SIEMENS

Photovoltaics

SINVERT

PVS ControlBox 300

Operating Instructions

Edition 01/2013

Answers for the environment.

SIEMENS

Photovoltaics

SINVERT PVS ControlBox 300

Operating Instructions

01/2013

A5E03642518A/003

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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℗ 02/2013 Technical data subject to change

Table of contents

Introduction

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Purpose of this manual

These Operating Instructions contain all the information required for the assembly, installation, and commissioning of the SINVERT PVS ControlBox 300.

Target group

This manual is aimed at qualified personnel in the following target groups:

- Planners
- Fitters
- Commissioning engineers
- Service and maintenance personnel
- Operators

Basic knowledge required

- Training as an electrical technician
- Experience in working with photovoltaic systems
- Experience in installing and commissioning photovoltaic systems
- Experience of working with inverters

Conventions

The designation "Microbox PC" will also be used in place of the designation SIMATIC IPC427C.

Trademarks

SINVERT® is a registered trademark of Siemens AG.

History

Currently released editions of this manual:

Edition	Comment
05/2011	Initial release
11/2011	• Expansion of the solar PV plant control parameters (DB_Parameter) • Parameterization, diagnostics and monitoring of the ControlBox • System restore and system backup of the Microbox PC • Various minor changes and additions
01/2013	Software update

Safety notes

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Qualified personnel

These operating instructions are intended for the following persons:

- Electrical technicians who commission the unit and connect it to other units in the PV system
- Service engineers and maintenance engineers who are installing upgrades or performing error analyses

This documentation is written for qualified personnel. It does not provide basic information about PV systems.

- Only trained specialists may install the unit. The installation engineer must be qualified according to the national guidelines.
- Operation, maintenance, and repair of this device may be made only by qualified staff who are trained to work on or with electrical devices.

Safety rules

⚠ DANGER

Danger due to high voltages

High voltages cause death or serious injury if safety instructions and notices are not observed or if the equipment is handled incorrectly.

Ensure that all work on this equipment is undertaken by appropriately qualified and trained personnel.

Keep to the five safety rules at all times and at every stage of work:

1. Isolate
2. Protect against reconnection
3. Check that voltage is not present
4. Ground and short-circuit
5. Cover nearby live parts or place guards around them

Description

3

3.1 General features

General features

The following table provides an overview of the features of the SINVERT PVS ControlBox 300:

- Heat dissipation by means of convection
- Connecting by means of copper cable
- Connection by means of fiber-optic cable (FOC)
- Remote maintenance of the SINVERT PVS inverters via an IPC427C industrial PC
- Active power reduction in 4 stages by means of 4 DI
- Dynamic network support as per characteristic curve Q(U)
- Dynamic network support as per characteristic curve P(f)
- Measurement of the electrical values of the solar PV plant at the infeed point
- Fixed presets for active power or cos(phi)

3.2 Hardware

SIMATIC IPC427C industrial PC (Microbox PC)

The Microbox PC is delivered with a CF memory (Compact Flash) with 8 GB capacity.

The automation basis of the ControlBox is the SIMATIC WinAC software PLC (WinAC Basis V4.0 (http://support.automation.siemens.com/WW/view/en/18535320)). The SIMATIC WinAC software PLC runs on the SIMATIC IPC427C industrial PC. The operating system of the PC is Windows XP embedded, which is especially well suited for use in industrial environments.

You can find additional information on the SIMATIC IPC427C industrial PC in the Operating Instructions SIMATIC IPC427C industrial PC (http://support.automation.siemens.com/WW/view/en/37028954).

Interface to the power utility

The digital signals of the ripple control receiver are read in by the digital modules on the SIMATIC ET200S and further processed in WinAC. Further information can be found in the documentation SIMATIC ET 200S distributed I/O system (http://support.automation.siemens.com/WW/view/en/1144348).

The actual values, such as the active power, voltage or frequency that are required for controlling the solar PV plant control are determined using the SENTRON PAC3200 Power Monitoring Device. You can find additional information in SENTRON PAC3200 Power Monitoring Device Manual (http://support.automation.siemens.com/WW/view/en/26504150).

Scalance switch

The SINVERT ControlBox offers connection using fiber-optic (FO) cables in linear bus topologies and ring topologies, or using an electrical port of the type SCALANCE XF204-2.

3.3 Functions

Solar PV plant control

Legal specifications such as the Renewable Energy Law (EEG) in Germany, the medium-voltage directive of the BDEW, or also customer-requested over-dimensioning of the PV generator in comparison to the inverter require, for example, the following functions of a PV plant:

- Reduction of the active power of the entire solar farm
- Frequency-dependent reduction of the active power of the entire solar farm
- Infeed of reactive power or adhering to a specified power factor
- Infeed of the maximum approved active power even if the PV generator is over-dimensioned
- Reduction of the active power by means of ripple control signals from the power utility as per §6 EEG

The description of the control functions of the solar PV plant control can be found in the chapter Solar PV plant control (Page 40).

DataLogger

The DataLogger collects the online data of all of the connected SINVERT PVS inverters, compresses the online data to average values, and transmits the average values to the SINVERT WebMonitor or to the web portal of Meteocontrol GmbH.

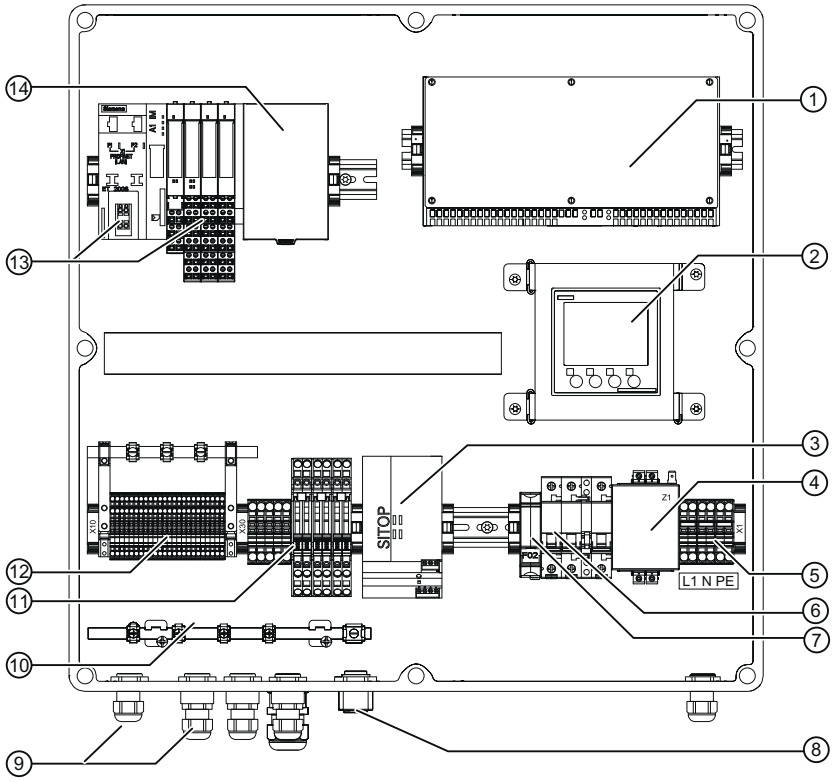
You can find additional information on the software functionality of the DataLogger in the chapter PVS DataLogger (Page 76).

Data server for WinCC

If you are using WinCC, you can use the WinAC software PLC as data server for the WinCC project. The WinCC configuration is created on a project-specific basis. A corresponding example project is stored on the ControlBox. This can be used as the basis for project-specific engineering.

3.4 Design

SINVERT PVS ControlBox 300



① SIMATIC IPC427C (-A100) industrial PC
② PAC3200 (-P1) for power measurement
③ Power supply
④ EMC filter
⑤ Terminal strip for the power supply (- X1)
⑥ Fuses -F1, -F2, -F3
⑦ Overvoltage protection (-F02)
⑧ Divisible cable gland
⑨ Cable glands
⑩ Cable propping bar
⑪ Terminals for current and voltage measurement (- X30)
⑫ Terminals for digital inputs, analog inputs, analog outputs (- X10)
⑬ ET200S with digital and analog inputs
⑭ Scalance (- A01)

Figure 3-1 SINVERT PVS ControlBox 300

3.5 Scope of supply

Scope of supply

The scope of supply of the SINVERT PVS ControlBox includes the following:

- SINVERT PVS ControlBox
- Accessories pack
  - Cable glands
  - Partition Creator CD
  - Certificate of License (COL) WinAC (in paper form and on USB flash drive)
- Installation instructions

Checking the consignment

Please check that the consignment is complete against the accompanying dispatch documentation. If any items are missing from the consignment, please notify the relevant contact person immediately.

Application planning

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Storage

When storing the SINVERT PVS ControlBoxes, it is essential that you comply with the storage conditions described in chapter Technical data (Page 111).

The devices must be stored such that they are protected against the ingress of foreign objects and substances.

Installation location

The PVS ControlBox is generally installed in a container next to a PVS inverter system or in a transfer station in the vicinity of the metering panel.

The installation location must fulfill the following requirements:

- Solid wall or metal structure
- No direct exposure to sun
- Installation in the interior (IP20)
- Classification as RAL area (Restricted Area Location)

Note

Technical data

In addition, observe the technical data in the chapter "Technical data (Page 111)" during installation.

External line side switch or circuit breaker

An external line side switch or circuit breaker must be provided as an isolating device for the ControlBox. The external line side switch or circuit breaker should be located in the vicinity of the ControlBox so that it can be unambiguously assigned to the ControlBox.

Backup fuse

The ControlBox must be protected with a backup fuse (≤ 16 A).

Installation

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Mounting position

The SINVERT PVS ControlBox uses pure convection cooling, and is therefore only designed for mounting on a vertical wall.

Ventilation requirements

A minimum clearance of 20 cm must be provided above the ControlBox.

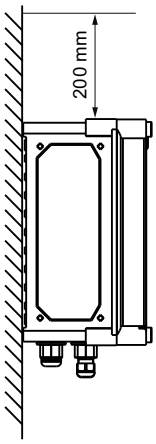


Figure 5-1 Minimum clearance for mounting

Requirements

Drill the drill holes for securing the PVS ControlBox as per the dimension drawing (see the chapter Dimension drawings (Page 119)).

- Use all 8 fastening options

Procedure

The following instructions describe the installation of the PVS ControlBox with 8 locking bolts and 8 fastening options.

Note

For reasons of clarity, installation is shown in the following table using the example of an empty ControlBox.

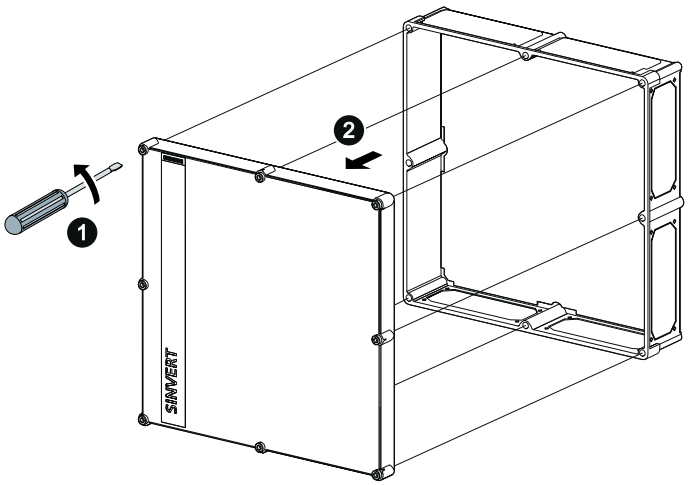
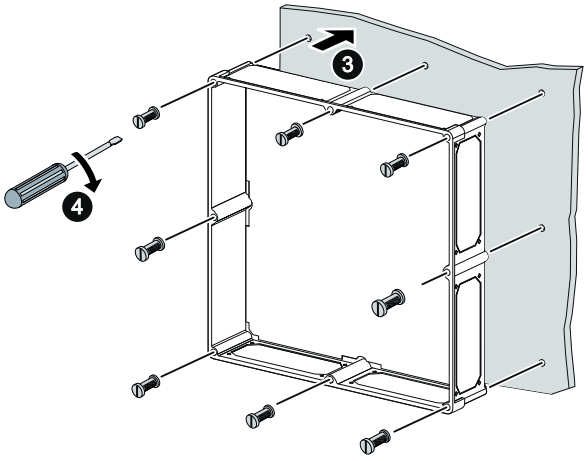
CAUTION

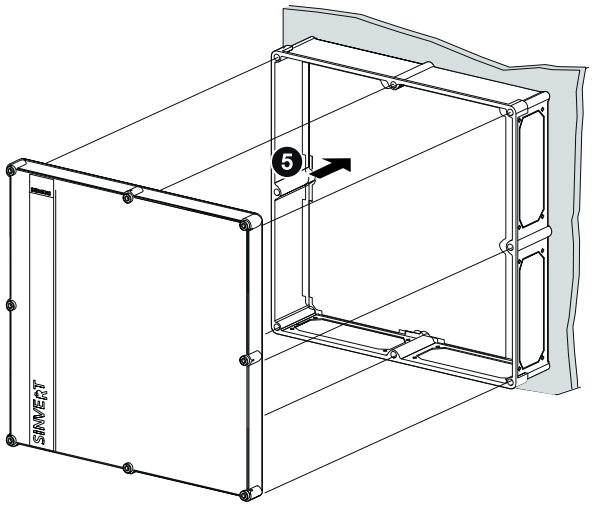
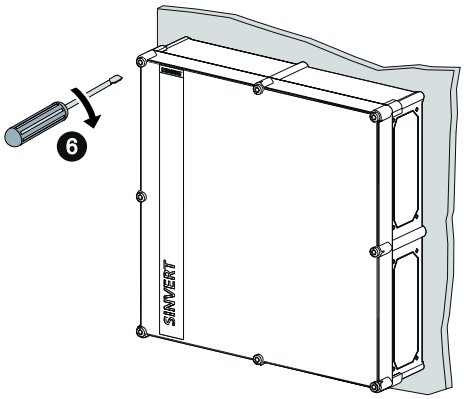
Improper handling can result in injury and material damage.

The ControlBox weighs approx. 20 kg. Improper handling can therefore result in injury to persons or damage to the ControlBox.

Ensure the following measures are taken:

- To distribute the weight, only load, lift and install the ControlBox together with another person.
- Do not lift the ControlBox by the cover.

Step	Operating instruction	Figure
① ②	Loosen the locking bolts of the cover of the ControlBox and remove the cover. • To do this, press the locking bolt down slightly and turn it slightly to the left. • Unlock the locking bolt using a Phillips screwdriver. This is done through the opening of the protective cap without disassembling it.	
③ ④	Screw the SINVERT PVS ControlBox firmly into place using suitable screws: • Max. torque: 3.5 Nm • To mount on a metal plate, use lens head screws or cylindrical head screws (min. M6 x 50 mm) and M6 washers. To mount on a wall, use round-head screws DIN 7996 6 x L [1] and M6 washers. • **Notice**! Countersunk screws are not permissible! • The mounting hardware is not supplied with the device. [1] Select a suitable length for the round-head screws.	

Step	Operating instruction	Figure
⑤	Place the cover of the ControlBox on the enclosure.	
⑥	Secure the cover of the ControlBox using the locking bolts. • To do this, press the locking bolt down slightly and turn it slightly to the right. This is done through the opening of the protective cap without disassembling it.	

Connection

6

DANGER

Danger, high voltage!

Risk of death or serious bodily injury.

Before starting work, disconnect the system and the devices from the power supply.

Information on laying the cables

- Ensure that you lay all cables with short-circuit protection and ground fault protection. To ensure short-circuit-proof and ground-fault-proof installation in accordance with VDE 0100-520 (VDE 0100-520:2003-06 Section 521.13 c) or IEC 60364-5-52 (IEC 60364-5-52:1993 Part 5, Chapter 5.2), the following requirements must be fulfilled:
  - Cables must not be installed in the proximity of combustible materials.
  - Ensure the lines are accessible.
  - Prevent the risk of mechanical damage.
  - Comply with the bending radiuses of the cable.
- Do not lay the feeder conductors over edges.
- Make sure that you provide strain relief for the cable.

6.1 Components to be connected

Overview of the components to be connected for the ControlBox 300

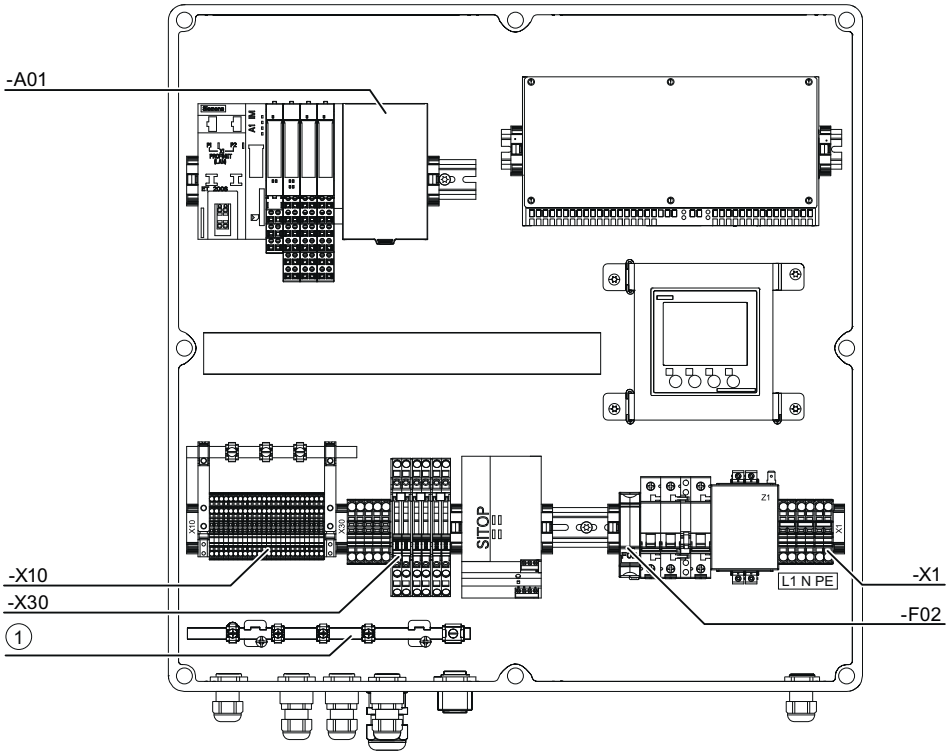


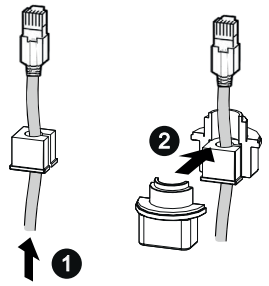
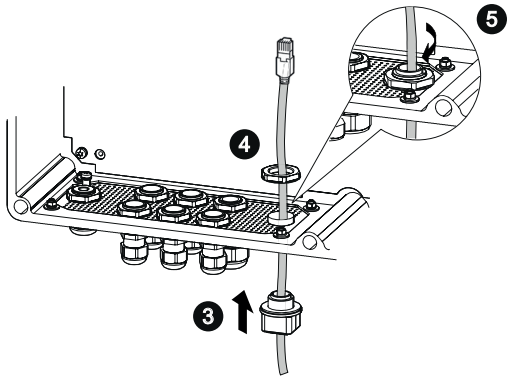
Figure 6-1 SINVERT ControlBox 300

-A01	Connection of the network (Scalance)
-X10	Connection of the signaling line (electric utility wireless ripple control receiver)
-X30	Connection of measurement current and measurement voltage
-X1	Power supply connection
-F02	External Ethernet connection
①	Shielding bus

6.2 Inserting the cables into the ControlBox

Divisible cable glands

Divisible cable glands are provided for cables with fixed connectors. Thanks to the divisible cable glands, you can run the cables into the enclosure and attach cable grips. The divisible cable glands are included in the scope of delivery and are included with the ControlBox as an accessory pack.

Step	Operating instruction	Figure
①	Place the pre-assembled network cable into the rubber insert of the divisible cable gland. The distance from the divisible cable gland to the connector should correspond to the length required to the connection socket.	
②	Close the cable gland by pushing the two halves together over the rubber insert until they latch into place.	
③ ④ ⑤	Route the network cable with the cable gland into the ControlBox enclosure and tighten the cable gland using the counter nut provided for this purpose.	

Cable cross-sections

Comply with the permitted cable cross-sections for the various terminals of the SINVERT PVS ControlBox.

Module	Terminal	Function	Terminal type	Cross-section and type of cable	
				metric	AWG
-X1	1/2 (L), 3/4 (N), 5/6 (PE)	Supply voltage	CAGE CLAMP®S	1.5 mm² ... 6 mm² PE: 6 mm²	16 AWG ... 10 AWG PE: 8 AWG
				solid or finely stranded	
-F02	RJ45	Ethernet	CONNECTOR	CAT5e Type: 2YY (ST) CY 2x2x0.75 / 1.5-100 LI GN	
-A01	P1 ... P4	Fiber-optic cable	BFOC port (multimode up to 5 km)	A multimode fiber-optic cable (FOC) must be used for transmitting the data. The wavelength is 1310 nm. Multimode fiber-optic cables with a core diameter of 50 or 62.5 µm can be used; the light source is an LED.	
-X10	1/3, 2/4, 5/7, 6/8	Sensor cables	CAGE CLAMP®S	0.25 mm² to 1.5 mm²	23 AWG ... 16 AWG
				solid or finely stranded	
-X30	1-5	Measuring line for measuring voltage (SENTRON PAC)	CAGE CLAMP®S	1.5 ... 6 mm²	16 ... 10 AWG
				solid or finely stranded	
-X30	11-16	Measuring line for measuring current (SENTRON)	CAGE CLAMP®S	2.5 ... 6 mm²	14 ... 10 AWG
				solid or finely stranded	

Grounding

The SINVERT PVS ControlBox must be grounded. The grounding of the SINVERT PVS ControlBox serves as a measure for overvoltage protection. In addition, a potential difference can build up without grounding.

Grounding takes place via the PE terminal on the terminal strip (-X1) (see the chapter Connecting the power supply (Page 30)).

Shielding

- The external signal cables and bus cables must be shielded.
- The maximum permitted length of the unshielded sensor cables is 1 m.
- The shielding must make contact over a wide surface area on the shielding bus that is provided for this.
- Contact is made using the shield terminals that are provided on the DIN rail.
- The shield terminals may only be tightened by hand, not with a screwdriver. Tightening the shield terminal clamp with a screwdriver may damage the insulation.

6.3 Connecting the network

Connecting to the Industrial Ethernet network with fiber-optic cable

For the Industrial Ethernet network connection, you need a fiber-optic cable with a BFOC port:

1. Route the cables into the ControlBox through the cable glands (see the chapter Inserting the cables into the ControlBox (Page 25)).
2. Connect the fiber-optic cables directly to the SCALANCE (–A01) on slot P5 or P6 an.

- Ensure there is sufficient bending radius when laying the fiber-optic cables (min. 15 cm)

Connecting to the Industrial Ethernet network with RJ45

For the Industrial Ethernet network connection, you need an external Ethernet cable with an RJ45 connector

1. Route the cables into the ControlBox through the cable glands (see the chapter Inserting the cables into the ControlBox (Page 25)).
2. Connect the external Ethernet cable directly to the external Ethernet connection (-F02).

6.4 Connecting electric utility signals

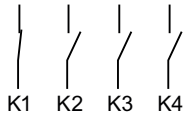
Electric utility signals of the wireless ripple control receiver

The signals that are provided by the electric utility for control are not defined in the EEG or in the medium-voltage directive.

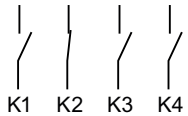
Often, the electric utility signals are passed on via digital interfaces of a wireless ripple control receiver. The wireless ripple control receiver has a specific number of relays, which signal the active power limit in various stages.

The following example shows the wiring of a four-stage wireless ripple control receiver.

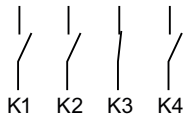
- 100% active power - full infeed



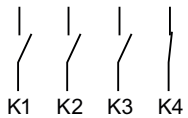
- 60% active power



- 30% active power



- 0% active power - no infeed



Connecting electric utility signals

The electric utility signals of the wireless ripple control receiver are connected to the digital inputs of the module (-X10).

Route the cables into the ControlBox through one of the cable glands.

Terminals	Description
1 / 3	Relay 1 from the wireless ripple control receiver
2 / 4	Relay 2 from the wireless ripple control receiver
5 / 7	Relay 3 from the wireless ripple control receiver
6 / 8	Relay 4 from the wireless ripple control receiver

6.5 Connecting the current measurement and voltage measurement

Requirements

The SENTRON PAC 3200 has been parameterized in accordance with requirements: These include:

- Adjustment to the physical conditions of use
- Integration into the communication system
- Country-specific settings, ergonomics, device protection

DANGER

Dangerous electrical voltage

Working with live equipment can lead to an electric shock.

Use an external voltmeter to ensure that the voltage measuring inputs are de-energized. The measured values display on the screen of the PAC3200 is not evidence that the equipment is de-energized.

Note

Connection details

Observe the following information from the SENTRON PAC3200 Power Monitoring Device Manual (http://support.automation.siemens.com/WW/view/en/26504150):

- Safety information for connecting
- Protection of the voltage measuring inputs by means of fuses from the connection examples to be provided by the customer
- Permissible connection details in the technical data

Connecting the current measurement and voltage measurement to the SENTRON PAC 3200

The measuring lines for measuring the current and voltage are connected to the terminal strip (-X30).

Route the cables into the ControlBox through one of the cable glands.

Terminal	Description
Voltage measuring inputs	
1	Line-to-neutral voltage U_{L1}
2	Line-to-neutral voltage U_{L2}
3	Line-to-neutral voltage U_{L3}
4	Neutral conductor U_N
5	Functional ground

Terminal	Description
Current measuring inputs	
11	Phase current, I_{L1}, input
12	Phase current, I_{L1}, output
13	Phase current, I_{L2}, input
14	Phase current, I_{L2}, output
15	Phase current, I_{L3}, input
16	Phase current, I_{L3}, output

6.6 Connecting the power supply

Connecting the power supply

⚠ DANGER

Dangerous electrical voltage

Working with live equipment can lead to an electric shock.

Ensure that the power supply cable is disconnected.

Note

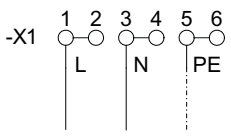
Conductor cross-sections

Select the cross-section of the power supply cable in such a way that the line losses are as low as possible. See the table in the chapter "Inserting the cables into the ControlBox (Page 25)".

Use a finely stranded cable if possible.

Connect the power supply to the terminal strip (-X1).

Route the cables into the ControlBox through one of the cable glands.

Terminal	Description	Circuit diagram
1	L	
2		
3	N	
4		
5	PE	
6		

6.7 Final work

Final work

1. Close off all of the unused connections with dummy plugs.
2. Tighten the cable gland firmly in place.
3. Ensure that the ventilation openings are unobstructed to ensure cooling through convection.

Commissioning

7

Requirements

Upon delivery, the ControlBox is configured for an inverter with the default IP addresses (see S7 program on the ControlBox (Page 40)). For other configurations, you must check the parameters of the software and adjust them if necessary:

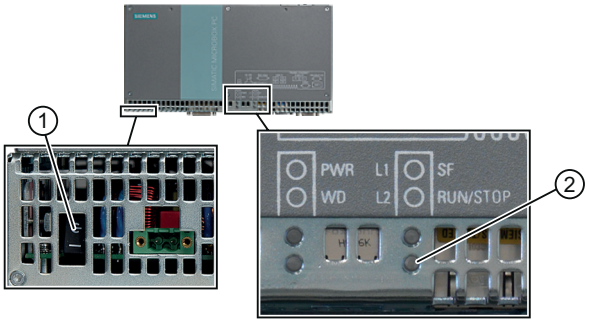
- Configuration of the data logger: You can find additional information on configuring the DataLogger in chapter PVS DataLogger (Page 76).
- Configuration of the solar PV plant control: You can find additional information on configuring the solar PV plant control in chapter Solar PV plant control (Page 40)

To operate the SIMATIC IPC427C industrial PC, log on to the SIMATIC IPC427C industrial PC via Remote Desktop (see Configuration and operation of the SIMATIC IPC427C (Page 38)).

Procedure

Proceed as follows to commission the ControlBox:

1. Close the external line side switch or circuit breaker (see Connecting the power supply (Page 30)).
2. Connect the fuses -F1, -F2, -F3.
3. Connect the SIMATIC IPC427C industrial PC to the ON/OFF switch.
4. After approx. 2.5 minutes, the RUN LED on the SIMATIC IPC427C industrial PC lights up (green) and the ControlBox is ready to operate.



① ON/OFF switch
② LED RUN

Figure 7-1 SIMATIC IPC427C industrial PC

Software

8

8.1 Safety notes

No additional software

Note

SIMATIC IPC427C industrial PC

Any additional software installed on the SIMATIC IPC427C industrial PC destabilizes the system.

Do not install any additional software on the SIMATIC IPC427C industrial PC.

8.2 Software on the IPC427C

Overview

The table below lists the most important software packages installed on the IPC427C (Microbox PC):

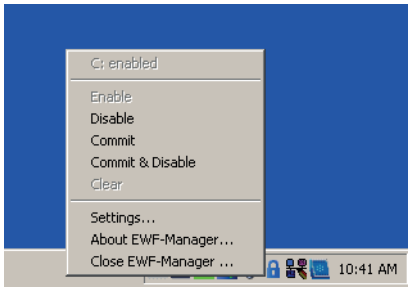
Software package	Description
Windows Embedded Standard	Operating system based on Windows XP
Simatic Net Edition	Data exchange via OPC
WinAC RTX	Soft PLC for solar PV plant control program
SIMATIC IPC DiagBase	Diagnostics hardware Microbox
PCDiagBridge	Data interface between DiagBase and WinAC RTX
SIMATIC IPC EWF Manager	Administering the write protection filter for the partitions
PST tool	Changing the names and IP addresses of Profinet devices
Simatic WinAC TimeSynchronisation	Synchronization of the clock in the WinAC RTX from the Windows system
Simatic IPC Image Partition Creator as CD in accessories pack	Data backup and data restore
Sinvert PVS DataLogger	Sending ControlBox data to Web portals
ConfigTool	Configuration tool for PVS inverters and ControlBoxes

EWF Manager

Partition "C:" of the SIMATIC IPC427C industrial PC is write-protected as delivered. The write protection enhances security, since changes on "C:" are lost after the next warm restart.

Furthermore, the write protection serves to increase the service life of the memory medium (CF card), since the number of write accesses is reduced.

Please refer to the Help (path "C:\Program Files\Siemens\EWFManager\Help") for further information on how to operate the EWF Manager.



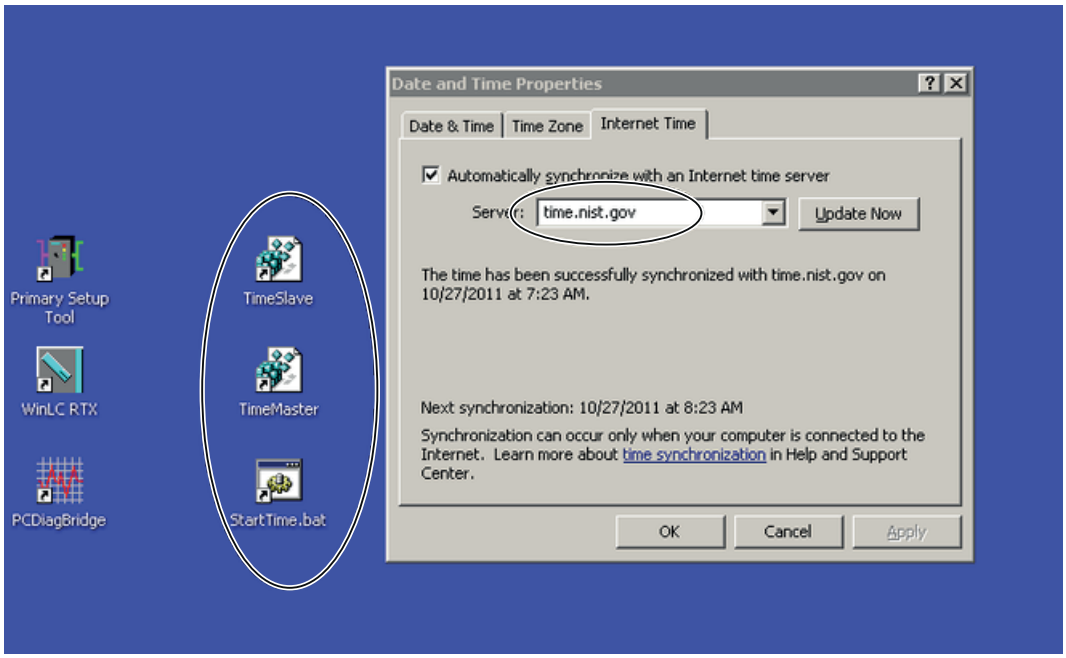
Time-of-day synchronization

The Microbox PC (IP address: 10.80.130.1) is set as NTP time-of-day master in the delivery condition. This means all devices that support the NTP time-of-day procedure (e.g. Scalance) can be set to this NTP master.

The Microbox PC itself fetches the time every hour from the address "time.nist.gov" provided Internet access is available.

If there is to be another NTP time-of-day master in the plant network, such as the WinCC computer, proceed as follows:

1. Execute the file "TimeSlave.reg" on the desktop.
2. Enter the address of the new NTP master on the "Internet Time" tab of the Windows clock.
3. Start the time-of-day service again: To do so, execute the file "StartTime.bat" on the desktop.



Note

For the changes to be accepted permanently, the EWF filter must be deactivated.

8.3 Configuration and operation of the SIMATIC IPC427C

Remote access to the SIMATIC IPC427C industrial PC

To operate the SIMATIC IPC427C industrial PC, log on to the SIMATIC IPC427C industrial PC with the following data via Remote Desktop:

- IP address: 10.80.130.1
- User name: Administrator
- Password: sinvert

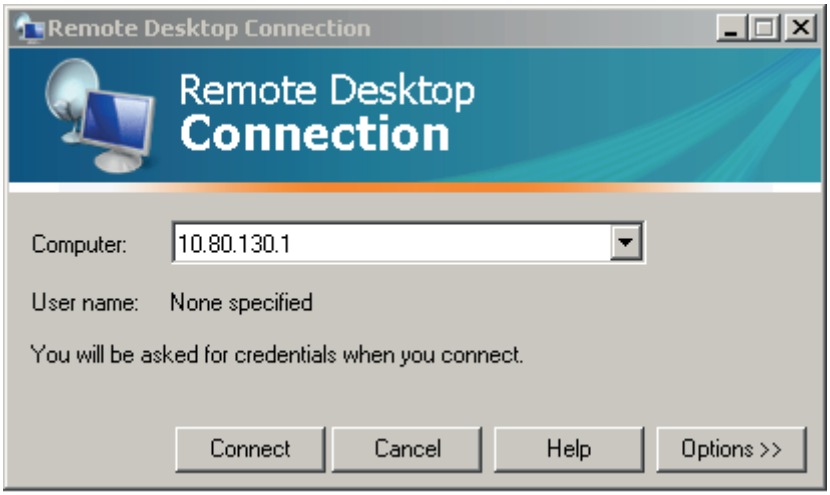


Figure 8-1 Remote Desktop connection

Enter the IP address and click on the *connect*. button

Local access to the SIMATIC IPC427C industrial PC

For local operation of the SIMATIC IPC427C industrial PC, you can connect the following operator controls and indicators:

- Screen (DVI connection)
- Keyboard (USB port)
- Mouse (USB port)

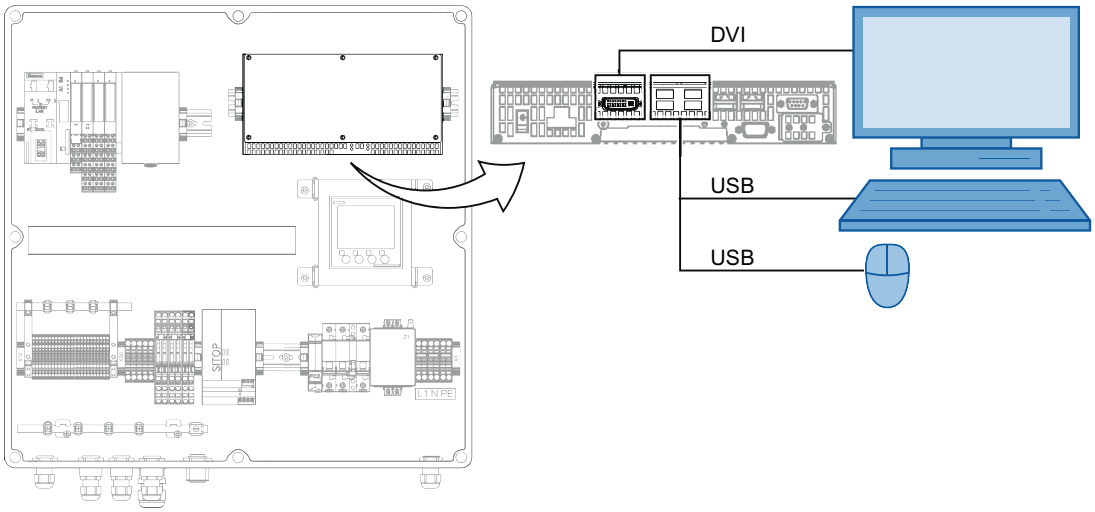


Figure 8-2 Local access to the SIMATIC IPC427C industrial PC

8.4 Solar PV plant control

8.4.1 S7 program on the ControlBox

Partition "D:\" of the SIMATIC IPC427C industrial PC contains the following programs and projects:

- An editable SIMATIC S7 / WinCC example project
- an executable S7 program

Information about the S7 program

Note

No CPU cold restart

The S7 program of the solar PV plant control does not support a CPU cold restart (OB102).

Note

Unstable control

If the chronological cycle in which the control setpoint values are transferred is too great, unstable control may result.

Ensure that control setpoint values are transferred in a chronological cycle of <2.5 seconds.

S7 program

The S7 program contains all the necessary functions and parameter settings for operating the solar PV plant control. The S7 program ControlBox_300.wld of the ControlBox is loaded onto the PLC memory and ready to execute as delivered.

The following S7 programs are stored in the directory D:\ ArchivWinACRTX:

- ControlBox_300.wld
- ComBox_200.wld

The solar PV plant control is parameterized at the factory for the communication and control for an inverter with the IP address 10.80.40.01.

In addition to this default setting, the following components are configured:

Configured components	Default
Communication to the SENTRON PAC3200	IP address: 10.80.134.1
Integration of the ET200S I/O devices (incl. electric utility ripple control signal interface)	IP address: 10.80.131.2
Parameterization of Scalance switch	IP address: 10.80.11.1
WinAC in the SIMATIC IPC427C industrial PC	IP address: 10.80.131.1
SIMATIC IPC427C industrial PC	IP address: 10.80.130.1
Parameterization of up to 8 weather stations	IP address: 10.80.132.1 to 10.80.132.8
Parameterization of the Scalance switch for each inverter	IP address: 10.80.20.1 to 10.80.20.30

Note

Only one ControlBox can be operated in a network segment.

You can change or expand these default settings by adjusting the various parameters. The following configuration options are available to you for this purpose:

- Configuration with SIMATIC Manager
- Parameterization with OPC client
- Parameter assignment via ConfigTool. You can download the ConfigTool for free from the Siemens Service & Support Portal (https://support.automation.siemens.com).

Parameterization with Step7 and OPC is described in the following chapters.

Editable S7/WinCC project

The supplied S7/WinCC example project is the basis for the S7 programs. The example project contains the solar PV plant control of 30 inverters (including WinCC).

The project "PVS_ParkCtrl_Vx.x.x.x.x.Basic.zip" is stored in the directory "D:\ S7Project".

8.4.2 Active power control

Active power control

A PI controller determines the manipulated variable from the control deviation in a value range from 0 to 100%. The manipulated variable represents the percentile setpoint value for the active power of the inverter. This is transferred to the respective inverter via the parameter interface.

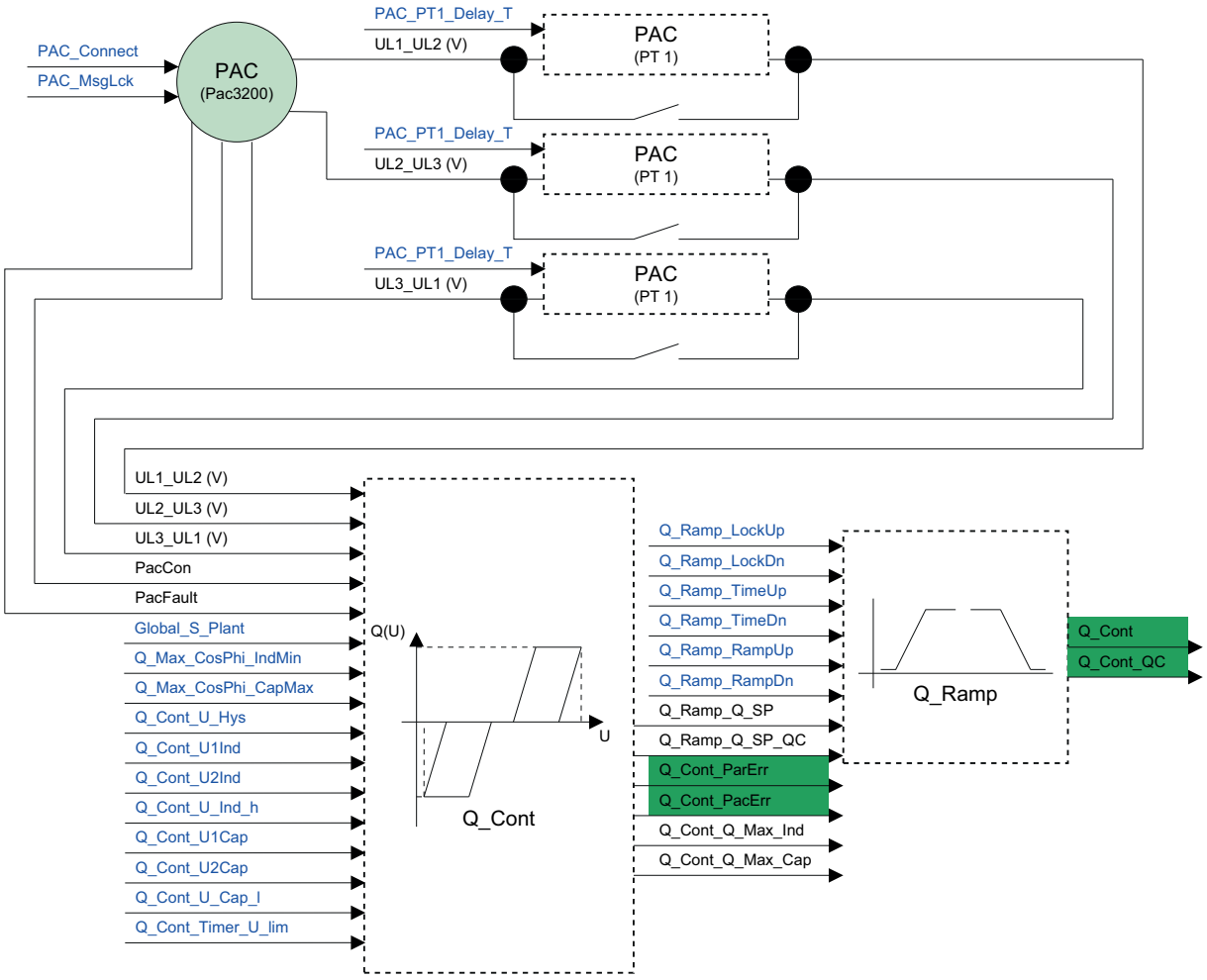


Figure 8-3 Functional diagram of active power control (Fig. 1 of 2)

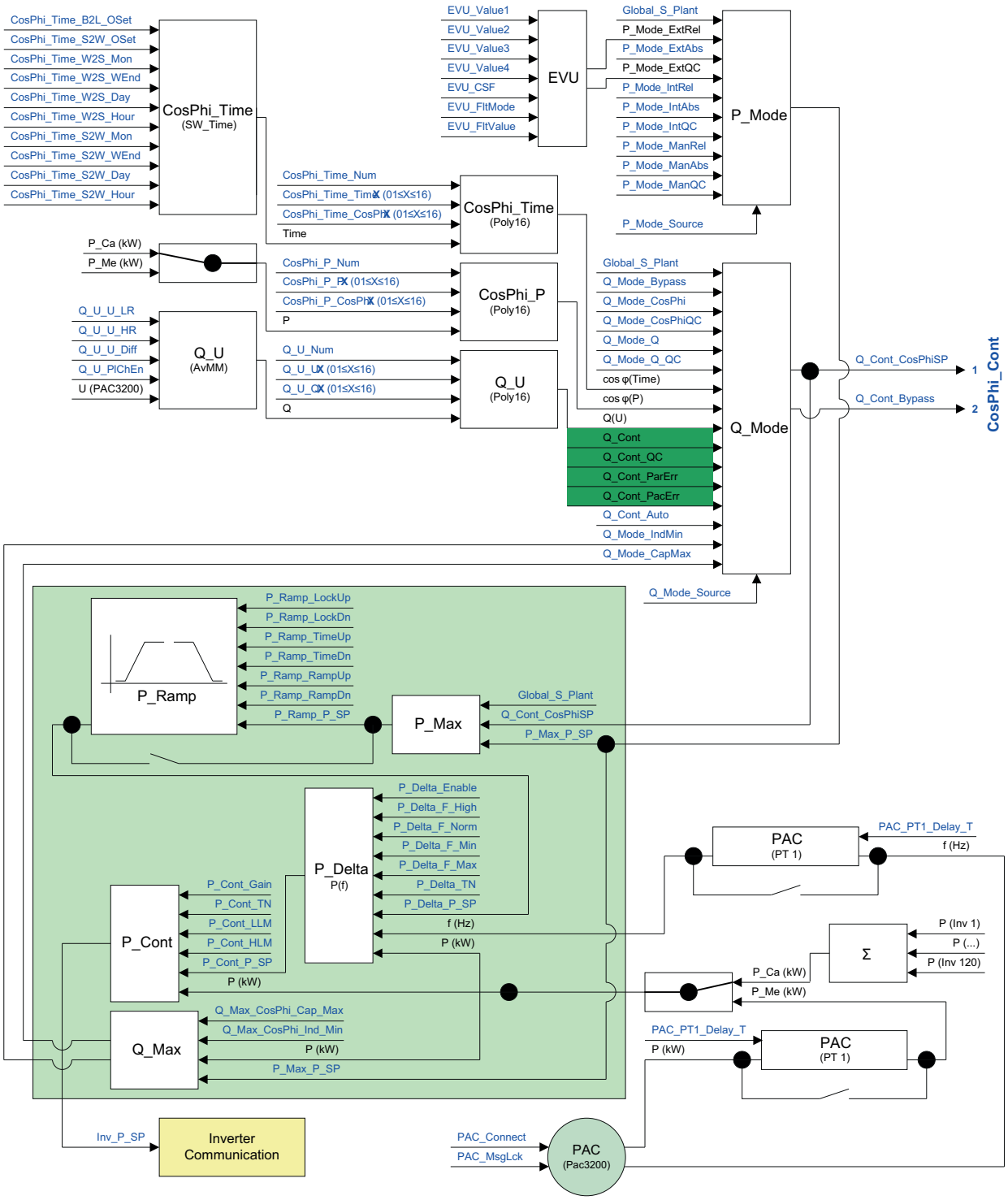


Figure 8-4 Functional diagram of active power control (Fig. 2 of 2)

Uniform setpoint

All inverters receive the same power setpoint as a percentage in a value range from 0 to 100%.

Linear setpoint

In the case of a linear setpoint, the current manipulated variable of the controller (= inverter power setpoint) is multiplied by a straight line with a negative gradient (linear equation y = m • x + n). As soon as the required inverter power setpoint is less than 100% (derating state), this multiplication results in an individual power setpoint for each inverter. This avoids simultaneous switching of the DC contactors and the associated sudden power variations.

Mathematical formulas

P_setpoint - P_rated • 2/n • x + m • Inv_P_Sp (x) =

P_rated: rated system power

n: number of inverters

x: number of the inverter

m: 100 + P_rated • 2

Inv_P_Sp: shared controller output

Example calculation

P_rated: 20 MW

n: 10

x: 1 to 10

m: 100 + 20 • 2 = 140

Calculation for Inv_P_Sp = 1.0 (100%)

P_setpoint(x) = - 20 • 2/10 • **x** + 140 • 1.00 =

P_setpoint(Inv01) = - 20 • 2/10 • **1** + 140 • 1,00 = **136 %**

P_setpoint(Inv02) = - 20 • 2/10 • **2** + 140 • 1,00 = **132 %**

P_setpoint(Inv03) = - 20 • 2/10 • **3** + 140 • 1,00 = **128 %**

P_setpoint(Inv04) = - 20 • 2/10 • **4** + 140 • 1,00 = **124 %**

P_setpoint(Inv05) = - 20 • 2/10 • **5** + 140 • 1,00 = **120 %**

P_setpoint(Inv06) = - 20 • 2/10 • **6** + 140 • 1,00 = **116 %**

P_setpoint(Inv07) = - 20 • 2/10 • **7** + 140 • 1,00 = **112 %**

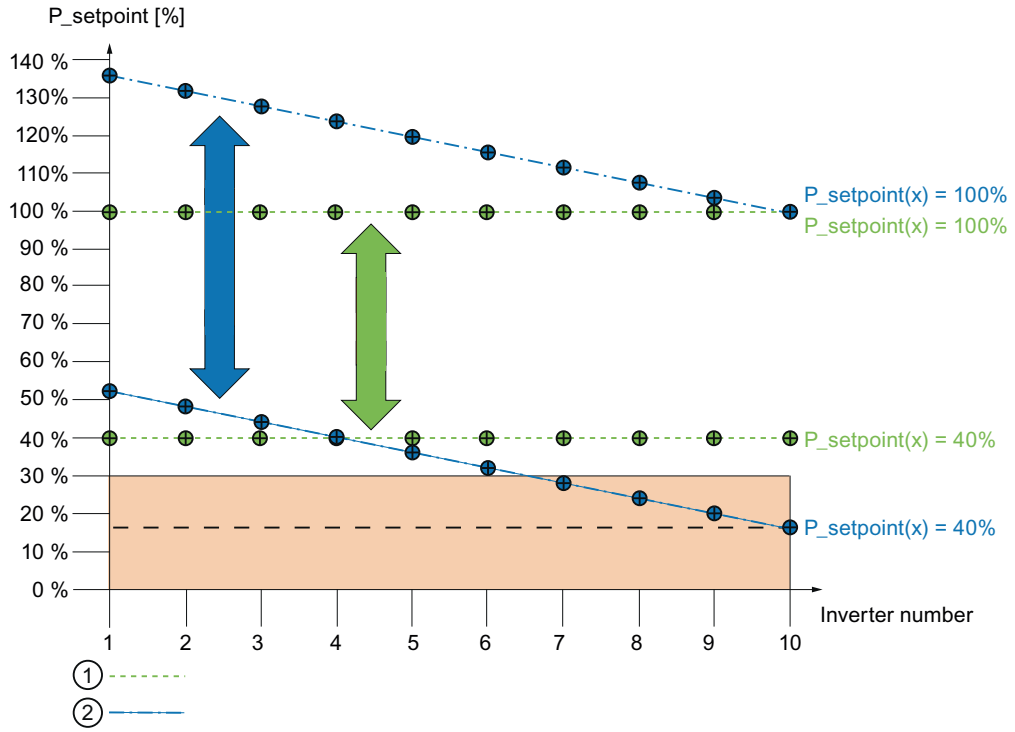
P_setpoint(Inv08) = - 20 • 2/10 • **8** + 140 • 1,00 = **108 %**

P_setpoint(Inv09) = - 20 • 2/10 • **9** + 140 • 1,00 = **104 %**

P_setpoint(Inv10) = - 20 • 2/10 • **10** + 140 • 1,00 = **100 %**

Calculation for Inv_P_Sp = 0.4 (40%)

P_setpoint(x) = - 20 • 2/10 • **x** + 140 • 0.4 =
P_setpoint(Inv01) = - 20 • 2/10 • **1** + 140 • 0,4 = **52 %**
P_setpoint(Inv02) = - 20 • 2/10 • **2** + 140 • 0,4 = **48 %**
P_setpoint(Inv03) = - 20 • 2/10 • **3** + 140 • 0,4 = **44 %**
P_setpoint(Inv04) = - 20 • 2/10 • **4** + 140 • 0,4 = **40 %**
P_setpoint(Inv05) = - 20 • 2/10 • **5** + 140 • 0,4 = **36 %**
P_setpoint(Inv06) = - 20 • 2/10 • **6** + 140 • 0,4 = **32 %**
P_setpoint(Inv07) = - 20 • 2/10 • **7** + 140 • 0,4 = **28 %**
P_setpoint(Inv08) = - 20 • 2/10 • **8** + 140 • 0,4 = **24 %**
P_setpoint(Inv09) = - 20 • 2/10 • **9** + 140 • 0,4 = **20 %**
P_setpoint(Inv10) = - 20 • 2/10 • **10** + 140 • 0,4 = **16 %**



① Uniform setpoint value specification
② Linear setpoint value specification

Figure 8-5 Uniform and linear setpoint value specifications

For a controller output "Inv_P_Sp" of 40%, for example, the inverters thus receive the following inverter setpoints:

- Inverter 1: 52 %
- Inverter 4: 40 %
- Inverter 10: 16 %

Lower threshold P_Cont_Threshold_LL and P_Cont_Min_Time

For linear setpoint control, it is possible to set a lower threshold value for shutting down inverters. In the example above, inverters 7 to 10 shut down. Ineffective or critical operating points of the inverters are avoided with this threshold. Shutdown of the relevant inverters if the value drops below the lower threshold can be delayed by using a time constant (P_Cont_Min_Time).

Connection hysteresis P_Cont_Hysteresis and P_Cont_Max_Time

If the inverter setpoint rises above the lower threshold and a parameterizable hysteresis, the inverter is switched on again. Switch-on can be delayed by a time constant (P_Cont_Max_Time).

The graphic blow illustrates the relationships described above:

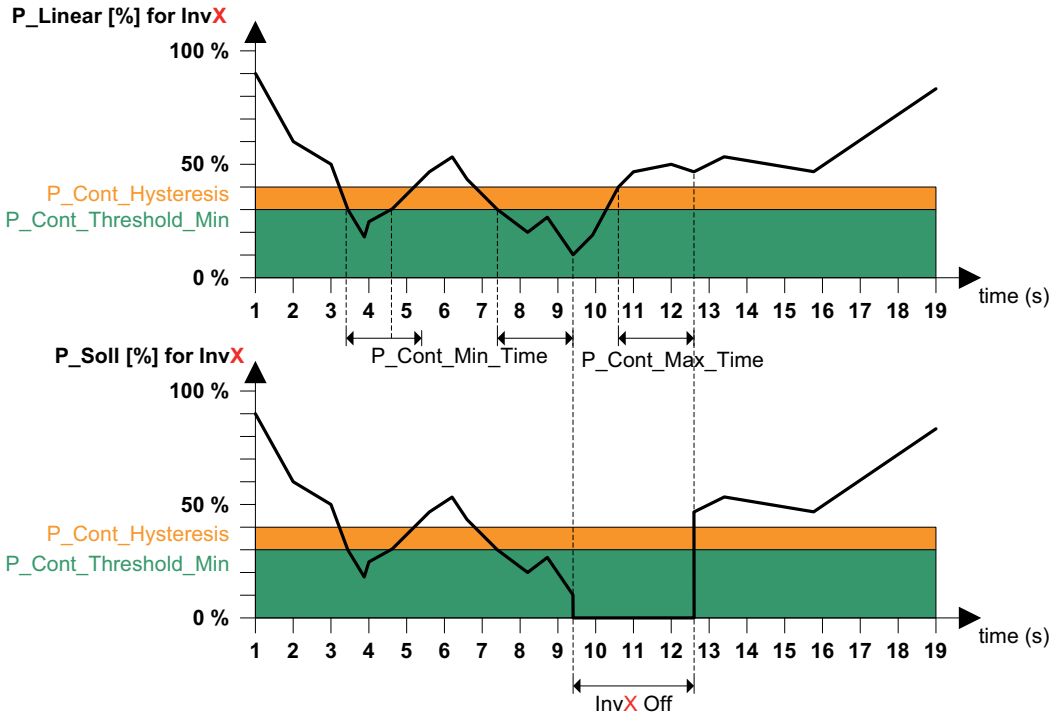


Figure 8-6 Connection hysteresis

Calculation of the required number of inverters in the case of power reduction

In the case of power reduction, the number of inverters (n) required for the desired power setpoint is calculated and activated in "linear setpoint" mode. The specified power setpoint is interpreted as the rated plant power "P_rated" for the period during which power is reduced. According to the n+1 principle, an additional inverter can be incorporated via parameterization to compensate for power fluctuations. The maximum number of inverters that can be connected can be specified via the parameter "P_Cont_InvSpare". When selecting and connecting, the runtimes and the availability of the inverters are taken into account so that the inverters with the lowest number of operating hours are always prioritized at activation. Prioritization is carried out once a day at a parameterizable time, and is retained until the next time trigger. The time can be set via the parameter "P_Cont_TimeInvOrder"

Example:

A solar PV plant consists of 10 inverters, each with 2 MVA rated power (→ 20 MVA rated plant power). The power utility specifies a power reduction of 50% (→ max. 10 MVA). To comply with these specifications, either 20 inverters, each with 50% of the rated power, or 10 inverters, each with 100% of the rated power, would have to be operated under ideal conditions. In "linear setpoint" mode, the second variant is activated.

8.4.3 Reactive power control

Reactive power control

A PI controller determines the manipulated variable from the control deviation in a value range from -0.999 to 1. The manipulated variable represents the setpoint value for the power factor "cos φ_Sp". This is transferred to the respective inverter via the parameter interface. To ensure that this value can be processed in the inverter, the setpoint source (0) reactive power / cos φ must be set to a fixed setpoint via the parameter 33833.

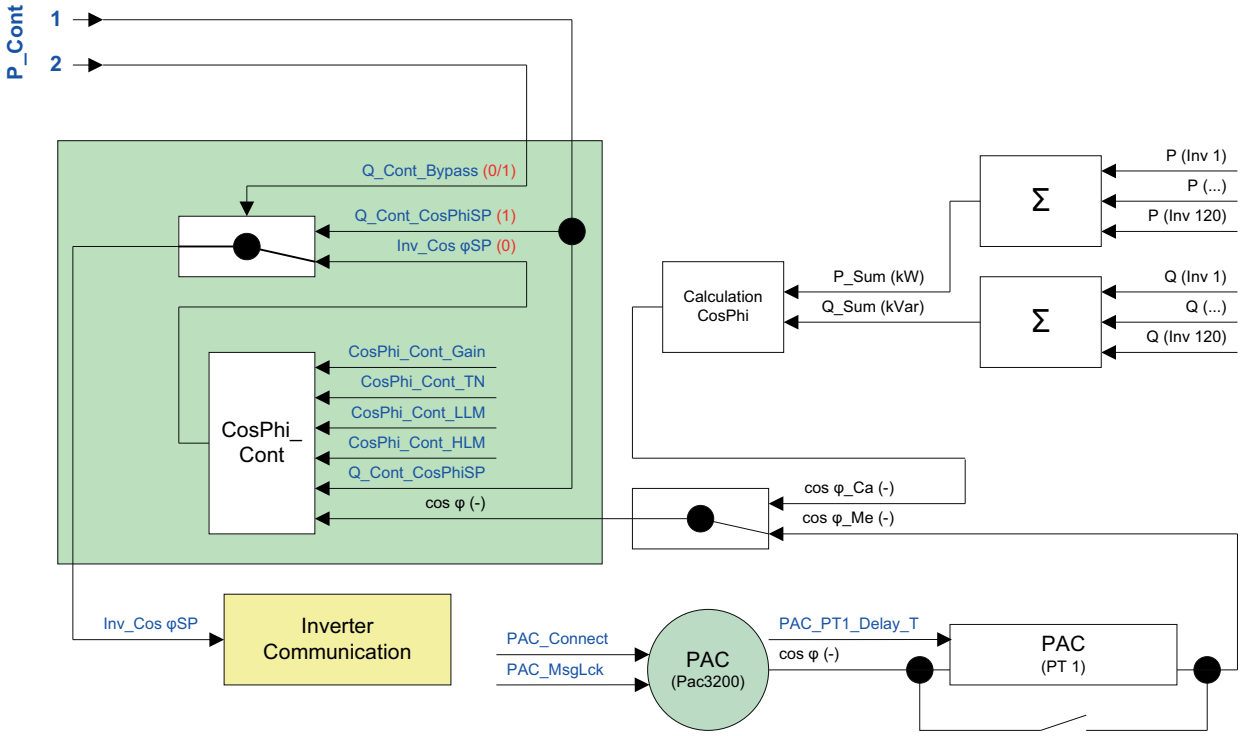


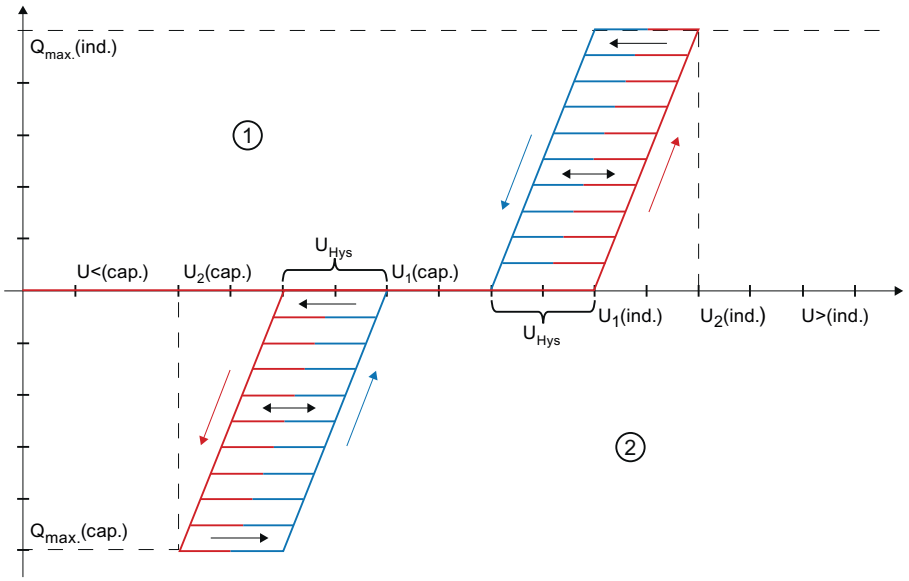
Figure 8-7 Functional diagram for the reactive power control

8.4.4 Reactive power control Q(U)

Reactive power control Q(U)

Reactive power control Q(U) can be activated to stabilize the line voltage. In this mode, a corresponding reactive power is fed in dependent on the voltage at the infeed point. This reactive power is within the possibilities of the inverters.

The relationships between the line voltage (U) and the reactive power Q to be fed in are illustrated by the following figure:



① underexcited
② overexcited

Figure 8-8 Reactive power control Q(U)

If the measured voltage in the medium voltage grid rises above a parameterizable limit U_1(ind.), the reactive power is specified as a setpoint in accordance with a defined straight line Q(U) = f(U).

Above a line voltage of $U_{2(ind.)}$, a maximum reactive power of $Q_{max.}$(ind.) is fed in at the grid connection point. If the line voltage continues to rise, the generating plant is disconnected from the grid above a voltage of U>(ind.) for safety reasons.

If the voltage falls, the currently generated reactive power must be kept constant within the voltage range U_{Hys} (hysteresis). The reactive power is not reduced until the lower dead band limit (blue line) is reached.

To determine the straight line Q=f(U), the parameters U_1, U_2., $Q_{max.}$ and the safety limit U> must be parameterized for the inductive range and for the capacitive range. If compensation in the capacitive range is not necessary, the parameters must be assigned 0. This operating mode can be prioritized by setting the parameter Q_Cont_Auto. With activated prioritization, all currently set operating modes and setpoint sources are ignored, and reactive power control Q(U) then has priority. This applies until the voltage at the grid connection point returns to within the tolerances.

Shutdown of the plant can be delayed by parameterizing a time constant.

8.4.5 Active power limitation by means of cos φ setpoint

Active power limitation by means of cos φ setpoint

The total active power P is limited depending on the reactive power control. The reactive power control is controlled by cos φ. It is possible to specify the cos φ in a positive or negative range, although this is not mathematically correct.

"cos φ - negative" means capacitive reactive power and "cos φ - positive" means inductive reactive power.

The following examples clearly demonstrate how the total active power P is limited depending on cos φ. The limits of the cos φ values are entered in the following parameters:

Data word	Variable name	DataType	Designation	cos φ
166.0	Q_Max_CosPhi_CapMax	REAL	Q max maximum power factor of capacitive power	-0.95
170.0	Q_Max_CosPhi_IndMin	REAL	Q max minimum power factor of inductive power	0.95

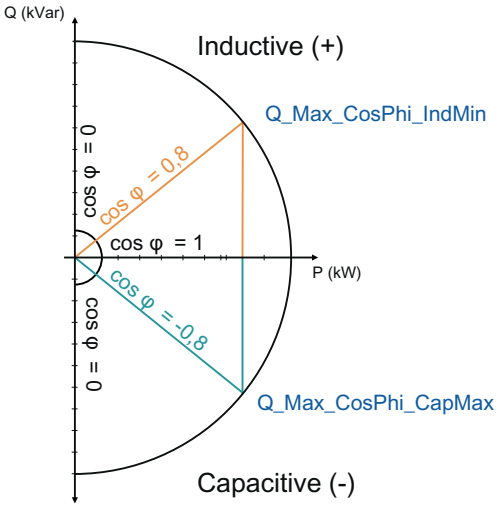


Figure 8-9 Functional diagram for active power limiting

8.5 The parameter interface of the solar PV plant control

8.5.1 Data blocks

Data blocks

The solar farm data to be parameterized is saved in the following data blocks:

- DB_Connection: Connection parameterizations for the inverters and the SENTRON PAC3200
- DB_Parameter: Parameters of the solar farm control

DB_Connection (DB1)

The DB_Connection includes all of the necessary connection parameters that can be set for establishing communication with the inverters and the SENTRON PAC3200.

Data word	Variable name	Data type	Designation	Default	Read / write access
(x-1)*16 +0	INV_x.IP1	INT	Inverter 1 IP-address 1. byte	10 for x = 1, otherwise 0	r / w
(x-1)*16 +2	INV_x.IP2	INT	Inverter 1 IP- address 2. byte	80 for x = 1, otherwise 0	r / w
(x-1)*16 +4	INV_x.IP3	INT	Inverter 1 IP- address 3. byte	40 for x = 1, otherwise 0	r / w
(x-1)*16 +6	INV_x.IP4	INT	Inverter 1 IP- address 4. byte	01 for x = 1, otherwise 0	r / w
(x-1)*16 +8	INV_x.LocalPort	INT	own port address	2000 + x	r / w
(x-1)*16 +10	INV_x.RemoPort	INT	Inverter port address, value range (2100 – 2103)	2100	r / w
(x-1)*16 +12	INV_x.ConnID	INT	Connection ID number	500 + x	r / w
(x-1)*16 +14	INV_x.StationsNo	INT	Internal address	0	r
1≤x≤120					
1920.0	PAC_IP.IP1	INT	PAC3200 IP-address 1. byte	10	r / w
1922.0	PAC_IP.IP2	INT	PAC3200 IP- address 2. byte	80	r / w
1924.0	PAC_IP.IP3	INT	PAC3200 IP- address 3. byte	134	r / w
1926.0	PAC_IP.IP4	INT	PAC3200 IP- address 4. byte	01	r / w
1928.0	PAC_LocalPort	INT	own port address	2000	r
1930.0	PAC_RemoPort	INT	PAC3200 port address	502	r
1932.0	PAC_ConnType	WORD	Connection Type	16#11	r
1934.0	PAC_ConnID	INT	Internal address	500	r
1936.0	PAC_CmpID	INT	Internal address	1	r

8.5.1.1 DB_Parameter

DB_Parameter (DB2)

The DB_Parameter contains all the necessary parameters that can be set for parameterizing the solar PV plant control. These parameters are marked with blue in the figures showing the active power control and reactive power control. There are mandatory fields that must be filled in during parameterization. All the others are imported default entries. The DB number of the DB_Parameter is set to DB2 by default and should not be changed.

Data word	Variable name	Data type	Designation	Default	Access Read / write	Mandatory field
0.0	Global_S_Plant	REAL	Maximum apparent power of site [kVA]	0	r / w	Yes
4.0	Global_TimeAct	REAL	Time interval for request SINVERT actual telegram [s]	2.0	r / w	No
8.0	Global_TimeMon	REAL	Monitoring time communication in [s]	30.0	r / w	No
12.0	Global_TimeRqFt	REAL	Timer fault request [s]	0.0	not used	No
16.0	Global_TimeRqCy	REAL	Timer cyclic request [s]	0.0	not used	No
20.0	Global_TimeRem	REAL	Timer Remance [s]	0.0	not used	No
24.0	Global_DB_ConNo	INT	Number DB Connection	1	r	No
26.0	Global_DB_ConNoCmp	INT	Number DB Connection Compare	5	r	No
28.0	Global_DB_SouNo	INT	Number DB-Parameter	2	r	No
30.0	Global_DB_SouNoCmp	INT	Number DB-Parameter Compare	6	r	No
32.0	Global_DB_DatNo	INT	Number DB Inverter Data	3	r	No
34.0	Global_DB_StaNo	INT	Number DB Inverter Status	8	r	No
36.0	Global_ActTelDisable	BOOL	Disable request actual telegram (P,Q)	false	r	No
36.1	PAC_Connect	BOOL	PAC connect	True	r / w	No
36.2	PAC_MsgLck	BOOL	PAC messagelock	false	r / w	No
38.0	PAC_PT1_Delay_T	REAL	PAC PT1 DelayTime [s]	1	r / w	No
42.0	EVU_Value1	REAL	EVU active power P1 [%]	70	r / w	No
46.0	EVU_Value2	REAL	EVU active power P2 [%]	50	r / w	No
50.0	EVU_Value3	REAL	EVU active power P3 [%]	30	r / w	No
54.0	EVU_Value4	REAL	EVU active power P4 [%]	10	r / w	No
58.0	EVU_CSF	BOOL	EVU external fault	false	r / w	No
60.0	EVU_FltMode	INT	EVU fault mode	0	r / w	No
62.0	EVU_FltValue	INT	EVU fault value	0	r / w	No
64.0	P_Mode_ExtAbs	REAL	P mode external absolute setpoint activepower [kW]	0.0	r / w	No
68.0	P_Mode_IntRel	REAL	P mode internal relative setpoint active power [%]	0.0	r / w	No
72.0	P_Mode_IntAbs	BYTE	P mode internal absolute setpoint active power [kW]	0.0	r / w	No

Data word	Variable name	Data type	Designation	Default	Access Read / write	Mandatory field
76.0	P_Mode_IntQC	REAL	P mode Quality Code internal setpoint P	16#80	r / w	No
78.0	P_Mode_ManRel	REAL	P mode manual relative setpoint active power [%]	0.0	r / w	No
82.0	P_Mode_ManAbs	BYTE	P mode manual absolute setpoint active power [kW]	0.0	r / w	No
86.0	P_Mode_ManQC	BYTE	P mode Quality Code manual setpoint P	16#80	r / w	No
88.0	P_Mode_Source	INT	P mode source (0: Plant; 1: ExtR; 2: ExtA; 3: IntR; 4: IntA; 5: ManR; 6: anA)	1 (ExtR = power utility)	r / w	No
90.0	P_Ramp_LockUp	BOOLEAN	P ramp locked ramp up	False	r / w	No
90.1	P_Ramp_LockDn	BOOLEAN	P ramp locked ramp down	False	r / w	No
92.0	P_Ramp_TimeUp	REAL	P ramp time up to get value [s]	30.0	r / w	No
96.0	P_Ramp_TimeDn	REAL	P ramp time down to get value [s]	30.0	r / w	No
100.0	P_Ramp_RampUp	REAL	P ramp ramp up [%]	20.0	r / w	No
104.0	P_Ramp_RampDn	REAL	P ramp ramp down [%]	20.0	r / w	No
108.0	P_Delta_Enable	INT	P Delta enable	0	r / w	No
110.0	P_Delta_F_High	REAL	P Delta high Frequency [Hz]	50.2	r / w	No
114.0	P_Delta_F_Norm	REAL	P Delta norm frequency [Hz]	50.0	r / w	No
118.0	P_Delta_F_Min	REAL	P Delta minimum frequency [Hz]	47.5	r / w	No
122.0	P_Delta_F_Max	REAL	P Delta maximum frequency [Hz]	51.5	r / w	No
126.0	P_Delta_F_Hys	REAL	P Delta Hysteresis limit frequency back to normal [Hz]	50.05	r / w	No
130.0	P_Delta_Grad_dP	REAL	P Delta Gradient of frequency reduction per Hz in %	40.00	r / w	No
134.0	P_Cont_Gain	REAL	P Controller Propotional Gain	0.2	r / w	No
138.0	P_Cont_TN	TIME	P Controller reset time	T#4s	r / w	No
142.0	P_Cont_LLM	REAL	P Controller low limit	0.0	r / w	No
146.0	P_Cont_HLM	REAL	P Controller high limit	100.0	r / w	No
150.0	Q_Mode_Bypass	BOOL	Q mode activate bypass	False	r / w	No
152.0	Q_Mode_CosPhi	REAL	Q mode Power Factor cosPhi	1.0	r / w	No
156.0	Q_Mode_CosPhiQC	BYTE	Q mode Quality Code Power Factor cosPhi	16#80	r / w	No
158.0	Q_Mode_Q	REAL	Q mode reactive power Q	0.0	r / w	No
162.0	Q_Mode_Q_QC	BYTE	Q mode Quality Code reactive power Q	16#80	r / w	No
164.0	Q_Mode_Source	INT	Q mode source (0: cosP = 1; 1: Cos = x; 2: CosP (t); 3: CosP (P); 4: Q = x; 5: Q(U); 6: Q_Cont)	0	r / w	No
166.0	Q_Max_CosPhi_CapMax	REAL	Q max maximum power factor of capacitive power	-0.95	r / w	No

Data word	Variable name	Data type	Designation	Default	Access Read / write	Mandatory field
170.0	Q_Max_CosPhi_IndMin	REAL	Q max minimum power factor of inductive power	0.95	r / w	No
174.0	CosPhi_Cont_Gain	REAL	Cos(Phi) Controller Propotional Gain	0.4	r / w	No
178.0	CosPhi_Cont_TN	TIME	Cos(Phi) Controller reset time	T#4s	r / w	No
182.0	CosPhi_Cont_LLM	REAL	Cos(Phi) Controller low limit	-0.95	r / w	No
186.0	CosPhi_Cont_HLM	REAL	Cos(Phi) Controller high limit	-0.95	r / w	No
190.0	CosPhi_Time_B2L_OSet	INT	Offset PLC system time -> PLC local time [0.5 h] in winter, valid: 24 . . +24.	2	r / w	Yes
192.0	CosPhi_Time_S2W_OSet	INT	Daylight saving time: Difference summer to winter time [0.5 h], valid: 2	2	r / w	Yes
194.0	CosPhi_Time_W2S_Mon	INT	Daylight saving time: winter to summer - month	3	r / w	No
196.0	CosPhi_Time_W2S_WEnd	INT	Daylight saving time: winter to summer - weekend (1 = first, 2 = second, ... , 5 = last)	5	r / w	No
198.0	CosPhi_Time_W2S_Day	INT	Daylight saving time: winter to summer - day of week (Sunday = 1)	1	r / w	No
200.0	CosPhi_Time_W2S_Hour	INT	Daylight saving time: winter to summer - hour	2	r / w	No
202.0	CosPhi_Time_S2W_Mon	INT	Daylight saving time: Summer to winter - Month	10	r / w	No
204.0	CosPhi_Time_S2W_WEnd	INT	Daylight saving time: Summer to winter weekend (1 first, 2 second, ..., 5 last)	5	r / w	No
206.0	CosPhi_Time_S2W_Day	INT	Daylight saving time: Summer to winter - day of week (Sunday 1)	1	r / w	No
208.0	CosPhi_Time_S2W_Hour	INT	Daylight saving time: Summer to winter – Hour	3	r / w	No
210.0	CosPhi_Time_Num	INT	Polygon CosPhi (Time) Number interpolation points	16	r / w	No
212.0	CosPhi_Time_TimeX	TOD	Interpolation point X – x-axis Time of day	TOD#0:0:0:0	r / w	No
216.0	CosPhi_Time_CosPhiX	REAL	Interpolation point X – y-axis Input cos(Phi)X	1.0	r / w	No

01≤x≤16 (Polygon cos(phi) = f(time of day))

Data word	Tag name	Data type	Designation	Default	Access Read / write	Manda-tory field
01≤x≤16 **(Polygon cos(phi) = f(time of day))**						
340.0	CosPhi_P_Num	INT	Polygon CosPhi (P) Number interpolation points	2	r / w	No
342.0	CosPhi_P_PX	REAL	Interpolation point X – x-axis Input PX [kW]	0.0	r / w	No
346.0	CosPhi_P_CosPhiX	REAL	Interpolation point X – y-axis Input cos(Phi) X	1.0	r / w	No

01≤x≤16 (Polygon cos(phi) = f(P))

Data word	Tag name	Data type	Designation	Default	Access Read / write	Manda-tory field
01≤x≤16 **(Polygon cos(phi) = f(P))**						
470.0	Q_U_U_LR	REAL	Input U Lower display limit	0.0	r / w	No
474.0	Q_U_U_HR	REAL	Input U Higher display limit	1000.0	r / w	No
478.0	Q_U_U_Diff	REAL	Input U difference of plausibility	400.0	r / w	No
482.0	Q_U_PlChEn	BOOL	Input U Enable plausibility check	True	r / w	No
484.0	Q_U_Num	INT	Polygon Q(U) Number interpolation points	2	r / w	No
486.0	Q_U_UX	REAL	Interpolation point X – x-axis Input UX [V]	400	r / w	No
490.0	Q_U_QX	REAL	Interpolation point X – y-axis Input QX [kVar]	0.0	r / w	No

01≤x≤16 (Polygon Q = f(U))

Data word	Variable name	Data type	Designation	Default	Access Read / write	Manda-tory field
01≤x≤16 **(Polygon Q = f(U))**						
614.0	ControlActive	BOOL	Power control activation : 0 =inactive; 1 =active	1	r / w	Yes
	WeatherStationMask	Struct		16#0	r / w	
616.0	Word0	WORD	Bit mask of connected weather stations; Bit0=WS1, Bit1=WS2, ...	16#0	r / w	Yes
	AC_PLCMask	Struct				
618.0	Word0	WORD	Bit mask of connected AC-PLC. Nr.= Bit position + 1	16#0	not used	No
620.0	Word1	WORD	Bit mask of connected AC-PLC. Nr.= 16 + (Bit position + 1)	16#0	not used	No

Data word	Variable name	Data type	Designation	Default	Access Read / write	Manda-tory field
622.0	Word2	WORD	Bit mask of connected AC-PLC. Nr.= 32 + (Bit position + 1)	16#0	not used	No
624.0	Word3	WORD	Bit mask of connected AC-PLC. Nr.= 48 + (Bit position + 1)	16#0	not used	No
626.0	Word4	WORD	Bit mask of connected AC-PLC. Nr.= 64 +Bit position + 1	16#0	not used	No
628.0	Word5	WORD	Bit mask of connected AC-PLC. Nr.= 80 + (Bit position + 1)	16#0	not used	No
630.0	Word6	WORD	Bit mask of connected AC-PLC. Nr.= 96 + (Bit position + 1)	16#0	not used	No
632.0	Word7	WORD	Bit mask of connected AC-PLC. Nr.= 112 + (Bit position + 1)	16#0	not used	No
	ScalanceMask	Struct				
634.0	Word0	WORD	Bit mask of connected Scalance Nr.= Bit position + 1	16#0	r / w	No
636.0	Word1	WORD	Bit mask of connected Scalance Nr.= 16 + (Bit position + 1)	16#0	r / w	No
638.0	Word2	WORD	Bit mask of connected Scalance Nr.= 32 + (Bit position + 1)	16#0	r / w	No
640.0	Word3	WORD	Bit mask of connected Scalance Nr.= 48 + (Bit position + 1)	16#0	r / w	No
642.0	Word4	WORD	Bit mask of connected Scalance Nr.= 64 +Bit position + 1	16#0	r / w	No
644.0	Word5	WORD	Bit mask of connected Scalance Nr.= 80 + (Bit position + 1)	16#0	r / w	No
646.0	Word6	WORD	Bit mask of connected Scalance Nr.= 96 + (Bit position + 1)	16#0	r / w	No
648.0	Word7	WORD	Bit mask of connected Scalance Nr.= 112 + (Bit position + 1)	16#0	r / w	No
	CombinerMask	Struct				
650.0	Word0	WORD	Bit mask of connected Combiner Nr.= Bit position + 1	16#0	not used	No
652.0	Word1	WORD	Bit mask of connected Combiner Nr.= 16 + (Bit position + 1)	16#0	not used	No
654.0	Word2	WORD	Bit mask of connected Combiner Nr.= 32 + (Bit position + 1)	16#0	not used	No
656.0	Word3	WORD	Bit mask of connected Combiner Nr.= 48 + (Bit position + 1)	16#0	not used	No
658.0	Word4	WORD	Bit mask of connected Combiner Nr.= 64 +Bit position + 1	16#0	not used	No
660.0	Word5	WORD	Bit mask of connected Combiner Nr.= 80 + (Bit position + 1)	16#0	not used	No
662.0	Word6	WORD	Bit mask of connected Combiner Nr.= 96 + (Bit position + 1)	16#0	not used	No
664.0	Word7	WORD	Bit mask of connected Combiner Nr.= 112 + (Bit position + 1)	16#0	not used	No

Data word	Variable name	Data type	Designation	Default	Access Read / write	Manda-tory field
666.0	PyrHighRange	REAL	High range measured analog input Pyranometer sensor	0	r / w	No
670.0	PyrLowRange	REAL	Low range measured analog input Pyranometer sensor	0	r / w	No
674.0	IrradiationHighRange	REAL	High range measured analog input Irradiation sensor	1200.0	r / w	No
678.0	IrradiationLowRange	REAL	Low range measured analog input Irradiation sensor	0	r / w	No
682.0	WindSpeedHighRange	REAL	High range measured analog input WindSpeed sensor	50.0	r / w	No
686.0	WindSpeedLowRange	REAL	Low range measured analog input WindSpeed sensor	0	r / w	No
690.0	P_Cont_DeadBW	REAL	Active power controller: Deadband sending manipulated variable	0.1	r / w	No
694.0	CosPhi_Cont_DeadBW	REAL	cosphi-controller: Deadband sending manipulated variable	0.0001	r / w	No
698.0	DeviceType	INT	Device-Type: 121= ComBox200; 102 = ControlBox300	*variable*	r	No
700.0	MajorVersion	INT	Major Version of Library	*variable*	r	No
702.0	MinorVersion	INT	Minor Version of Library	*variable*	r	No
704.0	ServicePack	INT	Service Pack of Library	*variable*	r	No
706.0	HotFix	INT	Hot Fix of Library	*variable*	r	No
708.0	AccessLevel	INT	Access level		r / w	No
…	**01<=Invnn<=30**		Assignment Inverter to weatherstation			
710.0	AssignWeatherIInvnn	INT	Assignment Inverter nn to weatherstation [1..8]	1	r / w	No
770.0	ConstPerfWs1	REAL	constant Wp for performance ratio weatherstation 1	2000.0	r / w	Yes
774.0	ConstPerfWs2	REAL	constant Wp for performance ratio weatherstation 2	2000.0	r / w	No
778.0	ConstPerfWs3	REAL	constant Wp for performance ratio weatherstation 3	2000.0	r / w	No
782.0	ConstPerfWs4	REAL	constant Wp for performance ratio weatherstation 4	2000.0	r / w	No
786.0	ConstPerfWs5	REAL	constant Wp for performance ratio weatherstation 5	2000.0	r / w	No
790.0	ConstPerfWs6	REAL	constant Wp for performance ratio weatherstation 6	2000.0	r / w	No
794.0	ConstPerfWs7	REAL	constant Wp for performance ratio weatherstation 7	2000.0	r / w	No
798.0	ConstPerfWs8	REAL	constant Wp for performance ratio weatherstation 8	2000.0	r / w	No
802.0	WinCC_exist	BOOL	WinCC exists in plant	0	r / w	No

Data word	Variable name	Data type	Designation	Default	Access Read / write	Mandatory field
802.1	P_Cont_Mode	BOOL	Controller Mode	0	r / w	No
802.2	P_Cont_FltMode	BOOL	Controller Fault Mode	1	r / w	No
804.0	P_Cont_TimeInvOrder	TOD	Controller Time to set Inverter Order	TOD#0:0:0:0	r / w	No
808.0	P_Cont_Threshold_LL	REAL	Controller Threshold Minimum	0.0	r / w	No
812.0	P_Cont_Threshold_HL	REAL	Controller Threshold Maximum	100.0	r / w	No
816.0	P_Cont_Max_Time	REAL	Controller Timer Inverter Maximize	2.0	r / w	No
820.0	P_Cont_Min_Time	REAL	Controller Timer Inverter Minimize	2.0	r / w	No
824.0	P_Cont_Hysteresis	REAL	Controller Hysteresis	1.0	r / w	No
828.0	P_Cont_InvSpare	INT	Controller Inverter Spare	1	r / w	No
830.0	P_Cont_DeadBand	REAL	Deadband active power PI controller	0.1	r / w	No
834.0	CosPhi_Cont_DeadBand	REAL	Deadband cos(Phi) PI controller	0.001	r / w	No
838.0	Q_Cont_Auto	BOOL	Q controller automatic switch	false	r / w	No
840.0	Q_Cont_U_Hys	REAL	Hystersis U	0.1	r / w	No
844.0	Q_Cont_U1Ind	REAL	Linear slope : U_1 at Q_1=0	21.4	r / w	No
848.0	Q_Cont_U2Ind	REAL	Linear slope : U_2 at Q=Q_{max}	21.65	r / w	No
852.0	Q_Cont_U_Ind_h	REAL	U:prot: Shutdown level	21.8	r / w	No
856.0	Q_Cont_Q_Max_Ind	REAL	Max. sustainable ind. reactive power	0.0	r / w	No
860.0	Q_Cont_U1Cap	REAL	Linear slope : U_1 at Q=0	0	r / w	No
864.0	Q_Cont_U2Cap	REAL	Linear slope : U_2 at Q=Q_{max}	0	r / w	No
868.0	Q_Cont_U_Cap_I	REAL	U:prot: Shutdown level	0	r / w	No
872.0	Q_Cont_Q_Max_Cap	REAL	Max. sustainable cap. reactive power	0.0	r / w	No
876.0	Q_Cont_Timer_U_lim	REAL	Delay time for reaction on limits for under voltage protection and over voltage protection	60.0	r / w	No
880.0	Q_Ramp_LockUp	BOOL	Q ramp locked ramp up	false	r / w	No
880.1	Q_Ramp_LockDn	BOOL	Q ramp locked ramp down	false	r / w	No
882.0	Q_Ramp_TimeUp	REAL	Q ramp time up to get value [s]	30.0	r / w	No
886.0	Q_Ramp_TimeDn	REAL	Q ramp time down to get value [s]	30.0	r / w	No
890.0	Q_Ramp_RampUp	REAL	Q ramp ramp up [%]	20.0	r / w	No
894.0	Q_Ramp_RampDn	REAL	Q ramp ramp down[%]	20.0	r / w	No

8.5.2 Parameter

Global parameters

The following parameters are global parameters. The variable name begins with the prefix "Global". The most important global parameters are described in the table below:

Variable name	Description
Global_S_Plant	Maximum rated infeed power of the solar PV plant
Global_TimeAct	Time interval in which the actual frames are requested by the inverter
Global_TimeMon	Monitoring time for connection to the inverter
Global_TimeRqFt	Time for re-writing after an error
Global_TimeRqCy	Time for write interval of cyclical writing
Global_TimeRem	Time interval for checking for parameter changes for backing up the data on a CF card
Global_ActTelDisable	Switch for requesting SINVERT actual frame: • 0: Request inactive • 1: enabled

PAC3200 parameters

The following parameters are parameters of the SENTRON PAC3200 connection. The variable name begins with the prefix "PAC". The PAC3200 parameters are described in the table below:

Variable name	Description
PAC_Connect	Switch for connection PAC3200: • 0: deactivated • 1: activated
PAC_MsgLck	Switch for transmission blocking (interrupted link) PAC3200: • 0: deactivated • 1: activated
PAC_PT1_Delay_T	Time filter (PT1 element) for the connection of the PAC3200 values

Activation of solar PV plant control

The functionality of the solar PV plant control (P and cos φ) can be generally activated or deactivated

Variable name	Description
ControlActive	Activate P/ cos φ control: • 0: deactivated • 1: activated

If the control is deactivated, no setpoints for P/ cos φ are sent to the inverter. The status of the solar PV plant control values remain set to "NOT Used". This means that, in the case of the DataLogger, for example, the data is not forwarded to the Portal.

Power utility interface parameters

The following parameters are parameters of the power utility interface for power reduction via ripple control receivers. The variable name begins with the prefix "EVU" (power utility). The power utility interface parameters are described in the table below:

Note

The values EVU_Valuex and EVU_FltValue specify the value by which the current power is reduced on activation.

Variable name	Description
EVU_Value1	Value of the active power reduction of contact 1 (I0.2) [%]
EVU_Value2	Value of the active power reduction of contact 2 (I0.3) [%]
EVU_Value3	Value of the active power reduction of contact 3 (I0.4) [%]
EVU_Value3	Value of the active power reduction of contact 4 (I0.5) [%]
EVU_CSF	Power utility external error
EVU_FltMode	Mode for the behavior in the event of an error (external error active, or several contacts active simultaneously): • 0: Last value retained (the last valid value of the active power reduction is applied) • 1: Substitute value input (the substitute value from the parameter EVU_FltValue applies) • 2: Smallest value input (the active contact with the lowest value of active power reduction is assumed)
EVU_FltValue	Substitute value [%] for selection mode 1 (substitute value input)

Selection of setpoints for power reduction

The active power setpoints can be specified by various sources. The following setpoint modes are distinguished:

- External setpoint (P_ExtRel (%) or P_ExtAbs (kW))
- Internal setpoint (P_IntRel (%) or P_IntAbs (kW))
- Manual setpoint (P_ManRel (%) or P_ManAbs (kW)) (permanently reserved for WinCC operation)
- Frequency-dependent setpoint reduction
- No setpoint specification, system running on rated power

The mode is set via the FB "P_Mode". The transferred setpoints are checked for plausibility with regard to adherence to the upper/lower setpoint limits. The erroneous specifications are rejected. The variable name begins with the prefix "P_Mode".

The relative setpoints must be seen as percentile values of the rated power of the inverter.

The parameters are described in the table below:

Variable name	Description
P_Mode_ExtAbs	External absolute setpoint (P) in [kW]; mode = 2
P_Mode_IntRel	Internal relative setpoint (P) in [%]; mode = 3
P_Mode_IntAbs	Internal absolute setpoint (P) in [kW]; mode = 4
P_Mode_IntQC	Quality code internal setpoint P
P_Mode_ManRel	Manual relative setpoint in [%]; mode = 5
P_Mode_ManAbs	Manual absolute setpoint in [kW]; mode = 6
P_Mode_ManQC	Quality code manual setpoint P
P_Mode_Source	Mode for selecting the setpoint source: • 0: No setpoint specification for power reduction • 1: Electric utility ripple control signals • 2: External absolute setpoint • 3: Internal relative setpoint • 4: Internal absolute setpoint • 5: Manual relative setpoint • 6: Manual absolute setpoint

Parameterization of setpoint ramp

Setpoint changes can be increased or reduced step-by-step by percentages via a ramp function.

The variable name begins with the prefix "P_Ramp". The parameters are described in the table below:

Variable name	Description
P_Ramp_LockUp	Ramp up switch: • 0: inactive • 1: activated
P_Ramp_LockDn	Ramp down switch: • 0: inactive • 1: activated
P_Ramp_TimeUp	Time for reaching the new setpoint [s]
P_Ramp_TimeDn	Time for reaching the new setpoint [s]
P_Ramp_RampUp	Percentile increase per step within the parameterized time
P_Ramp_RampDn	Percentile decrease per step within the parameterized time

Frequency-dependent power reduction

Depending on the line frequency, the calculated power delta is subtracted from the setpoint (P).

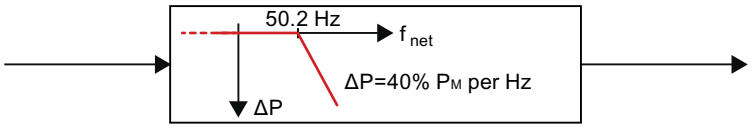


Figure 8-10 Frequency-dependent power reduction

The power delta "P_Delta" is calculated using the following formula:

P_Diff = ABS (Grad_dP * (F_High – F))

P_Diff: Power delta

Grad_dP: Gradient of reduction in % per Hz of deviation

F_High: Limit of the frequency at which the reduction begins (e.g. 50.2 Hz)

F: Current line frequency

F_Norm: Normal frequency (e.g. 50.0 Hz)

P: Current power

F_Hys: Threshold value after overfrequency, after which the reduction is canceled again.

The necessary variables for parameterizing the parameters are described in the following.

The variable name begins with the prefix "P_Delta". The parameters are described in the table below:

Variable name	Description
P_Delta_Enable	Switch P = f(f) • 0: inactive • 1: enabled
P_Delta_F_High	Limit of the frequency at which the reduction begins (e.g. 50.2 Hz) [Hz]
P_Delta_F_Norm	Rated line frequency [Hz]
P_Delta_F_Min	Minimum line frequency [Hz]
P_Delta_F_Max	Maximum line frequency [Hz]
P_Delta_F_Hys	Hysteresis threshold after which the reduction is canceled again. (e.g. 50.05 Hz)
P_Delta_Grad_dP	Gradient of the power reduction in % per Hz. (e.g. ΔP 40% / Hz)

Solar PV plant control PI controller parameters

The active power solar PV plant control is equipped with a continuous PI controller.

The variable name begins with the prefix "P_Cont". The following controller parameters can be set for optimizing the system.

Variable name	Description
P_Cont_Gain	Controller amplification proportional component
P_Cont_TN	Integral time (I component)
P_Cont_LLM	Manipulated variable limitation bottom
P_Cont_HLM	Manipulated variable limitation top
P_Cont_DeadBW	Value for dead band of the manipulated variable
P_Cont_DeadBand	Value for dead band regulative deviation

Solar PV plant control operating mode setpoint value specifications

The inverter power setpoints can be specified either in uniform setpoints mode or linear setpoints mode. The parameters are only relevant in the linear setpoint value specification mode (P_Cont_Mode = 1).

The variable name begins with the prefix "P_Cont_". The following parameters can be specified for parameterizing the modes:

Variable name	Description
P_Cont_Mode	Selection of the control type (0 = uniform setpoint value specification, 1 = linear setpoint value specification)
P_Cont_FltMode	Selection of error checking (0 = no error checking, 1 = with error checking)
P_Cont_TimeInvOrder	Time of day for defining the sequence of switching on the inverters depending on the inverter operating hours
P_Cont_Threshold_LL	Lower threshold value for shutting down the inverters after expiry of the time P_Cont_Min_Time
P_Cont_ Threshold_HL	Upper threshold value for connecting and shutting down standby inverters after expiry of the time P_Cont_Max_Time
P_Cont_Max_Time	Time delay for connecting inverters after violation of the lower threshold and the hysteresis (P_Cont_Threshold_Min + P_Cont_Hysteresis)
P_Cont_Min_Time	Time delay for shutting down inverters after violation of the lower threshold
P_Cont_Hysteresis	Hysteresis for connecting inverters on violation of the lower threshold P_Cont_Threshold_Min
P_Cont_InvSpare	Possible number of connectable standby inverters when power demand increases (calculated number of required inverters and reserve)

Selection of setpoints for reactive power reduction

The setpoint for controlling the reactive power can be specified by various sources. The following setpoint modes are distinguished:

Setpoint = power factor cos φ:

- If there is no setpoint specification, the system runs on cos φ = 1
- Setpoint cos φ for entire farm
- Characteristic curve cos φ(time) (polygon)
- Characteristic curve cos φ(P) (polygon)
- Setpoint Q for entire farm
- Characteristic curve Q(U) (polygon)
- Reactive power control Q(U) for stabilizing the line voltage (Q_Cont)

The mode is set via the FB "Q_Mode". The transferred setpoints are checked for plausibility with regard to adherence to the upper/lower setpoint limits. The erroneous specifications are rejected.

When Q control is disabled (Q_Mode_Bypass = 1), the setpoint is sent directly to the inverter. The parameters are described in the table below:

Variable name	Description
Q_Mode_Bypass	Disable Q control: • 1: Q control disabled • 0: Q control enabled
Q_Mode_CosPhi	Manual setpoint specification power factor cos φ (Q_Mode_Source = 1)
Q_Mode_CosPhiQC	Quality code manual setpoint cos φ
Q_Mode_Q	Manual setpoint specification reactive power Q (Q_Mode_Source = 4)
Q_Mode_Q_QC	Quality code manual setpoint reactive power Q
Q_Mode_Source	Mode for selecting the setpoint source: • 0: No setpoint specification (cos φ = 1) • 1: Manual setpoint specification power factor cos φ • 2: cos φ = f(time of day). Specification via polygon • 3: cos φ = f(P). Specification via polygon • 4: Manual setpoint specification Q • 5: Q = f(U). Specification via polygon • 6: Reactive power control Q(U)

Q solar farm control PI controller

The reactive power control is equipped with a continuous PI controller.

The variable name begins with the prefix "CosPhi_Cont. The following controller parameters can be set for optimizing the system:

Variable name	Description
CosPhi_Cont_Gain	Controller amplification proportional component
CosPhi_Cont_TN	Integral time (I component)
CosPhi_Cont_LLM	Manipulated variable limitation bottom
CosPhi_Cont_HLM	Manipulated variable limitation top
CosPhi_Cont_DeadBW	Value for dead band of the manipulated variable cos φ
CosPhi_Cont_DeadBand	Value for dead band of the control deviation cos φ

Parameter for power factor

The limits for the power factor can be parameterized as described in the table.

The variable name begins with the prefix "Q_Max".

Variable name	Description
Q_Max_CosPhi_CapMax	Maximum power factor for capacitive power
Q_Max_CosPhi_IndMin	Minimum power factor of the inductive power

Time setting

The local time settings must be made in the following parameters, e.g. a possible time offset to the system time and details for daylight saving <> standard time changeover. The parameters are described in the table below:

Variable name	Description
CosPhi_Time_B2L_OSet	Offset of PLC system time to the local time with the factor 0.5 h. Value range: -24 … +24. Offset = factor * value
CosPhi_Time_S2W_OSet	Standard > daylight saving time: Time difference between daylight saving and standard time with the factor 0.5 h. Permissible value: 2
CosPhi_Time_W2S_Mon	Changeover standard time > daylight saving time: Specified month of the changeover (January = 1, etc.)
CosPhi_Time_W2S_WEnd	Changeover standard time > daylight saving time: Number of the weekend of the changeover (1 = first, 2 = second, etc., 5 = last)
CosPhi_Time_W2S_Day	Changeover standard time > daylight saving time: Day of the week of the changeover (Sunday = 1, etc.)
CosPhi_Time_W2S_Hour	Changeover standard time > daylight saving time: Hour of the changeover in 24 hour format

Variable name	Description
CosPhi_Time_S2W_Mon	Changeover daylight saving time > standard time: Specified month of the changeover (January = 1, etc.)
CosPhi_Time_S2W_WEnd	Changeover daylight saving time > standard time: Number of the weekend of the changeover (1 = first, 2 = second, etc., 5 = last)
CosPhi_Time_S2W_Day	Changeover daylight saving time > standard time: Day of the week of the changeover (Sunday = 1, etc.)
CosPhi_Time_S2W_Hour	Changeover daylight saving time > standard time: Hour of the changeover in 24 hour format

Polygon configuration of reactive power reduction

You can parameterize 3 polylines for the following functions:

- cosφ = f(Time of day)
- cosφ = f(P)
- Q= f(U)

For the parameterization, enter the number of the respective interpolation points in the following parameters:

- CosPhi_Time_Num
- CosPhi_P_Num
- Q_U_Num

The number of interpolation points lies within a value range of 2<=x<=16. Depending on the number of interpolation points, the following parameters of the corresponding (x, y) coordinates must be parameterized (Interpolation point x – x-axis; Interpolation point x – y-axis).

Note

The values of the x axis interpolation points must be parameterized in ascending order, i.e. xn <= xn+1.

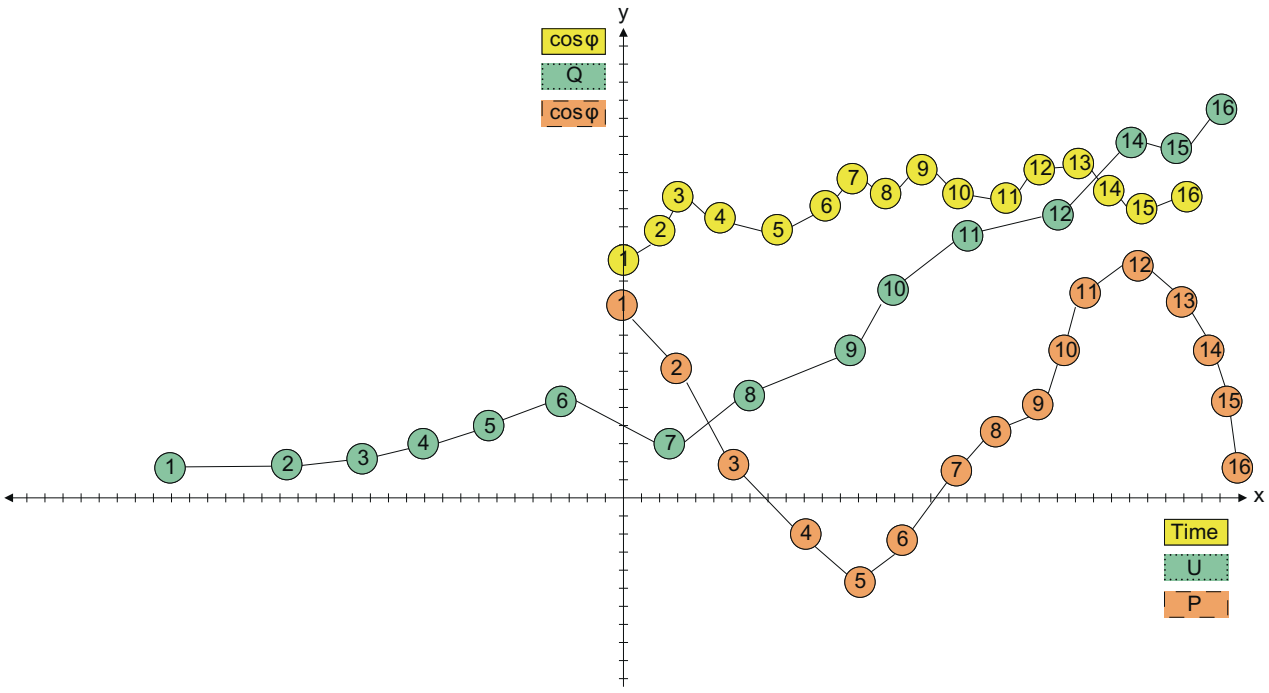


Figure 8-11 Polygon configuration of reactive power reduction

Polygon cos(phi) = f(time of day)

The polyline for the characteristic curve cos(phi) = f(time of day) is configured in the following parameters.

The variable name begins with the prefix "CosPhi_Time".

The variable X is indexed from 1 to 16.

Variable name	Description
CosPhi_Time_Num	Number of interpolation points (min. 2, max. 16)
CosPhi_Time_Timex	Interpolation points x – x axis Value in time of day format
CosPhi_Time_CosPhix	Interpolation points x – y axis Value cos(Phi)

Polygon cos(phi) = f(P)

The polyline for the characteristic curve cos(phi) = f(P) is configured in the following parameters.

The variable name begins with the prefix "CosPhi_P".

The variable X is indexed from 1 to 16.

Variable name	Description
CosPhi_P_Num	Number of interpolation points (min. 2, max. 16)
CosPhi_P_Timex	Interpolation points x – x axis Value for power P
CosPhi_P_CosPhix	Interpolation points x – y axis Value cos(Phi)

Polygon Q = f(U)

The polyline for the characteristic curve Q = f(U) is configured in the following parameters.

The interpolation points of the voltage values must be specified as phase-phase voltage (U_{LL}).

The measurements of the infeed voltage are calculated as an average value of the three measured values U1, U2 and U3. The measurements are checked for measuring plausibility. A measured value that does not lie within the parameterized permissible measurement difference is taken out of the average value generation.

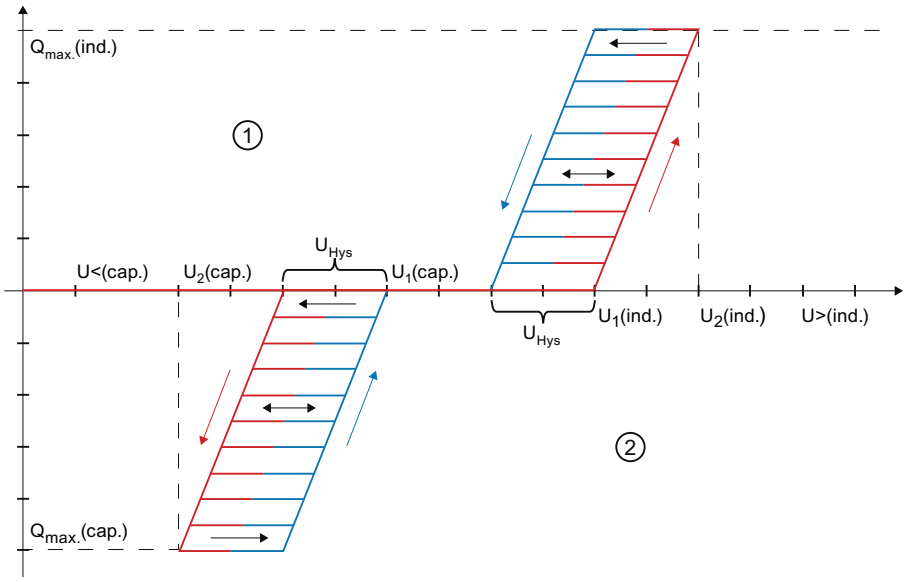
The variable name begins with the prefix "Q_U".

The variable X is indexed from 1 to 16. The parameters are described in the table below:

Variable name	Description
Q_U_Num	Number of interpolation points (min. 2, max. 16)
Q_U_Ux	Interpolation points x – x axis Value for voltage U [V]
Q_U_Qx	Interpolation points x – y axis Value Q [kVar]
Q_U_U_LR	Average value generation U_{12}; U_{23}; U_{31} Lower permissible value range for measured value U
Q_U_U_HR	Average value generation U_{12}; U_{23}; U_{31} Upper permissible value range for measured value U
Q_U_U_Diff	Average value generation U_{12}; U_{23}; U_{31} Permissible measurement difference between the measurements (U_{12}; U_{23}; U_{31})
Q_U_PlChEn	Average value generation U_{12};U_{23};U_{31} Plausibility switch: • 0: inactive • 1: activated

Reactive power control Q(U)

The reactive power control Q(U) is set via the mode Q_Mode_Source = 6 (DW164). In this mode, the line voltage is controlled within adjustable limits by infeed of reactive power according to the following scheme:



① underexcited
② overexcited

Figure 8-12 Reactive power control Q(U)

Variable name	Description
Q_Cont_Auto	Automatic activation Q(U): • 0: off • 1: on
Q_Cont_U_Hys	Dead band voltage range
Q_Cont_U1Ind	Interpolation point 1 voltage gradient inductive
Q_Cont_U2Ind	Interpolation point 2 voltage gradient inductive
Q_Cont_U_Ind_h	Set value of the rise-in-voltage protection U>. If this limit is exceeded, the inverters are shut down.
Q_Cont_Q_Max_Ind	Max. inductive reactive power (calculated from the parameter Q_Max_CosPhi_IndMin)
Q_Cont_U1Cap	Interpolation point 1 voltage gradient capacitive
Q_Cont_U2Cap	Interpolation point 2 voltage gradient capacitive
Q_Cont_U_Cap_l	Set value of the rise-in-voltage protection U>. If this lower limit is violated, the inverters are shut down.
Q_Cont_Q_Max_Cap	Max. capacitive reactive power (calculated from the parameter Q_Max_CosPhi_CapMax)
Q_Ramp_LockUp	Q ramp locked ramp up
Q_Ramp_LockDn	Q ramp locked ramp down

Variable name	Description
Q_Ramp_TimeUp	Q ramp time up to get value [s]
Q_Ramp_TimeDn	Q ramp time down to get value [s]
Q_Ramp_RampUp	Q ramp ramp up [%]
Q_Ramp_RampDn	Q ramp ramp down[%]

If Q_Cont_Auto is activated, reactive power control Q(U) is activated if required, regardless of the set control mode and setpoint source. Activation is determined by deviation of the permissible voltage limits

Activating weather stations

The number of available weather stations can be specified via a bit mask. Up to 8 weather stations can be configured by setting the associated mask bit.

The following assignment applies:

Bit 15 • • • Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
	Weather station 8	Weather station 7	Weather station 6	Weather station 5	Weather station 4	Weather station 3	Weather station 2	Weather station 1

Variable name	Description
WeatherStationMask *Word0*	Bit mask weather stations: Bit 0 activates weather station 1 Bit 1 activates weather station 2 . . . Bit 7 activates weather station 8

By activating a weather station, the corresponding data is made available automatically in frame 42.

Measuring ranges of the weather station sensors

The weather station contains sensors whose measuring ranges must be scaled appropriately.

Variable name	Description
PyrHighRange	High range analog input pyranometer sensor
PyrLowRange	Low range analog input pyranometer sensor
IrradiationHighRange	High range analog input insolation sensor
IrradiationLowRange	Low range analog input insolation sensor
WindSpeedHighRange	High range analog input wind speed sensor
WindSpeedLowRange	Low range analog input wind speed sensor

Assignment of weather station to inverters

Up to 8 weather stations can be distributed among up to 30 inverters.

This is configured by assigning a 30-line matrix of (AssignInvxxWeather) with the relevant value for the assigned weather station (value range: 1…8).

Variable name	Description
AssignWeatherInv01	Assignment of weather station to Inverter_01
AssignWeather Inv02	Assignment of weather station to Inverter_02
. . .	. . .
AssignWeatherInv30	Assignment of weather station to Inverter_30

Configuring the constants for calculating the performance ratio

For the 8 possible weather stations, the constants for calculating the performance ratio (PR) can be configured in the following parameters:

Variable name	Description
ConstPerfWs1	Constant W_p for calculating the PR for weather station 1
ConstPerfWs2	Constant W_p for calculating the PR for weather station 2
. . .	. . .
ConstPerfWs8	Constant W_p for calculating the PR for weather station 8

Configuring the device type

The system boxes distinguish between the following device types.

Variable name	Description	
DeviceType	102	ControlBox300
	121	ComBox200
	140	WeatherStation

WinCC station configuration available

With the parameter "WinCC_exist", you can specify whether or not a WinCC station is available. If WinCC is available, the setpoint and the setpoint source for P and cos phi can be controlled via WinCC faceplates. In this case, the specifications from DB2 are irrelevant.

Variable name	Description	
WinCC_exists	0	WinCC is not available
	1	WinCC is available

Versioning of the ControlBox software

The current software version can be determined from the following specifications:

Variable name	Description
MajorVersion	Major version
MinorVersion	Minor version
ServicePack	Service pack
HotFix	Hot fix

Activating the Scalance devices from the inverters

The following assignment applies:

Word0

Bit 15		Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Scalance inverter 16	• • •	Scalance inverter 9	Scalance inverter 8	Scalance inverter 7	Scalance inverter 6	Scalance inverter 5	Scalance inverter 4	Scalance inverter 3	Scalance inverter 2	Scalance inverter 1

Word1

Bit 15		Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Scalance inverter 32	• • •	Scalance inverter 25	Scalance inverter 24	Scalance inverter 23	Scalance inverter 22	Scalance inverter 21	Scalance inverter 20	Scalance inverter 19	Scalance inverter 18	Scalance inverter 17

When activated, the Scalance devices are parameterized as Profinet slaves by the ControlBox. The Scalance devices do not have to be parameterized as Profinet slaves. Nevertheless, the devices are fully functional. Activation offers the following benefits:

- Generation of diagnostics messages, e.g. if the Scalance device is not available or cannot be accessed, or if there is a break in the fiber optic cable
- Determining the network topology
- Default redundancy settings for fiber optic connection ⇒ ring with Scalance ControlBox as redundancy manager

Due to activation, the IP address, the port monitor, and the redundancy settings cannot be modified via the integral Web page of the Scalance devices. If this is desired (e.g. no fiber optic ring available), the Scalance must not be activated.

8.6 PVS DataLogger

8.6.1 Description

Description of function of the SINVERT PVS DataLogger

The SINVERT PVS DataLogger is a Windows service, which is installed on the SIMATIC IPC427C industrial PC of the ControlBox.

The DataLogger collects the online data of all of the connected SINVERT PVS inverters, compresses the online data to average values, and transmits the average values to the SINVERT WebMonitor or to the web portal of Meteocontrol GmbH.

The DataLogger is installed on the SIMATIC IPC427C industrial PC with Windows XP embedded.

Version

The ControlBox is delivered with DataLogger Version 1.2.

Files

The files of the SINVERT PVS DataLogger service can be found in the directory "D:\Program Files\Siemens\SINVERT PVS DataLogger".

The directory "SINVERT PVS DataLogger" contains the following files:

File extension	Description
.exe	Program file of the DataLogger
.prop	Configuration files in which the parameters for the communication with the web portal and the Simotions are configured. The parameters in these files must be configured prior to commissioning.
.csv	Text file in csv format, in which the online data of all of the connected SINVERT PVS inverters is saved.
.log	Log file in which error messages and warning messages are recorded.

Start DataLogger

SINVERT PVS DataLogger is set up as a Windows service and starts automatically.

Should the DataLogger service not start automatically, you can start it manually in the list via *Start → Settings → Control Panel → Administration → Services*.

When the configuration is complete and free of errors, the service is ready to operate.

If the configuration has errors or is not complete (e.g. no Simotions are set up), the start procedure of the DataLogger is aborted and an error message appears.

You can find error messages in the file "DataLogger_*Date_Time*.log" (e.g. DataLogger_011211_13-32-18.log).

Restart DataLogger

To ensure that the parameters take effect after a configuration, you must restart the DataLogger. To do this, open the list of the Windows services via Start → Settings → Control Panel → Administration → Services. Select the DataLogger service from the list and click on restart.

Installation/update

If you install a newer version of the DataLogger (update), warm restart of the ControlBox is required following installation.

8.6.2 Configuration

Procedure

Proceed as follows to configure the DataLogger:

1. Configure the parameters of the prop files as described in the following chapters.
2. Restart the DataLogger service so that the configuration will take effect.

Configuration files

The configuration files are structured according to a defined syntax and are supplied with comments.

```
① ; **************
  ; TRACE settings
  ; **************
② [LOGGING]
③ ; ******************************
  ; LOG_LEVEL: ERROR, WARNING, INFO
  ; - ERROR: only errors are traced, recommended for live service
  ; - WARNING: warning and errors are traced
  ; - INFO: everything is traced, only recommended for tests
  ; THIS VALUE MAY BE CHANGED.
  ; ******************************
④ LOG_LEVEL = ERROR
③ ; ******************
  ; Number of log files
  ; THIS VALUE MAY BE CHANGED.
  ; ******************
④ LOG_FILE_NUMBER = 5
```

① Comments on the following section
② Section
③ Comments on the following parameter
④ Definition of the parameter (variable = value)

Figure 8-13 Structure of the prop files

Note

Structure of the configuration files

The configuration files are structured according to a defined syntax. If this syntax is changed, the functioning of the DataLogger may be negatively impacted.

Do not change the structure of the configuration files.

Configuration file *settings.prop*

General settings of the DataLogger are configured in the *settings.prop* configuration file.

The following table describes the parameters that are configured in the *settings.prop* configuration file.

[Section] / Parameter	Description	Value range	Default value
[PORTAL]	In the [PORTAL] section, define the web portal to which the DataLogger will send the data. Delete the semicolon in the line of the web portal that you would like to integrate: • SINVERT WebMonitor: siemens_portal_configuration = portal_siemens.prop • Meteocontrol: meteocontrol_portal_configuration = portal_meteocontrol.prop Note: It is not possible to send to both web portals at the same time.		
[LOGGING]	In the [LOGGING] section, define the properties of the log files.		
LOG_LEVEL	Specifies what types of messages will be recorded in the log file (.log) during communication with the Simotion or the web portal.	• ERROR: Only error messages are recorded (recommended when operating) • WARNING: Error messages and warning messages are recorded • INFO: All messages are recorded (only recommended for test operation)	ERROR
LOG_FILE_NUMBER	Defines the number of log files that are created. If a log file reaches the parameterized size (see parameter LOG_FILE_SIZE_KB), a new log file is created. The completed log file is saved with the date and time. (e.g. DataLogger_010511_14-36-05.log)	0, 1 ...	5
LOG_FILE_SIZE_KB	Defines the maximum size of the log file in KB.	0, 1 ...	1000
[NETWORK_ADAPTER]	In the [NETWORK_ADAPTER] section, you define which network adapters you will control.		
USED_NETWORK_ADAPTER	Specifies the IP address of the network adapter for the Simotion.	• Empty: The standard network adapter is used • IP address (e.g. 10.80.40.100)	empty
[DATA_SOURCE]	In the [DATA_SOURCE] section, you define the data source for the DataLogger.		
DATA_SOURCE	Specifies where the DataLogger will get the data from.	• SIMOTION • INTERNAL: the data is obtained from the internal interface of the WinAC ODK. This means meteorological data can also be obtained	SIMOTION

[Section] / Parameter	Description	Value range	Default value
[SIMOTION]	In the [SIMOTION] section, you define the Simotion-specific times.		
SIMOTION_PORT	Defines the port on which the DataLogger accesses the SIMOTION	It is not recommended that you change this parameter.	2102
SIMOTION_TIMEOUT	Specifies the number of seconds after which a connecting process to Simotion is canceled if no connection can be established.	It is not recommended that you change this parameter.	5
[SAMPLE_RATE]			
DATA_SAMPLE_RATE	Specifies the time intervals in seconds at which the DataLogger calls up data from the Simotion or the solar PV plant control. If you select too small a value, the DataLogger will calculate a meaningful value and substitute it.	Rule: DATA_SAMPLE_RATE > SIMOTION_TIMEOUT * Number of Simotions / 5	20
[DATA_STORAGE]	In the [DATA_STORAGE] section, you define the saving behavior of the DataLogger.		
DATA_STORAGE_LIFE	Specifies how many days unsent data is saved in the csv file.	0, 1 ...	30
[SYSTEMBOX]	In the [Systembox] section, you define the consecutive number of the ControlBox.		
BOX_NO	Specifies the consecutive number of the ControlBox. Only required if several ControlBoxes are present in the plant.	1, 2 ...	empty
[SEND_MODE_INVERTER_SUBUNIT]			
SEND_MODE	Defines whether the data are to be transferred per inverter or per inverter subunit. You will find detailed information in the chapter "Data transmission (Page 87)".	• Subunit • Inverter	Subunit

Configuration file *pvdata.prop* (configuration for SINVERT WebMonitor)

The Simotions that are available in the system are configured in the *pvdata.prop* configuration file. If you would like to establish communication with SINVERT WebMonitor, you must specify the following information for each Simotion:

Information	Description	Value
IP address	IP address of Simotion	IP address in the form: xx.xx.xx.x
Inverter subunit	Number of inverter subunits	Possible values for: **PVS 600Series** • PVS500, PVS600: *1* • PVS1000, PVS1200: *2* • PVS1500 or PVS1800: *3* • PVS2000 or PVS2400: *4* **PVS 800Series** • PVS500, PVS600, PVS630, PVS640, PVS680, PVS720: *1* • PVS1000, PVS1200, PVS1260, PVS1280, PVS1360, PVS1440: *2*
Unambiguous number	MAC address	12-digit MAC address in the form: xxxxxxxxxxxx Note: The 12-digit MAC address corresponds to the first part of the registration code, which is included with the inverter.
Serial number of the inverter	Serial number, which has been given to you by your web portal.	The serial number corresponds to the third part of the registration code, which is included with the inverter.
Inverter type	Specifies the type of inverter, the data of which is sent to the Web portal.	Possible values: **PVS 600Series** • *PVS500, PVS1000, PVS1500, PVS2000* • PVS585, PVS1170, PVS1755, PVS2340 • *PVS600, PVS2400, PVS1200, PS1800* • *PVS630, PVS1260, PVS1890, PVS2520* **PVS 800Series** • *PVS500_800Series, PVS1000_800Series* • *PVS600_800Series, PVS1200_800Series* • *PVS630_800Series, PVS1260_800Series* • *PVS640_800Series, PVS1280_800Series* • *PVS680_800Series, PVS1360_800Series* • *PVS720_800Series, PVS1440_800Series*

Information	Description	Value
Firmware	Firmware of Simotion	Firmware in the form: *Inverter type-x-x-x* *(e.g. PVS500-1-3-2).*
Date of manufacture	Date of manufacture of the inverter (optionally, the date of the initial commissioning of the inverter can also be specified)	Date of manufacture in the form: YYYY-MM-DD
Change Index	Hotfix version of the Simotion firmware (last digit of the firmware of the Simotion)	Hotfix version in the form: x

Depending on whether the parameter `SEND_MODE` is assigned in the configuration file *settings.prop*, the data are sent per inverter (`SEND_MODE` = inverter) or per inverter subunit (`SEND_MODE` = subunit).

Example configuration for data transmission per inverter (`SEND_MODE` = inverter):

```
;Webmonitor:
  SIMOTION1 = 10.80.40.1 4 001234567890 TST123456789012 PVS500 PVS500-1-3-2 2011-02-02 1
              ①          ②  ③            ④               ⑤      ⑥            ⑦          ⑧
```

① IP address of Simotion
② Number of inverter subunits
③ Number, e.g. MAC address
④ Serial number of the inverter (see nameplate)
⑤ Inverter type
⑥ Firmware
⑦ Date of manufacture
⑧ Change Index

Figure 8-14 Example configuration pvdata.prop (inverter)

Example configuration for data transmission per inverter subunit (SEND_MODE = subunit):

```
;Webmonitor:
  SIMOTION1 = 10.80.40.1 4 001234567890 TST123456789011 TST123456789012 TST123456789013
                  ①      ②      ③             ④              ⑤              ⑥

              TST123456789014 PVS500 PVS500-1-3-2 2011-02-02 1
                     ⑦          ⑧        ⑨          ⑩        ⑪
```

① IP address of Simotion

② Number of inverter subunits

③ Number, e.g. MAC address

In the WebMonitor portal, assign a common identical number (e.g. MAC address of the inverter) to the inverter subunits belonging to one inverter.

④ - ⑦ Serial number of the inverter (see nameplate) + position number of the inverter subunit corresponding to the connection sequence of the PROFIBUS connection.

Example: inverter subunit ④ :

Serial number of the inverter **TST12345678901** + Position number of the inverter subunit **1** **= TST123456789011**

⑧ Inverter type

⑨ Firmware

⑩ Date of manufacture

⑪ Change Index

Figure 8-15 Example configuration pvdata.prop (subunit)

Configuration file *pvdata.prop* (configuration for Meteocontrol)

The Simotions that are available in the system are configured in the pvdata.prop configuration file. If you would like to establish communication with Meteocontrol, you must specify the following information for each Simotion:

Information	Description	Value
IP address	IP address of Simotion	IP address in the form: xx.xx.xx.x
Inverter subunit	Number of inverter subunits	Possible values for: **PVS 600Series** • PVS500, PVS600: *1* • PVS1000, PVS1200: *2* • PVS1500, PVS1800: *3* • PVS2000, PVS2400: *4* **PVS800Series** • PVS500, PVS600, PVS630, PVS640, PVS680, PVS720: *1* • PVS1000, PVS1200, PVS1260, PVS1280, PVS1360, PVS1440: *2*
Unambiguous number	Serial number	

Depending on whether the parameter SEND_MODE is assigned in the configuration file *settings.prop*, the data are sent per inverter (SEND_MODE = inverter) or per inverter subunit (SEND_MODE = subunit).

Example configuration for data transmission per inverter (SEND_MODE = inverter):

```
;Meteocontrol:
  SIMOTION1 = 10.80.40.1 4 001234567890
                      ①  ②  ③
```

① IP address
② Number of inverter subunits
③ Number, e.g. MAC address

Figure 8-16 Meteocontrol (pvdata)

Example configuration for data transmission per inverter subunit (SEND_MODE = subunit):

```
;Meteocontrol:
 SIMOTION1 = 10.80.40.1 4 TST123456789011 TST123456789012 TST123456789013 TST123456789014
             ①          ② ③               ④               ⑤               ⑥
```

① IP address

② Number of inverter subunits

③ - ⑥ Serial number of the inverter (see nameplate) + position number of the inverter subunit corresponding to the connection sequence of the PROFIBUS connection.

Example: inverter subunit ③:

Serial number of the inverter **TST12345678901** + Position number of the inverter subunit **1 = TST123456789011**

Figure 8-17 Example configuration Meteocontrol pvdata.prop (subunit)

Note

The individual information is specified separated from other information by a space, both during the configuration for SINVERT WebMonitor and for the web portal of Meteocontrol.

Configuration file *portal_siemens.prop*

The parameters for the SINVERT Webmonitor web portal are configured in the *portal_siemens.prop* configuration file. Upon delivery, the parameters are configured as described in the table.

Parameters	Description
PORTAL_MAIL_SAMPLE_RATE=600	Defines that the DataLogger determines data every 600 seconds (= 10 minutes) and sends it to the SINVERT Webmonitor.
IP-PORTAL=195.27.237.106	Specifies the IP address of the SINVERT Webmonitor.
PORT_PORTAL=80	Specifies the Internet port.
HOST_PORTAL=www.automation.siemens.com	Specifies the Internet address of the SINVERT Webmonitor.
HTTP_POST=/sinvertwebmonitor	Defines the directory of the SINVERT Webmonitor.

Configuration file *portal_meteocontrol.prop*

The parameters for the Meteocontrol web portal are configured in the *portal_meteocontrol.prop* configuration file. You only have to configure this configuration file if you use the Meteocontrol web portal. The following table describes the parameters that are configured in the *portal_meteocontrol.prop* configuration file.

Parameter	Description	Value range	Default value
LOGGER_SNR	Serial number, which has been given to you by Meteocontrol.	—	—
UTC_OFFSET	Specifies the deviation from UTC (Coordinated Universal Time). Example: • Germany: +1 • Portugal: +0	-12 … +0 … +12	—
PORTAL_MAIL_SAMPLE_RATE	Defines the number of seconds after which the DataLogger will determine data.	—	900
PORTAL_MAIL_SEND_RATE	Defines the number of seconds after which the DataLogger will send data to the Meteocontrol web portal.	—	10800
TYPE	Defines the manufacturer from which data will be sent to the Meteocontrol web portal.	—	siemens
FTP_HOST	Defines the FTP host of Meteocontrol.	—	www1.meteocontrol.de
FTP_USER	FTP username, which has been given to you by Meteocontrol.	—	—
FTP_PASSWORD	FTP password that has been given to you by Meteocontrol.	—	—
FTP_MODE	Defines whether the FTP connection is active or passive.	• Passive • Active	Passive
FTP_REPETITIONS	Number of attempts to send FTP data again following an FTP connection abort.	1 ... 10	1
LANGUAGE	Language in which the messages (faults and warnings) are sent to the portal (German, English, French, Spanish, Italian). Each message contains the following Information: Time stamp, fault name, fault code, fault description.	• de • en • fr • es • it	en

8.6.3 Data transmission

Depending on whether the parameter SEND_MODE is assigned in the configuration file *settings.prop*, the data are sent per inverter (SEND_MODE = inverter) or per inverter subunit (SEND_MODE = subunit).

Note

Please note that the set configuration in the DataLogger agrees with the settings of the respective portal (Web monitor or Meteocontrol).

Data transmission per inverter (SEND_MODE = inverter)

The following data is sent per inverter to **WebMonitor**:

WebMonitor		Data type	PVS	
ParamID	Description	WR[1] / weather station	Parameter	Meaning
1	PAC	INV	30120	ACrealpower
2	UAC	INV	34055	Voltagean
3	IAC	INV	34416	ACrealcurrenta
4	FAC	INV	34425	ACfrequency
5	PDC	INV	30165	DCpower
6	UDC	INV	30150	DCvoltage
7	IDC	INV	30155	DCcurrent
8	InternalTemp1	INV	31000	INVPmaxTemperature
9	InternalTemp2	INV	--	--
A	Radiation	Weather station	20206	Irradiation
B	ExternalTemp	Weather station	20205	ExternalTemp
C	Daily yield	INV	30288	ACdayEnhancedAccuracy
D	Status	INV	30002	INVPState
E	Total yield	INV	30291	ACtotalEnhancedAccuracy
F	Operating hours	INV	34110	INVSoperatingHours
10	Daily solar energy	Weather station	20210	DailySolarEnergy

[1] INV = Inverter

The following data is sent per inverter to **Meteocontrol**:

Meteocontrol	Parameter number	Meaning
Inverter		
P_AC	30120	Current AC active power
Q_AC	30125	Current AC reactive power
S_AC	30130	Current AC apparent power
U_DC	30150	Current DC voltage
I_DC	30155	Current DC current
P_DC	30165	Current DC power
COS_PHI	30180	Current power factor (CosPhi)
I_GDFI	34045	Current PV array grounding value
R_ISO	30195	Current isolation resistance
COS_PHI_NORM	30176	Current power factor setpoint (CosPhi)
T_WR	31000	Maximum inverter temperature
E_DAY	30288	AC daily energy
E_YEAR	30290	AC annual energy
E_TOTAL	30291	AC total energy
STATE1	30002	INV state
Fault_Bit_Messaging_INV	31200	Fault messages (INV[1])
Alarm_Bit_Messaging_INV	31206	Warnings (INV[1])
Inverter subunit		
I_DC1, I_DC5, I_DC9	34030	Current DC current at input 1
I_DC2, I_DC6, I_DC10	34031	Current DC current at input 2
I_DC3, I_DC7, I_DC11	34032	Current DC current at input 3
I_DC4, I_DC8, I_DC12	34033	Current DC current at input 4
I_AC1 = Total	34416	Current AC current phase 1
I_AC2 = Total	34417	Current AC current phase 2
I_AC3 = Total	34418	Current AC current phase 3
U_AC1 = ∅	34055	Current AC voltage phase 1
U_AC2 = ∅	34056	Current AC voltage phase 2
U_AC3 = ∅	34057	Current AC voltage phase 3
F_AC = ∅	34425	Current line frequency
T_INSU1	34121	Heat sink temperature (1st INSU)
Fault_Bit_Messaging_INSU 1(2/3/4)	31201 (/02/03/04)	Fault messages (INSU[2])
Alarm_Bit_Messaging_INS U1(2/3/4)	31207 (/08/09/10)	Warnings (INSU[2])

[1] INV = Inverter

[2] INSU = Inverter subunit

Data transmission per inverter subunit (SEND_MODE = subunit)

The messages of the inverter subunits are sent for the corresponding inverter subunits.

The messages of the inverter are sent to inverter subunit 1.

The following data is sent per inverter subunit to **WebMonitor**:

WebMonitor	Meaning	PVS parameter (INSU[1])
PAC	AC power	34420
UAC	AC voltage	Max (34055, 34056, 34057)
IAC	Current AC	Sum (34416, 34417, 34418)
FAC	AC frequency	34425
PDC	DC power	34040
UDC	DC voltage	34015
IDC	DC current	34016
InternalTemp	Heat sink temperature	34121
InternalTemp2	--	--
Radiation	(Weather)	(Weather)
ExternalTemp	(Weather)	(Weather)
DailyYield	AC daily energy	34100
Status	INSU state[1]	34000
Total yield	AC total energy	34103
Operating hours	INVSoperatinghours	34110
Daily solar energy	(Weather)	(Weather)

[1] INSU = Inverter subunit

The following data is sent per inverter subunit to **Meteocontrol**:

Meteocontrol	Meaning	PVS parameter
E_INT	Interval energy	(from the difference to the previously sent energy value)
I_AC1, I_AC2, I_AC3	Current AC	AC current phase 1 to 3 (34416, 34417, 34418)
U_AC1, U_AC2, U_AC3	AC voltage	AC voltage phase 1 to 3 (34055, 34056, 340575)
P_AC	AC active power	Current AC active power (34420)
Q_AC	Reactive power AC	Current AC reactive power (34421)
S_AC	Apparent power AC	Current AC apparent power (34422)
F_AC	AC frequency	Current line frequency (34425)
I_DC	DC current	Current DC current (34016)
U_DC	DC voltage	Current DC voltage (34015)
P_DC	DC power	Current DC power (34040)
I_DC1, I_DC2, I_DC3; I_DC4	DC current at input 1 to 4	DC current input 1 to 4 (34030, 34031, 34032, 34033)
E_DAY	AC daily energy	34100
E_YEAR	AC annual energy	34102
E-TOTAL	AC total energy	34103
OP_TIME	Operating hours	34110
T_WR	Heat sink temperature	34121
STATE	INSU[1] state	34000
name;errorcode;description	Faults/warnings	31201/02/03/04; 31207/08/09/10
PC	Current power in %	30401 (/02/03/04)
cos_PHI_Nom	Current power factor setpoint (cos phi)	30176
cos_PHI	Current power factor setpoint (cos phi)	30180

[1] INSU = Inverter subunit

Message sent to Meteocontrol

Meteocontrol permits the reception of fault messages.

The PVS inverter signals faults and warnings, divided according to inverter and inverter subunit. To enable defined transfer of faults and warnings, numbering of the faults and warnings of the Simotion is converted to continuous numbering for Meteocontrol.

Messages coming from an inverter subunit are designated in the portal with a number in brackets. For example, (1) means there is a message from inverter subunit 1. If the message text is not a number in brackets, it is a message concerning the overall inverter.

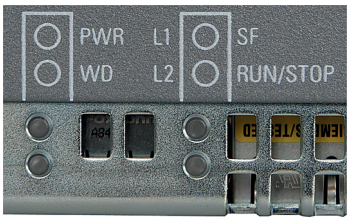
The table below shows the conversion from the Simotion numbering to the Meteocontrol numbering:

Faults/warnings	Simotion numbering	Conversion	Meteocontrol numbering
Fault			
Inverter	1 ... 99	⇒	1 ... 99
Inverter subunit 1	1 ... 159	⇒	200 ... 399 (1)
Inverter subunit 2	1 ... 159	⇒	400 ... 599 (2)
Inverter subunit 3	1 ... 159	⇒	600 ... 799 (3)
Inverter subunit 4	1 ... 159	⇒	800 ... 999 (4)
Alarms			
Inverter	1 ... 99	⇒	1001 ... 1199
Inverter subunit 1	1 ... 99	⇒	1200 ... 1399 (1)
Inverter subunit 2	1 ... 99	⇒	1400 ... 1599 (2)
Inverter subunit 3	1 ... 99	⇒	1600 ... 1799 (3)
Inverter subunit 4	1 ... 99	⇒	1800 ... 1999 (4)

8.7 Parameterization, diagnostics, and monitoring

8.7.1 Status indicators on the Microbox PC

Status indicators on the Microbox PC

Status indicators	Indicator	Meaning	LED	Description
	PWR	Power supply	OFF	Power supply
			GREEN	Supply voltage is applied
	WD	Watchdog status display	OFF	Watchdog switched off
			GREEN	Watchdog switched on (default); monitoring time of 16 secs not expired
			RED	Monitoring time expired without automatic restart; Caution! Microbox no longer working stably.
	L1-SF	Group fault	OFF	No group fault
			RED/YELLOW	Monitoring hardware (e.g. temperature, memory) responded
			RED	Group fault Profinet devices (weather station, Scalance, electric utility interface)
	L2-RUN/STOP	RUN	GREEN	ControlBox (WinAC) operating
		STOP	YELLOW	ControlBox (WinAC) in stop; Caution! Control no longer possible

8.7.2 Parameterization of Profinet devices

Introduction

The devices must be assigned unique names so that the connected Profinet devices (weather station and Scalance) can be detected by the ControlBox, and data can be exchanged between the individual devices. The Primary Setup Tool (PST) is used for assigning the names. Alternatively, Step7 (not included in the scope of delivery) can be used for assigning the names.

Name definition

The following name definitions are provided:

Device name	Meaning
WeatherStation01	1. Weather station with ET200S IM151-3PN (delivery condition)
. . .	. . . .
WeatherStation08	8. Weather station with ET200S IM151-3PN
ScalanceInverter01	Scalance XF204-2 in the 1st inverter unit
. . .	. . .
ScalanceInverter30	Scalance XF204-2 in the 30th inverter unit
ScalanceControlbox	Scalance XF204-2 in the ControlBox (delivery condition)
EVU-SS (electric utility interface)	Electric utility interface with ET200S IM151-3PN (delivery condition)

The corresponding IP address is assigned automatically by the ControlBox.

PST tool

Please proceed as follows:

1. Start the PST tool on the desktop of the Microbox PC.
2. Search the network with <F5>.
3. Select the Ethernet interface of the corresponding device and assign the new name.

It is helpful to connect each device individually to the network to be able to make a unique assignment. Alternatively, a flashing test can be carried out for the assignment.

The online help provides additional information on the PST tool.

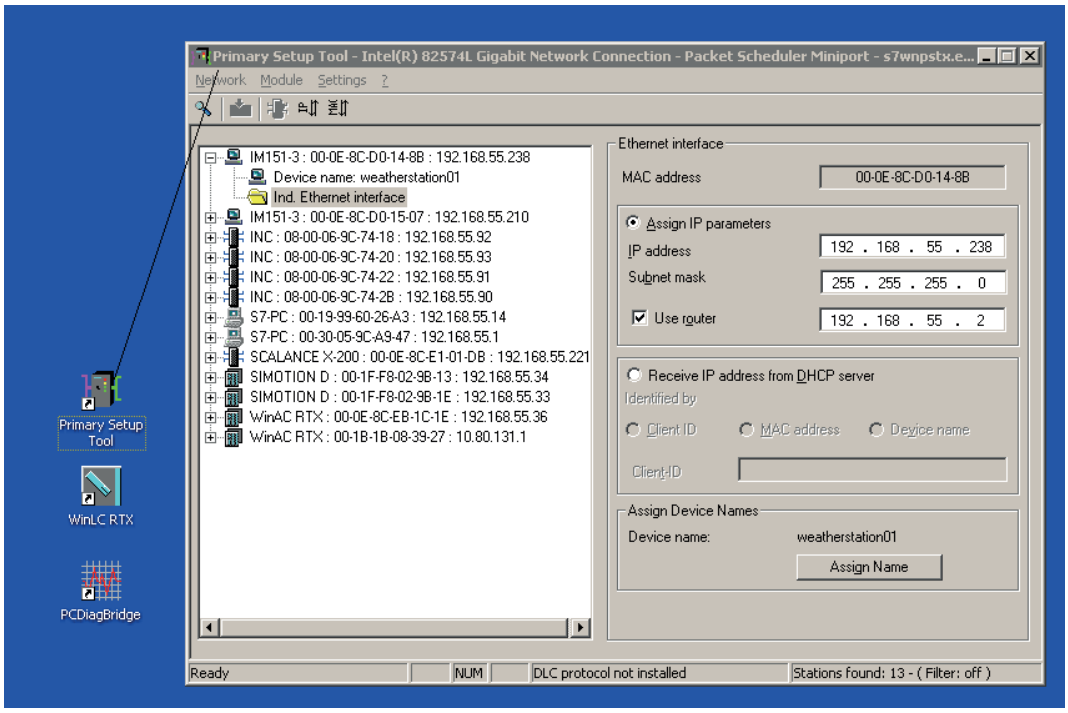


Figure 8-18 Primary Setup Tool (PST)

Changing the configuration

The sequence must be adhered to when commissioning the Profinet devices. A device must not be activated in the configuration (see Chapter Parameter (Page 60) for details of activation) until the device is on the bus and has been assigned the correct device name.

If a device is activated in the parameterization before it is connected to the Profinet bus, it remains designated as inactive in the Web server of WinAC. Diagnostics of the device remains inactive in this case. If the device is then connected, its activation is automatic.

If the device is not connected to the Profinet bus and it is to be represented as "Faulty", a restart of WinAC must be carried out. Restart of WinAC is also required if an unconnected device is to be deactivated. Without restart, the device remains in the "Faulty" status even though it has been deactivated.

Summary:

Device configured before last WinAC restart	Device connected	
	Yes	No
activated	2	3
deactivated	1	1
Configuration during operation	Device connected	
	Yes	No
Activated > deactivated	2	1 (after WinAC restart ⇒ faulty)
Activated > deactivated		3 (after WinAC restart ⇒ not active)
Representation in the Web server (topology) 1 = not active 2 = active 3 = faulty		

Result

When these requirements are met ...	**... these LEDs are inactive (dark)**
• All Profinet devices are connected (including wiring) • All encoders and fiber optic cables are connected • All Profinet devices have a unique device name and are activated (see Chapter Parameter (Page 60) for details of activation)	• Microbox PC: LED "L1" • IM151: LED "BF" and "SF" • Scalance: LED "F"

8.7.3 Parameterization, diagnostics, and monitoring with Step7

Requirement

Working with Step7 requires a computer with Step7 V5.5 installation and Ethernet connection, and the unzipped Step7 project of the ControlBox. The archived project must be on the Microbox under the following path: "D:\S7Projekt".

Knowledge of how to handle Step7 is required.

Parameterization

Parameterization is carried out optionally using the ConfigTool or direct via data blocks. To simplify parameterization, the most important parameters are defined in the variable table (VAT).

VAT listing: See Chapter Parameterization, diagnostics, and monitoring with the Web server (Page 98)

Diagnostics

Several tools are available in Step7 for diagnostics, such as diagnosing hardware and reading out the module status. Additional VATs have been created for program diagnostics.

VAT listing: See Chapter Parameterization, diagnostics, and monitoring with the Web server (Page 98)

The error messages of the ControlBox can be displayed via the Step7 Tool "CPU messages".

Listing of error messages: See Chapter Parameterization, diagnostics, and monitoring with the Web server (Page 98)

Monitoring

The most important values for monitoring the ControlBox are collected in VATs.

VAT listing: See Chapter Parameterization, diagnostics, and monitoring with the Web server (Page 98)

Note

In the block folder of the Step7 project, an "Online" filter is configured that only displays the VAT.

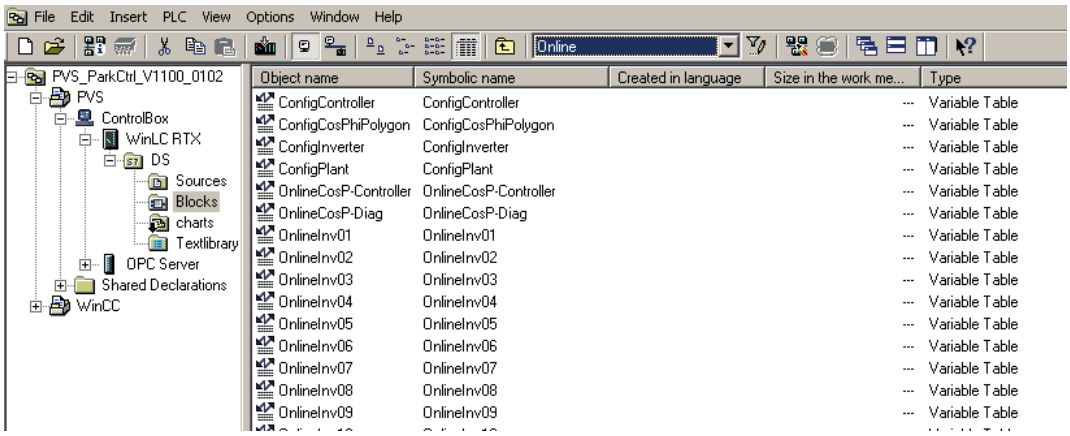


Figure 8-19 Step7 project "Online" filter: VAT display

8.7.4 Parameterization, diagnostics, and monitoring with the Web server

Introduction

The Web service of WinAC is available as standard for visualizing the ControlBox. A detailed description of the Web pages can be found in the Chapter "Web server" of the product manual of WinAC RTX 2010. The description below refers to the essential information of the Web pages.

Calling the Web pages

Enter the address of the Profinet interface "http://10.80.131.1" in a Web browser. For enabled Web browsers, see the WinAC RTX 2010 manual

For PDA devices and mobile phones, the address is: "http://10.80.131.1/basic"

The automatic refresh time of all Web pages is 10 secs. The available languages are German and English.

Parameterization

Parameterization cannot be carried out via the Web pages since write accesses are not possible in the Web pages. The parameters can be read out via the "Variable tables" Web page.

Variable table (VAT) name	Description
ConfigPlant	Parameters for the plant configuration
ConfigInverter	IP addresses of the inverters
ConfigController	Parameters of the solar PV plant control
ConfigCosPhiPolygon	Interpolation points for calculating the setpoints of the CosPhi control

Diagnostics

Several Web pages are available for diagnostics. The diagnostics buffer of the CPU can be read out. On the "Open communication" tab of the "Communication" page, the status and the connection parameters of the connection to the inverters and to the PAC3200 are displayed.

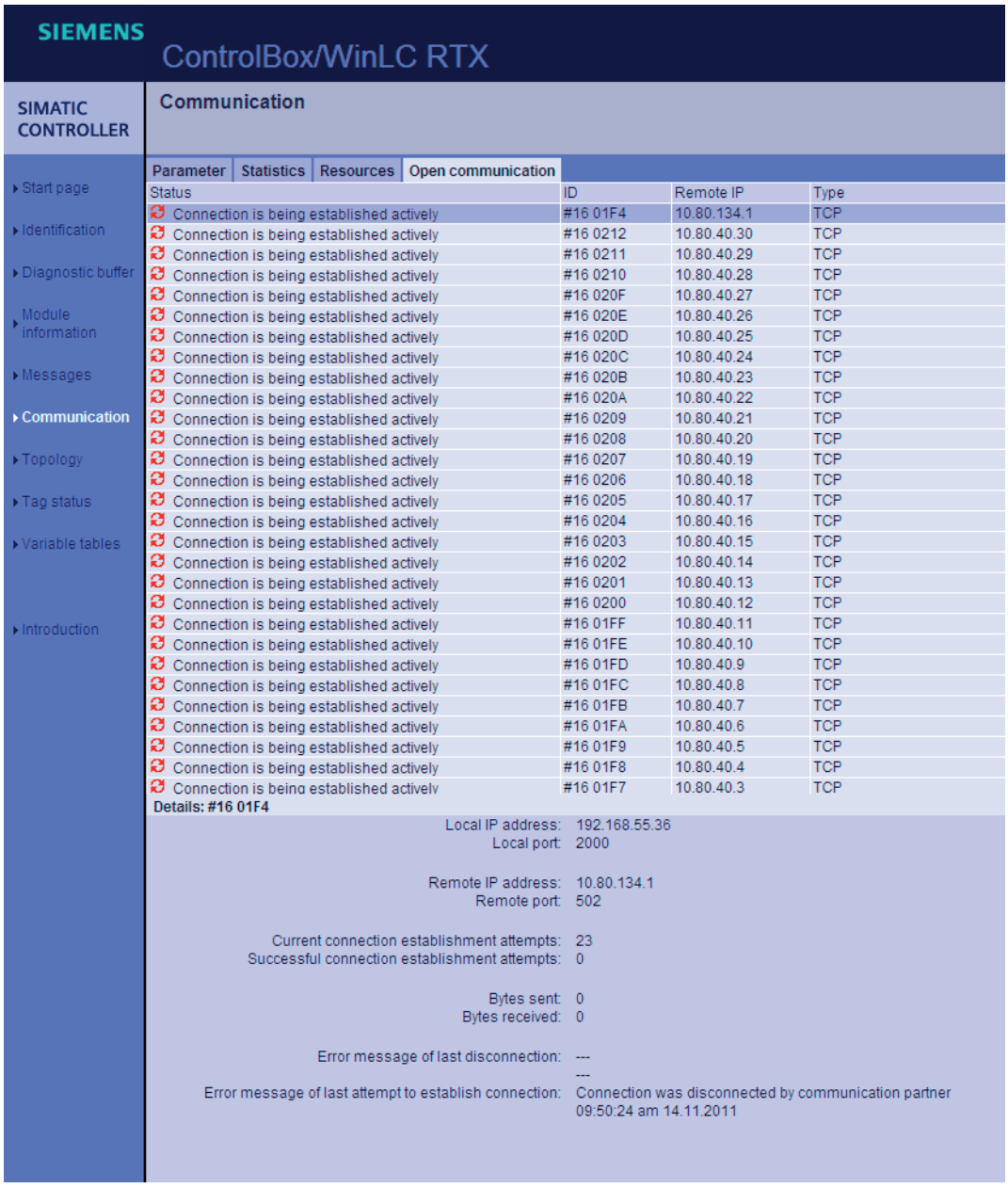


Figure 8-20 Diagnostics: Communication

On the "Module information" page, the status of the Profinet devices is displayed. The maximum configuration of the ControlBox for 30 inverters and 8 weather stations is always displayed here. The status representation varies depending on the activation of the devices at parameterization:

- Device configured and connected (active) = green check
- Device configured and not connected (faulty) = red wrench
- Device not configured (not active) = gray check

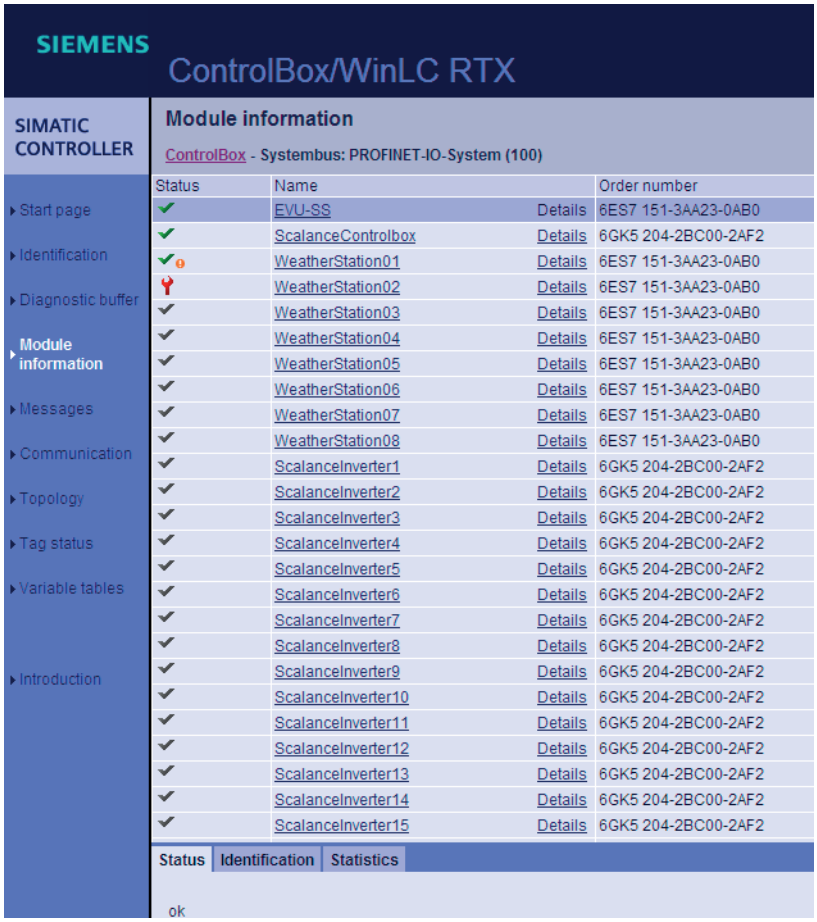


Figure 8-21 Diagnostics: Module information

On the "Topology" Web page, the network topology is read out online.

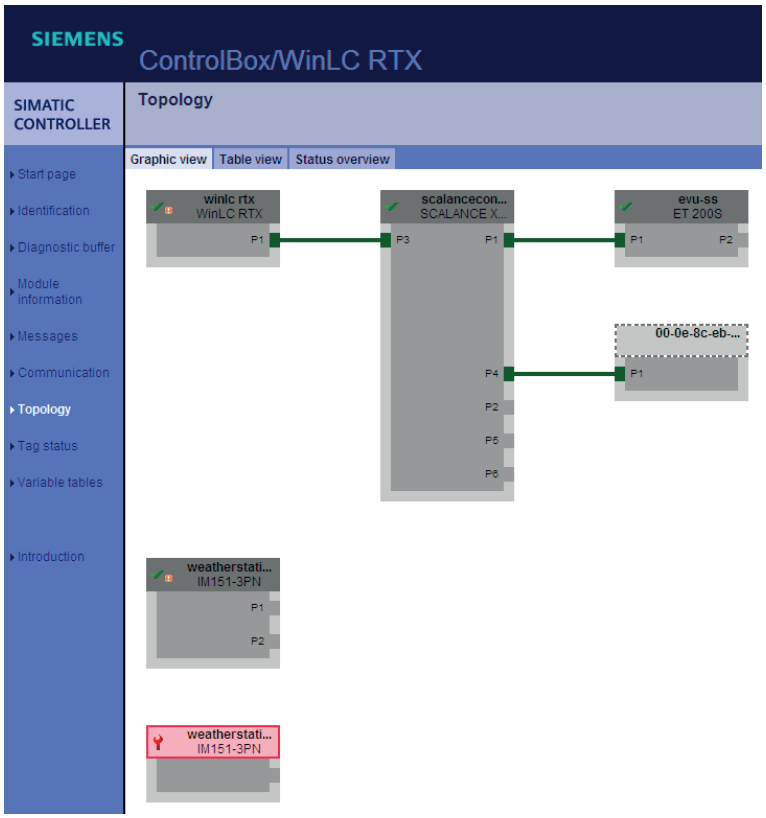


Figure 8-22 Diagnostics: Topology

Note: Scalance devices that are not activated but have a valid device name are also displayed in the topology.

There are 3 prepared VAT tables on the Variable tables page.

VAT name	Description
OnlineStatusDevice	Overview of the status of all connected devices
OnlineP-Diag	Diagnosis of the power limitation controller
OnlineCosP-Diag	Diagnosis of the CosPhi controller

The ControlBox generates the following error messages that are displayed on the "Messages" Web page.

- Report system errors → System messages from the Profinet devices
- Communication fault between ControlBox and inverter x (x= number of the inverter)
- Error when writing the setpoints from the ControlBox to inverter x
- Group fault inverter x (at least one fault is present from inverter x)
- Group warning inverter x (at least one warning is present from inverter x)
- Group fault PAC3200
- Group fault control
- Group fault hardware Microbox
- Group fault weather station *x* (x = number of the weather station); currently only diagnostics of the cable break

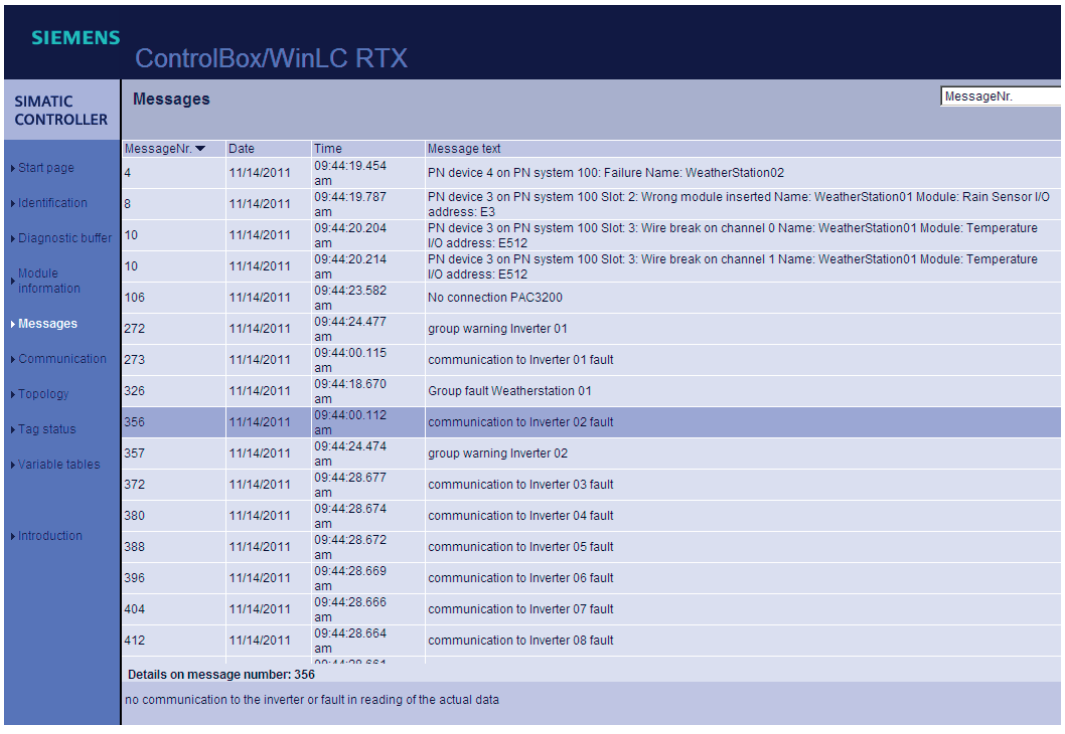


Figure 8-23 Diagnostics: Messages

Monitoring

The most important values for monitoring the ControlBox are available on the "Variable tables" Web page.

VAT name	Description
OnlineInv01 ... 30	Important values from inverter 1... 30 (extract from the current data frame)
OnlineWeather01 ... 08	Measured and calculated data of weather station 01 ... 08
OnlineP-Controller	Setpoints and actual values of the power limitation controller
OnlineCosPhi-Controller	Setpoints and actual values of the CosPhi controller
OnlinePlant	Calculated plant data such as medium-voltage energy values and performance ratio values

8.7.5 Parameterization, diagnostics, and monitoring with OPC Scout

Introduction

The ControlBox is supplied with a licensed OPC server of Simatic Net Edition 2008. This enables you to configure and visualize the ControlBox with OPC Scout V10. The most important data is stored in the configuration files on the desktop of the Microbox PC. Operation of the OPC Scout V10 software is described in the Online help. The refresh time of the values is 1 sec.

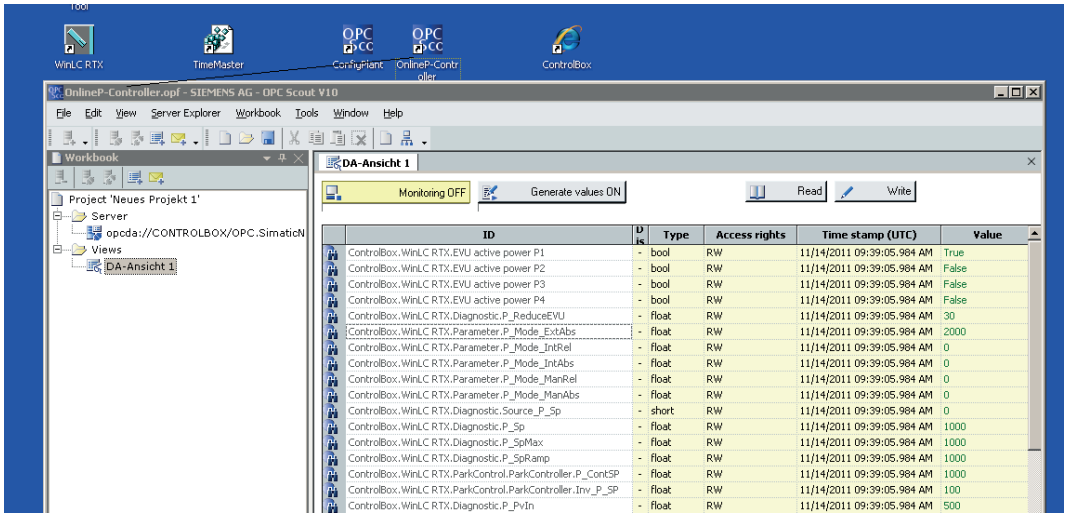


Figure 8-24 OPC Scout

Parameterization

The most important parameters are defined in 2 configuration files.

Name of the configuration file	Description
ConfigPlant.opf	Parameters for the plant configuration including inverters
ConfigController.opf	Parameters of the solar PV plant control without interpolation points for calculating the setpoints of the CosPhi control

Diagnostics/monitoring

For diagnostics/monitoring, 2 configuration files are defined.

Name of the configuration file	Description
OnlineP-Controller.opf	Setpoints and actual values including diagnostics data of the power limitation controller
OnlineCosP-Controller.opf	Setpoints and actual values including diagnostics data of the CosPhi controller

8.7.6 OPC interface

Introduction

For data exchange between the ControlBox and higher-level systems such as HMI systems, the OPC server of Simatic Net Edition 2008 is available. All the essential data of the ControlBox is available on this interface. OPC DA, OPC UA and OPC XML are supported. You can find an exact listing of the supported OPC protocols in the Online Help of Simatic Net.

Data interface

The following data is provided:

Symbolic name	S7 address	Meaning
Connection	DB 1	Connection parameters to the inverter and PAC
Parameters	DB 2	Parameters of the solar PV plant control
ActDataInv	DB 3	Selected data from the inverters for the DataLogger
Diagnostics	DB 7	Diagnostics data of the solar PV plant control
PlantOnline	DB 8	Calculated plant data such as efficiency, performance ratio and energy values
WeatherStation	DB 10	Measured and calculated weather data
ParkControl	DB 11	Measured and calculated values of the solar PV plant control
DataInv1-30	DB 30 ... 59	Complete data from the inverters including signal interface (current data frame)
EVU active power P1	I 0.2	EVU (electric utility) interface
EVU active power P2	I 0.3	EVU (electric utility) interface
EVU active power P3	I 0.4	EVU (electric utility) interface
EVU active power P4	I 0.5	EVU (electric utility) interface

8.8 System restore and system backup

Introduction

A system backup must always be carried out when software changes have been made on the Microbox PC.

A system restore is necessary, for example, when faults occur or when MicroBox PC components are replaced.

WinAC RTX

The S7 user program of the solar PV plant control runs in the WinAC RTX.

The program is located at "D:\WinACRTX".

If the program of the WinAC RTX has been deleted (as a result of operator input, for example) or a memory reset request is present (e.g. in the case of system crashes or memory faults), the S7 program must be reloaded.

The "Load archive.." function on the Controller Panel of the WinAC RTX is available for this purpose. The original project (delivery condition) is located in the path "D:\ArchivWinACRTX".

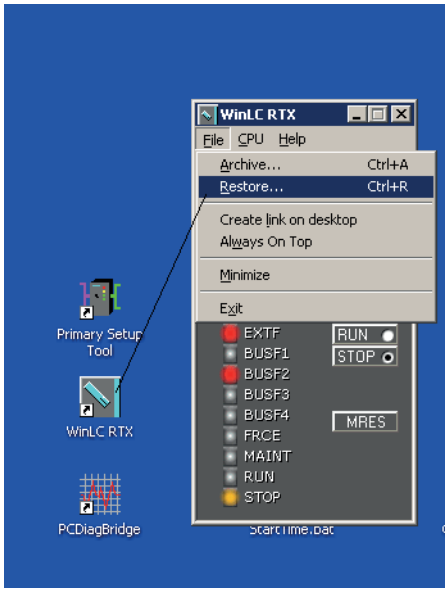


Figure 8-25 WinAC RTX

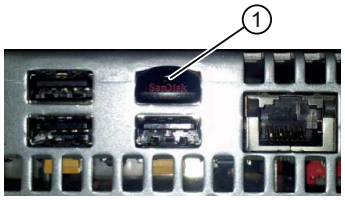
In the case of changes to the original project (e.g. resulting from changes to the parameters, or expansion of the program), we recommend that you generate a new archive of the S7 program.

Image Partition Creator

The program Simatic IPC Image Partition Creator is used for data backup and restoring of the operating system. The supplied USB flash drive is prepared for restoring. The USB flash drive also contains the Image files in the Image folder:

- ControlBox_300_V1200_xxxx
- ComBox_2_V1200_xxxx

The images contain the entire hard disk of the Microbox PC (partition C: and D:). When restoring, the extent can be selected, e.g. entire hard disk or partition C:.



① Slot for USB flash drive on the Mircobox PC

Figure 8-26 USB slot on the Microbox PC

Basic procedure

1. Backing up the licenses of C:. The EWF filter must be deactivated for this purpose.
2. When restoring partition D: the WinAC program, the WinCC project, and the configuration files of the DataLogger should be backed up.
3. Boot the Microbox PC using the USB flash drive (call the boot menu in the BIOS) and initiate a system restore.
4. Reboot the Microbox PC and re-install backed-up programs/files.

To create a bootable USB flash drive, e.g. if the supplied USB flash drive is lost, start the batch file Start_Image&PartitionCreator on the installation CD of Partition Creator.

Select "Create bootable USB FlashDrive with Image & Partition Creator" and follow the instructions.

Note

After modifying the system, a new image of partition C: must be created.

The BIOS settings for the boot sequence (1. Hard disk; 2. USB) are lost if the Microbox PC is booted without the USB flash drive. For this reason, the hard disk must be set at the first position in the boot menu for the next boot procedure with the USB flash drive.

Service and maintenance 9

9.1 Service

The ControlBox is maintenance free.

9.2 Corrective maintenance

Requirement

If the ControlBox signals a technical defect via its diagnostics interfaces (see ☐0 in this regard), identify the defective device. If this is not possible, contact Technical Assistance (see the chapter "Technical support (Page 121)").

Safety information

⚠ DANGER

Danger, high voltage!

Risk of death or serious bodily injury.

Turn off and lock out power before working on this equipment (see the chapter "Safety notes (Page 9)").

⚠ DANGER

Dangerous electrical voltage

Working with live equipment can lead to an electric shock.

Use an external voltmeter to ensure that the voltage measuring inputs are de-energized. The measured values display on the screen of the PAC3200 is not evidence that the equipment is de-energized.

⚠ CAUTION

Electrical voltage 24 V

The ControlBox 460 is operated with a UPS that can maintain the 24 V supply for approximately 2 minutes after shutdown of the mains voltage.

Before carrying out repair work, ensure that the 24 V supply of the UPS is no longer available.

Procedure

If a device is defective or damaged, proceed as follows:

1. Remove the device in compliance with the hazard information. If necessary, mark connections with the appropriate terminal designation to avoid wiring errors when assembling.
2. Pack the device in a suitable manner to prevent it from being damaged during transport.
3. Return the device to Siemens. You can obtain the address from:

- Your Siemens sales partner
- Technical Assistance
- Technical Support

Commissioning after the repair

Proceed as follows after replacing a defective device:

1. Re-install the device in compliance with the safety information in this chapter.
2. Ensure all connections have been correctly wired.
3. Follow the instructions from the chapter "Commissioning (Page 33)".

Technical data

10

10.1 ControlBox

General technical data

		6AG3611-3AA00-3AA0
product brand name		SINVERT
product designation		for Park Controling, WinCC and Web portal connections
Product-type designation		SINVERT PVS ControlBox 300
Product function Web-based diagnostics		Yes
Type of installation		indoor installation
Protection class IP		IP20
Operating resource protection class		I
Installation altitude at a height over sea level maximum	m	2 000
Ambient temperature		
• during operating	°C	0 … 49
• during storage	°C	-40 … +70
• during transport	°C	-40 … +70
Relative humidity without condensation		
• during operating phase	%	0 … 95
Climatic class according to EN 60721		3K3
Type of cooling		natural convection
RAL color number		RAL 7035
Color		light grey
Design of the interface for communication		Ethernet
Cable gland version		PG gland

Supply voltage

		6AG3611-3AA00-3AA0
Type of voltage of the supply voltage for power supply		AC
Signal voltage with DC nominal value	V	24
Supply voltage frequency		
• rated value	Hz	47 … 63
Supply voltage		
• rated value	V	170 … 264
Consumed current for rated value of supply voltage	A	0.35
Signal voltage for signal <0>		
• for DC	V	-30 … +5
Signal voltage for signal <1>		
• for DC	V	15 … 30

Communication

	6AG3611-3AA00-3AA0
Number of digital inputs	8
Design of the electrical connection at the digital inputs	Spring-type terminals, 2 x 6 terminals
Number of analog inputs for input range 4 mA … 20 mA	2
Number of analog outputs for output range 0 V ... 10 V	2
Number of 10/100/1000 Mbit/s RJ45 ports	1
Number of FO cores	2
Design of the FO plug-in contact	BFOC

Mounting/fixing/dimensions

		6AG3611-3AA00-3AA0
mounting position recommended		vertical
Type of mounting		wall mounting
Case		
• body material		Polycarbonate
• cover material		Polycarbonate
Width	mm	614
Depth	mm	175
Height	mm	614
Weight	kg	19.2

Approvals/certificates

	6AG3611-3AA00-3AA0
Verification of suitability	CE
Standard	
• EMC emitted interference industry according to IEC 61000-6-4	Yes
• EMC interference resistance industry according to IEC 61000-6-2	Yes
Product characteristic resistant to UV radiation	Yes
Fire classification non-flammable	Yes

10.2 Electronic modules

Technical data of the 8DI DC24V digital electronic module

You can find the daily updated technical data of the 8DI DC24V digital electronic module on the Internet (http://support.automation.siemens.com/WW/view/en/23849842/td).

Technical data of the 4AI analog electronic module

You can find the daily updated technical data of the 4AI analog electronic module on the Internet ().

Technical data of the 2AO analog electronic module

You can find the daily updated technical data of the 2AO analog electronic module on the Internet ().

10.3 Sentron PAC3200

Technical data of the Senton PAC3200

You can find the technical data of the Sentron PAC3200 in the Manual on the Internet (http://support.automation.siemens.com/WW/view/en/26504150).

Test standards

11

Operation (3K3 to EN 60721-3-3)

Condition	Test standard
Cold	IEC 60068-2-1 (Test AD)
Dry heat	IEC 60068-2-2 (Test Bd)
Humid heat	IEC 60068-2-78 (Test Cab)
Temperature change with defined rate of change	IEC 60068-2-14 (Test Nb)

Transport and storage (2K4 in accordance with EN 60721-3-2)

Condition	Test standard
Cold	IEC 60068-2-1 (Test Ab)
Dry heat	IEC 60068-2-2 (Test Bb)
Humid heat, cyclic	IEC 60068-2-30 (Test Db)
Rapid temperature change	IEC 60068-2-14 (Test Na)

Interference immunity (EN 61000-6-2)

Condition	Test standard
Burst pulses (fast transients)	Test standard IEC61000-4-4; tested with 1kV
Surge (energy-rich pulses)	Test standard IEC61000-4-5, tested with 1 kV (symmetrical) and 2 kV (asymmetrical)
ESD (electrostatic discharge)	Test standard IEC 61000-4-2; tested with 8 kV air discharge and 6 kV contact discharge
Radiated narrow-band electromagnetic fields	Test standard IEC 61000-4-3
Conducted interference, induced by high-frequency fields	Test standard IEC 61000-4-6

Ordering data

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Ordering data

Designation	Order No.
SINVERT PVS ControlBox 300	6AG3611-3AA00-3AA0

Appendix

A

A.1 Dimension drawings

SINVERT Control Box

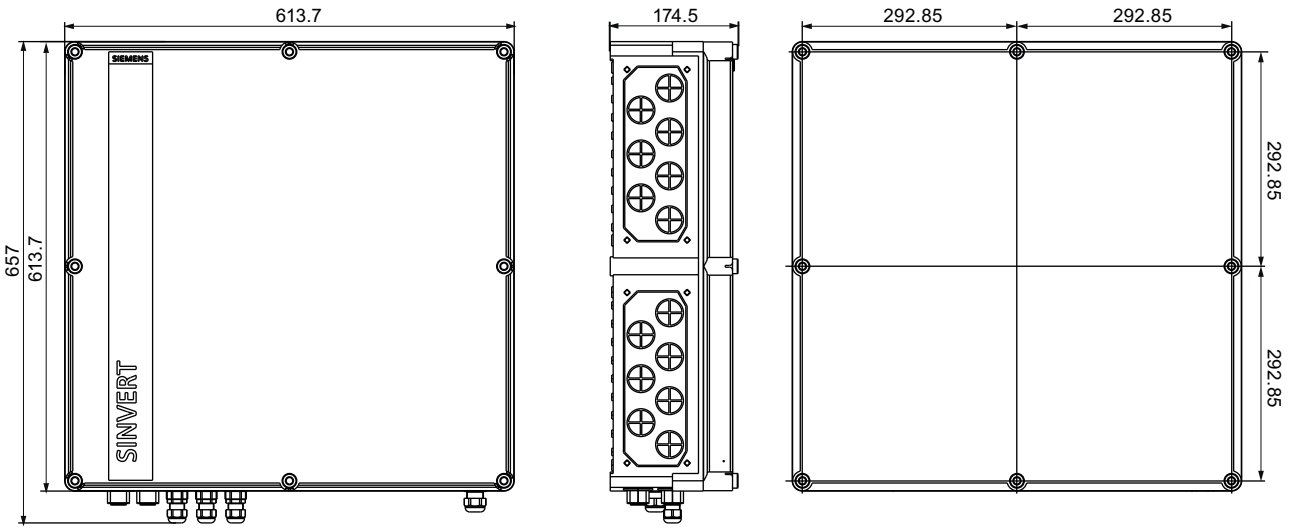

Figure A-1 Dimension drawing SINVERT Control Box

A.2 Calculation of the perfomance ratio

Introduction

The performance ratio is a location-independent measure of how effectively the irradiated energy is converted to used energy.

Scope

A weather station represents a defined area of the solar PV plant. The performance ratio for each area can be calculated using the assignment of the inverters to the areas (see parameters). The current, daily, monthly, yearly and overall performance ratio is calculated. The power is used for the current value. For the other values, the energy is used as the basis for calculation.

In addition, the performance ratio for the entire solar PV plant is calculated.

Calculation

$PR = (E_{el} / E_{ideal}) * 100$

E_{el}: measured electrical energy [kWh]

E_{ideal}: Irradiation energy [kWh]

PR: Performance ratio [%]

$E_{ideal} = (W_p / 1000\ W/m^2) * GA$

W_p: Nominal power of all modules in the case of STC [kW]

STC (standard conditions): Irradiance of 1000 W/m^2 and an ambient temperature of 25 ^{O}C

GA: measured irradiation energy [Wh/m^2]

$PR = (E_{el} / \text{constant } W_p * GA) * 100$

$PR\ [\%] = (E_{el}\ [kWh] * 1000\ W/m^2 * 100) / (\text{constant } W_p\ [kW] * GA\ [Wh/m^2])$

$PR\ [\%] = (E_{el} * 100000) / (\text{constant } W_p * GA)$

A.3 Technical support

Technical support for SINVERT products

- Information material und downloads for SINVERT products:
  SINVERT infocenter (http://www.siemens.com/sinvert-infocenter)
  Here you can find, for example:
  - Catalogs
  - Brochures
- Documentation on SINVERT products:
  SINVERT support (http://www.siemens.com/sinvert-support)
  Here you can find, for example:
  - Manuals and operating instructions
  - The latest product information, FAQs, downloads, tips and tricks
  - Characteristics and certificates
- Contacts for SINVERT are available at:
  SINVERT partners (http://www.siemens.com/sinvert-partner)

Technical assistance for SINVERT products

For all technical queries, please contact:

- Phone: +49 (911) 895-5900
  Monday to Friday, 8 am – 5 pm CET
- Fax: +49 (911) 895-5907
- E-mail: Technical assistance (mailto:technical-assistance@siemens.com)

A.4 Abbreviations

Abbreviations

Abbreviation	Meaning
EEG	Renewable Energy Act
BDEW	German Association of Energy and Water Industries
PV	Photovoltaics
FOC	Fiber-optic cable

A.5 References

Directives and laws

- Renewable Energy Act (EEG)
- Energy Industry Act (EnWG)
- Medium Voltage Directive

Manuals/Operating Instructions

- SIMATIC ET 200S distributed I/O system (SIMATIC ET 200S distributed I/O system (http://support.automation.siemens.com/WW/view/en/1144348))
- WinAC Basis V4.0 (WinAC Basis V4.0 (http://support.automation.siemens.com/WW/view/en/18535320))
- SENTRON PAC3200 Power Monitoring Device Manual (SENTRON PAC3200 Power Monitoring Device Manual (http://support.automation.siemens.com/WW/view/en/26504150))
- SIMATIC industrial PC SIMATIC IPC427C (SIMATIC IPC427C industrial PC (http://support.automation.siemens.com/WW/view/en/37028954))

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Service & Support

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www.siemens.com/sinvert/mall

Online-Support:
www.siemens.com/sinvert/support

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