3(0.7/1) and P_4(0.8/-0.95). (Generator sign convention)

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL



71426-003 PF (P) characteristic curve for example

Further information on the parameters

- For parameters pertaining to reactive power mode PF (P) characteristic curve, see chapter 4.5.1.18 PF displacement factor 87

Reactive power mode U setpoint mode

Specification of the voltage via an analog input, Modbus TCP or a fixed value (parameter P161). The analog input is parameterized via parameters P052 and P053. Switching between the analog input, Modbus TCP and the fixed value is possible using parameter P160.

If the switchover is carried out to a fixed reactive power setpoint in the event of a fault (failure of the telecontrol connection to the mains operator), the fixed replacement value (parameter P162) is always used.

Further information on the parameters

- For parameters pertaining to reactive power mode U setpoint mode, see chapter 4.5.1.21 Voltage control specifications in U setpoint mode 91

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

4.2 Technology of the interface

4.2.1 Overview

The Grid Demand Interface is an overall package and consists of:

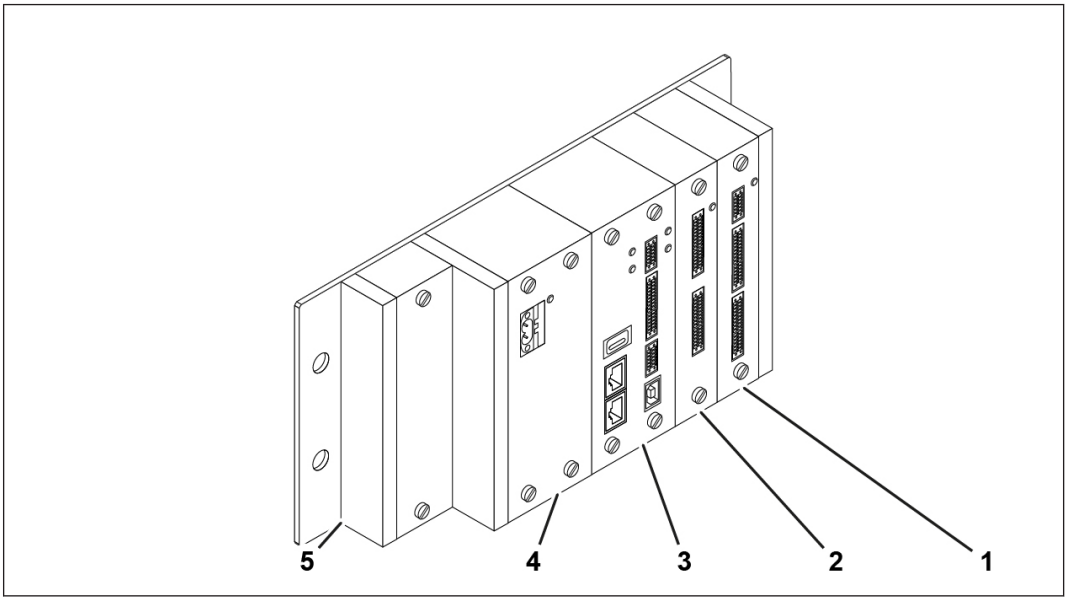
- Hardware with a CPU and appended I/O modules for the input and output of signals
- The application developed for the TEM system, consisting of:
  - Program which is loaded into the CPU, where it is processed
  - User interface for configuring the hardware for the TEM system, parameterization of the specific Grid Code requirements and display of system statuses

Component	Description
CPU with I/O modules	Programmable Logic Controller with: • Hardware for open-loop and closed-loop control of technical processes • Firmware for internal communication and programming • Ethernet interfaces for communication with external controllers and users • Front end with CPU-related user interface, called up via browser
Interface application	The programmed application for the CPU is merely referred to as the Interface Application in order distinguish it from the overall product. The Interface Application contains: • TEM-specific hardware addresses for the interfaces of the CPU and their I/O modules • Parameterizable procedures for open-loop and closed-loop control • Front end with application-related user interface, called up via browser

4.2.2 Hardware

The hardware of the Grid Demand Interface consists of a modular automation controller based on a programmable logic controller.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL



75753-001 Structure of the automation controller

1 Analog module for input and output signals

2 Digital module for input and output signals

3 Central Processing Unit (CPU)

4 Voltage supply (power module)

5 Rack

Rack

The rack is the basic element of the hardware. It features the following components and functions:

- Stable base plate for installation in switchgear cabinets
- Backplane for power distribution and data exchange to/from all modules
- Module has mounting for the power supply, the CPU and the I/O modules

Central Processing Unit (CPU)

The CPU contains the central processing unit with its memory, processors and interfaces. The CPU controls and regulates the technical process according to the loaded program, taking into account the signals from sensors and actuators. Communication with external regulation and control systems enables constant data exchange of actual values and setpoints. An operating system (firmware) is responsible for internal organization.

The operating system distinguishes between the operating modes:

- Programming mode for uploading programs or programming
- Run mode for running the loaded program

Analog module and digital module (I/O modules)

The I/O modules connect the CPU and actuators and sensors of the technical process. They convert the input and output signals so that the addressee and receiver can interpret them.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

A differentiation is made between:

- Input modules (signal input)
- Output modules (signal output)
- Digital signals (on or off, for example with switches)
- Analog signals

Web server

The CPU has a web server with an Ethernet interface for access by specialist personnel. File handling, parameterization and the display of actual values are possible via the web server with its graphical user interfaces. Once the interface application has been installed, the web server provides an application-related user interface. All you need is a web browser and the address.

Protocols used

- EtherCAT protocol for internal communication
- Modbus TCP for communication with the TEM-MFR

Further information on the parameters

- For parameter assignment of analog and digital inputs see chapter 4.5.1.22 Assignment of analog and digital inputs 93
- For parameter scaling of analog inputs and outputs, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97
- For Modbus communication parameters, see chapter 4.5.1.24 TEM MFR configuration and Modbus communication 101

4.2.3 Firmware

System software and operating system

The operating system is based on Linux system software from the component manufacturer. The most important features are:

- Simple update routines for manually updating the system software
- Secure system access through the use of certificates
- Web-based configuration
- User administration with roles and rights

4.2.4 Application software

General

The application software is based on CODESYS (COntroller DEvelopment SYStem). CODESYS is a development environment for applications on programmable controllers.

Application software

The software for the Grid Demand Interface application is programmed for use in TEM systems.

During installation, the application implements the control procedures for the general realization of the grid codes, configures general system properties, creates the user administration and installs the user interface.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Special requirements of a regional grid code can be met via the user interface by entering or varying parameter values.

Personnel

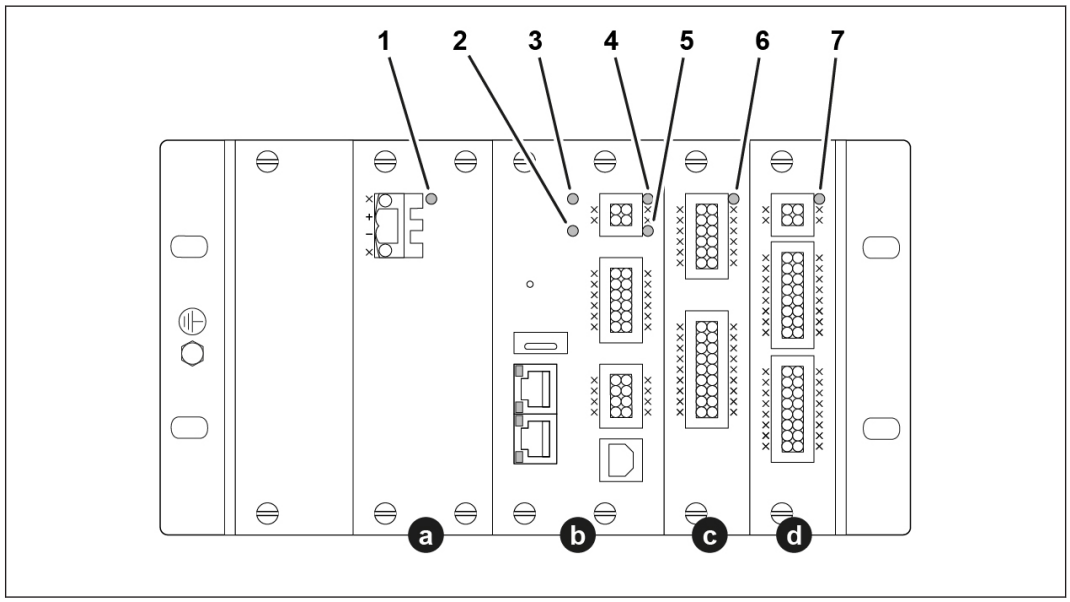
Installation and parameterization may only be carried out by qualified and authorized specialist personnel.

4.2.5 Operating locations, signals, messages

The Grid Demand Interface is not intended for being used by operating personnel. It does not have any operating locations for direct control of an application.

- Signals: LED displays of the hardware
- Possibility of displaying messages on the operating computer via parameterizable messages of the TEM system

LED displays



75782-001 Example illustration of LED arrangement

a Power supply (power module)

b Central Processing Unit (CPU)

c Digital module

d Analog module

(a) Power supply

Item	Name	Color	Description
1	Power	Green	Power supply is established

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

(b) Central Processing Unit (CPU)

Item	Name	Color	Description
2	Run	Green	EtherCAT is active
3	Status	Green / Red	Software is configurable
4	In	Green	Digital input is enabled
5	Out	Green	Digital output is enabled

c) Digital module

Item	Name	Color	Description
6	Run	Green	Digital module in operation

(d) analog module

Item	Name	Color	Description
7	Run	Green	Analog module in operation

4.2.6 Test modes

The Grid Demand Interface offers various test modes for certifications, verifications or optimizations. These are not intended for normal commissioning, but require in-depth knowledge of process engineering interrelationships in order to use them. The test modes are therefore not described in these instructions.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

4.3 User interface

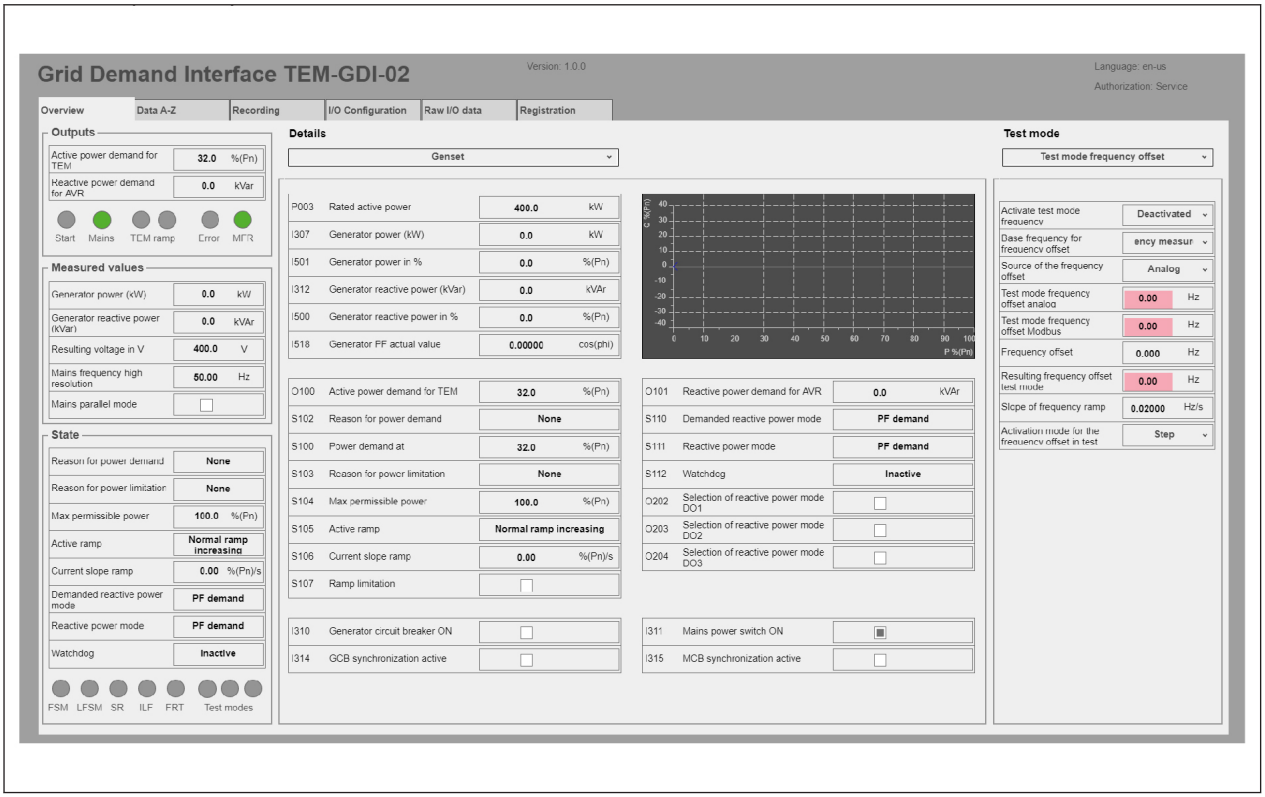
4.3.1 Conception

The programmed interface application is called up by means of a user interface.

A hardware connection of the Grid Demand Interface with an external computer must be established for calling up the user interface.

Access takes place via a password-protected login. Since the parameterization and configuration has a major influence on the grid conformity of the genset, the access authorizations must be issued according to user function. The operator is responsible for the security of the access.

The user interface is only used for the parameterization and visualization of system statuses during commissioning and subsequent changes. Access is not required for normal operation of the genset.



75754-001 Example illustration of the user interface

4.3.2 Overview tab

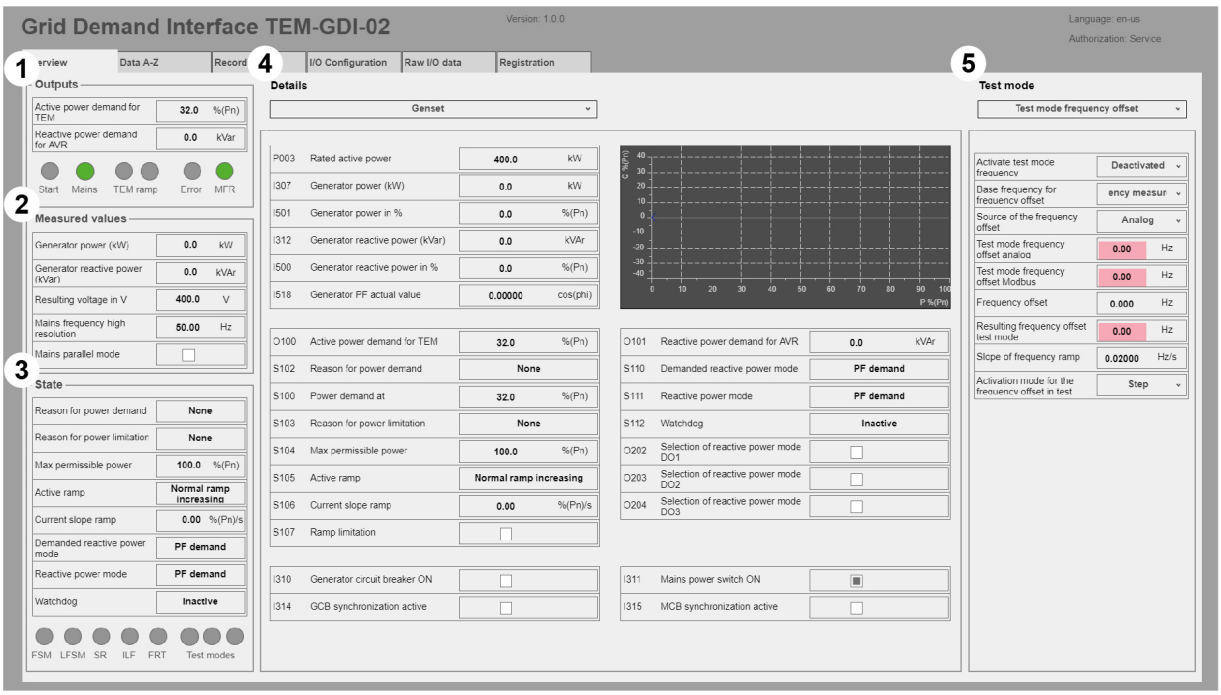
Purpose

The register is designed to:

- Display the current operating state of the Grid Demand Interface
- Activate test modes for frequency offset and voltage specification
- Assign parameters to and obtain status information on the individual functions of the GDI
- Display of warning messages

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Notes on the design of the interface



75755-001 Example illustration of the `Overview` tab

1 Outputs dialog area

2 Measured values dialog area

3 Status dialog area

4 Details dialog area

5 Test mode dialog area

Outputs dialog area

Functionality

This dialog area shows the demand values for active power and reactive power currently output by the Grid Demand Interface via the analog outputs.

Symbolic LEDs visualize the status of the most important digital outputs of the Grid Demand Interface.

Measured values dialog area

Functionality

This dialog area shows important measured values that are relevant for the functionality of the Grid Demand Interface.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Status dialog area

Functionality

This dialog area shows the current status for the generation of active power or reactive power. In Test mode, the active test mode is displayed.

Important system statuses are visualized by symbolic indicators.

Details dialog area

Functionality

This dialog area displays various parameters with their value or status and warning messages. A button in the upper area is used to make a preselection. The display belonging to the selection is sorted according to functionality in corresponding groups.

Test mode dialog area

Functionality

This dialogue area allows you to activate a test mode and to parameterize it.

The individual test modes are used to test the active and reactive power functions that depend on the grid status.

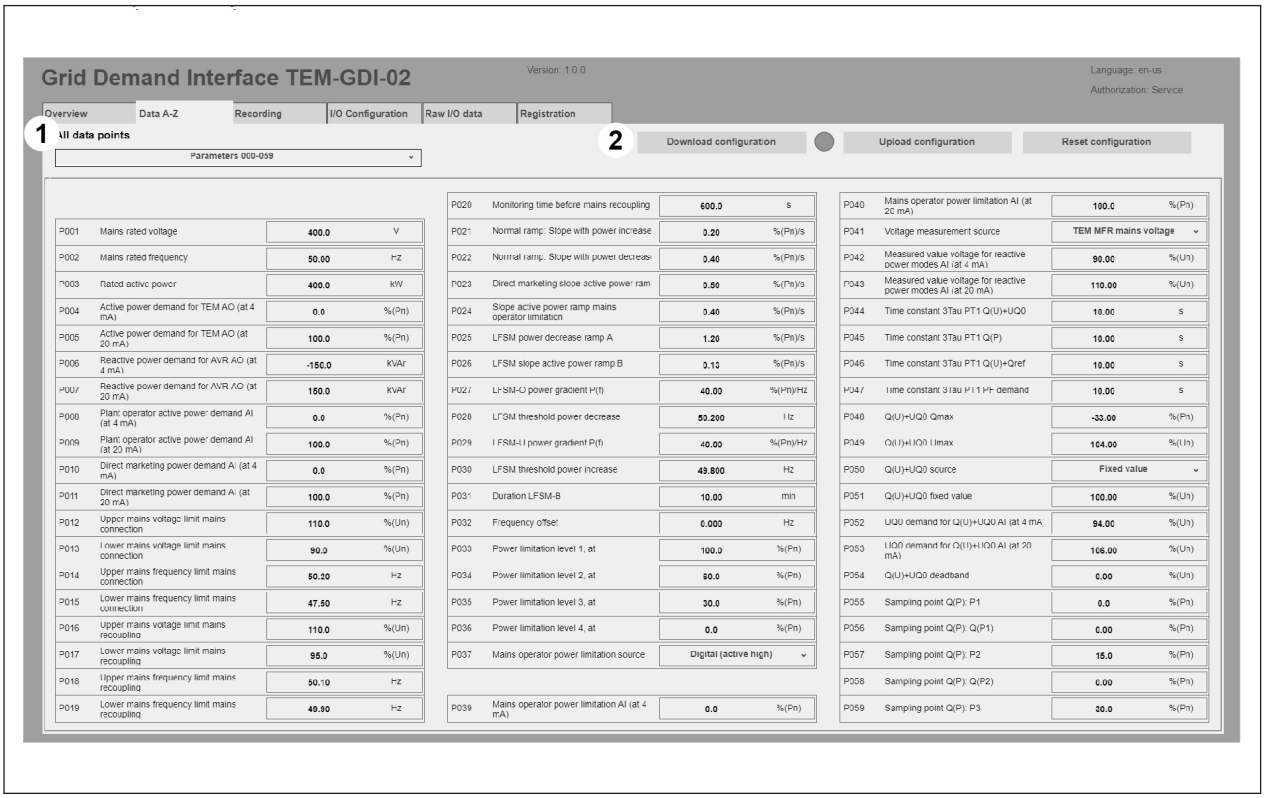
4.3.3 Data A-Z tab

Purpose

This tab is designed to display parameters, their values, and to handle configurations.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Notes on the design of the interface



75756-001 Example illustration: `Data A-Z` tab

1 All datapoints dialog area

2 Configuration handling

All datapoints dialog area

Functionality

This dialog area shows:

- all parameters in numerical order
- all status values in numerical order
- values of all digital and analog inputs
- MFR measured values which the Grid Demand Interface receives via Modbus
- Input signals which the Grid Demand Interface receives via Modbus
- Values of all digital and analog outputs
- all calculated inputs

A button in the upper area is used to make a preselection.

Configuration handling dialog area

This dialog area allows you to upload, save (download) and reset the grid demand interface configuration using the corresponding buttons.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

A symbolic LED indicates data access during reading and writing.

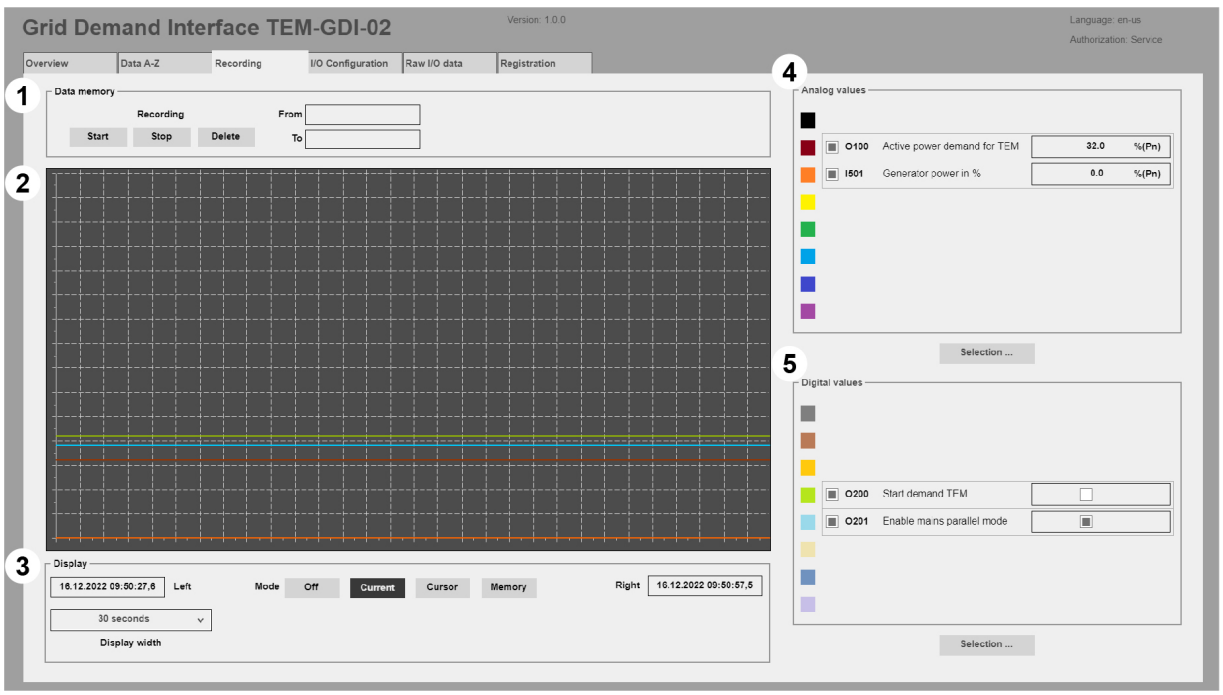
4.3.4 Logging tab

Purpose

The register is designed to:

- Visualization of analog and digital input and output signals of the Grid Demand Interface
- Recording, downloading and uploading of recorded data series

Notes on the design of the interface



75760-001 Example illustration of `Logging` tab

1 Data storage dialog area
2 Display pane
3 Display dialog area
4 Analog values dialog area
5 Digital values dialog area

Data storage dialog area

Functionality

This dialog area allows you to start and stop the recording of all selectable data points. It has a storage feature.

Download and upload of recorded measured values (only possible in "Memory" mode)

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Display pane

This display area visualizes the progression of the selected analog or digital values over time.

Display dialog area

Functionality

This dialog area configures the general display settings:

- Left and right: Timestamp from the left and right edge of the window
- Mode
  - Off: Display of the selected signals is deactivated.
  - Current: Displays the current signal curve.
  - Cursor: Stops the signal curve and activates a measurement cursor.
  - Memory: Displays the signal curve stored in the memory of the GDI.
- Display width: Set the time range to be displayed in the window.

Analog values dialog area

Functionality

This dialog area is used to select the desired analog measured values for the display and as a legend so the user can tell which curve corresponds to which measured value.

The selection button in the lower dialog area sensitizes the legend. Clicking causes individual curves in the display to become visible or hidden.

The possible selection is limited to a maximum of 8 curves.

Digital values dialog area

Functionality

This dialog area is used to select the desired digital measured values for the display and as a legend so the user can tell which curve corresponds to which measured value.

The selection button in the lower dialog area sensitizes the legend. Clicking causes individual curves in the display to become visible or hidden.

The possible selection is limited to a maximum of 8 curves.

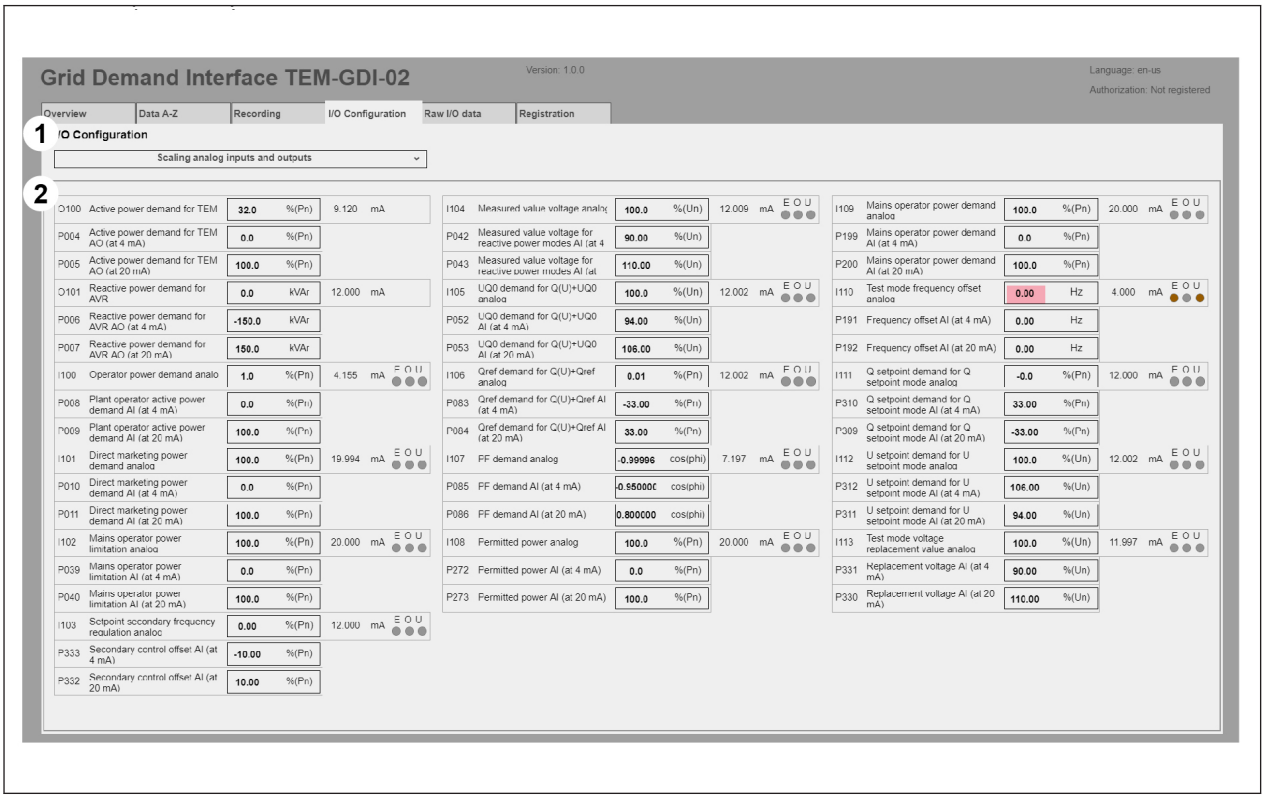
4.3.5 I/O configuration tab

Purpose

This tab is designed for assigning and scaling the inputs and outputs on the Grid Demand Inteface and the Modbus connection with the TEM MFR.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Notes on the design of the interface



75758-001 Example illustration of `I/O configuration` tab

1 I/O configuration dialog area

2 Display pane

I/O configuration dialog area

Functionality

A button in the upper area is used to make a preselection.

Display pane

This dialog area displays the number, name and value of the preselected group in tabular form.

Symbolic LEDs indicate the status in some cases:

- E: Error
- O: Upper limit violation
- U: Lower limit violation

4.3.6 Raw I/O data tab

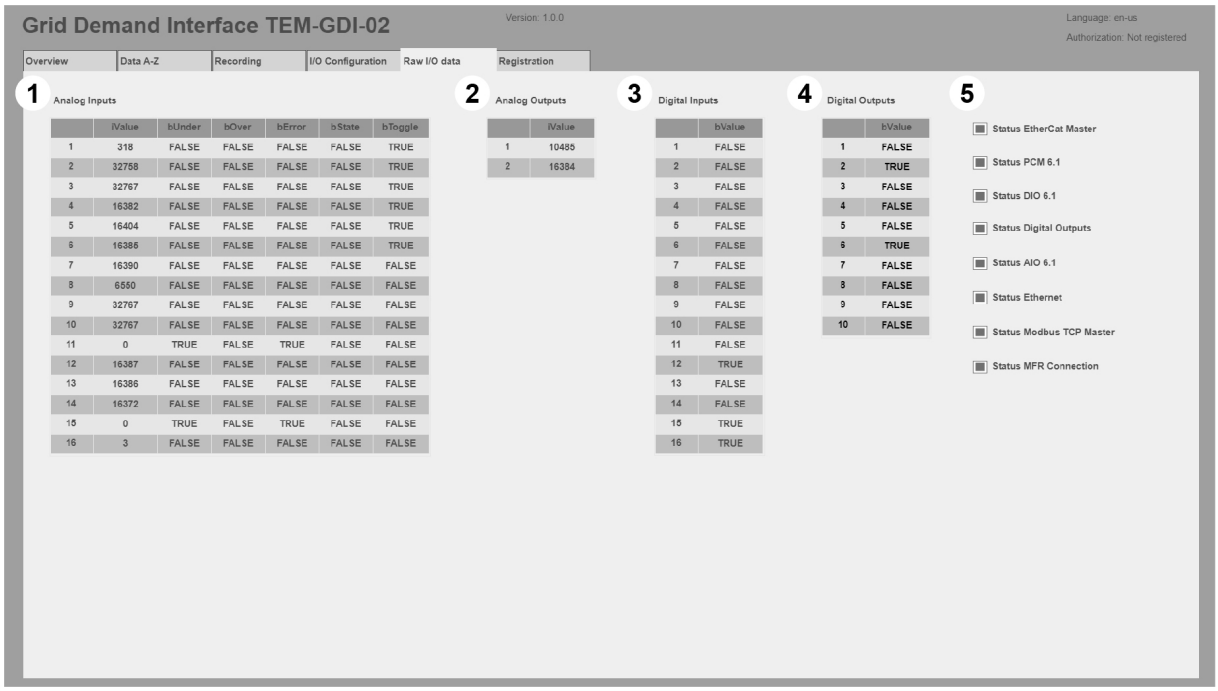
Purpose

The register is designed to:

- Display of the raw data of all analog and digital inputs and outputs of the Grid Demand Interface
- Display of the status information of the individual modules

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Notes on the design of the interface



75761-001 Example image of `Raw I/O data` tab

1 Analog Inputs dialog area

2 Analog Outputs dialog area

3 Digital Inputs dialog area

4 Digital Outputs dialog area

5 Status dialog area

Analog Inputs dialog area

Functionality

This dialog area shows the raw values (decimal value and status bits) at the analog inputs of the hardware.

Analog Outputs dialog area

Functionality

This dialog area shows the raw values (decimal value and status bits) at the digital outputs of the hardware.

Digital Inputs dialog area

Functionality

This dialog area shows the raw values (logical value) at the digital inputs of the hardware.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Digital Outputs dialog area

Functionality

This dialog area shows the raw values (logical value) at the digital outputs of the hardware.

Status dialog area

This dialog area shows the status of relevant connections.

4.3.7 Login tab

Purpose

The purpose of this tab is user login. Logged-in users can, for example, edit parameter values or change the language setting.

Notes on the design of the interface

75759-001 Example illustration of the `Login` tab

1 Personnel groups

2 Login and Logout

Personnel groups dialog area

This dialog area shows the currently logged-in users and lets you change the language.

Login and Logout dialog area

This dialog area is used to log in and log out users.

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Further information about the login

- For login, see chapter 7.8 Edit mode (with login) 143

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4.4 Integration in an energy supply plant

4.4.1 Connection to an energy supply plant

Control of the entire energy supply plant (EZA controller) by the GDI is not provided. It is a closed system, the function of which may not be extended by the operator.

Communication between the Grid Demand Interface and the external grid participants or the mains operator takes place via the control of the energy supply plant. The analog and digital inputs and outputs of the Grid Demand Interface should preferably be used for the signal exchange. Connection to a network is not required.

4.4.2 Notes concerning IT security

For open-loop and closed-loop control of the energy supply unit or genset, the digital exchange of data and commands takes place via internal bus systems (Modbus, CAN bus).

For the external data exchange via a Local Area Network (LAN) or the Internet, for example, the TEM system has interfaces which require special protection.

A network connection is not required for the functionality of the Grid Demand Interface. If the operator connects the Grid Demand Interface to a network anyway, the operator is responsible for the IT security and functionality of the Grid Demand Interface.

Risk of destruction of components

Disturbed or manipulated communication in control systems (e.g. Modbus) leads to faults or incorrect control commands. This can result in unforeseeable damage.

- The operator is solely responsible for the professional and proper IT security of the network connections and data streams pertaining to the product. The current standard for industrial network protection applies.
- Only use a local, protected connection
- If faults occur in the control system during operation that are indicative of a cyber attack:
  - Disconnect the product from the network immediately
  - Shut down the product as quickly as possible
  - Inform the operator or person responsible for the plant as well as the responsible dealer or service partner immediately
- The manufacturer is not liable for any damages or costs of any kind arising from an information and/or data security incident in the networks and bus systems.

For necessary information on IT security in Modbus systems, see

- Operating manual ⇒ General ⇒ Control
  - Fieldbus Interface Modbus

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For further information about the safety regulations, see

- Regional specifications and recommendations based on the ISO/IEC 27000 series, in particular:
  - ISO/IEC 27001 – Information Technology – Security techniques – Information security management systems – Requirements
  - ISO/IEC 27002 – Information Technology – Security techniques – Code of practice for information security controls
- Dealer or service partner in charge

4.4.3 Modbus Input Register

Address	Data format	Scaling	ID	Designation	Unit
40000/16	Int	100	S100	Power demand at	% Pn
40001/16	Int		S102	Power demand reason Variable, see: Power demand reason, power limitation reason, LFSM demand reason 55	-
40002/16	Int		S103	Power restriction reason Variable, see: Power demand reason, power limitation reason, LFSM demand reason 55	-
40003/16	Int	100	S104	Max. permissible power	% Pn
40004/16	Int		S105	Active ramp Variable, see: Active ramp 55	-
40005/16	Int	100	S106	Current ramp slope	% Pn/s
40006.0	Bool		S107	Ramp limitation	Bit
40007/16	Int	100	S108	Resulting mains operator power restriction	% Pn
40008/16	Int		S110	Requested reactive power mode Variable, see: Requested reactive power mode, reactive power mode 56	-
40009/16	Int		S111	Reactive power mode Variable, see: Requested reactive power mode, reactive power mode 56	-
40010/16	Int		S112	Watchdog Variable, see: Watchdog 56	-
40011.0	Bool		S120	Mains connection conditions fulfilled	Bit
40011.1	Bool		S121	Mains recoupling conditions fulfilled	Bit
40011.2	Bool		S122	Mains decoupling active	Bit
40012/16	Int	10	S126	Mains decoupling residual run time	s

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Address	Data format	Scaling	ID	Designation	Unit
40013/16	Int	10	S127	LS opened detected residual run time	s
40020.0	Bool		S130	FSM active	Bit
40020.1	Bool		S131	FSM reservation active	Bit
40022/16	Int	100	S133	FSM applied	% Pn
40023/16	Int	100	S134	FSM requested	% Pn
40024/16	Int	100	S135	FSM static overfrequency	%
40025/16	Int	100	S136	FSM static underfrequency	%
40026/16	Int		S140	LFSM request reason Variable, see: Power demand reason, power limitation reason, LFSM demand reason 55	-
40027/16	Int	100	S141	LFSM target power	% Pn
40028/16	Int	100	S142	LFSM starting power	% Pn
40029/16	Int	100	S143	LFSM-O statics	%
40030/16	Int	100	S144	LSFM-U statics	%
40031.0	Bool		S150	Secondary frequency control active	Bit
40031.1	Bool		S152	SR / ILF reservation active	Bit
40031.2	Bool		S172	ILF active	Bit
40031.3	Bool		S174	LFSM active	Bit
40032/16	Int		S151	SR / ILF mode Variable, see: SR/ILF mode 57	-
40033/16	Int	100	S153	SR / ILF applied	% Pn
40034/16	Int	100	S154	SR / ILF requested	% Pn
40040/16	Int		S160	FRT detected Variable, see: FRT detected 57	-
40050/16	Int	100	S169	Resulting frequency according to test mode and FRT	Hz
40051/16	Int	10	S170	Resulting voltage according to test mode	V
40052/16	Int	100	S171	Resulting voltage according to test mode	% Uc
40059.0	Bool		S200	Warning, problem with operator power demand	Bit
40059.1	Bool		S201	Warning, problem with direct sales power demand	Bit
40059.2	Bool		S202	Warning, problem with mains operator power demand	Bit

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Address	Data format	Scaling	ID	Designation	Unit
40059.3	Bool		S203	Warning, problem with mains operator power limitation (analog)	Bit
40059.4	Bool		S204	Warning, problem with mains operator power limitation (digital)	Bit
40059.5	Bool		S205	Warning, problem with mains voltage measurement	Bit
40059.6	Bool		S206	Warning, problem with communication with MFR	Bit
40059.7	Bool		S207	Warning, unauthorized mains synchronization	Bit
40059.8	Bool		S208	Warning, problem with UQ0 for Q(U)+UQ0	Bit
40059.9	Bool		S209	Warning, problem with U setpoint for U setpoint mode	Bit
40059.10	Bool		S210	Warning, problem with Qref for Q(U)+Qref	Bit
40059.11	Bool		S211	Warning, problem with Q setpoint for Q setpoint mode	Bit
40059.12	Bool		S212	Warning, problem with PF demand (analog)	Bit
40059.13	Bool		S213	Warning, problem with PF demand (digital)	Bit
40060/16	Int	100	O100	Active power demand to TEM	% Pn
40061/16	Int	100	O101	Reactive power demand to AVR	kVar
40062.0	Bool		O200	Start demand TEM	Bit
40062.1	Bool		O201	Enabling grid-parallel operation	Bit
40062.2	Bool		O202	Selection of reactive power mode DO1	Bit
40062.3	Bool		O203	Selection of reactive power mode DO2	Bit
40062.4	Bool		O204	Selection of reactive power mode DO3	Bit
40062.5	Bool		O205	Live Bit TEM MFR	Bit
40062.6	Bool		O206	TEM ramp LSB	Bit
40062.7	Bool		O207	TEM ramp MSB	Bit
40062.8	Bool		O208	TEM alarm	Bit
40070/16	Int	10	I301	Mains voltage L1-2	V
40071/16	Int	10	I302	Mains voltage L2-3	V
40072/16	Int	10	I303	Mains voltage L3-1	V

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Address	Data format	Scaling	ID	Designation	Unit
40073/16	Int	10	I304	Mains voltage Ph-Ph mean	V
40074/16	Int	10	I305	Generator voltage Ph-Ph mean	V
40075/16	Int	100	I306	Mains frequency high resolution	Hz
40076/32	DInt	1000	I307	Generator power	kW
40078/32	DInt	1000	I312	Generator reactive power	kVar
40080.0	Bool		I309	Mains decoupling is active	Bit
40080.1	Bool		I310	Generator circuit breaker ON	Bit
40080.2	Bool		I311	Mains circuit breaker ON	Bit
40080.3	Bool		I314	GLS synchronization active	Bit
40080.4	Bool		I315	NLS synchronization active	Bit
40080.5	Bool		I502	Grid-parallel operation	Bit
40080.6	Bool		I200	Operator demand	Bit
40080.7	Bool		I201	Direct sales demand	Bit
40080.8	Bool		I225	Mains operator demand	Bit
40080.9	Bool		I215	Enabling grid-parallel operation	Bit
40080.10	Bool		I216	Ramp and connection conditions after mains decoupling	Bit
40081/16	Int	100	I500	Generator reactive power	% Pn
40082/16	Int	100	I501	Generator power	% Pn
40083/16	Int	10000	I518	Generator PF actual value	-
40084/16	Int	100	I503	Resulting voltage	% Uc
40085/16	Int	100	I504	Resulting operator power demand	% Pn
40086/16	Int	100	I505	Resulting direct sales power demand	% Pn
40087/16	Int	100	I506	Resulting mains operator power demand	% Pn
40088/16	Int	100	I507	Resulting mains operator power limitation	% Pn
40089/16	Int	100	I508	Resulting secondary frequency control demand	% Pn
40090/16	Int	100	I509	Resulting permissible power	% Pn
40091/16	Int	10000	I510	Resulting PF demand	-
40092/16	Int	100	I511	Resulting Qset demand for Q setpoint mode	% Pn
40093/16	Int	100	I512	Resulting Qref demand for Q(U) +Qref	% Pn

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Address	Data format	Scaling	ID	Designation	Unit
40094/16	Int	100	I513	Resulting Uset demand for U set-point mode	% Uc
40095/16	Int	100	I514	Resulting UQ0 demand for Q(U) +UQ0	% Uc
40096/16	Int	100	I520	Resulting test mode frequency offset	Hz
40097/16	Int	10	I521	Resulting test mode voltage substitute value	% Uc
40098.0	Bool		I515	Resulting reactive power mode selection DI3	Bit
40098.1	Bool		I516	Resulting reactive power mode selection DI2	Bit
40098.2	Bool		I517	Resulting reactive power mode selection DI1	Bit
40098.3	Bool		I202	Mains operator power limitation level 1	Bit
40098.4	Bool		I203	Mains operator power limitation level 2	Bit
40098.5	Bool		I204	Mains operator power limitation level 3	Bit
40098.6	Bool		I205	Mains operator power limitation level 4	Bit
40098.7	Bool		I209	PF demand DI1	Bit
40098.8	Bool		I210	PF demand DI2	Bit
40098.9	Bool		I211	PF demand DI3	Bit
40098.10	Bool		I212	PF demand DI4	Bit
40098.11	Bool		I213	PF demand DI5	Bit
40099.0	Bool		I217	FSM demand	Bit
40099.1	Bool		I218	Disable LFSM	Bit
40099.2	Bool		I219	Disable LFSM-O	Bit
40099.3	Bool		I220	Disable LFSM-U	Bit
40099.4	Bool		I221	Secondary frequency control active	Bit
40099.5	Bool		I222	ILF reset	Bit
40099.6	Bool		I223	Keep active power reserve free	Bit
40099.7	Bool		I224	LFSM-O reset	Bit

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Values and meanings of variables

Power demand reason, power limitation reason, LFSM demand reason

Value	Meaning
0	None
1	Mains operator limitation level 1
2	Mains operator limitation level 2
3	Mains operator limitation level 3
4	Mains operator limitation level 4
5	Overfrequency
6	Underfrequency
7	Mains operator limitation, analog
8	Direct sales, analog
9	Power decrease because of P(U) limitation without ramp
10	Power decrease because of P(U) limitation with ramp
11	Optional ramp after recoupling to mains active
12	Optional ramp after coupling to mains active
13	FSM overfrequency or underfrequency
14	Permissible power
15	Mains operator power demand analog
16	Mains operator fixed value specification
17	Mains operator Modbus specification
18	Mains operator Modbus limitation
19	Modbus direct sales
20	Operator specification analog
21	Operator Modbus specification

Active ramp

Value	Meaning
0	No ramp
4	Ramp direct sales
5	Mains operator ramp limitation
7	LFSM ramp B
8	P(U)
9	Mains decoupling ramp

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Value	Meaning
10	Coupling ramp
11	LFSM ramp power decrease
12	LFSM ramp power increase
13	Mains operator setpoint ramp rising
14	Mains operator setpoint ramp falling
15	Normal ramp rising
16	Normal ramp falling

Requested reactive power mode, reactive power mode

Value	Meaning
0	PF demand
1	Q(P)
2	Q(U)+Qref
3	Q(U)+UQ0
4	Q setpoint mode
5	PF (P)
6	U setpoint mode
7	PF (U)

Watchdog

Value	Meaning
0	Inactive
1	DI
2	Q(U)+UQ0 UQ0 input
3	Q(U)+UQ0 U input
4	Q(U)+Qref Qref input
5	Q(U)+Qref U input
6	PF DI specification erroneous
7	PF AI specification
8	Q demand
9	U demand

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SR/ILF mode

Value	Meaning
0	Off
1	Setpoint
2	ILF

FRT detected

Value	Meaning
0	FRT not recognised
1	LVRT
2	HVRT

4.4.4 Modbus holding register

Address	Data format	Scaling	ID	Designation	Unit
40000/16	Int	100	I400	Operator Modbus power demand	% Pn
40001/16	Int	100	I401	Direct sales Modbus power demand	% Pn
40002/16	Int	100	I414	Mains operator Modbus power demand	% Pn
40003/16	Int	100	I402	Mains operator Modbus power limitation	% Pn
40004/16	Int	100	I403	Secondary frequency control: setpoint specified via Modbus	% Pn
40005/16	Int	100	I404	Modbus voltage measured value	% Uc
40006/16	Int	100	I405	UQ0 demand for Q(U)+UQ0, Modbus	% Uc
40007/16	Int	100	I406	Uset demand for U setpoint mode, Modbus	% Uc
40008/16	Int	100	I407	Qref demand for Q(U)+Qref, Modbus	% Pn
40009/16	Int	100	I408	Qset demand for Q setpoint mode, Modbus	% Pn
40010/16	Int	10000	I409	PF demand, Modbus	-
40011/16	Int	100	I410	Permissible power, Modbus	% Pn
40013.0	Bool		I411	Reactive power mode selection Modbus DI1	Bit

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Address	Data format	Scaling	ID	Designation	Unit
40013.1	Bool		I412	Reactive power mode selection Modbus DI2	Bit
40013.2	Bool		I413	Reactive power mode selection Modbus DI3	Bit
40014/16	Int	100	I415	Test mode frequency offset, Modbus	Hz
40015/16	Int	100	I416	Test mode voltage substitute value, Modbus	% Uc
40021/16	Int	100	P121	FSM active power range power increase	% Pn
40022/16	Int	100	P275	FSM active power range power decrease	% Pn
40023/16	Int	100	P123	FSM power gradient	% Pn per Hz
40024/16	Int	100	P122	FSM dead band	Hz
40025/16	Int	100	P021	Normal ramp: Slope with power increase	% Pn/s
40026/16	Int	100	P022	Normal ramp: Slope with power decrease	% Pn/s
40027/16	Int	100	P023	Direct sales slope active power ramp	% Pn/s
40028/16	Int	100	P276	Mains operator setpoint power increase ramp	% Pn/s
40029/16	Int	100	P277	Mains operator setpoint power decrease ramp	% Pn/s
40030/16	Int	100	P024	Active power ramp slope mains operator limitation	% Pn/s
40031/16	Int	100	P116	Slope of the connection ramp after mains coupling	% Pn/s
40032/16	Int	100	P117	Slope of the connection ramp after mains recoupling	% Pn/s
40033/16	Int	100	P163	P(U) maximum slope active power ramp	% Pn/s
40034/16	Int	100	P280	Maximum power ramp	% Pn/s
40035/16	Int	100	P281	Minimum power ramp	% Pn/s

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4.5 Configuration specifications

4.5.1 Sorted parameter list

The parameter list contains the parameters, each with its number and characteristic details. Suggestions for the parameter values to be entered can be found in the parameter value list of the respective grid code.

Further information

For downloading parameter value lists, see

- Service Library ⇒ Contents
  - Required brand ⇒ Required language ⇒ Single document ⇒ Parameter description ⇒ Components ⇒ GDI

Overview of parameter groups

In the following tables, the parameters are sorted according to parameter groups:

1. ⇨Genset
2. ⇨Voltage and frequency
3. ⇨Activation conditions
4. ⇨Active power priorities and ramps
5. ⇨Operators and direct sellers
6. ⇨Mains operator
7. ⇨Reaction in event of Fault Ride Through (FRT)
8. ⇨Frequency Sensitive Mode (FSM)
9. ⇨Limited Frequency Sensitive Mode (LFSM)
10. ⇨Voltage-dependent active power decrease (P(U))
11. ⇨Frequency steady-state with Integral Local Frequency (ILF)
12. ⇨Secondary control power setpoint specifications
13. ⇨Reactive power mode specifications
14. ⇨Reactive power mode Q(U) + Qref
15. ⇨Reactive power mode Q setpoint
16. ⇨Reactive power mode Q(P)
17. ⇨Reactive power mode Q(U) + UQ0
18. ⇨PF displacement factor
19. ⇨PF displacement factor
20. ⇨Displacement PF of (U)
21. ⇨Voltage control specifications in U setpoint mode
22. ⇨Assignment of analog and digital inputs
23. ⇨Scaling of analog inputs and outputs
24. ⇨TEM MFR configuration and Modbus communication

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Genset

No.	Parameter	Unit	Min - Max	Increment	Default
P003	**Rated active power**	kW	1 - 5000	0.1	400

Voltage and frequency

No.	Parameter	Unit	Min - Max	Increment	Default
P001	**Mains rated voltage**	V	100 - 250000	0.1	400
	The supply voltage that was agreed between the mains operator and subscriber. The set value must refer to the same voltage level as the voltage measured values that are received via the TEM MFR.				
P041	**Voltage measurement source** Variable, default: TEM MFR mains voltage				
	The source of the measured voltage value that is used to determine the voltage-dependent reactive power setpoints and the voltage-dependent active power limitation P(U). You can switch between the following values: • TEM MFR mains voltage • AI • Modbus • TEM MFR Generator voltage				
P324	**Activate voltage test mode** Variable, default: Deactivated				
	For testing the voltage-dependent active and reactive power functions.				
P326	**Source of the replacement voltage in test mode** Variable, default: Fixed value				
	In test mode, a replacement voltage can be specified in the following ways: • Fixed value • Analog • Modbus				
P325	**Voltage test mode**	$\%(U_n)$	0 150	0.01	100
	Defining a replacement voltage in test mode if `Fixed value` is selected as the source.				
P002	**Mains rated frequency**	Hz	45 65	0.01	50
	Rated frequency of the grid.				
P195	**Activate frequency test mode** Variable, default: Deactivated				

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No.	Parameter	Unit	Min - Max	Increment	Default
	For testing the frequency-dependent active power functions.				
P221	**Base frequency for frequency offset** Variable, default: Frequency measurement				
	Selection of the basis for generating the frequency deviation in test mode. • `Frequency measurement`: the currently measured mains frequency is used as a basis • `Rated frequency`: the rated frequency is used as a basis.				
P194	**Source of the frequency offset** Variable, default: Analog				
	In test mode, a frequency offset can be specified in the following ways: • Fixed value • Analog • Modbus				
P032	**Frequency offset**	Hz	-10 10	0.001	0
	Frequency offset which is added to the frequency value in test mode. The offset can be adapted for testing the frequency-dependent active power adjustment at overfrequency and underfrequency (LFSM), FSM or the frequency-dependent connection conditions.				
P193	**Slope of frequency ramp**	Hz/s	0.0001 1000	0.000 01	0.02
	Slope of the ramp when the frequency changes with the selection `Ramp` via parameter *P329 Activation mode for frequency offset in test mode*.				
P329	**Activation mode for the frequency offset in test mode** Variable, default: Jump				
	Selection of the type of frequency deviation in test mode. • `Jump`: Frequency changes occur as a discontinuous jump to the new value. • `Ramp`: Frequency changes take place evenly over a ramp to the new value.				
P105	**Activate GDI test mode** Variable, default: Deactivated				
	If this test mode is activated, all functions of the GDI for meeting grid codes are deactivated. Active power demands by the plant operator are communicated directly to the TEM system.				

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Activation conditions

No.	Parameter	Unit	Min - Max	Increment	Default
P106	**External enable, mains recoupling** Variable, default: Deactivated				
	Connection conditions and synchronization after the genset is disconnected from the mains due to triggering of decoupling protection devices. Activates/deactivates the digital input *Enable reconnection after mains decoupling*.				
P323	**Behavior after mains decoupling** Variable, default: Settling time				
	Defines the behavior after mains decoupling. • `Settling time`: Use the watchdog time before mains recoupling (parameter *P020 Watchdog time before mains recoupling*). • `Temporary permission for mains recoupling`: Use of the temporary mains recoupling permission (parameter *P119 Temporary mains recoupling authorization*).				
P322	**Mains decoupling detection window**	s	0 60	0.1	10
	Time window around the opening of the circuit breaker within which a mains decoupling can be detected.				
P118	**Watchdog time before mains connection**	s	0 3600	0.1	0
P119	**Temporary mains recoupling authorization**	s	0 36000	0.1	0
	If the frequency and voltage are within the permissible range before the set time has elapsed, mains recoupling may occur. If the time has elapsed without a mains recoupling successfully taking place, you must wait for an enable signal from the mains operator. Requirement: parameter *P106 External enable mains recoupling* is activated.				
P020	**Watchdog time before mains recoupling**	s	0 3600	0.1	600
	Time period during which the mains voltage and mains frequency must remain within the specified limit values before a mains reconnection may take place after tripping of decoupling protection devices.				
P015	**Mains connection lower limit for mains frequency**	Hz	45 65	0.01	47.5
	Minimum mains frequency at which the genset can be connected and synchronized with the higher-level grid during a normal operating start.				
P019	**Mains recoupling lower limit for mains frequency**	Hz	45 65	0.01	49.9
	Minimum mains frequency at which recoupling and synchronization of the genset with the higher-level grid is permitted after tripping of decoupling protection devices.				
P014	**Mains connection upper limit for mains frequency**	Hz	45 65	0.01	50.2
	Maximum mains frequency at which the genset can be connected and synchronized with the higher-level grid during a normal operating start.				

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No.	Parameter	Unit	Min - Max	Increment	Default
P018	**Mains recoupling upper limit for mains frequency**	Hz	45 65	0.01	50.1
	Maximum mains frequency at which recoupling and synchronization of the genset with the higher-level grid is permitted after tripping of decoupling protection devices.				
P013	**Mains connection lower limit for mains voltage**	%(U_n)	50 100	0.1	90
	Minimum voltage at the grid connection point at which connection and synchronization of the genset with the higher-level grid is permitted during a normal operating start. The parameter value refers to the smallest phase-to-phase voltage. The specification in % refers to the parameter *P001 Mains rated voltage*. The mains voltage measured by the TEM MFR is evaluated. The analog input *Voltage measured value* is not evaluated.				
P017	**Mains recoupling lower limit for mains voltage**	%(U_n)	50 100	0.1	95
	Minimum voltage at the grid connection point at which reconnection and synchronization of the genset with the higher-level grid is permitted after tripping of decoupling protection devices. The parameter value refers to the smallest phase-to-phase voltage. The specification in % refers to parameter *P001 Mains rated voltage*. The mains voltage measured by the TEM MFR is evaluated. The analog input *Voltage measured value* is not evaluated.				
P012	**Mains connection upper limit for mains voltage**	%(U_n)	100 150	0.1	110
	Maximum voltage at the grid connection point at which connection and synchronization of the genset with the higher-level grid is permitted during a normal operating start. The parameter value refers to the smallest phase-to-phase voltage. The specification in % refers to parameter *P001 Mains rated voltage*. The mains voltage measured by the TEM MFR is evaluated. The analog input *Voltage measured value* is not evaluated.				
P016	**Mains recoupling upper limit for mains voltage**	%(U_n)	100 150	0.1	110
	Maximum voltage at the grid connection point at which reconnection and synchronization of the genset with the higher-level grid is permitted after tripping of decoupling protection devices. The parameter value refers to the smallest phase-to-phase voltage. The specification in % refers to parameter *P001 Mains rated voltage*. The mains voltage measured by the TEM MFR is evaluated. The analog input *Voltage measured value* is not evaluated.				

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Active power priorities and ramps

No.	Parameter	Unit	Min - Max	Increment	Default
P021	**Normal ramp: Slope with power increase**	% (P_n)/s	0.01 20	0.01	0.2
	Slope of the load ramp of the genset in normal operation. The slope of the load ramp of the Grid Demand Interface (GDI) is additionally limited by the TEM load ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P022	**Normal ramp: Slope with power decrease**	% (P_n)/s	0.01 2	0.01	0.4
	Slope of the unloading ramp of the genset in normal operation. The slope of the GDI's unloading ramp is additionally limited by the TEM unloading ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P023	**Direct sales slope active power ramp**	% (P_n)/s	0.01 2	0.01	0.5
	Slope of the loading and unloading ramp of the genset in the case of an active power demand by third parties (e.g. a direct seller). The slope of the GDI's loading and unloading ramp is additionally limited by the TEM unloading ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P327	**Slope of active power ramp, permissible power**	% (P_n)/s	0.01 2	0.01	2
	Slope of the unloading ramp of the genset when the permissible output is limited.				
P024	**Active power ramp slope mains operator limitation**	% (P_n)/s	0.01 3	0.01	0.4
	Slope of the unloading ramp of the genset in the event of a power limitation by the mains operator. The slope of the GDI's unloading ramp is additionally limited by the TEM unloading ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P126	**Activation of the connection ramp for mains coupling** Variable, default: Deactivated				
	Option for activating a separate active power gradient (parameter *P116 Slope of the connection ramp after mains coupling*) during a normal operating start.				
P116	**Slope of the connection ramp after mains coupling**	% (P_n)/s	0.01 1.5	0.01	0.2

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No.	Parameter	Unit	Min - Max	Increment	Default
	Slope of the loading and unloading ramp of the genset during a normal operation start. The active power ramp is active until the desired power setpoint is reached after an operating start. The slope of the GDI's loading and unloading ramp is additionally limited by the TEM unloading ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P125	**Activation of connection ramp for mains recoupling** Variable, default: Activated				
	Option to activate a separate active power gradient (parameter *P117 Slope of the connection ramp after mains recoupling*) when starting the genset after a mains decoupling.				
P117	**Slope of the connection ramp after mains recoupling**	% (P_n)/s	0.01 1.5	0.01	0.13
	Slope of the loading and unloading ramp of the genset when starting after a mains decoupling. The active power ramp is active until the desired power setpoint is reached after an operating start. The slope of the GDI's loading and unloading ramp is additionally limited by the TEM unloading ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P276	**Mains operator setpoint power increase ramp**	% (P_n)/s	0.01 2	0.01	0.2
	Slope of the load ramp of the genset when active power is specified by the mains operator. The slope of the load ramp of the GDI is additionally limited by the TEM load ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P277	**Mains operator setpoint power decrease ramp**	% (P_n)/s	0.01 2	0.01	0.4
	Slope of the unloading ramp of the genset when active power is specified by the mains operator. The slope of the GDI's unloading ramp is additionally limited by the TEM unloading ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P246	**Active power ramp priority 1** Variable, default: Mains operator limitation				

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No.	Parameter	Unit	Min - Max	Increment	Default
	Selection of the priority of the active power functions listed below among each other. The function selected for priority 1 has the highest priority, while the function selected for priority 8 has the lowest priority. This results in the request value and the slope of the currently active function with the highest priority. The normal power demand (parameter *P201 System operator power demand source*) always has the lowest priority. • `Mains connection`: Slope of active power during normal operating start (parameter *P126 Activation of the connection ramp for mains connection*). • `Mains reconnection`: Slope of active power during mains recoupling after a previous mains decoupling (parameter *P125 Activation of the connection ramp during mains recoupling*). • `P(U)`: Voltage-related power decrease (parameter *P130 Voltage-related power decrease*). • `LFSM-B`: Slope after an active power adjustment due to overfrequency or underfrequency (parameter *P031 LFSM-B duration*). • `LFSM-A`: Active power adjustment due to overfrequency or underfrequency (parameter *P112 option LFSM-O* and *P113 option LFSM-U*). • `Mains operator setpoint`: Power demand by the mains operator (parameter *P203 Mains operator power demand source*). • `Mains operator limitation`: Power decrease by the mains operator (parameter *P037 Mains operator power limitation source*). • `Direct sales`: Power demand by third parties, for example a direct seller (parameter *P202 Direct sales power demand source*).				
P247	**Active power ramp priority 2** Variable, default: LFSM-A				
	See parameter *P246 Active power ramp priority 1*.				
P248	**Active power ramp priority 3** Variable, default: mains reconnection				
	See parameter *P246 Active power ramp priority 1*.				
P249	**Active power ramp priority 4** Variable, default: Mains connection				
	See parameter *P246 Active power ramp priority 1*.				
P250	**Active power ramp priority 5** Variable, default: LFSM-B				
	See parameter *P246 Active power ramp priority 1*.				
P251	**Active power ramp priority 6** Variable, default: P(U)				
	See parameter *P246 Active power ramp priority 1*.				
P252	**Active power ramp priority 7** Variable, default: Mains operator setpoint				
	See parameter *P246 Active power ramp priority 1*.				
P253	**Active power ramp priority 8** Variable, default: Direct sales				

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No.	Parameter	Unit	Min - Max	Increment	Default
	See parameter *P246 Active power ramp priority 1*.				
P129	**Maximum slope with sum of power increases**	% (P_n)/s	0.01 20	0.01	1.2
	Maximum positive power slope permitted by the genset if multiple ramps are active simultaneously.				
P255	**Maximum slope with sum of power decreases**	% (P_n)/s	0.01 20	0.01	1.2
	Maximum negative power slope permitted by the genset if multiple ramps are active simultaneously.				
P279	**Power ramp limitation** Variable, default: Deactivated				
	Defines a minimum and maximum for the following power ramps: • *P021 Normal ramp*: Slope with power increase • *P022 Normal ramp*: slope in case of power decrease • *P024 Active power ramp slope, mains operator limitation* • *P276 Mains operator setpoint power increase ramp* • *P277 Mains operator setpoint power decrease ramp* • *P163 P(U) maximum slope active power ramp* • *P023 Direct sales slope active power ramp* • *P116 Slope of the connection ramp after mains coupling* • *P117 Slope of the connection ramp after mains recoupling* The setting is made via the parameters *P280 Maximum power ramp* and *P281 Minimum power ramp*.				
P280	**Maximum power ramp**	% (P_n)/s	0.01 20	0.01	20
	Upper limit for the ramps specified under *P279 Limitation of power ramps*.				
P281	**Minimum power ramp**	% (P_n)/s	0.01 1.5	0.01	0.01
	Lower limit for the ramps specified under *P279 Limitation of power ramps*.				

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Operators and direct sellers

No.	Parameter	Unit	Min - Max	Increment	Default
P201	**Genset operator active power demand source** Variable, default: Analog				
	The system operator can demand power in one of the following ways: • `Analog`: the value is set via the analog input `Operator power demand`. The scaling of the analog signal is set via the parameters *P008 Plant operator power demand AI (at 4 mA)* and *P009 Plant operator power demand AI (at 20 mA)*. • `Modbus`: the value is specified via Modbus TCP.				
P202	**Direct sales active power demand source** Variable, default: Analog				
	The power demand by third parties, for example by a direct seller, can be made in one of the following ways: • `Analog`: the value specification is made via the analog input `Direct sales power demand`. The scaling of the analog signal is set via the parameters *P010 Direct sales power demand demand AI (at 4 mA)* and *P011 Direct sales power demand AI (at 20 mA)*. • `Modbus`: the value is specified via Modbus TCP.				
P271	**Option power limit** Variable, default: Deactivated				
	Option for specifying a permissible power, for example due to power limitations by the TEM system. It makes sense to specify this to the GDI if an active power reserve is to be kept free for primary or secondary control power. • `Deactivated`: the specification of a permissible power is deactivated. • `Analog`: the value is set via the analog input `Permitted power`. The scaling of the analog signal is set via parameters *P272 Permissible power AI (at 4 mA)* and *P273 Permissible power AI (at 20 mA)*. • `Modbus`: the value is specified via Modbus TCP.				

Mains operator

No.	Parameter	Unit	Min - Max	Increment	Default
P127	**Mains operator option power demand** Variable, default: Activated				
	Activates or deactivates the power demand by the mains operator.				
P203	**Mains operator power demand source** Variable, default: Analog				

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No.	Parameter	Unit	Min - Max	Increment	Default
	The power demand from the mains operator can be made in one of the following ways: • `Fixed value`: the value is specified via parameter *P315 Mains operator power demand fixed value*. • `Analog`: the value specification is made via the analog input `Mains operator power demand`. The scaling of the analog signal is set via the parameters *P199 Mains operator power request AI (at 4 mA)* and *P200 Mains operator power request AI (at 20 mA)*. • Modbus: the value is specified via Modbus TCP.				
P315	**Mains operator power demand fixed value**	%(P_n)	0 100	0.1	100
	Fixed power demand by mains operator.				
P037	**Mains operator power limitation source** Variable, default: Digital (active high)				
	The power restriction by the mains operator can be implemented in one of the following ways: • `Deactivated`: the power restriction by the mains operator is deactivated. • `Analog`: the value is specified via the analog input `Mains operator power limitation`. The scaling of the analog signal is set via the parameters *P039 Mains operator power limitation AI (at 4 mA)* and *P040 Mains operator power limitation AI (at 20 mA)*. • `Digital (active high)`: the value is set via the four digital inputs `Mains operator power limitation level 1` to `Mains operator power limitation level 4`. Each of the digital inputs is assigned a parameter via which the power limitation is set (see parameters *P033 – P036*). The power limitation of the input at which 24 V is applied is active. • `Digital (active low)`: the value is set via the four digital inputs `Mains operator power limitation level 1` to `Mains operator power limitation level 4`. Each of the digital inputs is assigned a parameter via which the power limitation is set (see parameters *P033 – P036*). The power limitation of the input at which 0 V is applied is active. • `Modbus`: the value is specified via Modbus TCP.				
P033	**Power limitation level 1, at**	%(P_n)	0 100	0.1	100
	Limitation of the active power output of the genset to the parameterized value if the digital input `Mains operator power limitation level 1` is active.				
P034	**Power limitation level 2, at**	%(P_n)	0 100	0.1	60
	Limitation of the active power output of the genset to the parameterized value if the digital input `Mains operator power limitation level 2` is active.				
P035	**Power limitation level 3, at**	%(P_n)	0 100	0.1	30
	Limitation of the active power output of the genset to the parameterized value if the digital input `Mains operator power limitation level 3` is active.				

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No.	Parameter	Unit	Min - Max	Increment	Default
P036	**Power limitation level 4, at**	%(P_n)	0 100	0.1	0
	Limitation of the active power output of the genset to the parameterized value if the digital input `Mains operator power limitation level 4` is active.				

Reaction in event of Fault Ride Through (FRT)

No.	Parameter	Unit	Min - Max	Increment	Default
P292	**FRT detection** Variable, default: Deactivated				
	Activates or deactivates FRT detection. If FRT detection is activated, frequency-dependent GDI functions use the pre-fault value of the measured frequency in the event of mains faults.				
P314	**Return from FRT delay**	s	0 180	0.1	5
	This parameter extends the reaction to the FRT case.				
P294	**HVRT limit value**	%(U_n)	110 150	0.1	115
	Detection threshold for FRT detection due to excessively high voltage (HVRT).				
P293	**LVRT limit value**	%(U_n)	0 90	0.1	85
	Detection threshold for FRT detection due to excessively low voltage (LVRT).				

Frequency Sensitive Mode (FSM)

No.	Parameter	Unit	Min - Max	Increment	Default
P120	**Option FSM** Variable, default: Deactivated				
	Option to activate a frequency-dependent active power characteristic curve when frequency deviations occur. • `Deactivated`: FSM function is deactivated. • `Activated`: FSM function is activated. • `Digital input`: FSM is activated if a voltage of 24 V is present at the digital input `FSM demand`.				
P275	**FSM active power range power decrease**	%(P_n)	0 100	0.01	10
	Lower active power range used by the FSM function.				
P121	**FSM active power range power increase**	%(P_n)	0 100	0.01	10
	Upper active power range used by the FSM function.				

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No.	Parameter	Unit	Min - Max	Increment	Default
P123	**FSM power gradient**	% (P_n)/ Hz	16.67 10000	0.01	50
	Power gradient with which the active power output of the genset is increased or decreased in the event of frequency deviations.				
P124	**FSM slope active power ramp**	% (P_n)/s	0.01 6	0.01	0.4
	Slope of the loading and unloading ramp when the active power is adjusted by the FSM function. The slope of the GDI's loading and unloading ramp is additionally limited by the TEM unloading ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P128	**FSM control range reserved** Variable, default: Deactivated				
	Limitation of the active power demand upwards and downwards by the FSM control band so that it can always be called up. Active power reserves are only taken into account if the FSM function is activated. Power decreases by the TEM system, due to environmental conditions for example, are not considered. • `Deactivated`: the FSM control band is not kept free. • `Activated`: the active power setpoints (e.g. that of the plant operator) are limited to the following values at the rated frequency: – Maximum power – primary reserve (*P121 FSM active power range power increase*) – Minimum power (30 %) + primary reserve (*P275 FSM active power range power decrease*) • `Digital input`: the above-mentioned active power limitation only takes place if a voltage of 24 V is present at the digital input `Keep active power reserve free`.				
P231	**Restoration of primary control power** Variable, default: Deactivated				
	Option to activate an alternative FSM characteristic curve when using a dead band. If this option is activated, the demand value of the FSM function jumps to a characteristic curve, parameterized via the static value, when leaving the dead band, which always runs through the zero point at the rated frequency • For more information on the FSM function and its characteristic curve, see chapter 4.1.5.3 Frequency Sensitive Mode (FSM) 26.				
P122	**FSM dead band**	Hz	0 0.5	0.01	0
	Dead band of the frequency-dependent active power adjustment around the rated frequency.				
P335	**FSM sliding dead band option** Variable, default: Deactivated				
	Activates or deactivates the sliding dead band for the FSM function.				
P336	**FSM Sliding dead band**	Hz	0 0.2	0.001	0

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No.	Parameter	Unit	Min - Max	Increment	Default
	Defines the dead band within which the input frequency of the FSM function does not change.				
P337	**Time constant 3Tau FSM sliding dead band**	s	5 60	0.1	15
	Defines the time constant for the PT1 function of the frequency filtering.				

Limited Frequency Sensitive Mode (LFSM)

No.	Parameter	Unit	Min - Max	Increment	Default
P112	**Option LFSM-O** Variable, default: Activated				
	Option for activating a frequency-dependent active power characteristic curve when an overfrequency occurs (LFSM-O).				
P113	**Option LFSM-U** Variable, default: Activated				
	Option for activating a frequency-dependent active power characteristic curve when an underfrequency occurs (LFSM-U).				
P114	**Activation delay LFSM-O**	s	0 60	0.01	0
	If the mains frequency exceeds the frequency threshold (*P028 LFSM power decrease limit value*), the active power is not reduced until the set activation delay has elapsed.				
P028	**LFSM limit power decrease**	Hz	50.05 53	0.001	50.2
	Limit value of the frequency, which leads to a frequency-dependent active power decrease of the genset if exceeded.				
P027	**LFSM-O Power gradient P(f)**	% (P_n)/Hz	16.67 100	0.01	40
	Power gradient with which the active power output of the genset is reduced at overfrequency.				
P115	**Activation delay LFSM-U**	s	0 60	0.01	0
	If the mains frequency falls below the frequency threshold (*P030 LFSM power increase limit value*), the active power is not increased until the set activation delay has elapsed.				
P030	**LFSM limit power increase**	Hz	45 49.95	0.001	49.8
	Limit value of the frequency which leads to a frequency-dependent active power increase of the genset if undershot.				
P029	**LFSM-U Power gradient P(f)**	% (P_n)/Hz	16.67 100	0.01	40
	Power gradient with which the active power output of the genset is increased in case of underfrequency.				

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No.	Parameter	Unit	Min - Max	Increment	Default
P220	**LFSM power increase ramp A**	% (P_n)/s	0.01 6	0.01	1.2
P025	**LFSM power decrease ramp A**	% (P_n)/s	0.01 6	0.01	1.2
	Slope of the loading ramp of the genset in case of an active power adjustment due to over- or underfrequency (LFSM). The slope of the load ramp of the GDI is additionally limited by the TEM load ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P031	**Duration LFSM-B**	min	0 60	0.01	10
	Time span after an active power adjustment that occurred due to over- or underfrequency (LFSM), in which the mains frequency has to be within the tolerance band without exception in order to effect a transition into normal operation. The active power ramp set via parameter *P026 LFSM slope active power ramp B* is active while the set time elapses.				
P026	**LFSM slope active power ramp B**	% (P_n)/s	0.01 2	0.01	0.13
	Slope of the loading and unloading ramp of the genset after an active power adjustment due to over- or underfrequency (LFSM). The slope of the GDI's loading and unloading ramp is additionally limited by the TEM unloading ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P138	**LFSM-O limit value mode** Variable, default: Deactivated				
	Option to activate a modified frequency-dependent active power characteristic curve if an overfrequency (LFSM-O) occurs. If this option is activated, the maximum achieved active power decrease is maintained until the frequency has normalized again.				
P139	**LFSM-O Limit value mode: Frequency**	Hz	50 52	0.001	50.1
	Frequency limit value below which the genset returns to normal operation.				
P140	**LFSM-O Limit value mode: Delay**	s	0 600	0.1	30
	Duration during which the mains frequency must be permanently below the deactivation threshold (*P139 LFSM-O limit value mode: Frequency*) for the genset to return to normal operation.				

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Voltage-dependent active power decrease (P(U))

No.	Parameter	Unit	Min - Max	Increment	Default
P130	**Voltage induced power decrease** Variable, default: Deactivated				
	Activates or deactivates the voltage-dependent active power decrease.				
P198	**P(U) activation delay**	s	0 600	0.1	0
	If the mains voltage exceeds the voltage threshold (P132 sampling point P(U) U1), the active power is not reduced until the set activation delay has elapsed.				
P165	**P(U) Response time power decrease**	s	0 300	0.1	3
	Corresponds to the time within which the active power setpoint changes due to a voltage change. If the value is set to zero, the active power gradient always corresponds to the value of parameter *P163 P(U) Maximum slope of active power ramp*.				
P132	**Sampling point P(U) U1**	%(U_n)	80 120	0.01	108
	Voltage value of the first sampling point for definition of the P(U) characteristic curve. The parameter value corresponds to the voltage threshold above which the active power is reduced.				
P166	**Sampling point P(U) U2**	%(U_n)	80 120	0.01	110
	Voltage value of the second sampling point for defining the P(U) characteristic curve. The parameter value corresponds to the voltage limit value from which the active power decrease remains constant.				
P167	**Sampling point P(U1)**	%(P_n)	0 100	0.01	100
	Active power limitation of the first sampling point of the P(U) characteristic curve.				
P168	**Sampling point P(U2)**	%(P_n)	0 100	0.01	30
	Active power limitation of the second sampling point of the P(U) characteristic curve.				
P170	**Activation of voltage induced ramp at power decrease** Variable, default: Activated				
	Option to activate a separate active power gradient (parameters *P165*, *P163*) if there is an active power limitation due to an overvoltage.				
P163	P(U) maximum slope of active power ramp	% (P_n)/s	0.01 1.2	0.01	0.2
	Maximum gradient with which the active power setpoint changes due to a voltage change. The resulting active power gradient of the P(U) function corresponds to the maximum of the gradients resulting from parameters *165* and *163*. The slope of the GDI's unloading ramp is additionally limited by the TEM unloading ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				

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Frequency steady-state with Integral Local Frequency (ILF)

No.	Parameter	Unit	Min - Max	Increment	Default
P237	**ILF mode** Variable, default: Deactivated				
	Option to activate the ILF function (local integral frequency control). This function is used to provide secondary control power in cases where central coordination of secondary control power provision is no longer possible. • Deactivated: ILF is deactivated. • Activated: ILF is activated. • Digital input: ILF is activated if a voltage of 24 V is present at the digital input `Secondary frequency control active`.				
P266	**ILF control D proportional gain**	%	0 1000	0.01	0
	Active weighting of the D component of the frequency controller when the ILF function is active. If the parameter value is "0", the value is not effective.				
P265	**ILF control I proportional gain**	%	0 1000	0.01	0
	Active weighting of the I component of the frequency controller when the ILF function is active. If the parameter value is "0", the value is not effective.				
P264	**ILF control P proportional gain**	%	0 1000	0.01	0
	Active weighting of the P component of the frequency controller when the ILF function is active. If the parameter value is "0", the value is not effective.				
P239	**ILF overfrequency activation due to limit value**	Hz	50.2 54	0.01	50.3
	Limit value of the frequency, above which the local integral frequency control is activated. If local frequency control is active, the external setpoint of the secondary control power is ignored (see parameter *P232 Secondary frequency control: Setpoint*).				
P241	**ILF overfrequency blocking due to limit value**	Hz	50 54	0.01	50.1
	If the local integral frequency control is active due to an overfrequency, it is blocked when this limit value is not reached. The active power setpoint of the ILF function at the moment of falling below the limit value remains active. The local integral frequency control is reactivated when this limit value is exceeded again.				
P240	**ILF underfrequency activation due to limit value**	Hz	46 49.8	0.01	49.7
	Limit value of the frequency, below which the local integral frequency control is activated. If local frequency control is active, the external setpoint of the secondary control power is ignored (see parameter *P232 Secondary frequency control: Setpoint*).				
P242	**ILF underfrequency blocking due to limit value**	Hz	46 50	0.01	49.9

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No.	Parameter	Unit	Min - Max	Increment	Default
	If the local integral frequency control is active due to an underfrequency, it is blocked when this limit value is exceeded. The active power setpoint value of the ILF function at the moment of exceeding the limit value remains active. The local integral frequency control is reactivated when this limit value is undershot again.				
P238	**ILF slope of active power ramp**	% (P_n)/s	0.01 3	0.01	0.4
	Slope of the loading and unloading ramp when the active power is adjusted by the ILF function. The slope of the GDI's loading and unloading ramp is additionally limited by the TEM unloading ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P243	**ILF reset mode** Variable, default: Manual (digital input) and automatic				
	Selection of a method for resetting the ILF function to its initial state. • `Manual (digital input)`: the ILF function is reset when a voltage of 24 V is applied to the digital input `ILF Reset`. • `Automatic`: the ILF function is reset if the mains frequency remains permanently in the defined frequency range (*P267 ILF overfrequency deactivation by limit value*, *P268 ILF underfrequency deactivation by limit value*) within the defined time (*P244 ILF reset timeout*) • `Manual (digital input) and automatic`: the ILF function can be reset either manually or automatically.				
P267	**ILF overfrequency deactivation by limit value**	Hz	50 51	0.01	50.03
	Frequency value below which the measured mains frequency must be so that the ILF function is reset to its initial state.				
P268	**ILF underfrequency deactivation by limit value**	Hz	49 50	0.01	49.97
	Frequency value above which the measured mains frequency must be so that the ILF function is reset to its initial state.				
P244	**ILF reset timeout**	s	0 3600	0.1	300
	Time period within which the measured mains frequency must remain continuously in the defined frequency band until the ILF function is reset to its initial state.				

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Secondary control power setpoint specifications

No.	Parameter	Unit	Min - Max	Increment	Default
P232	**Secondary frequency control: Setpoint** Variable, default: Deactivated				
	Option for demand of an active power offset for the provision of secondary control power. • `Deactivated`: the external specification of a setpoint for secondary frequency control is deactivated. • `Activated`: the external specification of a setpoint for secondary frequency control is activated. • `Digital input`: the external specification of a setpoint for secondary frequency control is activated if a voltage of 24 V is present at the digital input Secondary frequency control active.				
P328	**Keep control band clear** Variable, default: Deactivated				
	Upward and downward limitation of the active power demand by the secondary control reserve so that this can always be called up. Active power reserves are only taken into account if the external specification of a setpoint for secondary frequency control is activated. Power decreases by the TEM system, due to environmental conditions for example, are not considered. • `Deactivated`: The secondary control reserve is not kept free. • `Activated`: the active power setpoints (e.g. that of the plant operator) are limited to the following values at the rated frequency: – Maximum power – secondary reserve (*P234 upper reserve limit*) – Minimum output (30 %) + secondary reserve (*P233 lower reserve limit*) • `Digital input`: the above-mentioned active power limitation only takes place if a voltage of 24 V is present at the digital input Keep active power reserve free.				
P234	**Upper reserve limit**	%(P_n)	0 100	0.01	0
	Upper limit of the active power reserve for the provision of secondary control power. This corresponds to the maximum power increase (positive control power) to be provided as part of the secondary control. Parameter *P328 Keep control band free* can be used to set whether the reserve is kept free.				
P233	**Lower reserve limit**	%(P_n)	-100 0	0.01	0
	Lower limit of the active power reserve for the provision of secondary control power. This corresponds to the maximum power decrease (negative control power) to be provided as part of the secondary control. Parameter *P328 Keep control band free* can be used to set whether the reserve is kept free.				
P236	**Active power ramp slope**	% (P_n)/s	0.01 3	0.01	0.4

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No.	Parameter	Unit	Min - Max	Increment	Default
	Slope of the loading and unloading ramp of the genset when an active power offset is specified for the provision of secondary control power. The slope of the GDI's loading and unloading ramp is additionally limited by the TEM unloading ramp for the selected TEM grid operating mode. • For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159.				
P235	**Setpoint source** Variable, default: Fixed value				
	The specification of an active power offset for the provision of secondary control power can take place in one of the following ways: • `Fixed value`: The specification of an active power offset for the provision of secondary control power is carried out via parameter *P320 Fixed setpoint*. • `Analog`: the value is set via the analog input Setpoint secondary frequency control. The scaling of the analog signal is set via parameters *P333 Secondary control offset AI (at 4 mA)* and *P332 Secondary control offset AI (at 20 mA)*. • `Modbus`: the value is specified via Modbus TCP.				
P320	**Fixed setpoint**	%(P_n)	-100 100	0.01	0
	Fixed specification of an active power offset for the provision of secondary control power.				

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Reactive power mode specifications

No.	Parameter	Unit	Min - Max	Increment	Default
P308	**Reactive power mode** Variable, default: Selection via DI				
	Selection of the reactive power mode. • `Selection via DI`: the active reactive power mode is selected via the three digital inputs `Selection reactive power mode DI 1`, `Selection reactive power mode DI 2` and `Selection reactive power mode DI 3` or `Modbus`, depending on what is set for parameter *P204 Reactive power mode source*. – For more information on the correlation between GDI ramps and TEM network operating modes, see chapter 7.12.1 Establish voltage supply 159. • `PF specification`: the specification of a PF setpoint is active. • `Q(P)`: the active power-dependent reactive power characteristic is active. • `Q(U)+Qref`: the voltage-dependent reactive power characteristic is active. The characteristic curve can be shifted along the reactive power axis by specifying a Qref value. • `Q(U)+UQ0`: the voltage-dependent reactive power characteristic is active. The characteristic curve can be shifted along the voltage axis by specifying a UQ0 value. • `Q Setpoint mode`: the specification of a reactive power setpoint is active. • `PF (P)`: the active power-dependent PF characteristic is active. • `U Setpoint mode`: the specification of a voltage setpoint is active. • `PF (U)`: the voltage-dependent PF characteristic is active.				
P098	**Reactive power watchdog mode** Variable, default: Always On				
	Watchdog for logging a failure of the telecontrol system. • `Deactivated`: no monitoring of the telecontrol system. • `Always on`: in a fault-free state, a voltage of 24 V is permanently present at the DI `Watchdog reactive power demand`. • `Pulse`: in a fault-free state, a pulsed signal is present at the DI `Watchdog reactive power demand`.				
P319	**Watchdog DI exit downtime**	s	0 300	0.1	0
	Delay time after resumption of the telecontrol connection until exit from reactive power watchdog mode.				
P172	**Watchdog DI enter downtime**	s	0 300	0.1	60
	Delay time after failure of the telecontrol connection until the transition to reactive power watchdog mode.				

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No.	Parameter	Unit	Min - Max	Increment	Default
P204	**Reactive power mode Source** Variable,default: Digital				
	Selection of the source for external specification of the reactive power mode. This parameter is only evaluated if the option `Selection via DI` is selected for parameter *P308 Reactive power mode*. • `Digital`: the active reactive power mode is selected via the three digital inputs *Selection reactive power mode DI 1*, *Selection reactive power mode DI 2* and *Selection reactive power mode DI 3*. • `Modbus`: the active reactive power mode is selected via Modbus TCP.				

Reactive power mode Q(U) + Qref

No.	Parameter	Unit	Min-Max	Increment	Default
P076	**Sampling point Q(U) + Qref: Q(U1)**	%(P_n)	-100 100	0.01	33
	Reactive power value of the first sampling point for defining the Q(U) characteristic curve. The characteristic curve has 4 sampling points that must be parameterized accordingly. Under-excited operation is characterized by a negative sign of the reactive power.				
P078	**Sampling point Q(U) + Qref: Q(U2)**	%(P_n)	-100 100	0.01	0
P080	**Sampling point Q(U) + Qref: Q(U3)**	%(P_n)	-100 100	0.01	0
P082	**Sampling point Q(U) + Qref: Q(U4)**	%(P_n)	-100 100	0.01	-33
P075	**Sampling point Q(U) + Qref: U1**	%(U_n)	80 120	0.01	94
	Voltage value of the first sampling point for defining the Q(U) characteristic curve. The characteristic curve has 4 sampling points that must be parameterized accordingly.				
P077	**Sampling point Q(U) + Qref: U2**	%(U_n)	80 120	0.01	96
P079	**Sampling point Q(U) + Qref: U3**	%(U_n)	80 120	0.01	104
P081	**Sampling point Q(U) + Qref: U4**	%(U_n)	80 120	0.01	106
P158	**Q(U) + Qref delay**	s	0 30	0.1	0

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No.	Parameter	Unit	Min-Max	Increment	Default
	The activation delay can be set in the case that the reactive power values of sampling points 2 and 3 are identical. If the voltage falls out of the defined voltage band with a constant supply of reactive power, the modification of the reactive power setpoint is only active after the set activation delay has elapsed.				
P141	**Q(U) + Qref power factor minimum**	PF	0.0001 1	0.000 01	1
	Limitation of the reactive power supply to a minimum displacement PF. With a parameter value of “1”, this functionality is deactivated.				
P142	**Q(U) + Qref Power threshold activation**	%(P_n)	0 100	0.1	0
	Limitation of the reactive power supply at low active power output. This parameter is used to set the active power threshold above which reactive power is provided in accordance with the characteristic curve of the Q(U)+Qref function.				
P143	**Q(U) + Qref Power threshold deactivation**	%(P_n)	0 100	0.1	0
	Limitation of the reactive power supply at low active power output. This parameter is used to set the active power limit value below which the reactive power setpoint is set to zero.				
P046	**Time constant 3Tau PT1 Q(U) + Qref**	s	0.01 300	0.01	10
	When being controlled according to the Q(U)+Qref function, this is the time until 95 % of the reactive power setpoint (3τ) is reached. The control behavior corresponds to that of a PT1 element.				
P096	**Watchdog reaction, reactive power mode Q(U) + Qref** Variable, default: Q(U) + Qref				
	Selection of the reactive power mode to which the watchdog reaction switches when the Q(U) +Qref function is active. Switchover takes place in the event of a telecontrol system failure (see *P098 Reactive power watchdog mode*) or in the event of an invalid signal when a value is specified via an analog input. If the Q(U)+Qref function is selected, there is no changeover of the reactive power mode.				
P316	**Watchdog replacement value mode Q(U) + Qref** Variable, default: Keep value				
	If the reactive power mode Q(U)+Qref was selected as the reaction to a failure of the telecontrol system (Watchdog response) (regardless of which reactive power mode was previously active), then either a fixed value or the last valid Qref value can be selected here as the Qref value. • `Keep value`: Keep last valid value. • `Fixed value`: activates parameter *P111 Watchdog fixed replacement value Q(U)+Qref*.				
P111	**Watchdog fixed replacement value Q(U) + Qref**	%(P_n)	-100 100	0.01	0
	Setpoint of the reactive power value Qref for shifting the Q(U) characteristic curve in the event of a fault. Under-excited operation is characterized by a negative sign of the reactive power				

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No.	Parameter	Unit	Min-Max	Increment	Default
P109	**Q(U) + Qref displacement source** Variable, default: Fixed value				
	A Qref value for shifting the Q(U) characteristic curve can be specified in one of the following ways: • `Fixed value`: a Qref value is specified via parameter *P108 Q(U)+Qref shift fixed value*. • `Analog`: the value is specified via the analog input `Qref specification for Q(U) +Qref`. The scaling of the analog signal is set via the parameters *P083 Qref default for Q(U)+Qref AI (at 4 mA)* and *P084 Qref default for Q(U)+Qref AI (at 20 mA)*. • `Modbus`: the value is specified via Modbus TCP.				
P108	**Q(U) + Qref shift fixed value**	%(P_n)	-100 100	0.01	0
	Setpoint of the reactive power value Qref for shifting the Q(U) characteristic curve in normal operation. Under-excited operation is characterized by a negative sign of the reactive power.				

Reactive power mode Q setpoint

No.	Parameter	Unit	Min-Max	Increment	Default
P137	**Time constant 3Tau Q Setpoint mode**	s	0.01 300	0.01	10
	When controlling according to Q setpoint mode, time until 95 % of the reactive power setpoint (3τ) is reached. The control behavior corresponds to that of a PT1 element.				
P133	**Watchdog reaction reactive power mode Q setpoint mode** Variable, default: Q setpoint mode				
	Selection of the reactive power mode to which the watchdog reaction switches when Q setpoint mode is active. Switchover takes place in the event of a telecontrol system failure (see *P098 Reactive power watchdog mode*) or in the event of an invalid signal when a value is specified via an analog input. If Q setpoint mode is selected, the reactive power mode is not switched.				
P318	**Watchdog replacement value mode Q setpoint mode** Variable, default: Keep value				
	If the reactive power mode Q setpoint mode was selected as the reaction in the event of a telecontrol system failure (watchdog response) (regardless of which reactive power mode was previously active), either a fixed value or the last valid value can be selected here as the reactive power setpoint. • `Keep value`: Keep last valid value. • `Fixed value`: activates parameter *P136 Watchdog fixed replacement value Q Setpoint mode.*				

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No.	Parameter	Unit	Min-Max	Increment	Default
P136	**Watchdog fixed replacement value Q setpoint mode**	%(P_n)	-100 100	0.01	0
	Fixed replacement value for reactive power demand in the event of a fault. Underexcited operation is identified by a minus sign.				
P134	**Q setpoint mode source** Variable, default: Fixed value				
	A reactive power setpoint can be specified in one of the following ways: • `Fixed value`: a reactive power setpoint is specified via parameter *P135 Q setpoint mode fixed value*. • `Analog`: the value is specified via the analog input `Qset specification for Q setpoint mode`. The scaling of the analog signal is set via the parameters *P310 Qset specification for Q setpoint mode AI (at 4 mA)* and *P309 Qset specification for Q setpoint mode AI (at 20 mA)*. • `Modbus`: the value is specified via Modbus TCP.				
P135	**Q Setpoint mode Fixed value**	%(P_n)	-100 100	0.01	0
	Fixed setpoint for reactive power demand in normal operation. Under-excited operation is indicated by a negative sign.				

Reactive power mode Q(P)

No.	Parameter	Unit	Min - Max	Increment	Default
P056	**Sampling point Q(P): Q(P1)**	%(P_n)	-100 100	0.01	0
P058	**Sampling point Q(P): Q(P2)**	%(P_n)	-100 100	0.01	0
P060	**Sampling point Q(P): Q(P3)**	%(P_n)	-100 100	0.01	0
P062	**Sampling point Q(P): Q(P4)**	%(P_n)	-100 100	0.01	0
P064	**Sampling point Q(P): Q(P5)**	%(P_n)	-100 100	0.01	0
P066	**Sampling point Q(P): Q(P6)**	%(P_n)	-100 100	0.01	0

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No.	Parameter	Unit	Min - Max	Increment	Default
P068	**Sampling point Q(P): Q(P7)**	%(P_n)	-100 100	0.01	0
P070	**Sampling point Q(P): Q(P8)**	%(P_n)	-100 100	0.01	0
P072	**Sampling point Q(P): Q(P9)**	%(P_n)	-100 100	0.01	0
P074	**Sampling point Q(P): Q(P10)**	%(P_n)	-100 100	0.01	0
P055	**Sampling point Q(P): P1**	%(P_n)	0 150	0.1	0
	Active power indication of the first sampling point of the Q(P) characteristic curve. The characteristic curve has 10 sampling points.				
P057	**Sampling point Q(P): P2**	%(P_n)	0 150	0.1	15
P059	**Sampling point Q(P): P3**	%(P_n)	0 150	0.1	30
P061	**Sampling point Q(P): P4**	%(P_n)	0 150	0.1	40
P063	**Sampling point Q(P): P5**	%(P_n)	0 150	0.1	50
P065	**Sampling point Q(P): P6**	%(P_n)	0 150	0.1	60
P067	**Sampling point Q(P): P7**	%(P_n)	0 150	0.1	70
P069	**Sampling point Q(P): P8**	%(P_n)	0 150	0.1	80
P071	**Sampling point Q(P): P9**	%(P_n)	0 150	0.1	90
P073	**Sampling point Q(P): P10**	%(P_n)	0 150	0.1	100

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No.	Parameter	Unit	Min - Max	Increment	Default
P045	**Time constant 3Tau PT1 Q(P)**	s	0.01 300	0.01	10
	When controlling according to the Q(P) characteristic curve, the time until 95 % of the reactive power setpoint (3τ) is reached. The control behavior corresponds to that of a PT1 element.				
P095	**Watchdog reaction reactive power mode Q(P)** Variable, default: Q(P)				
	Selection of the reactive power mode to which the watchdog reaction switches when the Q(P) function is active. Switchover takes place if the telecontrol system fails (see *P098 Reactive power watchdog mode*). If the Q(P) function is selected, the reactive power mode is not switched.				

Reactive power mode Q(U) + UQ0

No.	Parameter	Unit	Min - Max	Increment	Default
P048	**Q(U) + UQ0 Qmax**	%(P_n)	-100 100	0.01	-33
	Parameterization of the Q(U)+UQ0 characteristic curve: Maximum reactive power provided by the genset. Under-excited operation is characterized by a negative sign of the reactive power.				
P049	**Q(U) + UQ0 Umax**	%(U_n)	80 120	0.01	104
	Parameterization of the Q(U)+UQ0 characteristic curve: Voltage value from which the maximum underexcited reactive power is drawn from the genset.				
P054	**Q(U) + UQ0 dead band**	%(U_n)	0 5	0.01	0
	Within the set dead band limits around the Q(U)+UQ0 characteristic curve, there is no voltage-dependent change in reactive power.				
P044	**Time constant 3Tau PT1 Q(U) + UQ0**	s	0.01 300	0.01	10
	When controlling according to the Q(U)+UQ0 characteristic curve, time until 95 % of the reactive power setpoint (3τ) is reached. The control behavior corresponds to that of a PT1 element.				
P094	**Watchdog reaction reactive power mode Q(U) + UQ0** Variable, default: Q(U) + UQ0				
	Selection of the reactive power mode to which the watchdog reaction switches when the Q(U) +UQ0 function is active. Switchover takes place in the event of a telecontrol system failure (see *P098 Reactive power watchdog mode*) or in the event of an invalid signal when a value is specified via an analog input. If the Q(U)+UQ0 function is selected, the reactive power mode is not switched.				

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No.	Parameter	Unit	Min - Max	Increment	Default
P317	**Watchdog replacement value mode Q(U) + UQ0** Variable, default: Keep value				
	If the reactive power mode Q(U)+UQ0 was selected as the reaction in the event of a telecontrol system failure (watchdog response) (regardless of which reactive power mode was previously active), either a fixed value or the last valid UQ0 value can be selected here as the UQ0 value. • `Keep value`: Keep last valid value. • `Fixed value`: activates parameter *P110 Watchdog fixed replacement value Q(U)+UQ0*.				
P110	**Watchdog fixed replacement value Q(U) + UQ0**	%(U_n)	80 120	0.01	100
	Fixed value of the preset voltage UQ0 at which no reactive power exchange takes place in the event of a fault (zero crossing).				
P050	**Q(U) + UQ0 source** Variable, default: Fixed value				
	A UQ0 value for shifting the Q(U) characteristic curve can be specified in one of the following ways: • `Fixed value`: a UQ0 value is specified via parameter *P051 Q(U)+UQ0 fixed value*. • Analog: the value is specified via the analog input `UQ0 specification for Q(U)+UQ0`. The scaling of the analog signal is set via the parameters *P052 UQ0 specification for Q(U)+UQ0 AI (at 4 mA)* and *P053 UQ0 specification for Q(U)+UQ0 AI (at 20 mA)*. • Modbus: the value is specified via Modbus TCP.				
P051	**Q(U) + UQ0 fixed value**	%(U_n)	80 120	0.01	100
	Fixed value of the preset voltage UQ0 at which no reactive power exchange takes place (zero crossing).				

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PF displacement factor

No.	Parameter	Unit	Min - Max	Increment	Default
P092	**PF specification source** Variable, default: Digital (active high)				
	A PF value can be specified in one of the following ways: • `Fixed value`: a PF value is specified via parameter *P107 Fixed PF value*. • `Analog`: the value is specified via the analog input PF specification. The scaling of the analog signal is set via the parameters *P085 PF default AI (at 4 mA)* and *P086 PF default AI (at 20 mA)*. • `Digital (active high)`: the value is specified via the five digital inputs `PF specification DI1` through `PF specification DI5`. Each of the digital inputs is assigned a parameter that is used to set a PF value (see *P087 – P091*). The PF specification of the input where 24 V is applied will be active. • `Digital (active low)`: the value is specified via the five digital inputs `PF specification DI1` to `PF specification DI5`. Each of the digital inputs is assigned a parameter that is used to set a PF value (see *P087 – P091*). The PF specification of the input where 0 V is applied will be active. • Modbus: the value is specified via Modbus TCP.				
P087	**PF specification DI1 value**	PF	-0.99991	0.00001	-0.95
	Setpoint of the displacement PF if the digital input `PF specification DI1` is active. Underexcited operation is identified by a minus sign before the displacement factor.				
P088	**PF specification DI2 value**	PF	-0.99991	0.00001	-0.98
	Setpoint of the displacement PF if the digital input `PF specification DI2` is active. Under-excited operation is characterized by a negative sign before the displacement factor.				
P089	**PF specification DI3 value**	PF	-0.99991	0.00001	1
	Setpoint of the displacement PF if the digital input `PF specification DI3` is active. Under-excited operation is characterized by a negative sign before the displacement factor.				
P090	**PF specification DI4 value**	PF	-0.99991	0.00001	0.98
	Setpoint of the displacement PF if the digital input PF specification DI4 is active. Under-excited operation is characterized by a negative sign before the displacement factor.				
P091	**PF specification DI5 value**	PF	-0.99991	0.00001	0.95
	Setpoint of the displacement PF if the digital input PF specification DI5 is active. Under-excited operation is characterized by a negative sign before the displacement factor.				
P107	**Fixed PF value**	PF	-0.99991	0.00001	1
	Specification of a fixed setpoint for the displacement PF, which is used in normal operation of the genset. Under-excited operation is characterized by a negative sign before the displacement factor.				

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No.	Parameter	Unit	Min - Max	Increment	Default
P047	**Time constant 3Tau PT1 PF demand**	s	0.01 300	0.01	10
	When controlling according to the PF specification, time until 95 % of the reactive power setpoint (3T) is reached. The control behavior corresponds to that of a PT1 element.				
P097	**Watchdog reaction reactive power mode PF specification** Variable, default: PF specification				
	Selection of the reactive power mode to which the watchdog reaction switches when the PF specification is active. Switchover takes place in the event of a telecontrol system failure (see *P098 Reactive power watchdog mode*) or in the event of an invalid signal when a value is specified via an analog input. If the PF specification is selected, the reactive power mode is not switched.				
P313	**Watchdog replacement value mode PF** Variable, default: Keep value				
	If the reactive power mode PF specification was selected as the reaction in the event of failure of the telecontrol system (watchdog response) (regardless of which reactive power mode was previously active), either a fixed value or the last valid PF value can be selected here as the PF value. • Keep value: Keep last valid value. • Fixed value: activates parameter *P093 Watchdog fixed replacement value PF*.				
P093	**Watchdog fixed replacement value PF**	PF	-0.9999 1	0.000 01	1
	Specification of a fixed setpoint for the displacement PF used in the event of a fault. Under-excited operation is characterized by a negative sign before the displacement factor.				

Displacement PF of (P)

No.	Parameter	Unit	Min - Max	Increment	Default
P146	**Sampling point PF(P1)**	PF	-0.9999 1	0.000 01	1
	PF specification of the first sampling point of the PF (P) characteristic curve. The characteristic curve has 4 sampling points that must be parameterized accordingly. Under-excited operation is characterized by a negative sign before the displacement factor.				
P148	**Sampling point PF(P2)**	PF	-0.9999 1	0.000 01	1
P150	**Sampling point PF(P3)**	PF	-0.9999 1	0.000 01	1
P152	**Sampling point PF(P4)**	PF	-0.9999 1	0.000 01	1

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No.	Parameter	Unit	Min - Max	Increment	Default
P145	**Sampling point PF(P) P1**	%(P_n)	0 150	0.1	0
	Active power demand of the first sampling point of the PF (P) characteristic curve. The characteristic curve has 4 sampling points.				
P147	**Sampling point PF(P) P2**	%(P_n)	0 150	0.1	0
P149	**Sampling point PF(P) P3**	%(P_n)	0 150	0.1	0
P151	**Sampling point PF(P) P4**	%(P_n)	0 150	0.1	0
P153	**Time constant 3Tau PF(P)**	s	0.01 300	0.1	2
	When controlling according to the PF (P) characteristic curve, time until 95 % of the reactive power setpoint (3τ) is reached. The control behavior corresponds to that of a PT1 element.				
P144	**Watchdog reaction reactive power mode PF(P)** Variable, default: PF(P)				
	Selection of the reactive power mode to which the watchdog reaction switches when the PF(P) function is active. Switchover takes place if the telecontrol system fails (see *P098 Reactive power watchdog mode*). If the PF(P) function is selected, the reactive power mode is not switched.				
P154	**PF(P) activation mains voltage**	%(U_n)	0 120	0.1	0
	When the set voltage threshold is reached, the reactive power is provided according to the PF (P) characteristic curve. • If the set activation threshold value is greater than the deactivation threshold value (*P155 PF(P) deactivation mains voltage*), the PF(P) characteristic curve is activated at high voltages and deactivated at low voltages. • If the set activation threshold value is lower than the deactivation threshold value (*P155 PF(P) deactivation mains voltage*), the PF(P) characteristic curve is activated at low voltages and deactivated at high voltages.				

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

No.	Parameter	Unit	Min - Max	Increment	Default
P155	**PF(P) deactivation mains voltage**	%(U_n)	0 120	0.1	0
	When the set voltage threshold is reached, the provision of reactive power is set to zero. • If the activation limit value (*P154 PF(P) activation mains voltage*) is greater than the set deactivation threshold value, the PF(P) characteristic curve is activated at high voltages and deactivated at low voltages. • If the activation threshold value (*P154 PF(P) activation mains voltage*) is lower than the set deactivation threshold value, the PF(P) characteristic curve is activated at low voltages and deactivated at high voltages.				

Displacement PF of (U)

No.	Parameter	Unit	Min - Max	Increment	Default
P283	**Sampling point PF(U1)**	PF	-0.9999 1	0.000 01	0.95
	PF specification of the first sampling point of the PF (U) characteristic curve. The characteristic curve has 4 sampling points that must be parameterized accordingly. Under-excited operation is characterized by a negative sign before the displacement factor.				
P285	**Sampling point PF(U2)**	PF	-0.9999 1	0.000 01	1
P287	**Sampling point PF(U3)**	PF	-0.9999 1	0.000 01	1
P289	**Sampling point PF(U4)**	PF	-0.9999 1	0.000 01	-0.95
P282	**Sampling point PF(U) U1**	%(U_n)	80 120	0.01	94
	Voltage specification of the first sampling point of the PF(U) characteristic curve. The characteristic curve has 4 sampling points.				
P284	**Sampling point PF(U) U2**	%(U_n)	80 120	0.01	96
P286	**Sampling point PF(U) U3**	%(U_n)	80 120	0.01	104
P288	**Sampling point PF(U) U4**	%(U_n)	80 120	0.01	106
P290	**Time constant 3Tau PF(U)**	s	0.01 300	0.01	10

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No.	Parameter	Unit	Min - Max	Increment	Default
	When controlling according to the PF (U) characteristic curve, time until 95 % of the reactive power setpoint (3τ) is reached. The control behavior corresponds to that of a PT1 element.				
P291	**Watchdog reaction reactive power mode PF(U)** Variable, default: PF(U)				
	Selection of the reactive power mode to which the watchdog reaction switches when the PF(U) function is active. Switchover takes place if the telecontrol system fails (see *P098 Reactive power watchdog mode*). If the PF(U) function is selected, the reactive power mode is not switched.				

Voltage control specifications in U setpoint mode

No.	Parameter	Unit	Min - Max	Increment	Default
P173	**U Setpoint mode Control P proportional gain**	%	0 100000	0.01	0
	Active weighting of the P component of the voltage controller. If the parameter value is "0", the value is not effective.				
P175	**U Setpoint mode Control D proportional gain**	%	0 100000	0.01	0
	Active weighting of the D component of the voltage controller. If the parameter value is "0", the value is not effective.				
P174	**U Setpoint mode Control I proportional gain**	%	0 100000	0.01	0
	Active weighting of the I component of the voltage controller. If the parameter value is "0", the value is not effective.				
P179	**U Setpoint mode PID sampling time**	s	0.02 100	0.01	10
	Active sampling time of the PID algorithm.				
P197	**Time constant 3Tau U setpoint mode**	s	0.01 300	0.01	10
	When controlling according to U setpoint mode, time until 95 % of the reactive power setpoint (3τ) is reached. The control behavior corresponds to that of a PT1 element.				
P157	**Watchdog reaction reactive power mode U setpoint mode** Variable, default: U setpoint mode				
	Selection of the reactive power mode to which the watchdog reaction switches when U setpoint mode is active. Switchover takes place in the event of a telecontrol system failure (see *P098 Reactive power watchdog mode*) or in the event of an invalid signal when a value is specified via an analog input. If U setpoint mode is selected, the reactive power mode is not switched.				

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No.	Parameter	Unit	Min - Max	Increment	Default
P321	**Watchdog replacement value mode U setpoint mode** Variable, default: Keep value				
	If the U setpoint mode was selected as the reaction in the event of a telecontrol system failure (watchdog response) (regardless of which reactive power mode was previously active), either a fixed value or the last valid value can be selected here as the voltage setpoint. • Keep value: Keep last valid value. • Fixed value: activates parameter *P162 Watchdog fixed replacement value U setpoint mode*.				
P162	**Watchdog fixed replacement value U Setpoint mode**	%(U_n)	80 120	0.01	100
	Fixed replacement value for voltage specification in the event of a fault.				
P160	**U setpoint mode source** Variable, default: Fixed value				
	A voltage setpoint can be specified in one of the following ways: • Fixed value: a voltage setpoint is specified via parameter *P161 U setpoint mode fixed value*. • Analog: the value is specified via the analog input `Uset specification for U setpoint mode`. The scaling of the analog signal is set via the parameters *P312 Uset specification for U setpoint mode AI (at 4 mA)* and *P311 Uset specification for U setpoint mode AI (at 20 mA)*. • Modbus: the value is specified via Modbus TCP.				
P161	**U setpoint mode fixed value**	%(U_n)	80 120	0.01	100
	Fixed setpoint for voltage demand in normal operation.				

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Assignment of analog and digital inputs

No.	Parameter	Unit	Min - Max	Increment	Default
P256	**Parameterizable input AI1** Variable, default: operator power demand				
	Assignment of a functionality for the analog input `AI1`: • Not used • Operator power demand • Direct sales power demand • Mains operator power demand • Mains operator power limitation • Permissible power • Setpoint secondary frequency control • UQ0 specification for Q(U)+UQ0 • Qref specification for Q(U)+Qref • PF specification • Uset specification for U setpoint mode • Qset specification for Q setpoint mode • Measured voltage value • Test mode frequency offset Test mode voltage replacement value				
P257	**Parameterizable input AI2** Variable, default: Direct sales power demand				
P258	**Parameterizable input AI3** Variable, default: Mains operator power limitation				
P259	**Parameterizable input AI4** Variable, default: Setpoint secondary frequency control				
P260	**Parameterizable input AI5** Variable, default: Measured voltage value				
P261	**Parameterizable input AI6** Variable, default: UQ0 Default for Q(U) + UQ0				
P262	**Parameterizable input AI7** Variable, default: Qref Default for Q(U) + Qref				

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No.	Parameter	Unit	Min - Max	Increment	Default
P263	**Parameterizable input AI8** Variable, default: PF specification				
P300	**Parameterizable input AI9** Variable, default: Permissible power				
P301	**Parameterizable input AI10** Variable, default: Mains operator power demand				
P302	**Parameterizable input AI11** Variable, default: Test mode frequency offset				
P303	**Parameterizable input AI12** Variable, default: Qset specification for Q setpoint mode				
P304	**Parameterizable input AI13** Variable, default: Uset specification for U setpoint mode				
P305	**Parameterizable input AI14** Variable, default: Test mode voltage replacement value				
P306	**Parameterizable input AI15** Variable, default: Not used				
P307	**Parameterizable input AI16** Variable, default: Not used				
P205	**Parameterizable input DI 1** Variable, default: Operator demand				

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No.	Parameter	Unit	Min - Max	Increment	Default
	Assigning a functionality for the digital input DI1: • Not used • Operator demand • Direct sales demand • Mains operator demand • Mains operator power limitation level 1 • Mains operator power limitation level 2 • Mains operator power limitation level 3 • Mains operator power limitation level 4 • Reactive power mode selection DI1 • Reactive power mode selection DI2 • Reactive power mode selection DI3 • PF demand DI1 • PF demand DI2 • PF demand DI3 • PF demand DI4 • PF demand DI5 • Watchdog reactive power demand • Enable reconnection after mains decoupling • Activate ramp and connection conditions after mains decoupling • FSM demand • Disable LFSM • Disable LFSM-O • Disable LFSM-U • LFSM-O reset • Secondary frequency control active • ILF Reset Keep active power reserve free				
P206	**Parameterizable input DI 2** Variable, default: Direct sales demand				
P207	**Parameterizable input DI 3** Variable, default: Mains operator power limitation level 1				

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No.	Parameter	Unit	Min - Max	Increment	Default
P208	**Parameterizable input DI 4** Variable, default: Mains operator power limitation level 2				
P209	**Parameterizable input DI 5** Variable, default: Mains operator power limitation level 3				
P210	**Parameterizable input DI 6** Variable, default: Mains operator power limitation level 4				
P211	**Parameterizable input DI 7** Variable, default: Selection of reactive power mode DI 1				
P212	**Parameterizable input DI 8** Variable, default: Selection of reactive power mode DI 2				
P213	**Parameterizable input DI 9** Variable, default: Selection of reactive power mode DI 3				
P214	**Parameterizable input DI 10** Variable, default: PF specification DI1				
P215	**Parameterizable input DI 11** Variable, default: PF specification DI2				
P216	**Parameterizable input DI 12** Variable, default: PF specification DI3				
P217	**Parameterizable input DI 13** Variable, default: PF specification DI4				

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No.	Parameter	Unit	Min - Max	Increment	Default
P218	**Parameterizable input DI 14** Variable, default: PF specification DI5				
P219	**Parameterizable input DI 15** Variable, default: Watchdog reactive power demand				
P156	**Parameterizable input DI 16** Variable, default: Enable reconnection after mains decoupling				

Scaling of analog inputs and outputs

No.	Parameter	Unit	Min - Max	Increment	Default
P004	**Active power demand at TEM AO (at 4 mA)**	%(P_n)	-5 150	0.1	0
	Lower limit of the active power demand of the GDI to the TEM via the analog output `Active power demand to TEM`. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P005	**Active power demand at TEM AO (at 20 mA)**	%(P_n)	-5 150	0.1	100
	Upper limit of the active power demand of the GDI to the TEM via the analog output Active power demand to TEM. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P006	**Reactive power demand to AVR AO (at 4 mA)**	kVAr	-5000 5000	0.1	-150
	Lower limit of the reactive power demand of the GDI to the generator controller (AVR) via the analog output `Reactive power request to AVR`. Reactive power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limits.				
P007	**Reactive power demand to AVR AO (at 20 mA)**	kVAr	-5000 5000	0.1	150
	Upper limit of the reactive power demand of the GDI to the generator controller (AVR) via the analog output `Reactive power request to AVR`. Reactive power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limits.				

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No.	Parameter	Unit	Min - Max	Increment	Default
P008	**Plant operator power demand AI (at 4 mA)**	%(P_n)	-5 150	0.1	0
	Lower limit of the active power demand of the plant operator to the GDI via the analog input `Operator power demand`. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P009	**Plant operator power demand AI (at 20 mA)**	%(P_n)	-5 150	0.1	100
	Upper limit of the active power demand of the plant operator to the GDI via the analog input Operator power demand. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P010	**Direct sales power demand AI (at 4 mA)**	%(P_n)	-5 150	0.1	0
	Lower limit of the active power demand of third parties (e.g. a direct seller) to the GDI via the analog input `Direct sales power demand`. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P011	**Direct sales power demand AI (at 20 mA)**	%(P_n)	-5 150	0.1	100
	Upper limit of the active power demand of third parties (e.g. a direct seller) to the GDI via the analog input `Direct sales power demand`. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P039	**Mains operator power limitation AI (at 4 mA)**	%(P_n)	-5 150	0.1	0
	Lower limit of the active power limitation by the mains operator via the analog input Mains operator power limitation. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limits.				
P040	**Mains operator power limitation AI (at 20 mA)**	%(P_n)	-5 150	0.1	100
	Upper limit of the active power limitation by the mains operator via the analog input `Mains operator power limitation`. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limits.				
P333	**Secondary control Offset AI (at 4 mA)**	%(P_n)	-100 0	0.01	-10
	Lower limit of the specification of the active power offset of the secondary frequency control to the GDI via the analog input `Setpoint secondary frequency control`. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P332	**Secondary control Offset AI (at 20 mA)**	%(P_n)	0 100	0.01	10

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No.	Parameter	Unit	Min - Max	Increment	Default
	Upper limit of the specification of the active power offset of the secondary frequency control to the GDI via the analog input `Setpoint secondary frequency control`. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P042	**Measured voltage value for reactive power modes AI (at 4 mA)**	$\%(U_n)$	-5 150	0.01	90
	External measured voltage value if an input current of 4 mA is measured at the GDI analog input `Voltage measured value`. The range between 4 mA and 20 mA is interpolated linearly.				
P043	**Measured voltage value for reactive power modes AI (at 20 mA)**	$\%(U_n)$	-5 150	0.01	110
	External measured voltage value if an input current of 20 mA is measured at the GDI analog input `Voltage measured value`. The range between 4 mA and 20 mA is interpolated linearly.				
P052	**UQ0 Specification for Q(U) + UQ0 AI (at 4 mA)**	$\%(U_n)$	80 120	0.01	94
	Specified voltage UQ0 when an input current of 4 mA is measured at the GDI's analog input `Specification for Q(U)+UQ0`. The range between 4 mA and 20 mA is interpolated linearly.				
P053	**UQ0 Specification for Q(U) + UQ0 AI (at 20 mA)**	$\%(U_n)$	80 120	0.01	106
	Specified voltage UQ0 when an input current of 20 mA is measured at the GDI's analog input `UQ0 specification for Q(U)+UQ0`. The range between 4 mA and 20 mA is interpolated linearly.				
P083	**Qref specification for Q(U) + Qref AI (at 4 mA)**	$\%(P_n)$	-100 100	0.01	-33
	Setpoint of the reactive power value Qref when an input current of 4 mA is measured at the GDI's analog input `Qref specification for Q(U)+Qref`. The range between 4 mA and 20 mA is interpolated linearly.				
P084	**Qref specification for Q(U) + Qref AI (at 20 mA)**	$\%(P_n)$	-100 100	0.01	33
	Setpoint of the reactive power value Qref when an input current of 20 mA is measured at the GDI's analog input `Qref specification for Q(U)+Qref`. The range between 4 mA and 20 mA is interpolated linearly.				
P085	**PF specification AI (at 4 mA)**	PF	-0.999 1	0.000 001	-0.95
	Setpoint of the displacement PF when an input current of 4 mA is measured at the GDI's analog input `PF specification`. Under-excited operation is characterized by a negative sign before the displacement factor. The range between 4 mA and 20 mA is interpolated linearly.				
P086	**PF specification AI (at 20 mA)**	PF	-0.999 1	0.000 001	0.8

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No.	Parameter	Unit	Min - Max	Increment	Default
	Setpoint of the displacement PF when an input current of 20 mA is measured at the GDI's analog input `PF specification`. Under-excited operation is characterized by a negative sign before the displacement factor. The range between 4 mA and 20 mA is interpolated linearly.				
P272	**Permissible power AI (at 4 mA)**	%(P_n)	-5 150	0.1	0
	Lower limit of the permissible power via the analog input `Permissible power`. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P273	**Permissible power AI (at 20 mA)**	%(P_n)	-5 150	0.1	100
	Upper limit of the permissible power via the analog input `Permissible power`. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P199	**Mains operator power demand AI (at 4 mA)**	%(P_n)	-5 150	0.1	0
	Lower limit of the mains operator's active power demand to the GDI via the analog input `Mains operator power demand`. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P200	**Mains operator power demand AI (at 20 mA)**	%(P_n)	-5 150	0.1	100
	Upper limit of the mains operator's active power demand to the GDI via the analog input `Mains operator power demand`. Active power demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P191	**Frequency offset AI (at 4 mA)**	Hz	-10 10	0.01	0
	Lower limit of the specification of a test offset on the frequency to the GDI via the analog input `Test mode frequency offset`. Demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P192	**Frequency offset AI (at 20 mA)**	Hz	-10 10	0.01	0
	Upper limit of the specification of a test offset on the frequency to the GDI via the analog input `Test mode frequency offset`. Demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P310	**Qset specification for Q setpoint mode AI (at 4 mA)**	%(P_n)	-100 100	0.01	33
	Setpoint of the reactive power demand Qset, if an input current of 4 mA is measured at the GDI's analog input `Qset specification for Q setpoint mode`. The range between 4 mA and 20 mA is interpolated linearly.				
P309	**Qset specification for Q setpoint mode AI (at 20 mA)**	%(P_n)	-100 100	0.01	-33

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No.	Parameter	Unit	Min - Max	Increment	Default
	Setpoint of the reactive power demand Qset, if an input current of 20 mA is measured at the GDI's analog input `Qset specification for Q setpoint mode`. The range between 4 mA and 20 mA is interpolated linearly.				
P312	**Uset specification for U setpoint mode AI (at 4 mA)**	%(U_n)	80 120	0.01	106
	Setpoint of the voltage specification Uset if an input current of 4 mA is measured at the GDI's analog input `Uset specification for U setpoint mode`. The range between 4 mA and 20 mA is interpolated linearly.				
P311	**Uset specification for U setpoint mode AI (at 20 mA)**	%(U_n)	80 120	0.01	94
	Setpoint of the voltage specification Uset if an input current of 20 mA is measured at the GDI's analog input `Uset specification for U setpoint mode`. The range between 4 mA and 20 mA is interpolated linearly.				
P331	**Replacement voltage AI (at 4 mA)**	%(U_n)	-5 150	0.01	90
	Lower limit for specifying a voltage in test mode to the GDI via the analog input `Test mode voltage replacement value`. Demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				
P330	**Replacement voltage AI (at 20 mA)**	%(U_n)	-5 150	0.01	110
	Upper limit for specifying a voltage in test mode to the GDI via the analog input `Test mode voltage replacement value`. Demands between 4 mA and 20 mA are interpolated linearly based on the upper and lower limit.				

TEM MFR configuration and Modbus communication

No.	Parameter	Unit	Min - Max	Increment	Default
P187	**TEM MFR IP Address[1]**		0 255	1	172
	First digit of the IP address of the TEM MFR. The complete IP address is specified via parameters *P187*, *P188*, *P189* and *P190*.				
P188	**TEM MFR IP Address[2]**		0 255	1	22
P189	**TEM MFR IP Address[3]**		0 255	1	20
P190	**TEM MFR IP Address[4]**		0 255	1	21

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No.	Parameter	Unit	Min - Max	Increment	Default
P196	**Switchover DO TEM warning** Variable, default: active high				
	Switchover of the digital output `TEM warning`. • `Active high`: if a warning message is present, a voltage of 24 V is present at the digital output `TEM warning`. • `Active low`: if a warning message is present, a voltage of 0 V is present at the digital output `TEM warning`.				
P185	**Modbus Server option** Variable, default: Deactivated				
	Option to activate the Modbus server to enable the GDI to communicate with higher-level devices via Modbus TCP.				
P274	**Modbus Server: Local Port**		0 49151	1	503
	GDI port used.				
P295	**Write FSM parameters via Modbus** Variable, default: Deactivated				
	Activates or deactivates the authorization to write FSM parameter values via Modbus TCP.				
P296	**Write active power ramps via Modbus** Variable, default: Deactivated				
	Activates or deactivates the authorization to write the parameter values of the active power ramps via Modbus TCP.				

4.5.2 Inputs and outputs

Parameterization

The assignment of the analog inputs and the digital inputs can be parameterized. The assignment is made via the user interface of the web server.

Further information on the user interface

- For parameter inputs and outputs, see chapter 4.3.5 I/O configuration tab 44

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Analog inputs (default assignment)

GDI: Type / No.	Signal name	Description
AI1	Operator power demand	Specification of the active power setpoint for the genset by the plant operator. The active power setpoint is specified by an input current between 4 mA and 20 mA. Alternatively, the power can be specified via Modbus TCP. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P008 Plant operator active power demand AI at (4 mA) • P009 Plant operator active power demand AI at (20 mA)
AI2	Direct sales power demand	Determination of the active power setpoint for the genset by a third party (e.g. direct seller). The active power setpoint is specified by an input current between 4 mA and 20 mA. Alternatively, the power can be specified via Modbus TCP. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P010 Direct sales power demand AI (at 4 mA) • P011 Direct sales power demand AI (at 20 mA)
AI3	Mains operator power limitation	Limitation of the active power by the mains operator as part of mains safety management. The active power limitation is specified by an input current between 4 mA and 20 mA. Alternatively, the setpoint can be specified via Modbus TCP. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P039 Mains operator power limitation AI (at 4 mA) • P040 Mains operator power limitation AI (at 20 mA)
AI4	Setpoint secondary frequency control	Demand of an active power offset for the provision of secondary control power. The active power offset is specified by an input current between 4 mA and 20 mA. Alternatively, the power limitation can be set via four digital inputs or Modbus TCP. For more information on the parameters, see chapter 4.5.1.12 Secondary control power setpoint specifications 77 • P233 Secondary control power lower reserve • P234 Secondary control power upper reserve

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GDI: Type / No.	Signal name	Description
AI5	Measured voltage value	Measured voltage at the mains connection point of the generation plant. The voltage measured value is required for the reactive power functionality of the Grid Demand Interface. The measured voltage is indicated by an input current between 4 mA and 20 mA. Alternatively, the voltage measurement values can be specified externally via Modbus TCP. The voltage measurement of the TEM MFR is used by default. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P042 Measured voltage value for reactive power modes AI (at 4 mA) • P043 Measured voltage value for reactive power modes AI (at 20 mA)
AI6	UQ0 specification for Q(U) +UQ0	Specification of a voltage value UQ0 by the mains operator for parallel offset of the Q(U) characteristic curve when using the reactive power mode: Q(U) + UQ0. The voltage value UQ0 is specified by an input current between 4 mA and 20 mA. Alternatively, the UQ0 specification can be made via Modbus TCP. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P052 Q(U) UQ0 specification for Q(U) + UQ0 AI (at 4 mA) • P053 Q(U) UQ0 specification for Q(U) + UQ0 AI (at 20 mA)
AI7	Qref specification for Q(U) + Qref	Specification of a reactive power value Qref by the mains operator for shifting the reactive power characteristic curve when using the reactive power mode: Q(U) + Qref. The reactive power value Qref is specified by an input current between 4 mA and 20 mA. Alternatively, the Qref specification can be made via Modbus TCP. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P083 Qref specification for Q(U) + Qref AI (at 4 mA) • P084 Qref specification for Q(U) + Qref AI (at 20 mA)

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

GDI: Type / No.	Signal name	Description
AI8	PF specification	Specification of a displacement PF by the mains operator to change the reactive power output when using the reactive power mode: PF. The displacement PF is specified by an input current between 4 mA and 20 mA. Alternatively, PF can be specified via digital inputs or Modbus TCP. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P085 PF specification AI (at 4 mA) • P086 PF specification AI (at 20 mA)
AI9	Permissible power	Optional analog input for specifying a permissible power, for example due to power limitations by the TEM system. The permissible power is specified by an input current between 4 mA and 20 mA. Alternatively, the specification can be made via Modbus TCP. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P272 Permissible power AI (at 4 mA) • P273 Permissible power AI (at 20 mA)
AI10	Mains operator power demand	Specification of the active power setpoint for the genset by the mains operator. The active power setpoint is specified by an input current between 4 mA and 20 mA. Alternatively, the power can be specified via Modbus TCP. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P199 Mains operator power requirement AI (at 4 mA) • P200 Mains operator power requirement AI (at 20 mA)
AI11	Test mode frequency offset	Specification of a frequency offset for testing frequency-dependent active power functions. The specification of a frequency offset is only possible when test mode is activated. The frequency offset is specified by an input current between 4 mA and 20 mA. Alternatively, the specification can be made via Modbus TCP. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P191 Frequency offset AI (at 4 mA) • P192 Frequency offset AI (at 20 mA)

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GDI: Type / No.	Signal name	Description
AI12	Qset specification for Q set-point mode	Specification of a reactive power setpoint Qset by the mains operator when using the reactive power mode: Q setpoint mode. The reactive power setpoint Qset is specified by an input current between 4 mA and 20 mA. Alternatively, the Qset specification can be made via Modbus TCP. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P310 Qset specification for Q setpoint mode AI (at 4 mA) • P309 Qset specification for Q setpoint mode AI (at 20 mA)
AI13	Uset specification for U set-point mode	Specification of a voltage setpoint Uset by the mains operator when using the mode: U setpoint mode. The voltage setpoint Uset is specified by an input current between 4 mA and 20 mA. Alternatively, the Uset specification can be made via Modbus TCP. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P312 Uset specification for U setpoint mode AI (at 4 mA) • P311 Uset specification for U setpoint mode AI (at 20 mA)
AI14	Test mode replacement value	Specification of a simulated voltage value for testing voltage-dependent functions. The specification of a frequency offset is only possible when test mode is activated. The voltage offset is specified by an input current between 4 mA and 20 mA. Alternatively, the specification can be made via Modbus TCP. For more information on the parameters, see chapter 4.5.1.23 Scaling of analog inputs and outputs 97 • P331 Replacement voltage AI (at 4 mA) • P330 Replacement voltage AI (at 20 mA)

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Digital inputs (default assignment)

<table>
<tr><th>GDI:
Type
/
No.</th><th>Signal name</th><th colspan="4">Description</th></tr>
<tr><td>DI1</td><td>Operator demand</td><td colspan="4">Start contact in the event of an active power demand to the genset by the plant operator.</td></tr>
<tr><td>DI2</td><td>Direct sales demand</td><td colspan="4">Start contact in the event of an active power demand to the genset by a third party (e.g. a direct seller).</td></tr>
<tr><td>DI3
DI4
DI5
DI6</td><td>Mains operator power limitation DI3, DI4, DI5, DI6</td><td colspan="4">Limitation of the active power by the mains operator as part of mains safety management.
Alternatively, the power limitation can be set via an analog input (AI3) or Modbus TCP.
For more information on the parameters, see chapter 4.5.1.6 Mains operator 68
• DI3 / P033 Mains operator power limitation level 1
• DI4 / P034 Mains operator power limitation level 2
• DI5 / P035 Mains operator power limitation level 3
• DI6 / P036 Mains operator power limitation level 4</td></tr>
<tr><td rowspan="10">DI7
DI8
DI9</td><td rowspan="10">Reactive power mode DI1, DI2, DI3 (optional)</td><td colspan="4">Selection of the reactive power mode by the mains operator.</td></tr>
<tr><td>DI1</td><td>DI2</td><td>DI3</td><td>Reactive power mode</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>PF</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Q(U)+Qref</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Q(P)</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Q(U)+UQ0</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Q setpoint mode</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>PF (P)</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>U setpoint mode</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>PF (U)</td></tr>
</table>

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Digital inputs (without pre-assignment)

GDI: Type / No.	Signal name	Description
DI_	Activate ramp and connection conditions after mains decoupling	Optional digital input for activating the ramp and the switch-on conditions after a mains decoupling.
DI_	Activate FSM	Optional digital input to activate the FSM function.
DI_	Disable LFSM	Optional digital input for blocking the LFSM-O and LFSM-U function. If a voltage of 24 V is present at this input, the LFSM function is deactivated.
DI_	Disable LFSM-O	Optional digital input for blocking the LFSM-O function. If a voltage of 24 V is present at this input, the LFSM-O function is deactivated.
DI_	Disable LFSM-U	Optional digital input for blocking the LFSM-U function. If a voltage of 24 V is present at this input, the LFSM-U function is deactivated.
DI_	LFSM-O reset	Optional input for resetting the LFSM-O limit value mode if this is activated and active via parameter P138. For more information on the parameters, see chapter 4.5.1.9 Limited Frequency Sensitive Mode (LFSM) 72
DI_	Activate secondary control power setpoint value and / or ILF	Optional digital input to activate the secondary control power setpoint and / or the ILF function. Parameter P232 is used to set whether this digital input is evaluated for activation of the secondary control power setpoint. Parameter P237 is used to set whether this digital input is evaluated for activation of the ILF function. For more information on the parameters, see chapter 4.5.1.11 Frequency steady-state with Integral Local Frequency (ILF) 75
DI_	ILF reset	Optional digital input for resetting the ILF function. The ILF function is only reset via this digital input if the manual reset of the ILF function is selected via parameter 243. For more information on the parameters, see chapter 4.5.1.11 Frequency steady-state with Integral Local Frequency (ILF) 75
DI_	Keep active power reserve free	Optional digital input for activating the retention of an active power reserve for provision of primary and secondary control power. Parameter P128 is used to set whether this digital input is evaluated. How the active power reserve is kept free is described through this parameter. For more information on the parameters, see chapter 4.5.1.8 Frequency Sensitive Mode (FSM) 70

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5 Preservation, packaging, transport and storage

Table of contents

5.1 Symbols on the packaging..... 110
5.2 Removing from transport..... 111
5.3 Information on packaging..... 112

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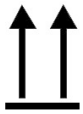
5.1 Symbols on the packaging

	**Top** Shows the correct upright position of the package. Only transport and store the packages in an upright position.
	**Protect from moisture** Protect packages from moisture and store in a dry place.
	**Fragile** Indicates packages with fragile or damageable contents. Treat packages with care, do not throw and be careful not to knock or bump them.

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5.2 Removing from transport

Immediately check the delivery for completeness and transport damage upon receipt.

In the event of visible transport damage on the outside, proceed as follows:

1. Do not accept the delivery or only accept under reserve
2. Note the extent of the damage on the transport documents or on the hauler's delivery note
3. Lodge complaint

Note

Make a claim for each fault as soon as it is detected. Claims for damage may only be made within the legal and contractually agreed claim deadlines.

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5.3 Information on packaging

The individual packages are packed according to the transport conditions to be expected.

Note

For required information on packaging, see

- Operating Manual ⇒ General ⇒ Operating media regulations
  - Technical Bulletin (TR) 2169 Specification for preservation, packaging, transport and storage

The packaging should protect the individual components up to assembly. Therefore, do not destroy the packaging and only remove it directly before assembly.

Handling packaging materials

Danger to the environment

Incorrect disposal of packaging materials may cause environmental damage.

- Dispose of packaging material according to the respectively applicable legal regulations and local specifications.
- Pass recyclable packaging material on to be recycled
- Commission a specialist company if necessary

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

6 Assembly

Table of contents

6.1 Safety notes ... 114
6.2 General ... 115
6.2.1 Guidelines ... 115
6.2.2 Local situation and documents ... 115
6.2.3 Power supply timing ... 115
6.3 Scope of delivery ... 116
6.4 Own share ... 117
6.5 Preparation ... 118
6.5.1 Signal lines provided by the operator and Grid code ... 118
6.6 Assembly ... 119
6.6.1 Installation site ... 119
6.6.2 Switching off the voltage supply ... 120
6.6.3 Installing Grid Demand Interface and connecting equipotential bonding ... 120
6.7 Cable routing and connection ... 122
6.7.1 Overview of connections ... 122
6.7.2 Leading the cables into the switchgear cabinet ... 123
6.7.3 Connecting the generator controller ... 124
6.7.4 Connecting the power supply ... 126
6.7.5 Connecting the TEM-MFR ... 127
6.7.6 Connecting digital module and analog module ... 128
6.7.7 Electrical checks ... 133

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6.1 Safety notes

WARNING!

Electric shock if live components are touched

This can lead to severe injuries and even death.

- Only authorized specialist personnel may work on the electrical system.
- Turn off electrical power supply and secure against restarting:
  - Disconnect electrical system.
  - Secure against reconnection.
  - Check that equipment is de-energized.
  - Ground and short-circuit the electrical system.
  - Cover or cordon off adjacent components which are electrically live.

The disconnection of the plant also includes the measuring lines. Since individual measuring lines are connected upstream of the generator circuit breaker (GLS), they can carry mains voltage even when the genset is stopped and the power supply of the switchgear cabinet is disconnected.

WARNING!

Injury due to improper installation

This can lead to severe injuries and even death.

- Only authorized specialist personnel may install the product.
- Ensure sufficient installation space.
- Handle sharp-edged components carefully.
- Ensure tidiness and cleanliness in the workplace.
  - Do not leave tools lying around.
  - Components left lying around and on top of one another are accident hazards.
- Assemble components properly.
  - Observe specified tightening torques.
- Secure components from being knocked over or falling down.

Risk of destruction of components

Electrostatic charging of the assembly personnel or their tools can damage sensitive components or restrict their function.

- Observe handling regulations for components subject to electrostatic hazards

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6.2 General

6.2.1 Guidelines

All components must be assembled and connected properly. Depending on the region, additional demands may apply or acceptance testing may be required.

Tightening

The prescribed tightening torques for electrical operating equipment, housing, etc. must be adhered to.

Electrical connections

The cable routing and connections to electrical operating equipment must comply with the following general guidelines:

- Pay attention to the wiring diagram of the switchgear cabinet for installing and connecting the Grid Demand Interface and the wiring diagram supplement during retrofitting
- Adhere to the specified cable routing in the switchgear cabinet. Route cables in the existing lateral cable ducts to the levels with the operating equipment such that they are free from tension. Comply with permissible bending radii. Secure cables with suitable fastening means
- Protect cables to be laid outside switchgear cabinets from damage and secure with suitable fastening means. Options for protecting cables include rigid or flexible conduits made of metal or plastic, cable ducts, or the use of cut-resistant cables. Comply with permissible bending radii.
- Properly install and close or seal entries for electrical connections in switchgear cabinets, etc.
- Cover open cable ends with a protective cap as a safeguard before installation
- Manufacture the connections and cable connections such that they cannot come loose during operation
- Secure the connections and cable connections such that they cannot be loosened easily by persons. The method of securing or loosening should require a tool
- Label unmarked cables or wires according to the wiring diagram
- Adapt technical documentation accordingly

6.2.2 Local situation and documents

This document describes the assembly and connection as realistically as possible according to the standard situation. If adjustments are to be made or if there are any queries, contact the responsible service partner.

The wiring diagram supplied always applies.

- Before assembly, compare the local situation with this manual and the wiring diagram

6.2.3 Power supply timing

Do not supply power to the system until all hardware is installed and all electrical connections are established.

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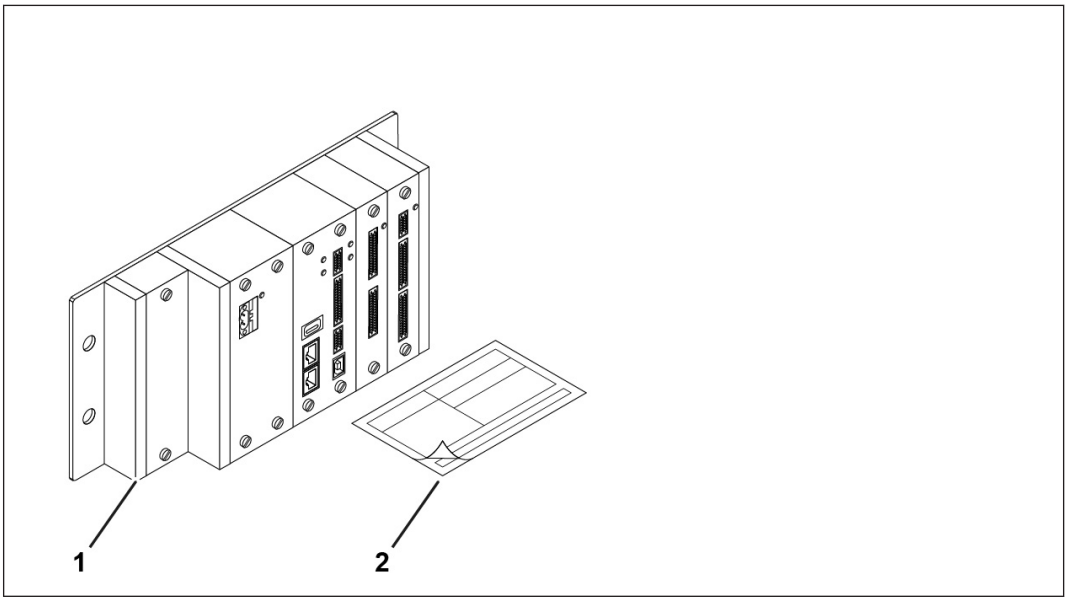
6.3 Scope of delivery

The Grid Demand Interface (1) consists of several hardware components which are already installed and programmed with a standard configuration.

The product includes a wiring diagram (2). The wiring diagram contains information about the installation location, the electrical connection and the interface designations for integration in an existing control system (TEM system).

Data sheets for configuration and parameter value lists for grid codes are available via SerLib. For security reasons, the login for comprehensive access to the user interface is protected by authorized service personnel.



75787-002 Example illustration of scope of delivery

1 Grid Demand Interface as assembly

2 Wiring diagram

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6.4 Own share

The following is also required for installation:

- Standard tools
- Standard fastening elements for electric cables
- Standard elements for cable entries into switchgear cabinets
- Fastening screws depending on the switchgear cabinet assembly system (4 pieces)
- Standard cables for analog signals to the generator controller
- Standard cables for analog and digital signal lines in the switchgear cabinet
- Cables for the 24 V DC power supply
- Cables provided by the operator from the control of the energy supply plant to the switchgear cabinet
- LAN patch cable for connecting the TEM-MFR

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6.5 Preparation

6.5.1 Signal lines provided by the operator and Grid code

The operator must provide various signal lines from the higher-level controller of the energy supply plant for connecting the Grid Demand Interface.

Signal lines for integrating the Grid Demand Interface into the control of the energy supply plant and Grid code-specific signal lines are generally needed.

- Prior to installation, determine which signal lines are required for the Grid code
- Check whether all signal lines provided by the operator are present and labeled

Further information

- TEM-GDI-02 wiring diagram documentation and project-accompanying documents
- Inputs and outputs, see chapter 4.5 Configuration specifications 59
- Copying templates for project-specific assignment of the digital module and the analog module, see chapter 12 Appendix 183

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

6.6 Assembly

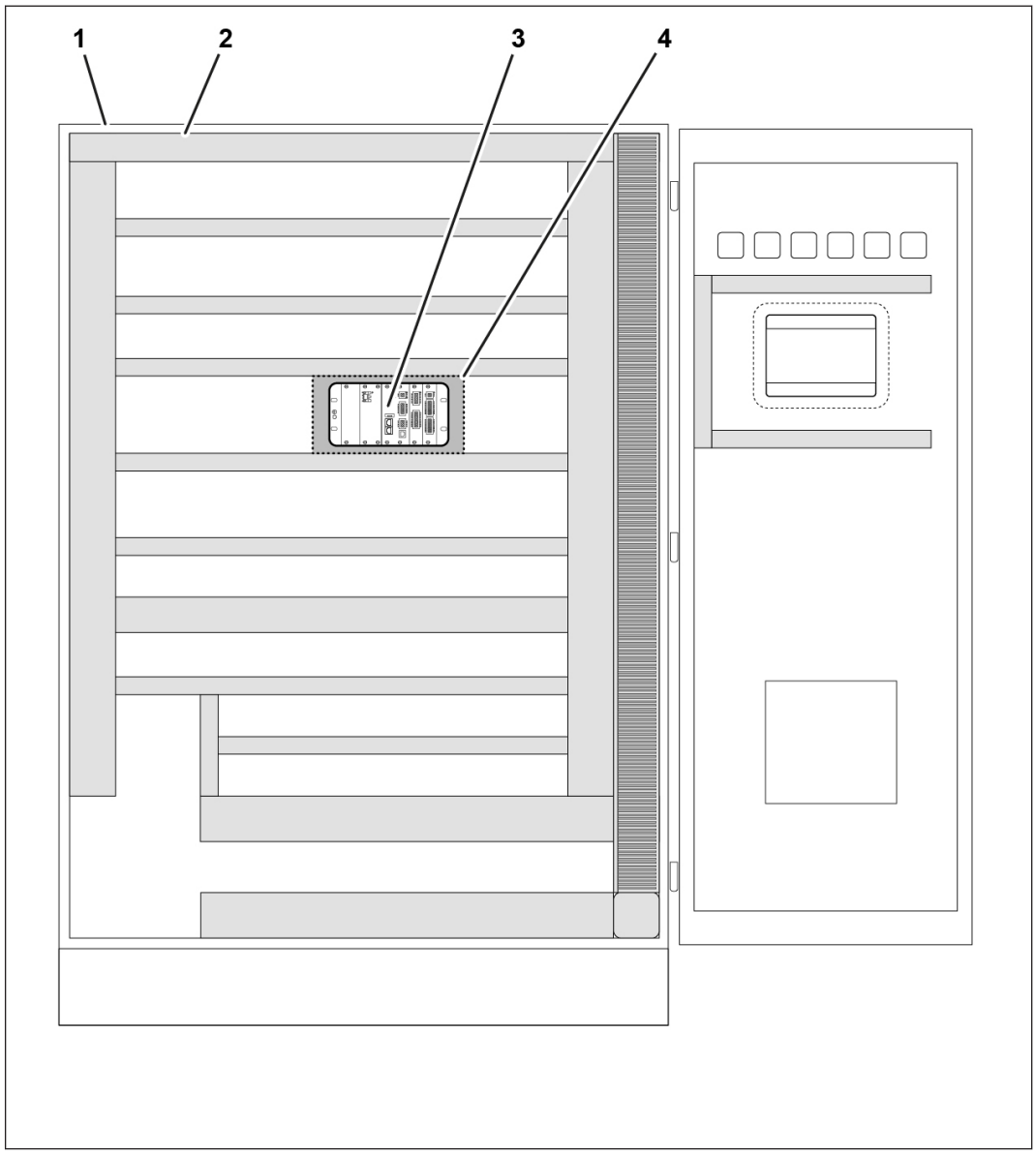
6.6.1 Installation site

Risk of destruction of components

Overheating of the Grid Demand Interface can lead to malfunctions and damage to the device

- Pay attention to information on clearance in the wiring diagram

Installation should take place in the auxiliary cabinet (HAS) if possible. The illustration shows an example installation location. Alternatively, a different installation location must be selected depending on the occupancy of the rails with operating elements.



75788-001 Example illustration of installation in the auxiliary cabinet (HAS)

1 Auxiliary cabinet (HAS)

2 Cable ducts for cable routing to the connecting locations

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3 Installation site

4 Clearance

6.6.2 Switching off the voltage supply

The connection of the power supply for the auxiliary cabinet depends on the design of the plant on site.

- Shut down energy supply unit (genset) and secure
- Disconnect incoming power supply and measuring lines, relieve strain and secure
- Open auxiliary cabinet and ensure safe working conditions. For necessary information on safety, see chapter 6.1 Safety notes 114

6.6.3 Installing Grid Demand Interface and connecting equipotential bonding

The type of installation depends on the situation on site, and is therefore described using examples. The connection of the Grid Demand Interface to the equipotential bonding system of the switchgear cabinet must be electrically conductive in order to safeguard the equipotential bonding.

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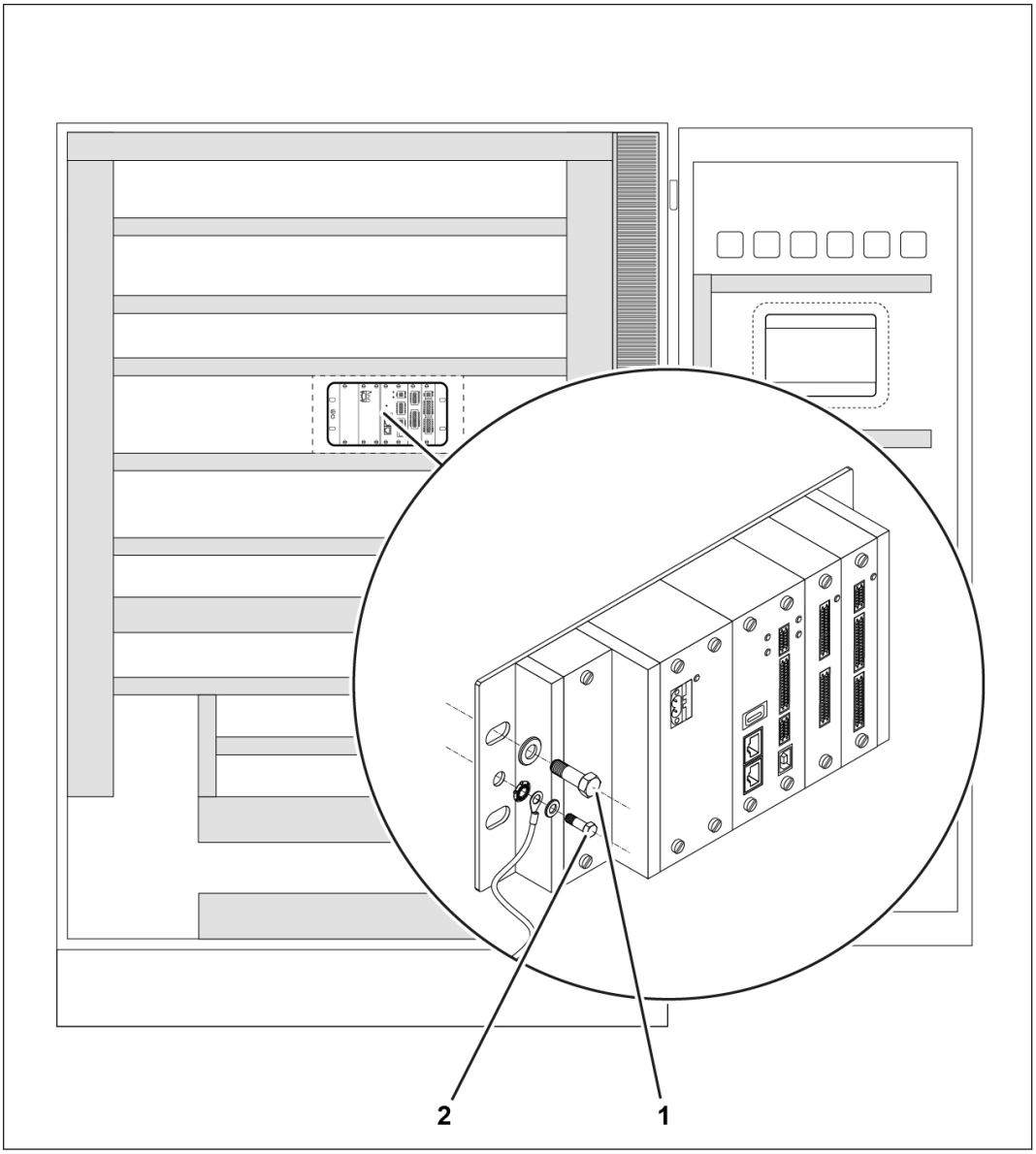


75789-001 Grid Demand Interface example illustration

- Position and install the Grid Demand Interface in the switchgear cabinet
  - Choose fastening materials (1) in accordance with the type of switchgear cabinet. Recommendation: M6 hex bolts and tightening torque of 5 Nm.
  - Use suitable screws and lock washers for reliable equipotential bonding (2). Recommendation: M5 hex bolts and tightening torque of 3 Nm

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

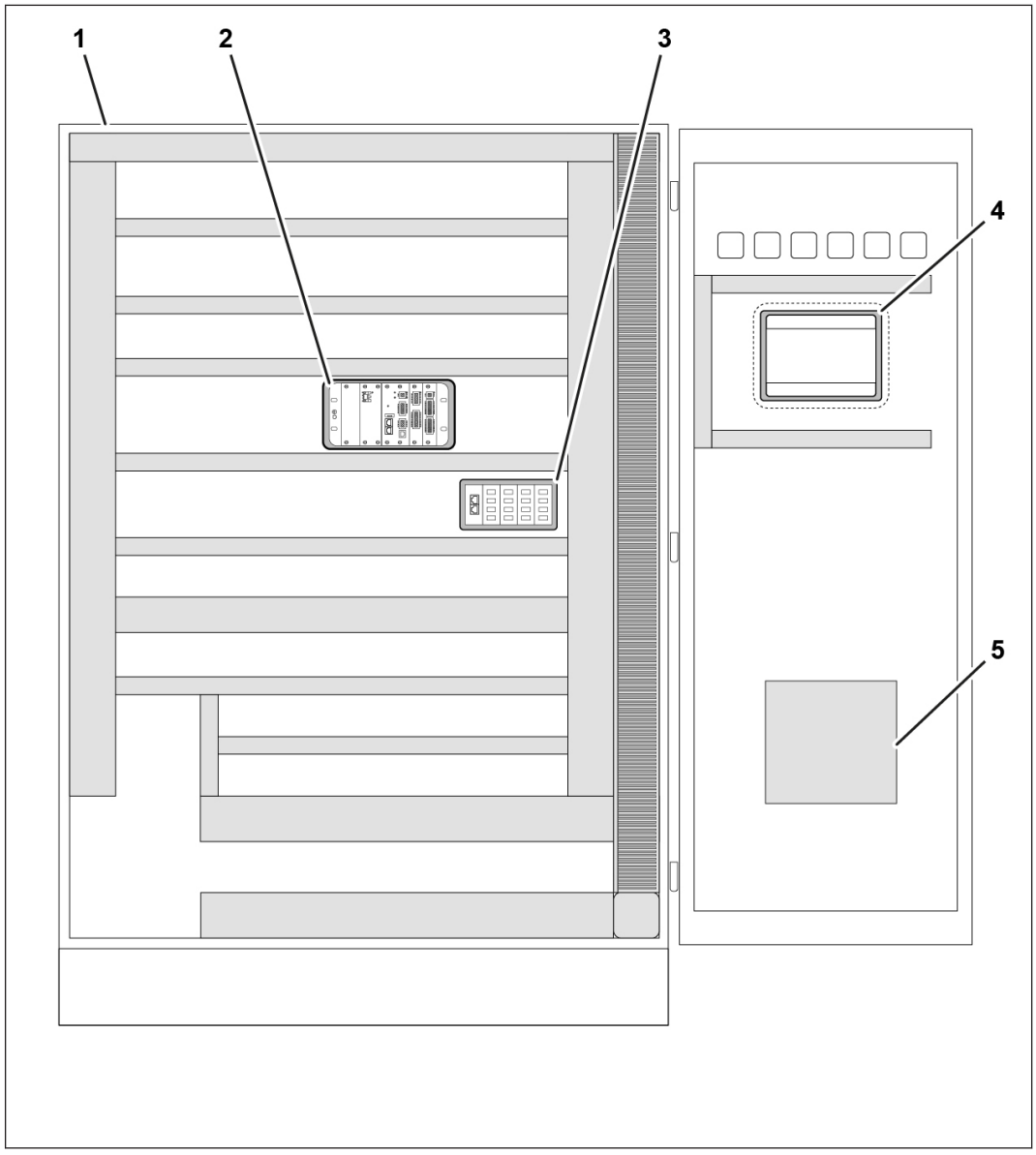
6.7 Cable routing and connection

6.7.1 Overview of connections

Auxiliary cabinet

The cable entry depends on the local conditions. With the auxiliary cabinet, the cable can enter from the top or the bottom.

The wiring diagrams are in the pocket (5). The provided and updated wiring diagram for the Grid Demand Interface (GDI) must be kept there.



75790-001 Example illustration of connections and cable routing in the auxiliary cabinet (HAS)

1 Auxiliary cabinet (HAS)

2 Grid Demand Interface

3 I/O Controller

4 TEM MFR

5 Pocket for wiring diagrams

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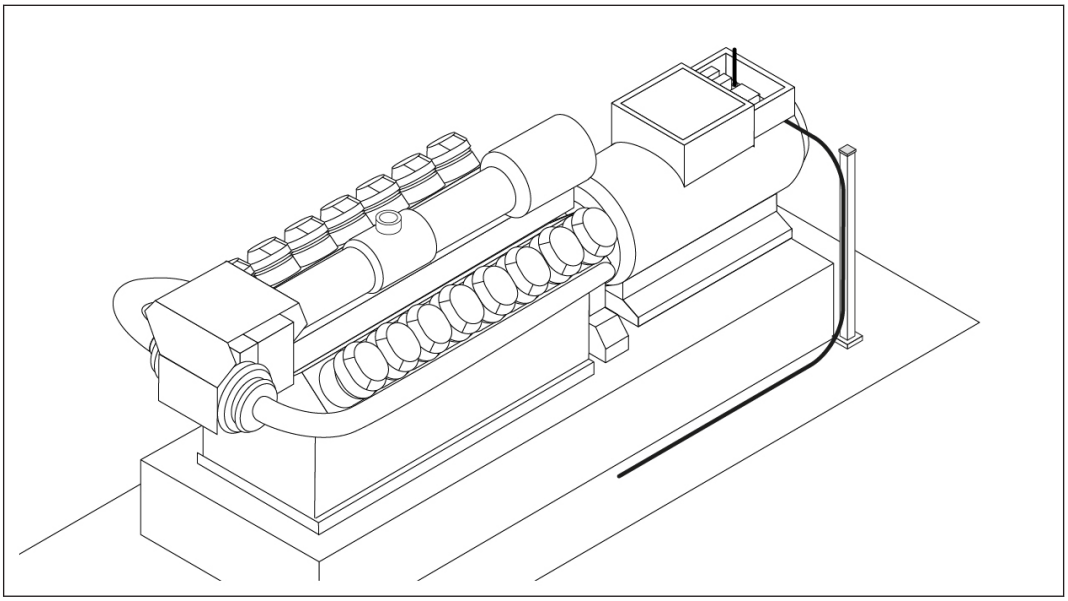
Generator controller

The cable routing depends on the local conditions. With the auxiliary terminal box, the cable can enter from the bottom.

A connecting cable is already prepared, depending on the project planning.



75791-001 Schematic example illustration of cable routing

For necessary information on the cabling, see

- Operating Manual ⇒ General ⇒ Application and Installation Guide
  - Power plants layout ⇒ Cabling

6.7.2 Leading the cables into the switchgear cabinet

The cable routing and the installation location must be selected on site according to the possible cable inlet and the occupancy of the rails with operating elements.

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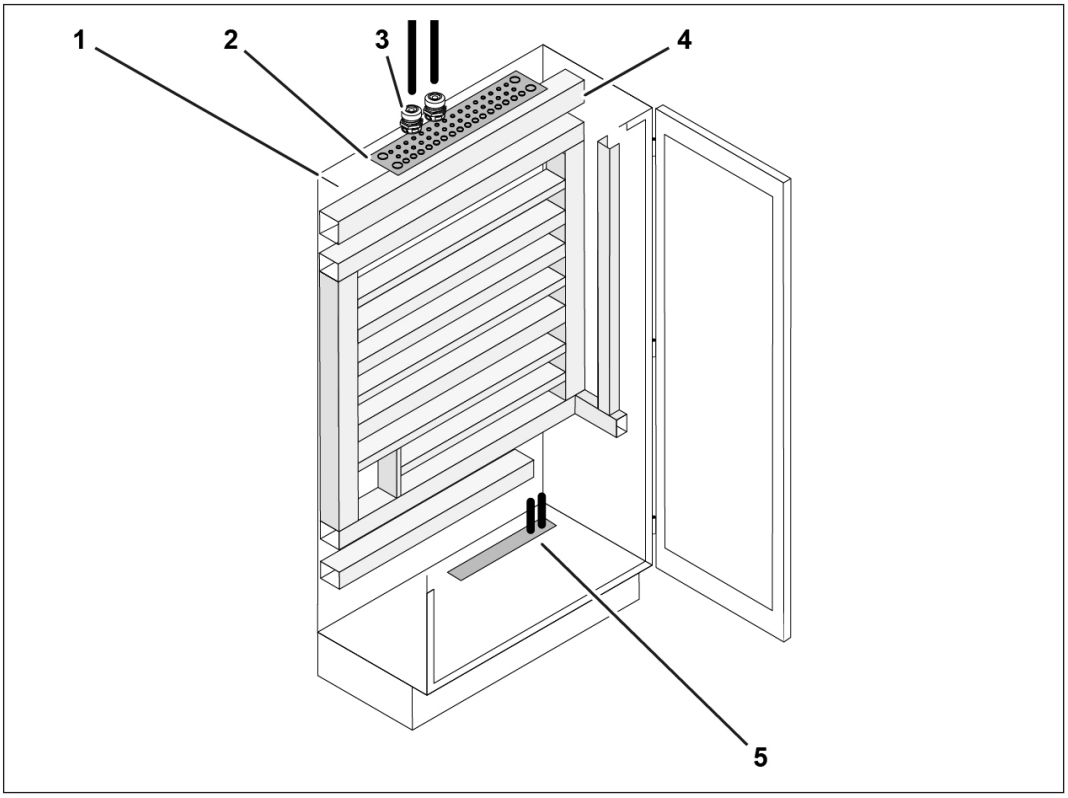

75792-001 Example illustration cable ducts in auxiliary cabinet

1 Cable duct

2 Top cable inlet

3 Cable gland (not included in the scope of delivery)

4 Cable ducts (example)

5 Bottom cable inlet

- Depending on the situation, prepare cable inlet (2) or (7) with e.g., cable glands
- Shorten the cables from the control of the energy supply plant to their approximate lengths and lead them into the auxiliary cabinet (HAS)
- Shorten the cables for the generator controller to their approximate lengths and lead them into the auxiliary cabinet (HAS)
- Seal the insertion point properly

6.7.3 Connecting the generator controller

The generator controller is in the auxiliary terminal box. The arrangement in the auxiliary terminal box and the layout of the terminal panel may differ depending on the type of generator.

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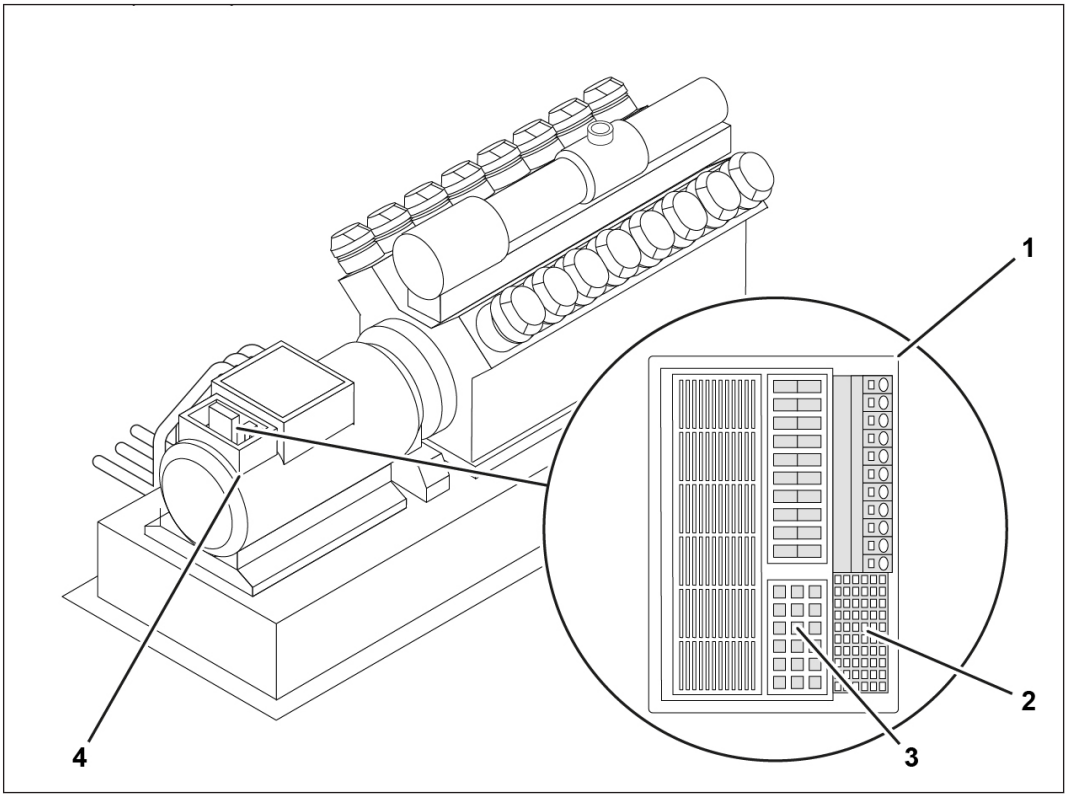

75793-001 Example illustration of ABB Unitrol generator controller

1 Generator controller, e.g. ABB Unitrol

2 Terminal panel for digital and analog signal lines

3 Terminal allocation legend

4 Auxiliary terminal box

- Prepare with cable glands, for example, depending on cable entry
- Shorten cables for the generator controller to their approximate lengths and lead them into the auxiliary terminal box
- Seal the insertion point properly
- Lead signal line in auxiliary terminal box to generator controller (1)
- Connect signal lines in terminal panel (2)

Analog terminal allocation

No.	Abb.	Signal
49	BI2	Analog input 2, negative (PELV)
50	AI2	Analog input 2, positive (PELV)

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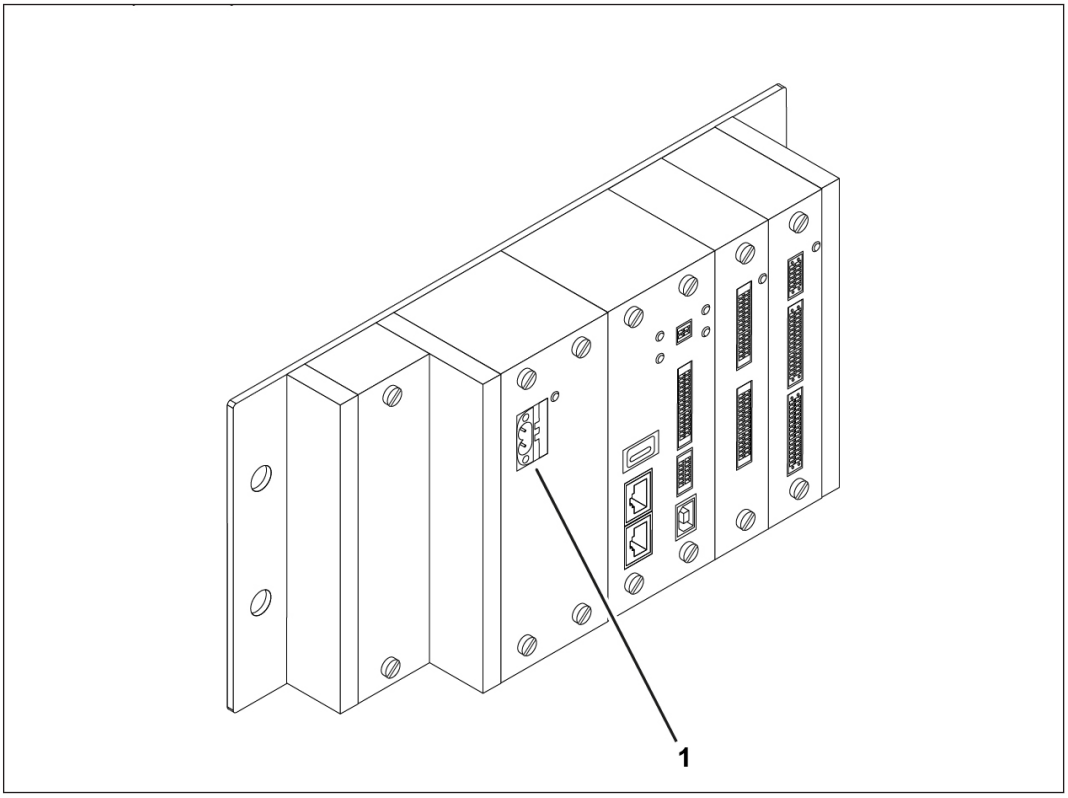
For required information for generator controller, see

- Assembly note for ABB Unitrol 1005 for CES gensets
- Wiring diagram for auxiliary cabinet (HAS)
- Grid Demand Interface (GDI) wiring diagram

6.7.4 Connecting the power supply

The power supply for the Grid Demand Interface (GDI) is provided via a 24 V DC current source in the auxiliary cabinet (HAS).



75794-001 Grid Demand Interface example illustration

- Connect power supply (1)

For required information on the power supply, see

- Wiring diagram for auxiliary cabinet (HAS)
- Grid Demand Interface (GDI) wiring diagram

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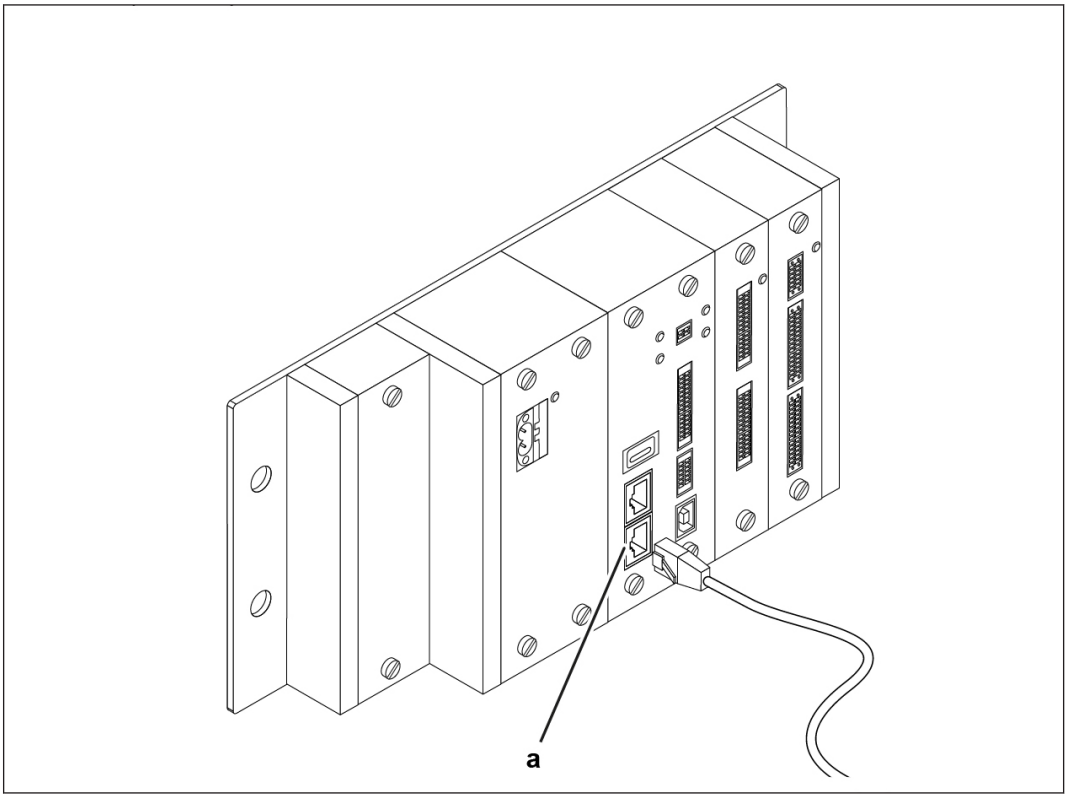
6.7.5 Connecting the TEM-MFR



75796-001 Grid Demand Interface example illustration

a Connection: Ethernet port 1

- Connect LAN patch cable to Grid Demand Interface

For further information on the TEM MFR, see

- TEM MFR operating manual
- Wiring diagram for auxiliary cabinet (HAS)
- Grid Demand Interface (GDI) wiring diagram

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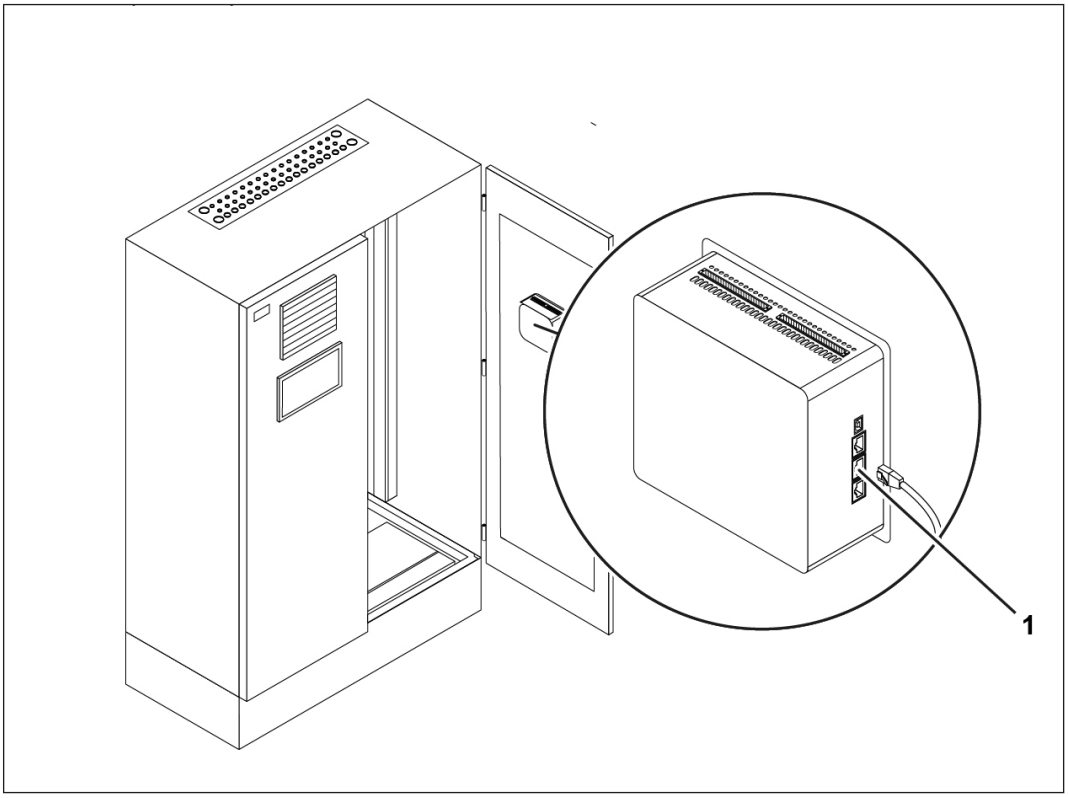


75786-001 TEM MFR example illustration

1 Connection: LAN B

- Connect LAN patch cable to TEM MFR

6.7.6 Connecting digital module and analog module

The allocation of the connections depends on the project planning and can vary on site. The project-specific wiring diagram acts as a basis.

To be connected:

- Signal connections with fixed assignments for the general configuration of the control system
- Signal connections to be variably allocated in order to comply with the implemented Grid code or with the specifications of the energy supply plant's operator.

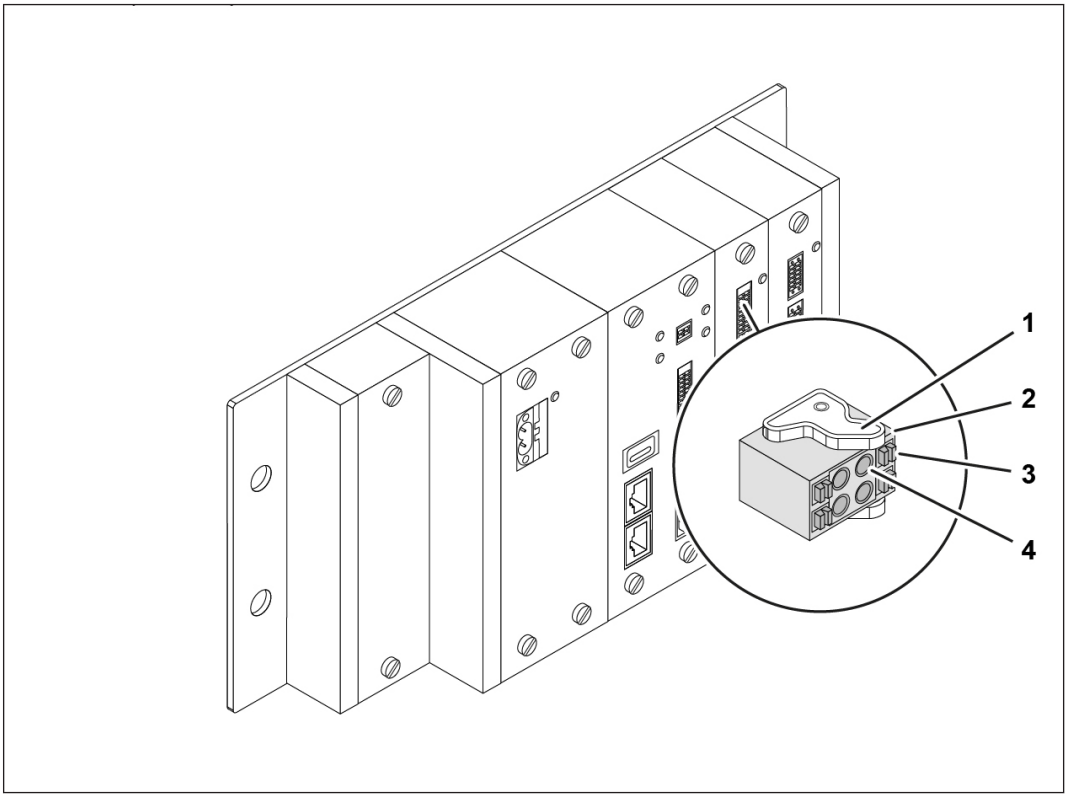
For required information on connecting the signal lines, see

- Wiring diagram for energy supply plant and energy supply unit
- Wiring diagram for auxiliary cabinet (HAS)
- Grid Demand Interface (GDI) wiring diagram

Connect signal lines

The signal lines are connected using the integrated terminal elements. If necessary, a terminal element can be lifted out of the module via the clamping lever.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL



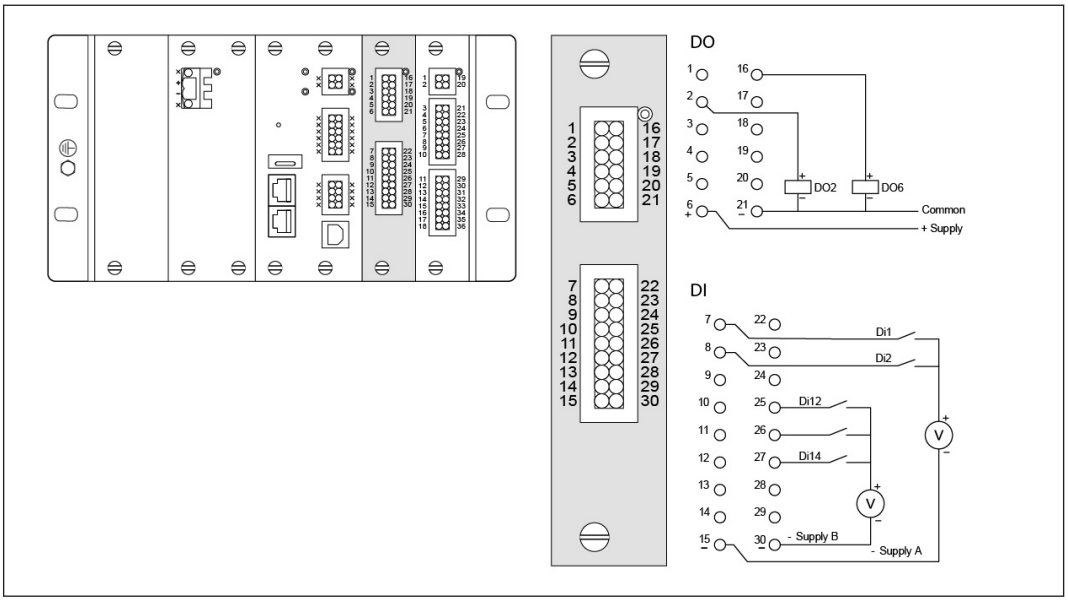
75795-001 Example illustration of terminal elements

1 Clamping lever
2 Terminal block
3 Spring opener for releasing the cable clamp
4 Insertion shaft for cable ends (socket)

- Connect required signal lines
  - Strip cable ends by approx. 10 mm
  - Fit wire end sleeves to the ends of the signal lines
  - Slide cable ends into the insertion shaft in parallel

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Overview of digital module hardware connections



75783-002 Example illustration of digital module

The following table lists the internal hardware assignment for all sockets:

- The sockets that are actually assigned depend on the project planning
- The numbers in the first column correspond to the lettering on the side of the module
- The designations in the second column indicate the signal type and are provided with a consecutive number for the input and output sockets. The overview tables for the Grid codes and the user interface use these in their assignment specifications

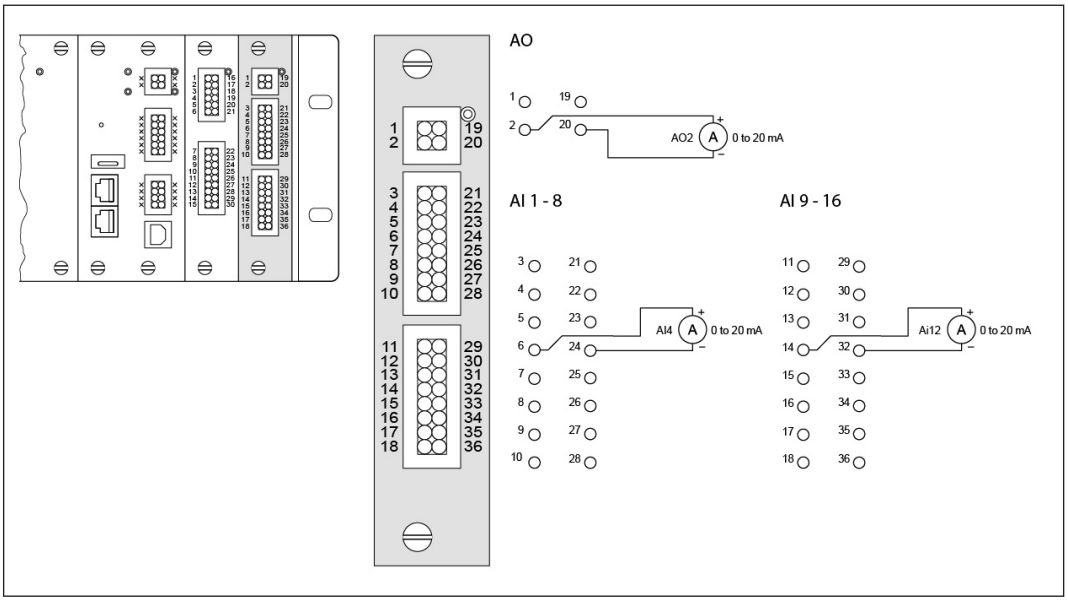
No.	Assignment	Description
1	DO1	Digital output 1
2	DO2	Digital output 2
3	DO3	Digital output 3
4	DO4	Digital output 4
5	DO5	Digital output 5
6	DO SUP+	+24 V supply, digital output
16	DO6	Digital output 6
17	DO7	Digital output 7
18	DO8	Digital output 8
19	DO9	Digital output 9
20	DO10	Digital output 10
21	DO SUP-	Supply, digital output, general
7	Di1	Digital input 1
8	Di2	Digital input 2

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

No.	Assignment	Description
9	Di3	Digital input 3
10	Di4	Digital input 4
11	Di5	Digital input 5
12	Di6	Digital input 6
13	Di7	Digital input 7
14	Di8	Digital input 8
15	Di SUP-	Digital input reference supply, general (DI1-DI8)
22	Di9	Digital input 9
23	Di10	Digital input 10
24	Di11	Digital input 11
25	Di12	Digital input 12
26	Di13	Digital input 13
27	Di14	Digital input 14
28	Di15	Digital input 15
29	Di16	Digital input 16
30	Di SUP-	Digital input reference supply, general (DI9-DI16)

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Overview of analog module hardware connections



75784-002 Analog module example illustration

The following table lists the internal hardware assignment for all sockets:

- The sockets that are actually assigned depend on the project planning
- The numbers in the first column correspond to the lettering on the side of the module
- The designations in the second column indicate the signal type and are provided with a consecutive number for the input and output sockets. The overview tables for the Grid codes and the user interface use these in their assignment specifications

No.	Assignment	Description
1/19	AO1	Analog output 1
2/20	AO2	Analog output 2
3/21	AI1	Analog input 1
4/22	AI2	Analog input 2
5/23	AI3	Analog input 3
6/24	AI4	Analog input 4
7/25	AI5	Analog input 5
8/26	AI6	Analog input 6
9/27	AI7	Analog input 7
10/28	AI8	Analog input 8
11/29	AI9	Analog input 9
12/30	AI10	Analog input 10
13/31	AI11	Analog input 11
14/32	AI12	Analog input 12

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

No.	Assignment	Description
15/33	AI13	Analog input 13
16/34	AI14	Analog input 14
17/35	AI15	Analog input 15
18/36	AI16	Analog input 16

6.7.7 Electrical checks

Before commissioning, the electrical installation must be checked for safety and function by an authorized qualified specialist in accordance with the regional regulations by testing and measuring. The results must be documented in a test report.

The scope of testing includes the following general points and is to be determined according to the local conditions and the specific installation.

- Cable routing (cable correctly secured, short-circuit-proof routing, insulation, etc.)
- Installed operating equipment (fastening, insulation, no damage)
- Continuity of equipotential bonding
- Check continuity of cables
- Insulation resistance
- Power supply of the auxiliary cabinet (HAS) and the equipment
- Perform electrical safety tests without and with power supply
- Only approve the installation for commissioning after successful testing
- If commissioning will take place at a later time, put the auxiliary cabinet (HAS) into a safe condition, re-establish the power supply and enable the plant for operation

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

7 Commissioning

Table of contents

7.1 Safety notes ... 136
7.2 Preparation ... 137
7.3 On-site checks ... 138
7.4 Connecting the service computer ... 139
7.5 Configuring the service computer for the interface application ... 140
7.6 Launching the user interface ... 141
7.7 Read mode (no login) ... 142
7.8 Edit mode (with login) ... 143
7.9 Managing configurations ... 145
7.10 Software update ... 146
7.10.1 Which software is affected? ... 146
7.10.2 Compatibility and qualification ... 146
7.10.3 Downloading the update files from the Service Library ... 146
7.10.4 Saving the configuration of the Grid Demand Interface ... 146
7.10.5 Configuring the service computer for the upload ... 147
7.10.6 Launch the system web page of the Grid Demand Interface ... 147
7.10.7 Updating the operating system ... 148
7.10.8 Updating the application software (CODESYS) ... 151
7.10.9 Updating the application (user interface) ... 153
7.10.10 Checking the update ... 155
7.11 Editing entries ... 157
7.12 Procedure for initial commissioning ... 159
7.12.1 Establish voltage supply ... 159
7.12.2 Modify the IP address of the Grid Demand Interface ... 159
7.12.3 Set date and local time ... 159
7.12.4 Set power gradients ... 159
7.12.5 Configuring the TEM MFR ... 165
7.12.6 Synchronizing generator controller (AVR) and Grid Demand Interface ... 165
7.12.7 Assign and adjust inputs and outputs ... 165
7.12.8 Enter parameter values ... 166
7.12.9 Testing frequency-dependent functions in grid-parallel operation ... 166

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

7.1 Safety notes

WARNING!

Electric shock if live components are touched

This can lead to severe injuries and even death.

- Only authorized specialist personnel may work on the electrical system.
- Turn off electrical power supply and secure against restarting:
  - Disconnect electrical system.
  - Secure against reconnection.
  - Check that equipment is de-energized.
  - Ground and short-circuit the electrical system.
  - Cover or cordon off adjacent components which are electrically live.

The disconnection of the plant also includes the measuring lines. Since individual measuring lines are connected upstream of the generator circuit breaker (GLS), they can carry mains voltage even when the genset is stopped and the power supply of the switchgear cabinet is disconnected.

WARNING!

Injury due to improper commissioning

This can lead to severe injuries and even death.

- Only authorized specialist personnel may operate the product

Risk of destruction of components

Electrostatic charging of assembly personnel or their tools can damage sensitive components or restrict their function.

- Observe handling regulations for components subject to electrostatic hazards

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

7.2 Preparation

Required for initial commissioning:

- Personal login data for the user interface
- Genset data sheet
- Configuration specifications for the inputs and outputs
- Parameter value list for the desired grid code
- Setting specifications of the mains operator
- Depending on the configuration, further specifications of the plant operator

Further information on configuration

- For copying templates for project-specific assignment of the digital module and the analog module, see chapter 12 Appendix 183

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

7.3 On-site checks

Before commissioning, the following product-specific checks must be carried out by specialist personnel for commissioning in addition to general checks:

- The conditions and assumptions applicable during configuration match the conditions on site
- Grid Demand Interface mounted securely in the switchgear cabinet with sufficient clearance
- Cables properly laid and connected
- No damage, contamination or corrosion visible
- Switchgear cabinet door fully assembled and lockable

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

7.4 Connecting the service computer

Switching off the voltage supply

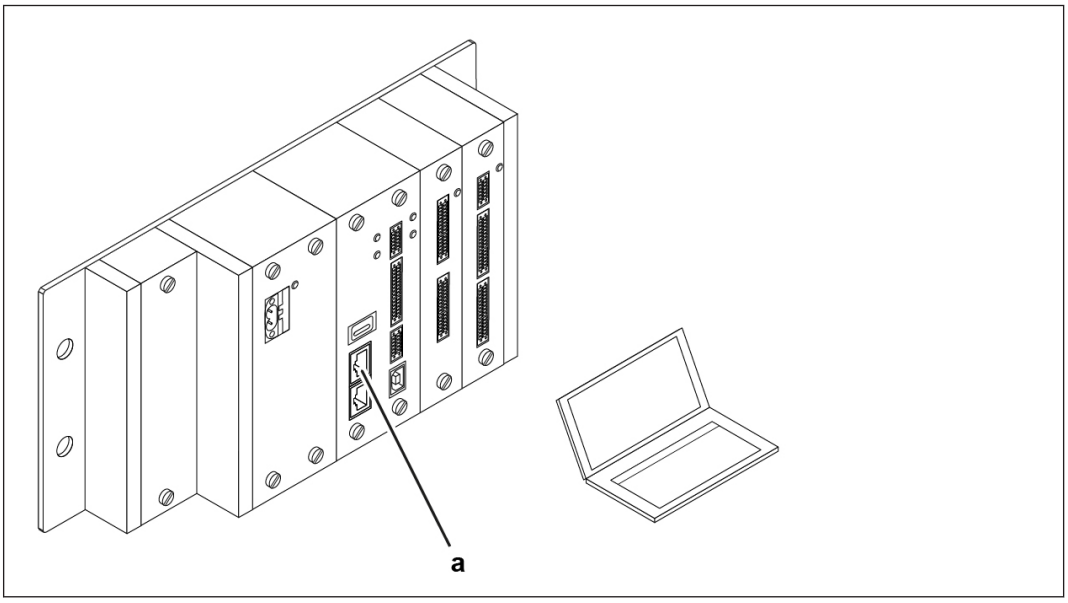
The connection of the voltage supply for the auxiliary cabinet depends on the design of the plant on site.

- Shut down and secure the genset.
- Disconnect, relieve and secure the power supply and measurement lines to the control cabinet.
- Open auxiliary cabinet and ensure safe working conditions.
- For necessary information on safety, see chapter 7.1 Safety notes 136.

Connecting the Grid Demand Interface and the service computer

The service computer is connected directly to the front of the CPU via an RJ45 interface (a).

Ethernet port 0 should preferably be used for commissioning and maintenance.



75772-001 Schematic example illustration

a Ethernet port 0

- Connect the service computer to the Grid Demand Interface
  - Place the service computer outside the switchgear cabinet.
  - Open switchgear cabinet door.
  - Connect the service computer to Ethernet port 0 using a suitable cable.
  - Leave switch cabinet door slightly open and secure it.

Switching on the power supply

- Establish power supply for the auxiliary cabinet
  - The CPU starts up.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

7.5 Configuring the service computer for the interface application

If the interface application is installed, the following address details apply.

Internet Protocol (TCP/IP) properties	
General	
○ Obtain IP address automatically	
⊙ Use the following IP address	
IP address:	172.22.21.1
Subnet mask:	255.255.255.0
Default gateway	
○ Obtain DNS server address automatically	
⊙ Use the following DNS server addresses:	
Preferred DNS server:	
Alternative DNS server:	

- Adapt the IP configuration of the service computer

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

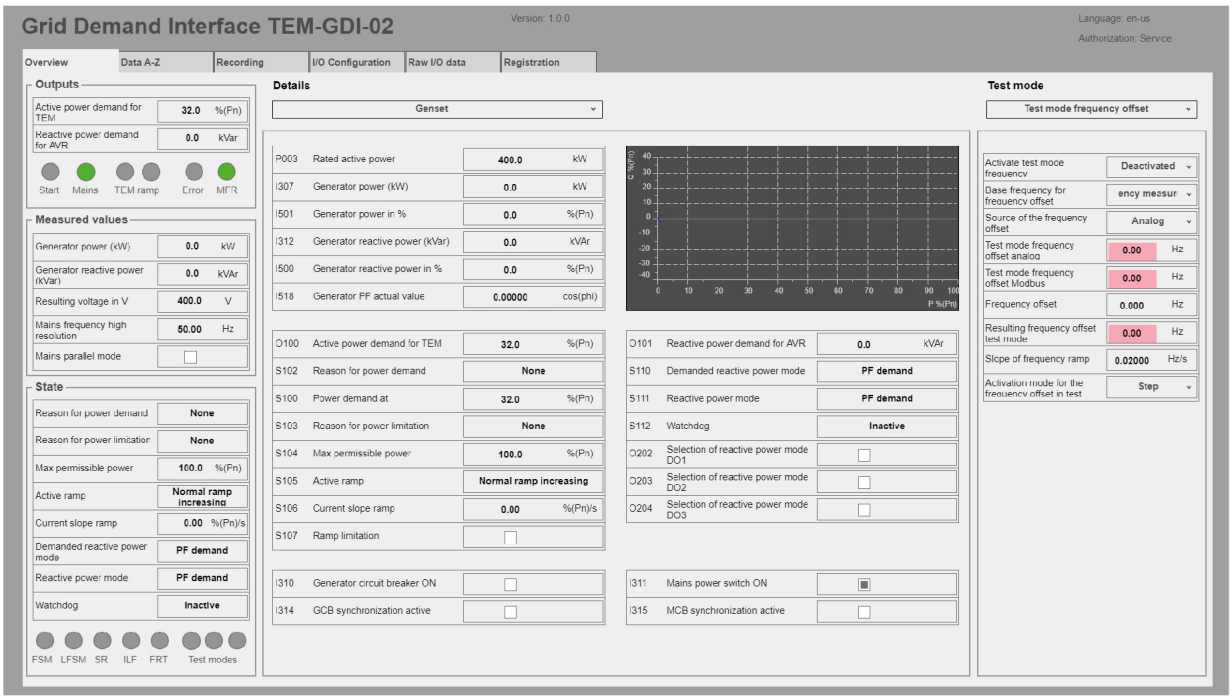
7.6 Launching the user interface

Note

After entering the IP address in the browser, a warning about the security of the desired website may appear. The type and content of the warning depends on the computer's operating system.

- Because the user interface is trustworthy, continue the loading process anyway
  - The browser offers a corresponding input option for this. For MS Windows® this is the button labeled `Load web page anyway (not recommended).`

- Launch a browser on the service computer
- Enter the IP address for the installed interface application in the address line: `https://172.22.21.22:8443/webvisu.htm`
  - The front end with the user interface and the `Overview` tab appears.
  - The user interface is still locked, but it can be used to read the current settings.



75754-001 Example illustration of the `Overview` tab

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

7.7 Read mode (no login)

After launching the user interface, it always appears in read mode. Read mode is sufficient for a quick overview of the current situation. The scope of the displays and the functionality of the user interface is accordingly limited.

The user interface switches to editing mode via a corresponding login. This mode is only available to authorized specialist personnel.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

7.8 Edit mode (with login)

Risk of destruction of components

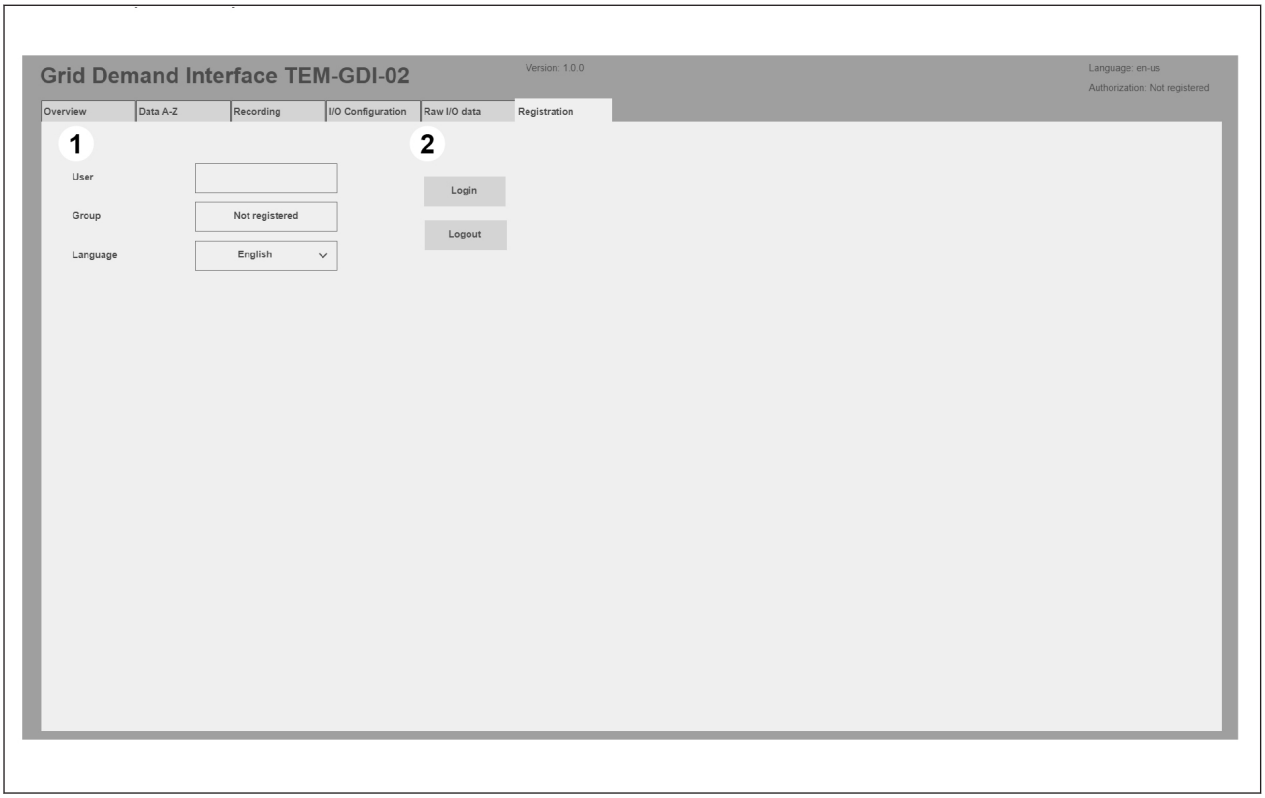
Incorrect entries can lead to incorrect functionality of the Grid Demand Interface and non-compliance with specifications

- Only authorized service personnel accredited by the manufacturer with a login may log in. Disclosing the login to others is prohibited.
- Always log out after finishing work

To unlock the user interface, simply log in with the corresponding login.

Login for service personnel (SL)

- User interface > `Login` tab



75759-001 Example illustration of the `Login` tab

1 Personnel groups

2 Login and Logout

- User interface > `Login` tab
- In the `Login` area (2), enter your personal service login:
  - User: `Service`
  - Password: `TemGdi1968`

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

– The logged-in user appears in the Personnel groups area (1).
– The user interface is now operable according to the permissions concept and allows user input in the corresponding tabs.

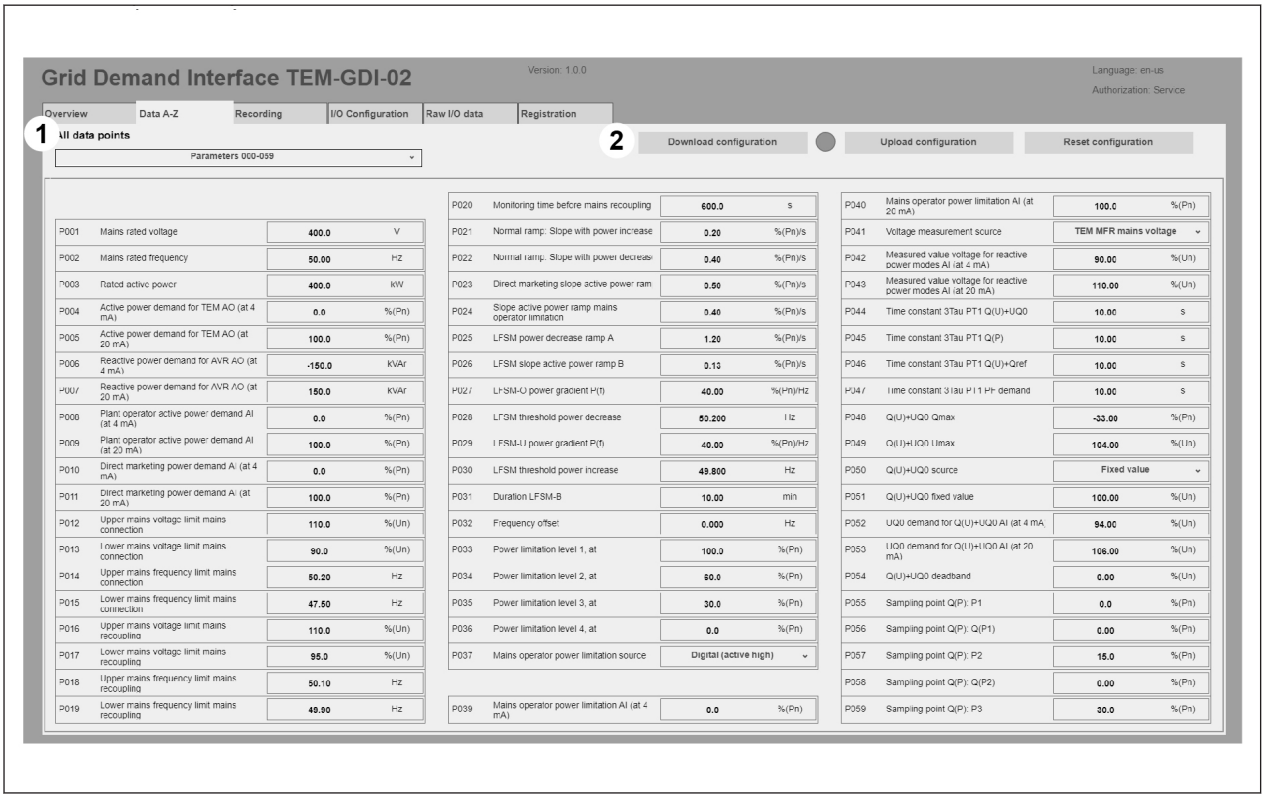
357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

7.9 Managing configurations

Note

Always save the current configuration before editing!

In edit mode, the `Data A-Z` tab contains a dialog area (2) for managing individual configurations.



75756-001 User interface with `Data A-Z` tab in edit mode

Procedure

- Open the web browser and call up the user interface
- Click the `Login` tab
  - Log in as service personnel.
  - The user interface appears in edit mode.
- Click on the Data A-Z tab
- Click on the desired button in the dialog area (2)
  - A dialog box opens with the corresponding functionality.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

7.10 Software update

7.10.1 Which software is affected?

The following software may be affected by an update:

- Operating system: Firmware for the internal processes (hardware)
- Application software: general software for managing and executing programmed applications
- Application: concrete application for the user to communicate with the Grid Demand Interface, for example the user interface

An update does not have to include the entire software. The Release Note provides information about the affected software.

Depending on the situation (e.g. faults), additional updates or new installations may be necessary. Since an unusual update can also lead to additional work (for example in the configuration), the responsible service partner should be contacted in case of doubt.

7.10.2 Compatibility and qualification

Risk of destruction of components

The operating system of the Grid Demand Interface may only be updated with the files provided by CES. External system files are not directly compatible!
If other files are used, the Grid Demand Interface may malfunction and the genset may come to a standstill.

- Updates only by authorized and trained specialist personnel
- Only use the approved files and only carry out the steps described for the update

7.10.3 Downloading the update files from the Service Library

The update files and the Release Notes are available in the Service Library.

- Download files and Release Notes to the service computer.

Release Notes

The Release Notes for the update should contain the following information:

- Version number of the TEM-GDI-02 software after the update
- Information on the update login
- Update file for TEM-GDI-02 software
- Version number of OS and bootloader
- Update file for OS and bootloader if a different version is installed
- Version number of CODESYS runtime
- Update file for CODESYS runtime, if another version is installed

7.10.4 Saving the configuration of the Grid Demand Interface

Only for updates to the already configured or parameterized Grid Demand Interface

- Back up the current settings before updating

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

Further information

- For information on backing up, see chapter 7.9 Managing configurations 145

7.10.5 Configuring the service computer for the upload

To access the internal memory of the Grid Demand Interface, the following address details apply:

Internet Protocol (TCP/IP) properties

General

○ Obtain IP address automatically

⊙ Use the following IP address

IP address:	172.22.21.1
Subnet mask:	255.255.255.0
Default gateway	

○ Obtain DNS server address automatically

⊙ Use the following DNS server addresses:

Preferred DNS server:	
Alternative DNS server:	

- Adapt the IP configuration of the service computer

7.10.6 Launch the system web page of the Grid Demand Interface

- Launch a browser on the service computer
- Enter the IP address for the `system web page` in the address line: `https://172.22.21.22/sys/tools.shtml`
  - The `System web page` dialog box for the login appears.
- Enter special update login
  - The `system web page` appears.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

75999-001 Example illustration of the system web page with `Home` tab

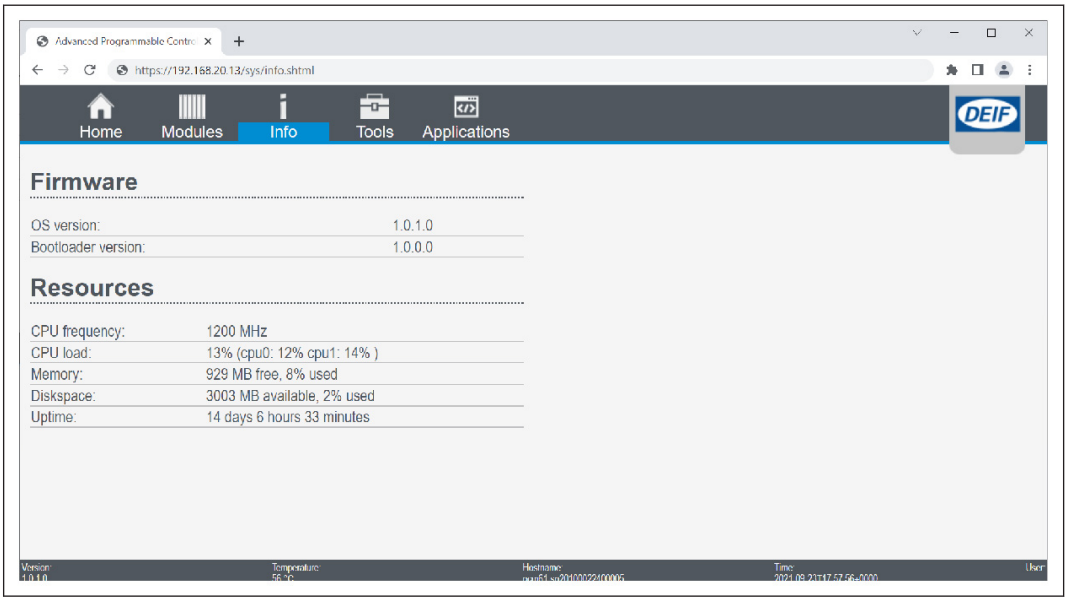
7.10.7 Updating the operating system

Check the operating system

The required version of the operating system is specified in the Release Notes of the update.

Navigation

- System web page > Info



76000-001 Example illustration of the system web page with `Info` tab

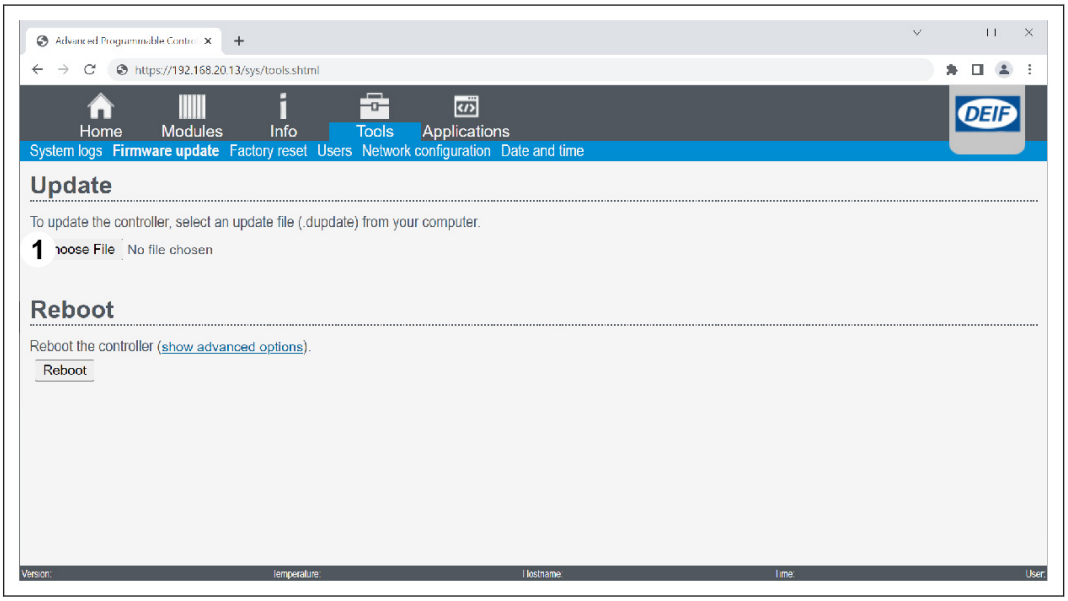
357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

- In the `Firmware` display area, check:
  - Version of the operating system (`OS`) and `Bootloader`
- If the required version is already installed, continue with the update process

Update the operating system

Navigation

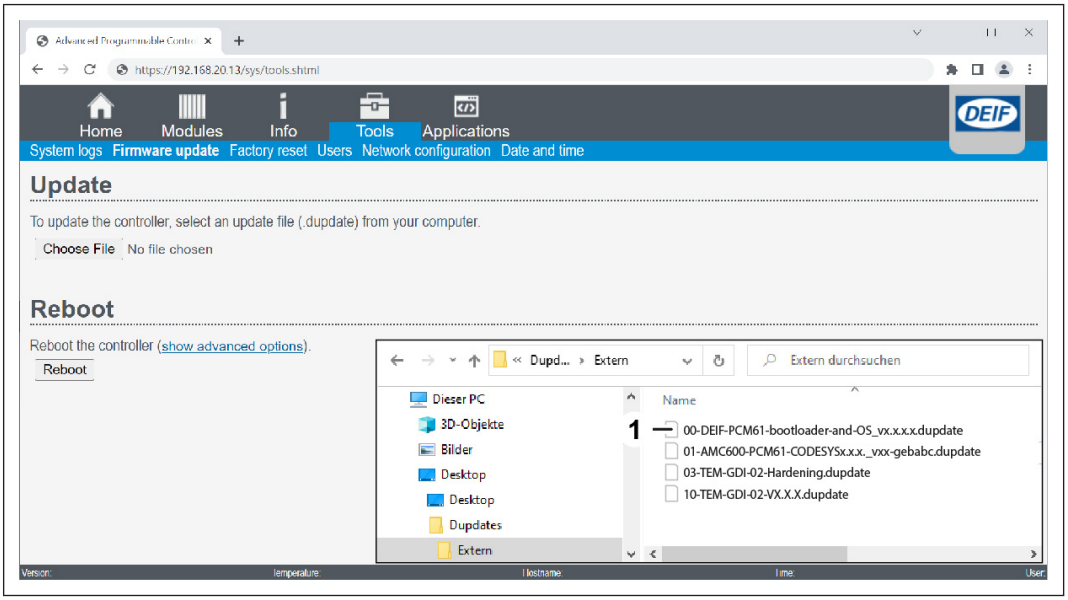
- System web page > Tools > Firmware update



75998-001 Example illustration of the system web page with `Tools` tab

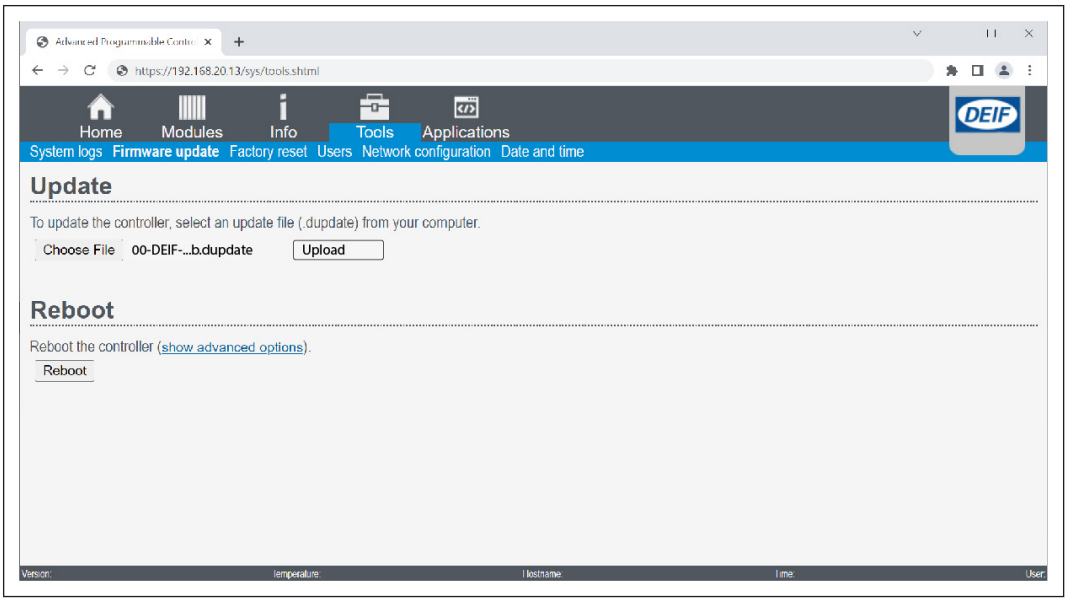
- Click on the `Select file` button (1) in the `Update` display area
  - A file explorer appears.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL



76015-001 Example illustration of the system web page with `Tools` tab

- Click on the file specified in the Release Notes for the `bootloader and OS` (1)
  - The `file name` and the `Upload` button appear in the Update display area.



76010-001 Example illustration of the system web page with `Tools` tab

- Click on the `Upload` button
  - The file is installed. The process can take approx. 1 minute.
- After completing the installation, check whether the `Info` tab shows the installed versions

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

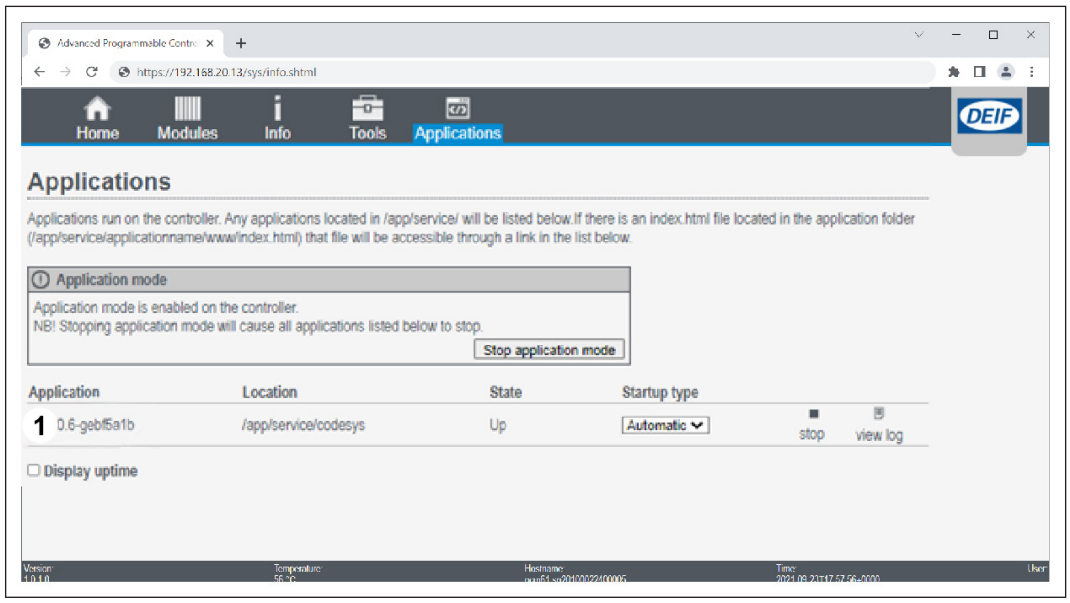
7.10.8 Updating the application software (CODESYS)

Check application software (CODESYS)

The required version of the application software (CODESYS) is specified in the Release Notes of the update.

Navigation

- System web page > Applications



76001-001 Example illustration of the system web page with `Applications` tab

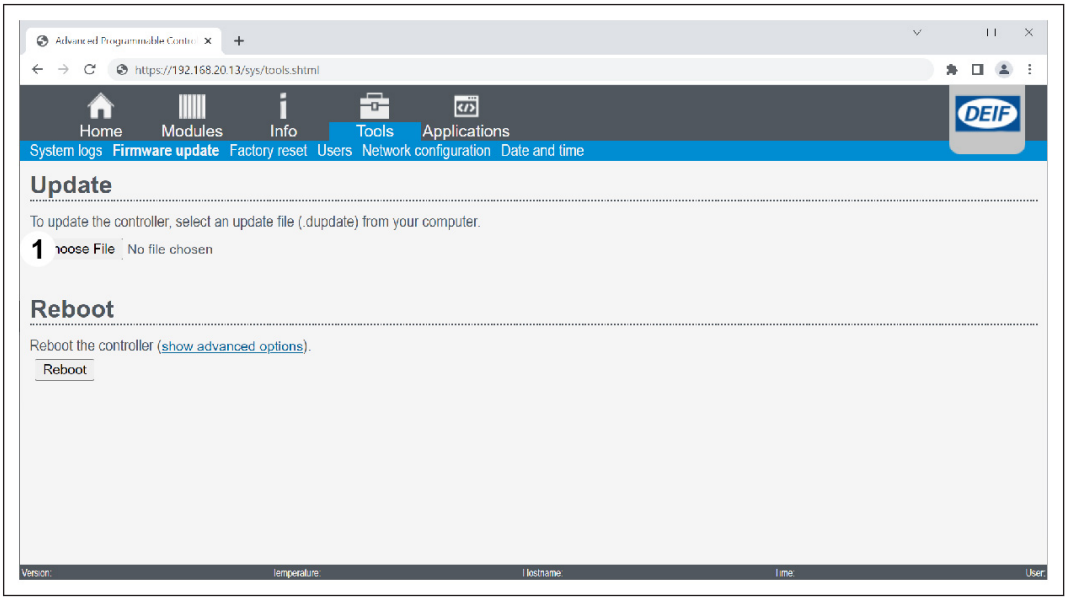
- In the Applications > Application display area, check the following:
  - Version of the application software (1).
- If the required version is already installed, continue with the update process

Update the application software

Navigation

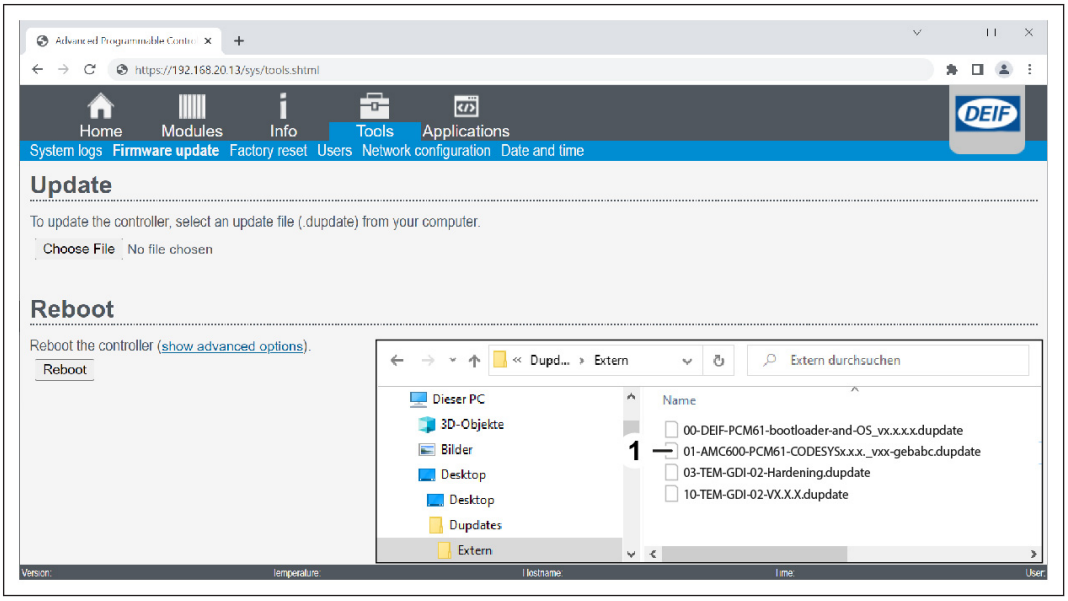
- System web page > Tools > Firmware update

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL



75998-001 Example illustration of the system web page with `Tools` tab

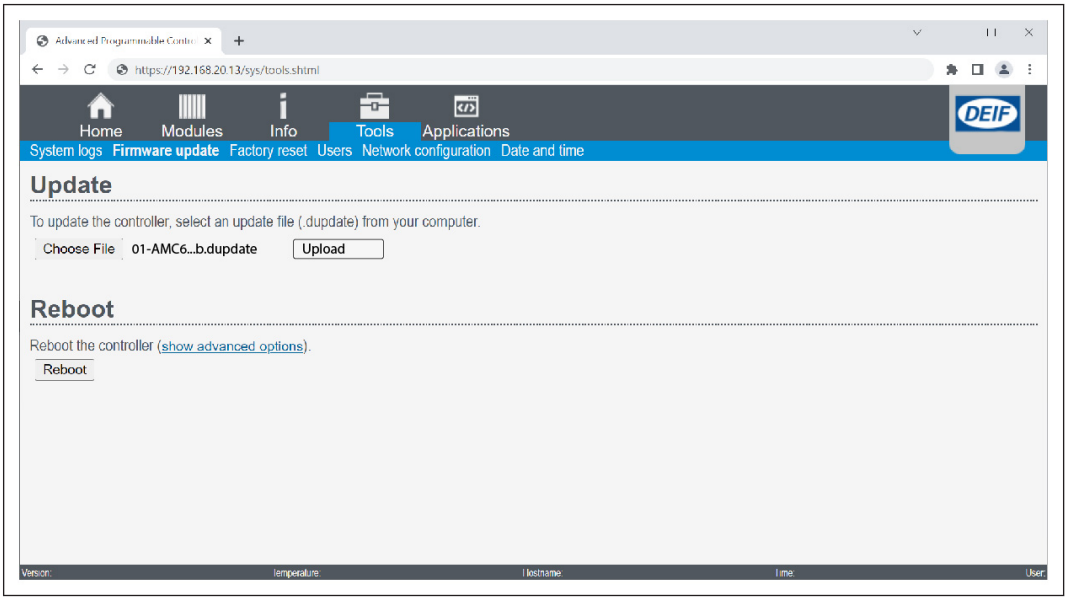
- Click on the `Select file` button in the `Update` display area
  - A file explorer appears.



76003-001 Example illustration of the system web page with `Tools` tab

- Click on the file specified in the Release Notes for CODESYS (1)
  - The `file name` and the `Upload` button appear in the Update display area.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL



76002-001 Example illustration of the system web page with `Tools` tab

- Click on the `Upload` button
  - The file is installed. The process can take approx. 1 minute.
- After completing the installation, check whether the `Info` tab shows the installed versions

7.10.9 Updating the application (user interface)

Check application (user interface)

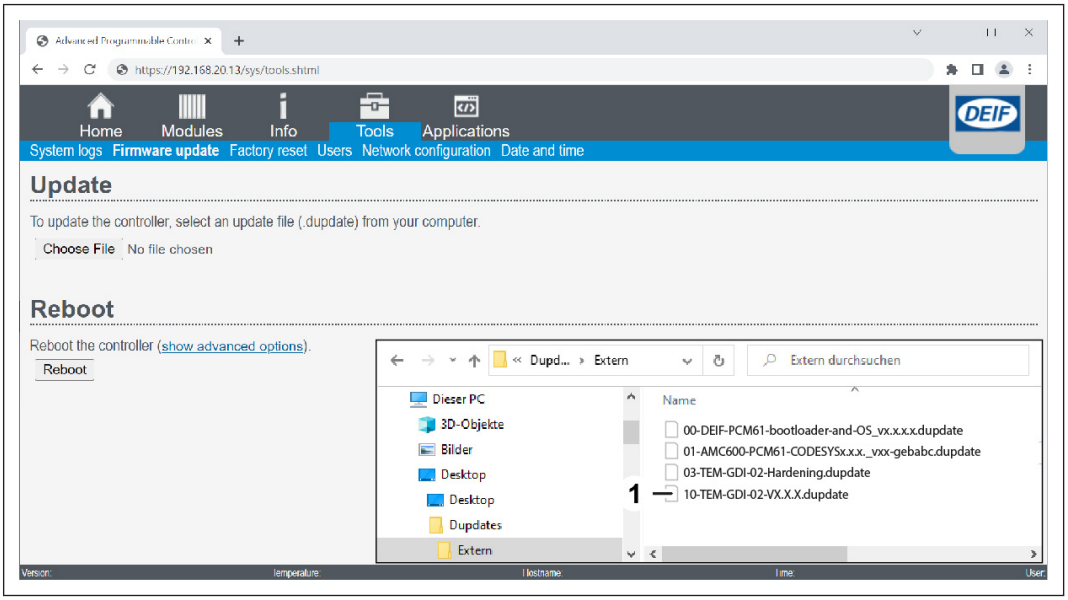
When updating, the application must be reinstalled. This is the minimum requirement. This step is therefore not required.

Update application (user interface)

Navigation

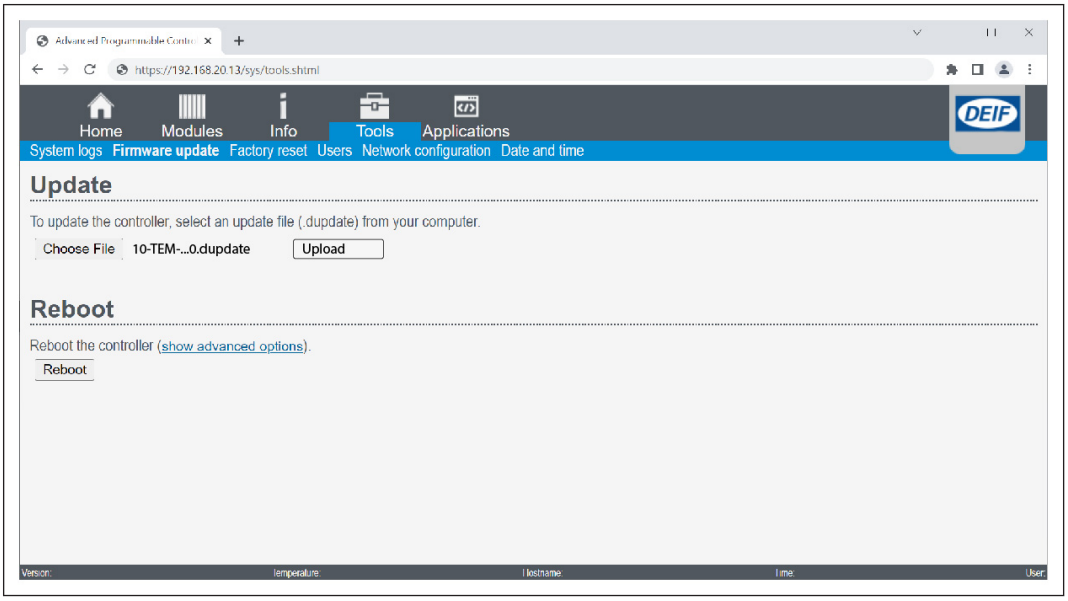
- System web page > Tools > Firmware update
- Click on the `Select file` button in the `Update` display area
  - A file explorer appears.

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL



76006-001 Example illustration of the system web page with `Tools` tab

- Click on the file specified in the Release Notes for the user interface (1)
  - The `file name` and the `Upload` button appear in the Update display area.



76011-001 Example illustration of the system web page with `Tools` tab

- Click on the `Upload` button
  - The file is installed. The process can take approx. 1 minute.
- After completing the installation, check whether the `Info` tab shows the installed versions

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7.10.10 Checking the update

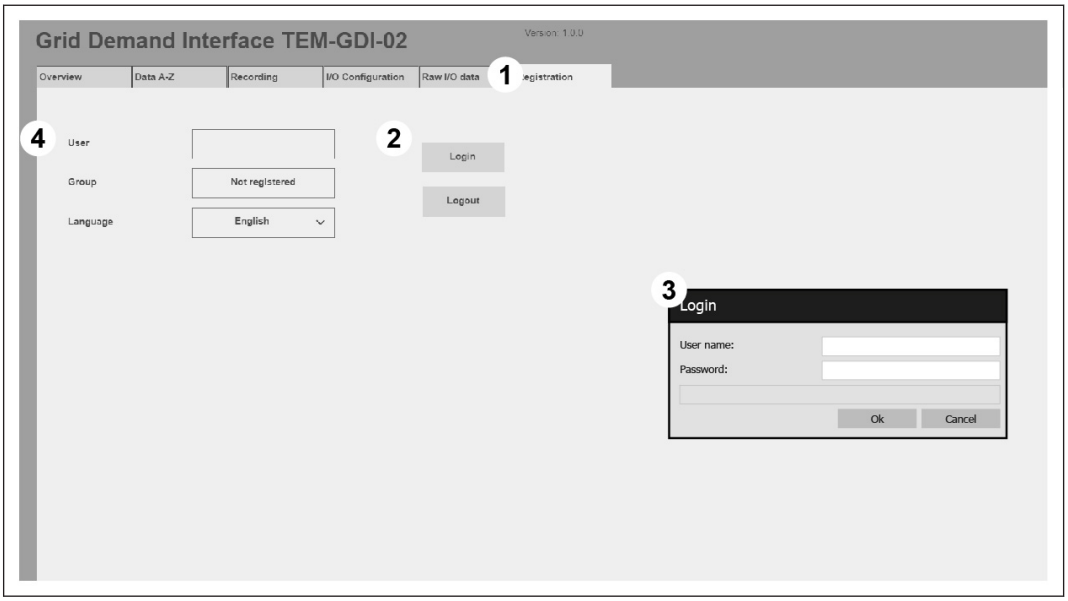
Check user interface version

- Launch a browser on the service computer
- Enter the IP address for the installed interface application in the address line:
  `172.22.21.22:8443/webvisu.htm`
  - The front end with the user interface and the `Overview` tab appears.
  - The user interface is still locked, but it can be used to read the current settings.

76007-001 Example illustration of the user interface with the `Overview` start page

- Check whether the displayed `Version identifier` (1) matches the information in the Release Notes

Checking the login



76008-001 Example illustration of the user interface with the `Login` tab

- Click on the `Login` tab (1) in the user interface
- Click on the `Login` button (2)
  - The Login dialog box (3) appears.
- Log in as service personnel
  - The user interface appears in edit mode.
- Check whether the input box (4) is enabled
  - If this is the case, log out using the Logout button. The update has been carried out successfully.
  - If this is not the case, check the files and repeat the update. If the update is still not successful, contact the relevant CES Service specialist.

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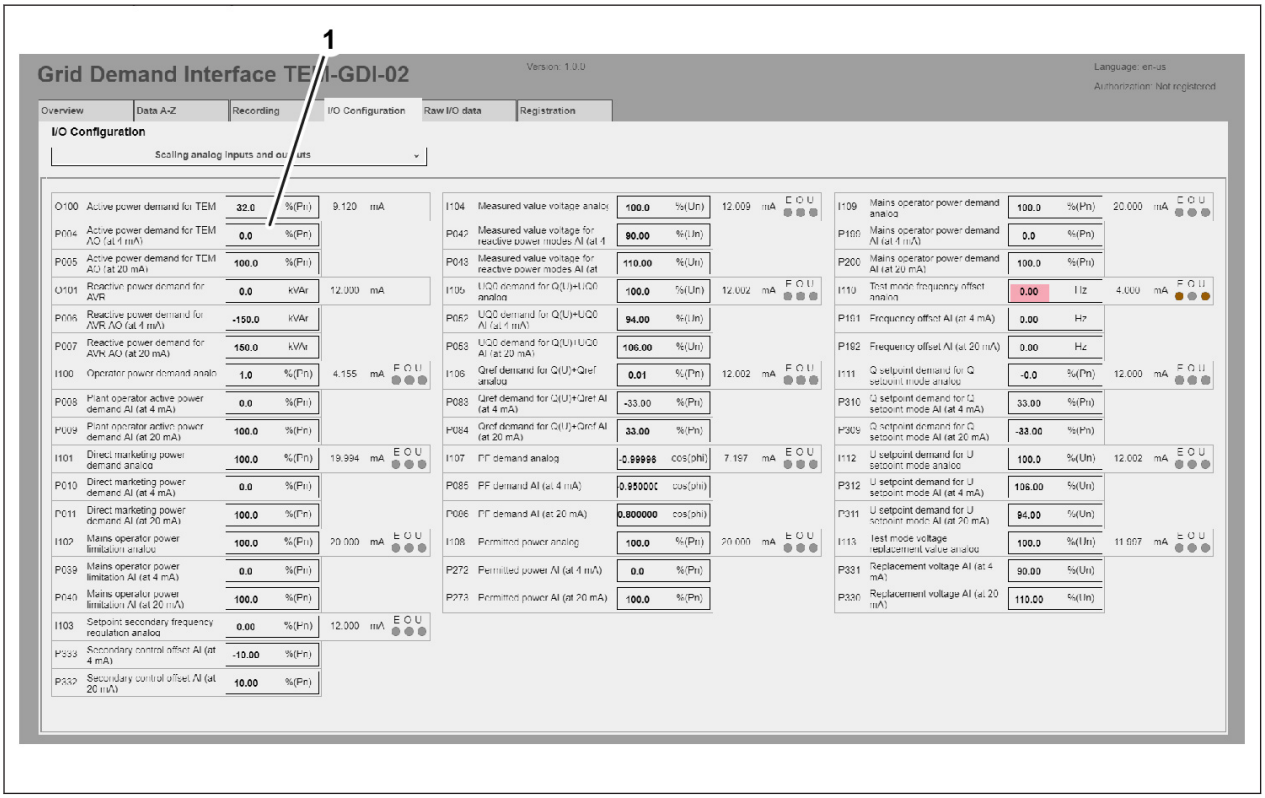
7.11 Editing entries

Note

Always back up the current configuration before making changes!

The web server of the Grid Demand Interface makes the user interface available in edit mode for changes by authorized specialist personnel. In edit mode, the user interface has enabled areas to click on.



75812-002 Example illustration of input-enabled user interface

1 Input-enabled area

The following are provided for changed:

- `Overview` tab or alternatively `Data A-Z` tab for changing parameter values
- `I/O configuration` tab for changing inputs and outputs

Procedure

- Open the web browser and call up the user interface
- Click the `Login` tab
  - Log in as service personnel.
  - The user interface appears in edit mode.
- Click on the `Overview` or `I/O configuration` tab

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  - The desired tab appears and displays the current entries in tabular form.
  - Editable entries show their entry or status in an input-enabled area (1).
- Search for the desired entry and click in the input-enabled area
  - A small dialog box opens for input.
- Edit entry and confirm with the `Enter` key
  - The input is accepted and becomes active.

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7.12 Procedure for initial commissioning

The initial commissioning is carried out in consultation between the operator and the commissioner.

Depending on the regional and project-specific requirements, the GDI must be parameterized according to the respective valid parameter value list.

7.12.1 Establish voltage supply

- Establish voltage supply for the switchgear cabinet with the built-in Grid Demand Interface
  - The Grid Demand Inteface starts up automatically.

7.12.2 Modify the IP address of the Grid Demand Interface

The IP addresses of the two Ethernet ports can be changed in the system settings of the web server.

- Launch a browser on the service computer
- Enter the address in the address bar: `https://172.22.21.22/sys/networkconfig.shtml`
- Enter service login
- Modify IP addresses

7.12.3 Set date and local time

The date and time can be changed in the system settings of the web server.

- Launch a browser on the service computer
- Enter the address in the address bar: `https://172.22.21.22/sys/time.shtml`
- Enter service login
- Change date and/or time

7.12.4 Set power gradients

The power gradients for increasing and decreasing the active power output are limited by both the GDI and the TEM system. A resulting power gradient always results from a minimum of one GDI parameter and one TEM parameter. Refer to the GDI parameter lists for information on setting the GDI ramps and TEM ramps according to the valid grid code.

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The following tables show which parameter combinations produce which power gradients.

Normal operation

	GDI Parameter	TEM Parameters
Increase active power	Parameter P021 (ramp R_1 up) ≤ 0.5 % P_n/s	Parameter 23003 Min: 0.1 % P_n/s Max: 1.5 % P_n/s
	Parameter P021 (ramp R1 up) > 0.5 % P_n/s	Parameter 23101 Min: 0.5 % P_n/s Max: 1.5 % P_n/s
Increase active power (upper 5 %)	Parameter P021 (Ramp R_1 up)	Parameter 23004 Min: 0.1 % P_n/s Max: 0.5 % P_n/s
Reduce active power	Parameter P022 (ramp R_1 down)	Parameter 23006 Min: 0.1 % P_n/s Max: 2.0 % P_n/s

Active power demand by third parties (e.g. direct sellers)

	GDI Parameter	TEM Parameters
Increase active power	Parameter P023 (Ramp R_2) < 1.5 % P_n/s	Parameter 23101 Min: 0.5 % P_n/s Max: 1.5 % P_n/s
	Parameter P023 (Ramp R_2) ≥ 1.5 % P_n/s	Parameter 23102 Min: depends on TEM rated power Max: 2.0 % P_n/s
Reduce active power	Parameter P023 (Ramp R_2) < 1.5 % P_n/s	Parameter 23006 Min: 0.1 % P_n/s Max: 2.0 % P_n/s
	Parameter P023 (Ramp R_2) ≥ 1.5 % P_n/s	From TEM Version 2.50.23: Parameter 23007 Min: 0.1 % P_n/s Max: 2.0 % P_n/s
		Up to TEM Version 2.50.22: Parameter 23102 Min: depends on TEM rated power Max: 2.0 % P_n/s

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Active power limitation by the mains operator

	GDI Parameter	TEM Parameters
Reduce active power	Parameter P024 (Ramp R_3)	Parameter 23006 Min: 0.1 % P_n/s Max: 2.0 % P_n/s

Active power change in the event of underfrequency or overfrequency (LFSM)

	GDI Parameter	TEM Parameters
Increase active power	Parameter P220 (Ramp R_{4a} up)	Parameter 23102 Min: depends on TEM rated power Max: 2.0 % P_n/s
Reduce active power	Parameter P025 (Ramp R_{4a} down)	From TEM Version 2.50.23: Parameter 23007 Min: 0.1 % P_n/s Max: 2.0 % P_n/s
		Up to TEM Version 2.50.22: Parameter 23102 Min: depends on TEM rated power Max: 2.0 % P_n/s

Active power change after an overfrequency or underfrequency event (according to LFSM)

The active power gradients below are only applied if the ramp according to LFSM is activated via GDI parameter P031.

	GDI Parameter	TEM Parameters
Increase active power	Parameter P026 (Ramp R_{4b}) ≤ 0.16 % P_n/s	Parameter 23103 Min: 0.1 % P_n/s Max: 0.16 % P_n/s
	Parameter P026 (Ramp R_{4b}) > 0.16 % P_n/s	Parameter 23102 Min: depends on TEM rated power Max: 2.0 % P_n/s
Reduce active power	Parameter P026 (Ramp R_{4b}) ≤ 0.16 % P_n/s	Parameter 23006 Min: 0.1 % P_n/s Max: 2.0 % P_n/s

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	GDI Parameter	TEM Parameters
	Parameter P026 (Ramp R_{4b}) > 0.16 % P_n/s	From TEM Version 2.50.23: Parameter 23007 Min: 0.1 % P_n/s Max: 2.0 % P_n/s
		Up to TEM Version 2.50.22: Parameter 23102 Min: depends on TEM rated power Max: 2.0 % P_n/s

Active power change at normal operation start

The active power gradients below are only applied if the ramp for a normal operating start is activated via GDI parameter P126.

	GDI Parameter	TEM Parameters
Increase active power	Parameter P116 (Ramp R_5) ≤ 0.16 % P_n/s	Parameter 23103 Min: 0.1 % P_n/s Max: 0.16 % P_n/s
	Parameter P116 (Ramp R_5) > 0.16 % P_n/s	Parameter 23101 Min: 0.5 % P_n/s Max: 1.5 % P_n/s
Reduce active power	Parameter P116 (Ramp R_5)	Parameter 23006 Min: 0.1 % P_n/s Max: 2.0 % P_n/s

Active power change after reconnection following mains decoupling

The active power gradients below are only applied if the ramp is activated when reconnecting after mains decoupling via GDI parameter P125.

	GDI Parameter	TEM Parameters
Increase active power	Parameter P117 (Ramp R_6) ≤ 0.16 % P_n/s	Parameter 23103 Min: 0.1 % P_n/s Max: 0.16 % P_n/s
	Parameter P117 (Ramp R_6) > 0.16 % P_n/s	Parameter 23101 Min: 0.5 % P_n/s Max: 1.5 % P_n/s
Reduce active power	Parameter P117 (Ramp R_6)	Parameter 23006 Min: 0.1 % P_n/s Max: 2.0 % P_n/s

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Active power change due to frequency sensitive mode (FSM)

If FSM is activated via GDI parameter P120, TEM mains operation mode 3 is permanently active with the TEM parameters for the active power gradients specified below.

	GDI Parameter	TEM Parameters
Increase active power	Parameter P124 (Ramp R_7)	Parameter 23102 Min: depends on TEM rated power Max: 2.0 % P_n/s
Reduce active power	Parameter P124 (Ramp R_7)	From TEM Version 2.50.23: Parameter 23007 Min: 0.1 % P_n/s Max: 2.0 % P_n/s
		Up to TEM Version 2.50.22: Parameter 23102 Min: depends on TEM rated power Max: 2.0 % P_n/s

Active power decrease in case of overvoltage P(U)

The active power gradients below are only applied if P(U) is enabled via GDI parameter P130.

	GDI Parameter	TEM Parameters
Reduce active power	Parameter P163 (Ramp R_8)	Parameter 23006 Min: 0.1 % P_n/s Max: 2.0 % P_n/s

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Active power change due to the secondary control power setpoint:

If this function is activated via GDI parameter P232, TEM mains operation mode 3 is permanently active with the TEM parameters for the active power gradients specified below.

	GDI Parameter	TEM Parameters
Increase active power	Parameter P236 (Ramp R_9)	Parameter 23102 Min: depends on TEM rated power Max: 2.0 % P_n/s
Reduce active power	Parameter P236 (Ramp R_9)	From TEM Version 2.50.23: Parameter 23007 Min: 0.1 % P_n/s Max: 2.0 % P_n/s
		Up to TEM Version 2.50.22: Parameter 23102 Min: depends on TEM rated power Max: 2.0 % P_n/s

Active power change due to ILF mode

If ILF Mode is activated via GDI parameter P237, TEM mains operation mode 3 is permanently active with the TEM parameters for the active power gradients specified below.

	GDI Parameter	TEM Parameters
Increase active power	Parameter P238 (Ramp R_{10})	Parameter 23102 Min: depends on TEM rated power Max: 2.0 % P_n/s
Reduce active power	Parameter P238 (Ramp R_{10})	From TEM Version 2.50.23: Parameter 23007 Min: 0.1 % P_n/s Max: 2.0 % P_n/s
		Up to TEM Version 2.50.22: Parameter 23102 Min: depends on TEM rated power Max: 2.0 % P_n/s

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7.12.5 Configuring the TEM MFR

The TEM MFR is configured using the ToolKit.

- The TEM MFR must be accessible to the GDI at the IP address 172.22.20.21.
- Parameter 3112 "Self-acknowledge" must be set to the value "Yes".
- Parameter 3184 "Modbus protocol number" must be set to the value "5003".
- Parameter 7485 "Modbus/TCP Slave ID" must be set to the value "1"

For information on parameterizing the TEM MFR, see

- Servicedokumentation ⇒ TEM MFR, Operating Manual TEM MFR for SL or CL2

7.12.6 Synchronizing generator controller (AVR) and Grid Demand Interface

The generator controller is configured via the manufacturer's user interface (Unitrol: CMT 1000 software).

- The maximum underexcited reactive power output (4 mA input signal) set in the generator controller must correspond to the value of the GDI parameter 006 `AO setpoint reactive power 4 mA`.
- The maximum overexcited reactive power output (20 mA input signal) set in the generator controller must correspond to the value of the GDI parameter 007 `AO setpoint reactive power 20 mA`.

For information required for parameterizing the generator controller, see

- Servicedokumentation ⇒ ABB Unitrol for CES gensets, Commissioning guide for SL or CL2

7.12.7 Assign and adjust inputs and outputs

Note

The Grid Demand Interface must be configured when the genset is stationary.

The scope and assignment of the inputs and outputs depend on the locally applicable mains connection conditions and the project-specific circumstances.

To process incoming signals in the Grid Demand Interface and output signals to the respective components of the control systems, do the following:

- assign the "virtual" inputs and outputs of the programmed interface application to the physical connections of the digital and analog modules (mapping); and
- with analog signals, adjust the levels of inbound and outbound currents to match the technological requirements of the control system (scaling)

For an overview of the physical assignment of inputs and outputs, the status of signals and their values, see the `Raw I/O data` tab.

The `I/O configuration` > `Scaling of analog inputs and outputs` tab provides an overview of the input values and currents of the analog values.

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The user interface displays measured values received from the TEM MFR: `Data A-Z` tab > `MFR measured values`.

The displayed values for analog inputs and outputs can be converted into currents based on the table below.

Displayed value	Current
0	4 mA
32767	20 mA

- Launch the user interface and switch to editing mode
- Click on the `I/O configuration` tab
- Assign and scale inputs and outputs (depending on the signal)

Further information on the parameters

- For the assignment of the inputs and outputs, see chapter 4.5 Configuration specifications 59

7.12.8 Enter parameter values

Note

The Grid Demand Interface must be parameterized when the genset is stationary.

The parameter values to be set depend on the locally valid grid code and the project-specific conditions.

- Click on the `Overview` tab or the `Data A-Z` tab
- Enter parameter values

Further information on the parameters

- For parameter descriptions, parameter lists and parameter values, see chapter 4.5 Configuration specifications 59

7.12.9 Testing frequency-dependent functions in grid-parallel operation

To test frequency-dependent functions, such as LFSM, in grid-parallel operation, a frequency offset can be added to the measured mains frequency or to the set rated frequency. The frequency offset is set via the web server in the "Overview" tab in the "Test mode frequency offset" menu. The frequency offset is activated via parameter P195. Parameter P194 can be used to set whether the frequency offset is generated internally or specified externally via analog input or Modbus TCP.

The frequency offset can be specified as a fixed value, step or ramp. When the step is selected, the frequency offset specified via parameter 032 is set without delay. When the ramp is selected, the frequency offset specified via parameter 032 is set, taking into account the frequency gradient specified via parameter P193.

The measured values for the active power and the simulated frequency can be recorded in the PLC memory under the "Logging" tab. When the maximum size of the data log is reached, the oldest entries are overwritten. Recorded values can be exported in CSV format.

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8 Operation

Table of contents

8.1 Safety notes 168
8.2 Operating locations 169

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

8.1 Safety notes

WARNING!

Injuries due to improper operation

This can lead to severe injuries and even death.

- Only authorized and instructed operating personnel may operate the energy supply unit (genset) with the installed Grid Demand Interface.
- The operating personnel are prohibited from making any changes to the hardware and its connections, parameters, files, etc.
- Before operation, ensure that all the covers and safety devices have been mounted and are functioning properly.
- Never shut down or remove safety devices during operation.

Risk of destruction of components

Unusual odors, noises or other problems may indicate critical system conditions or damage to the product

- Never examine or open the product, but shut down the genset immediately and switch off the power supply of the relevant switchgear cabinet
- Contact the responsible service personnel

Risk of destruction of components

Liquids penetrating components can lead to damage

- Keep liquids away from the product

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8.2 Operating locations

The Grid Demand Interface is not intended for operating by the operating personnel of the energy supply unit (genset). It does not have any operating locations for the operating personnel.

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357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

9 Troubleshooting

Table of contents

9.1 Safety notes..... 172

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

9.1 Safety notes

Conduct in the event of faults

1. In the event of faults that pose an immediate danger to people or property, press the emergency stop switch immediately
2. Inform those responsible at the operating site of the fault
3. In case of troubleshooting in the danger zone, stop the genset normally and secure it against restarting ⇒ Job card B 0-0-10
4. Depending on the type of fault, have it rectified by authorized specialist personnel or fix it yourself ⇒ Section Rectifying fault

   → If necessary, commission the contact person: .

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10 Maintenance

Table of contents

10.1 Safety notes 174
10.2 Grid Demand Interface maintenance schedule 175
10.3 Work instructions 176
10.3.1 Replace backup battery power module 176

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

10.1 Safety notes

WARNING!

Electric shock if live components are touched

This can lead to severe injuries and even death.

- Only authorized specialist personnel may work on the electrical system.
- Turn off electrical power supply and secure against restarting:
  - Disconnect electrical system.
  - Secure against reconnection.
  - Check that equipment is de-energized.
  - Ground and short-circuit the electrical system.
  - Cover or cordon off adjacent components which are electrically live.

The disconnection of the plant also includes the measuring lines. Since individual measuring lines are connected upstream of the generator circuit breaker (GCB), they can carry mains voltage even when the genset is stopped and the power supply of the switch cabinet TPEM Control Cabinet (TPEM CC) is disconnected.

WARNING!

Risk of injury from improper maintenance

This can lead to severe injuries and even death.

- Only authorized specialist personnel may perform maintenance on the product
- Only qualified specialist personnel may work on the electrical system
- Only qualified specialist personnel may work on the fuel gas system
- Only use original parts

CAUTION!

Risk of burns from touching hot operating media or hot components.

This can lead to minor and severe injuries.

- Wear personal protective equipment.
- Allow the operating media or components to cool down to the ambient temperature.

Risk of destruction of components

Electrostatic charging of the assembly personnel or their tools can damage sensitive components or restrict their function.

- Observe handling regulations for components subject to electrostatic hazards

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10.2 Grid Demand Interface maintenance schedule

All the maintenance work that is required for fault-free operation is summarized in the maintenance schedule. The maintenance schedule applies to both flex operation and continuous operation.

It is imperative that the assembly, maintenance and repair work is carried out.

The work may be carried out by personnel who meet the following minimum requirements:

OL (CL1)	Are maintenance activities for which the operating personnel must have the minimum requirement Operator Level (OL)
BL (CLQ)	Are assembly and repair activities for which the service personnel must have the minimum requirement BOP Specialist Level (BL)
SL (CL2)	Are maintenance and repair activities for which the service personnel must have the minimum requirement Service Level (SL)

For further information on the safety regulations, see

- Operating Manual ⇒ General ⇒ Safety regulations
  - Safety and Product Information Specification

Maintenance work	Interval	CL
Check the electrical cables, connections, contacts etc. on the Grid Demand Interface and on the connected components. Make sure that the Grid Demand Interface is firmly seated and adequately ventilated at the installation site. Check functionality.	With other switchgear cabinets	SL
Change buffer battery.	After every 5 years	SL

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10.3 Work instructions

Tools

- Standard tools

Spare parts

- Buffer battery type CR2430 3V, designed for operating temperatures from -40 to 85 °C. **Important**: Do not use a standard CR2430 battery!

Auxiliary media

- If necessary, computer or laptop and network cable (Cat6 patch cable)

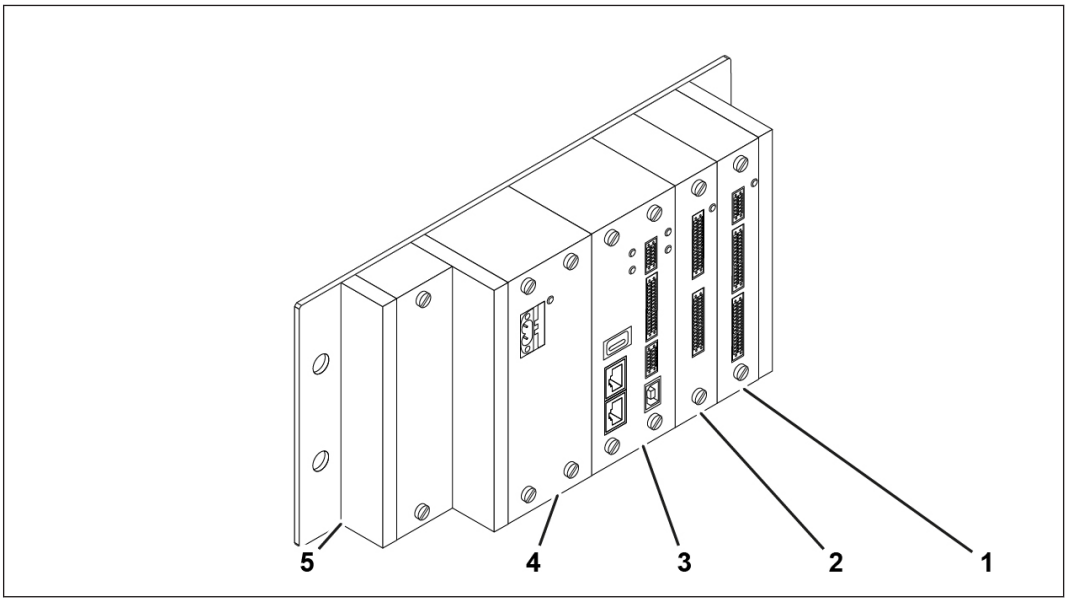
References

- Operating Manual ⇒ General ⇒ Safety regulations

10.3.1 Replace backup battery power module

The Grid Demand Interface consists of a rack (5) with built-in modules.

The module for the voltage supply (power module) (4) contains a lithium battery to maintain the voltage supply to the real-time clock even when the switchgear cabinet is switched off.



75753-001 Structure of the automation controller

1 Analog module for input and output signals

2 Digital module for input and output signals

3 Central Processing Unit (CPU)

4 Voltage supply (power module)

5 Rack

1. Data backup

- Save the current settings before switching off the Grid Demand Interface
  - For information on backing up, see chapter 7.9 Managing configurations 145

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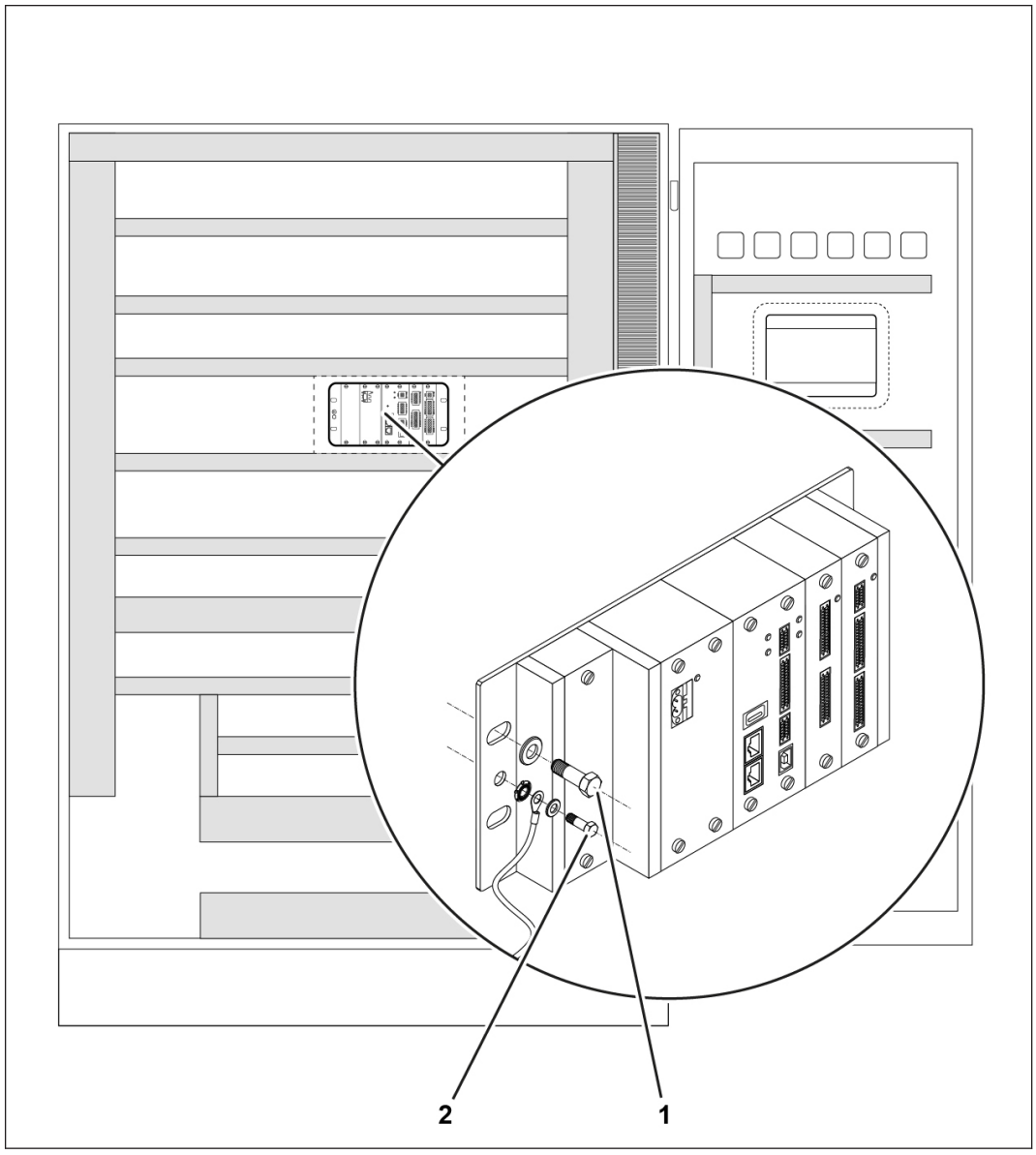
2. Preparatory work

- Disconnect the Grid Demand Interface from the power supply: Switch off the power supply to the relevant switchgear cabinet.
- Open the relevant switch cabinet and check that there is no voltage



75789-001 Example illustration of the rack with the modules installed

- Dismantle the Grid Demand Interface
  - Remove the potential equalization fastening screw (2).
  - Remove the screws (1) and remove the Grid Demand Interface from the switchgear cabinet.

3. Replace buffer battery

Use a new, identical buffer battery. The backup battery is not a standard battery!

Battery designation: see above information

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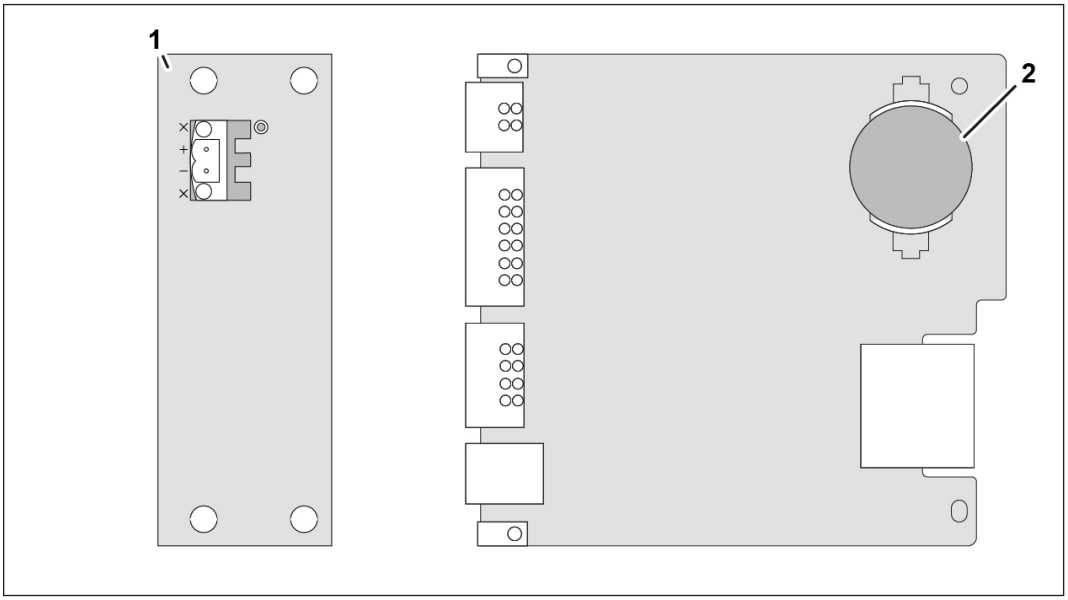


76019-001 Example illustration of voltage supply module with front and side view

- Remove the voltage supply module (1) from the rack
- Replace the old backup battery (2) with the new backup battery

4. Start EmiBox and check functionality

- Re-install the voltage supply module in the rack
- Re-install the Grid Demand Interface in the switchgear cabinet
- Restore voltage supply
- Check configuration of the Grid Demand Interface
- Perform function test

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

11 Dismantling and disposal

Table of contents

11.1 Safety notes..... 180
11.2 Disposing of components..... 181

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

11.1 Safety notes

CAUTION!

Injuries due to improper dismantling

This can lead to minor and severe injuries.

- Only service personnel may disassemble the product.
- Properly release the saved residual energies or allow them to escape.
- Handle open sharp-edged components carefully.
- Dismantle the components properly. Observe the partially high dead weight of the components. Secure components from being knocked over or falling down. If necessary, use lifting equipment.
- In case of doubt, contact the responsible dealer.

Danger to the environment

Auxiliary and operating media and materials can cause environmental damage

- When dismantling, adhere to all the valid national and regional environmental protection regulations
- Ensure that the auxiliary and operating media do not leak
- Drain off, collect and dispose of the auxiliary and operating media properly
- Sort the reusable materials (e.g. plastics, metals) and recycle them
- If necessary, commission a designated and certified specialist company to do this
- Improper dismantling may cause environmental damage

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

11.2 Disposing of components

Dismantling components

- Dismantle components and cabling

Notes on recycling

Unless a return agreement or disposal agreement was concluded, recycle the dismantled components.

The local authority or specialist companies for disposal shall provide information on environmentally sound disposal.

Warnings

Danger to the environment

Incorrect disposal of components and operating media may cause environmental damage.

- Electronic scrap, electronic components, lubricants and other auxiliary media are subject to the treatment of special refuse
- Electronic scrap, electronic components, lubricants and other auxiliary media may be disposed of only by designated and certified specialist companies

Proceed as follows:

- Scrap metals
- Disconnect and recycle electronic components and cables
- Recycle plastic elements
- Sort the remaining components as per the material properties and dispose of them properly

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

12 Appendix

Table of contents

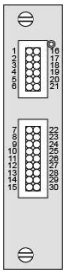
12.1 Copy template GDI 02: Digital module assignment (DIO6-1)..... 184
12.2 Copy template GDI 02: Analog module assignment (AIO6-1)..... 185

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

12.1 Copy template GDI 02: Digital module assignment (DIO6-1)

Order:

Grid code:



Legend

Of	Signal comes from Ex: External (operator) / In: Internal (TEM system)
Signal	Signal name or signal function
Connection	Digital module connecting sockets

Of	Signal	Connection				Signal	Of
		1			16		
		2			17		
		3			18		
		4			19		
		5			20		
		6			21		
		7			22		
		8			23		
		9			24		
		10			25		
		11			26		
		12			27		
		13			28		
		14			29		
		15			30		

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL

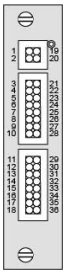
12.2 Copy template GDI 02: Analog module assignment (AIO6-1)

Order:

Grid code:

Legend

Of	Signal comes from Ex: External (operator) / In: Internal (TEM system)
Signal	Signal name or signal function
Connection	Analog module connecting sockets



Of	Signal	Connection				Signal	Of
		1			19		
		2			20		
		3			21		
		4			22		
		5			23		
		6			24		
		7			25		
		8			26		
		9			27		
		10			28		
		11			29		
		12			30		
		13			31		
		14			32		
		15			33		
		16			34		
		17			35		
		18			36		

357-005-EN : : BA : VAR, COV, IMP, B, BA, BS, DEM, EIN, IBN, IST, WP, SK, MH, SB, STB, TA, TL