

string.bloxx CB/CC

Manual



Vers. No. 1.0



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Table of Contents

1	Safety Information	5
1.1	Intended use	5
1.2	Checking for transport damage	5
1.3	Personnel	5
1.4	Special risks	6
1.5	Siting locations	6
1.6	Modifications	6
1.7	Servicing and cleaning	6
1.8	Disposal	7
1.9	General hazards due to non-observance of the safety information	7
1.10	Labels on the DC Combiner Box	7
1.11	Labels and warning symbols in this manual	8
1.12	Conventions in this manual	8
2	Introduction	9
2.1	The documentation for the DC Combiner Box	10
2.2	About this manual	10
2.3	System description	11
3	Installation	13
3.1	Tools and materials required	13
3.2	Enclosure installation	14
3.2.1	Wall mounting of string.CB	
3.2.2	Ground installation (string.CC)	
3.3	Installing the electrical connections	
3.3.1 3.3.2	Providing a ground connection	
3.3.3	Connecting the inverter	
3.3.4	Connecting the field bus	
4	Maintenance	27
4.1	Removal/replacement of a fuse	27
4.2	Replacing the elements for surge arrester	28
5	Block diagram	31



6	Declaration of Conformity	33
	International Sales and Service	35

Safety Information

Before starting installation, setting up and maintenance work is carried out, it is essential to read and follow the appropriate warning and safety information given in this manual.

Installation, setting up, operation and maintenance of the DC Combiner Box must take place as intended, i.e. under the conditions of use laid down in this manual and in the technical data for the relevant module in the DC Combiner Box.

1.1 Intended use

The DC Combiner Box is designed for monitoring and testing solar modules. The DC Combiner Box is equipped with diverse string.bloxx modules. Solar module strings (wired combinations of many solar modules) – termed PV strings in the following – can be connected to the modules. The modules are used exclusively for measurement tasks involving solar modules. Any application which goes beyond this scope does not fall within the intended use of the modules.

To ensure safe operation the modules must only be operated according to the details given in the manuals and technical data sheets.

1.2 Checking for transport damage

Immediately after delivery, check the packaging and the DC Combiner Box visually and make sure they are intact. Also check the shipment for completeness (accessory parts, documentation, auxiliary aids, etc.). If the packaging has been damaged in transit or if you suspect that the product is damaged or may malfunction, the product must not be put into operation. In this case contact your customer consultant or Gantner Instruments Environment Solutions GmbH.

1.3 Personnel

The installation, operation and maintenance of the DC Combiner Box must only be carried out by competent persons. Competent persons are those who through their apprenticeship as specialist electricians or an equivalent professional education have sufficient knowledge in the field of electrical power installation and are familiar with the relevant national occupational protection regulations, accident prevention regulations, guidelines and accepted engineering rules. They must be able to reliably assess



the results of their work and must be familiar with the contents of this manual.

In particular, pay attention to the following:

- the details on transport, installation, operation, servicing, maintenance and disposal in this manual
- the parameters, limits and the details about the operating and ambient conditions on the name-plates and in the data sheets.

1.4 Special risks

The DC Combiner Box is used as a component in solar power system installations and must therefore be integrated into the safety concept of the system.

Once solar modules have been connected in the DC Combiner Box, a very high voltage is continuously present, which, if touched, can lead to death or serious personal injury. Therefore, make sure that only qualified personnel can open the DC Combiner Box.

1.5 Siting locations

Depending on the version, the DC Combiner Box can be mounted on a wall or a frame (string.CB) or on a pedestal (string.CC). In both cases the on-site installation can be outdoors.

1.6 Modifications

Making modifications to the DC Combiner Box is not permitted.

1.7 Servicing and cleaning

Maintenance may only take place in the voltage-free state. In all cases, before working on the built-in modules, make sure that voltage isolation from the strings and the inverter is provided through load disconnection.

For further information refer to Chapter 4, page 27.

Never attempt to repair nor to again operate devices which are defective, have developed a fault or are damaged. In this case it is essential to contact your customer consultant or Gantner Instruments Environment Solutions GmbH.

The outside of the DC Combiner Box can be cleaned with the usual household detergents. Do not use any aggressive cleansers, because they may attack the enclosure material (polyester).

1.8

Disposal

Devices which are no longer usable must be disposed of according to national and local regulations regarding environmental protection and raw-material recycling. Electronic components must not be disposed of with household garbage.

1.9

General hazards due to non-observance of the safety information

The DC Combiner Box conforms to the state of the art and is operationally safe. However residual risks may arise when it is used or operated improperly by untrained personnel.

Any person commissioned with the task of siting, operating, servicing or repairing a DC Combiner Box must have read and understood the operating manual and in particular the information relating to safety.

1.10

Labels on the DC Combiner Box



This symbol is the CE marking. This shows that we guarantee that our product meets the requirements of the relevant EC directives.



This symbol is the legally prescribed label regarding disposal. Old devices which are no longer usable must be disposed of according to national and local regulations regarding environmental protection and raw-material recycling, separately from normal household garbage.



1.11

Labels and warning symbols in this manual

To prevent personal injury and damage to property it is essential that you follow the warning and safety information given in this operating manual.

A DANGER

Indicates an immediate danger which will result in death or serious bodily harm if not avoided.



Meaning: High voltage may be present on the module connections. Connection or disassembly may only be carried out by persons trained for it.



Meaning: Before connecting or disconnecting cables make sure that all sources of power are Locked Out.

1.12

Conventions in this manual

To simplify reading this manual we use the following notation:

IMPORTANT

Paragraphs with this symbol give important information about the product or about using the product.

Tip

Contains application hints and other particularly useful information.

italics signifies highlighted text

indicates special features or restrictions

Introduction

Dear Customer,

Thank you for purchasing a DC Combiner Box (DCB) produced by Gantner Instruments Environment Solutions GmbH. We are sure that with this module you have obtained an excellent product which will enable you to make reliable measurements.

This manual is also included in the items supplied. Always keep the manual close to hand. To prevent personal injury and damage to property it is essential that you follow the warning and safety information given in this manual (Chapter 1, page 5). Please contact us if you do not know how to proceed even after reading the manual thoroughly.

If you find faults on the product or errors in the accompanying documentation or if you have suggestions for improvement, please contact your customer consultant or Gantner Instruments Environment Solutions GmbH directly. We would be glad to receive your comments and ideas.

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2.1 The documentation for the DC Combiner Box

The documentation for the DC Combiner Box (DCB) consists of this manual and the manual for the string.bloxx module used in the DC Combiner Box. You can also download the manuals as PDF files from our home page www.gantner-environment.de.

The installation described in the manual of the string.bloxx module (connection of fuse-holders, surge arrester, disconnectors, etc.) has already been carried out in the DC Combiner Box. The description of the interface parameters and the relevant addresses for the Modbus communication can be found in the manual for the string.bloxx module used based on the different string.bloxx modules (number of PV strings that can be connected, system voltage).

2.2 About this manual

This manual describes the installation and maintenance of the DC Combiner Box.

The manual is divided into several chapters:

- Safety information in Chapter 1, page 5ff.
- You will find a description of the system and the main combination and expansion options in the next section.
- The description of the installation and the terminal assignments can be found in Chapter 3, *Installation*, page 13ff.
- You will find maintenance instructions in Chapter 4, *Maintenance*, page 27ff.
- A circuit diagram of the DC Combiner Box can be found in Chapter 5, *Block diagram*, page 31ff.
- The declaration of conformity can be found in Chapter 6, *Declaration of Conformity*, page 33ff.

2.3 System description

The DC Combiner Box (DCB) was developed for the integration of the measurement and test technology in solar power systems. Many solar module strings (wired combinations of many solar modules) – termed PV strings in the following – are brought together in an enclosure suitable for outdoor operation where the electrical quantities of the individual PV strings are also measured. The modules enable the direct voltage side of photovoltaic systems (PV systems) to be monitored independently of the inverter and you can also detect errors promptly and rectify them:

- · soiling due to pollen, dust and soot
- · influence of the weather, e.g. hail, snow loads
- installation errors
- · production errors
- · theft and vandalism

Depending on the version, you can connect between 8 and 32 PV strings per DC Combiner Box. Each DCB contains overvoltage protection, fusing for the individual PV strings and a disconnection device. Versions for a system voltage of 1500V are also available. You can combine several DCBs in one system.

With the appropriate string.bloxx module, parameters, such as voltage and current or temperature, can be directly displayed with the integral LC display for operation and checking on site. All built-in string.bloxx modules have a Modbus interface for control and for reading out data.



3

Installation

The DC Combiner Box is obtainable in two versions:

- 1. The string.CB version is suitable for wall mounting or for mounting on a frame, e.g. In the shadow of a solar panel.
- 2. The string.CC version possesses a pedestal and can be installed directly in the ground on site.





Fig. 3-1 string.CB (left) and string.CC (right).

3.1

Tools and materials required

You will require the following tools for the installation:

- Screwdrivers, 2mm and 10mm width
- Hexagonal spanner, AF size depends on disconnector
- Wire stripper
- Tool for tightening the cable glands, e.g. $SKINMATIC^{\circledR}$ installation tools.
- In addition for string.CB:
 - Hammer, approx. 300g
- In addition for string.CC:
 - Hexagonal spanner, AF17
 - Pedestal filler, e.g. expanded clay (4 ... 8mm grain size)
 - Gravel or sand (2 ... 4mm grain size)

3.2 Enclosure installation

3.2.1 Wall mounting of string.CB

Mounting on a wall or frame can carried out at the side or at top and bottom. Mounting with the lugs above and below the DC Combiner Box is advantageous in this case.

To be able to fasten the lugs on the DC Combiner Box, you have to fit the supplied drive-in nuts and screw the lugs on in the desired position.



Fig. 3-2 Mounting lug with accessories.

Fitting the drive-in nuts

1. Insert the drive-in nut with the knurled side at the bottom into the recess at the corner of the DC Combiner Box (Fig. 3-3).



Fig. 3-3 Hammering in a drive-in nut.

2. Use the drive-in stamp and a hammer to drive the nut in as far as the stamp will go (Fig. 3-4).

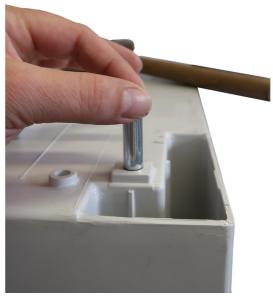


Fig. 3-4 The driven-in nut.

3. Repeat the procedure for all four corners.

Fitting the lugs

- 1. Place the lugs in position: either for mounting at the top and bottom (preferred) or for mounting at the side. Refer also to Fig. 3-5 and Fig. 3-6 on page 16.
- 2. Use the screws shown in Fig. 3-2 to screw the lugs on firmly.

Top/bottom fixture

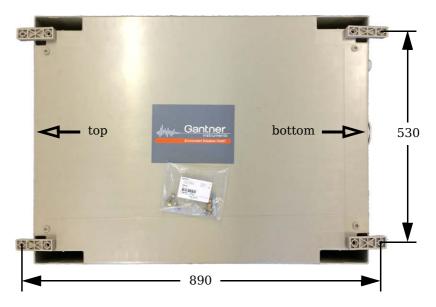


Fig. 3-5 DC Combiner Box from behind; all dimensions in mm.



Turn the lugs to the position illustrated in Fig. 3-5 to fasten the DC Combiner Box to a wall or frame above and below the DCB.

Side fixture

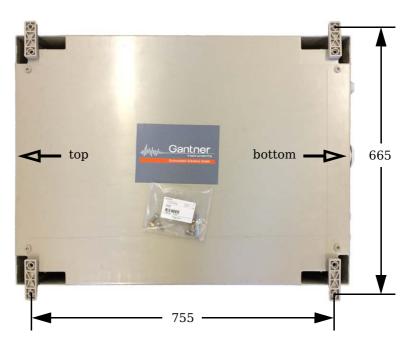


Fig. 3-6 DC Combiner Box from behind; all dimensions in mm.

Turn the lugs into the position illustrated in Fig. 3-6 to fasten the DC Combiner Box to a wall or frame on the left and right side of the DCB.

3.2.2 Ground installation (string.CC)

For the ground installation, you must first assembly the supplied pedestal.

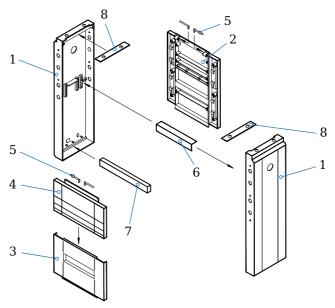


Fig. 3-7 Individual parts of the plug-in plastic pedestal.

- 1. Engage the rear panel (Part 2) in the holes on the side parts (Part 1). In doing this, fit the aluminum angle bracket (Part 6) into the lugs on the side parts and fix it with two plastic hinge bolts (Part 5).
- 2. Insert the wooden slat (Part 7) for the spacing of the side parts into the retaining ribs on the side parts (Part 1).
- 3. Engage the lower front panel (Part 3) in the holes on the side parts (Part 1).
- 4. Place the upper front panel (Part 4) on the lower front panel (Part 3) and fix it with two plastic hinge bolts (Part 5).
- 5. Push the threaded plates (Part 8) for the cable cabinet fixture into the upper grooves of the side parts (Part 1).
- 6. For the next step, place the DCB on its back.
- 7. Insert the metal strips in the DC Combiner Box to the right and left at the bottom and push the M10 screws through (Fig. 3-8).
- 8. Push the M10 bonded sealing washer on from the outside onto the screws such that the seal faces the DC Combiner Box (Fig. 3-9).



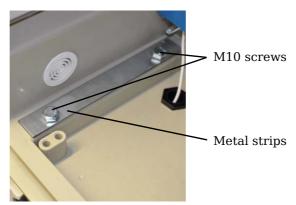


Fig. 3-8 DCB - pedestal joint (view of left side inside DCB).



M10 sealing washer (view of left underside of the DCB). Fig. 3-9

9. Place the DC Combiner Box on the pedestal and use a washer under each nut in the pedestal (Fig. 3-10).



Fig. 3-10 DCB placed on the pedestal (view of left side in the pedestal).

10. Manually tighten the screws with an AF17 wrench (Fig. 3-11).



Fig. 3-11 Tighten the connecting screws (view of left side in the pedestal).

On-site installation

Where possible, place the assembled ground-mounting pedestal with the DC Combiner Box on a firm, level substrate (compacted gravel bed, concrete base or similar). After siting, fix the side parts through earth-moist concrete or use screw/anchor joints.

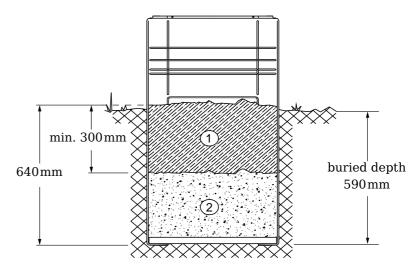


Fig. 3-12 Ground-mounted pedestal; 1: Pedestal filler or coarse gravel (4 ... 8 mm grain size); 2: Gravel or sand (2 ... 4 mm grain size)

Fill after installing the connecting cables (Section 3.3, *Installing the electrical connections*, page 20), as shown in Fig. 3-12 with gravel or sand (2) and above that a pedestal filler, e.g. expanded clay. The filler (1) must be approx. 50 mm above the level of the surrounding ground in order to prevent the formation of condensation.



3.3 Installing the electrical connections

The DC Combiner Box can be fitted with various string.bloxx modules so that large and different numbers of PV strings can be connected or voltages up to 1500V can be used. However, for the basic electrical configuration, the number of connections is not relevant; instead of a maximum of eight PV strings (smallest expansion stage), with other versions, for example, 24 PV strings can be connected. The procedure for the connection of a PV string is identical.

3.3.1 Providing a ground connection



Fig. 3-13 DC Combiner Box for 20 PV strings; the ground terminal is identified.

Procedure

- 1. Open the door of the DC Combiner Box.
- 2. Pass a ground cable (10 ... 32 mm² conductor cross-sectional area) through the cable aperture on the right side directly beneath the ground terminal (M20, 6.5 ... 12 mm cable diameter). Do not tighten the union nut on the cable gland yet.
- 3. Strip off about 18mm of cable insulation.

- 4. Insert the cable into the earth terminal and tighten the clamping screw.
- 5. Tighten the union nut on the cable gland to a torque of $6\,\mathrm{Nm}$.
- 6. Connect the ground cable to a suitable grounding point.

3.3.2

Connecting the PV strings







The cables to be connected may be carrying voltages of up to 1500 volts!

Before connecting, make sure that the PV string cables to be connected are not live. Connection of the cables to the PV strings must only be made once the DC Combiner Box has been wired.

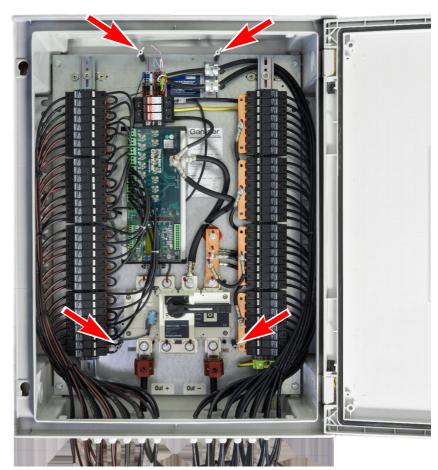


Fig. 3-14 Fully wired DC Combiner Box with 32 PV strings; the wing nuts of the Plexiglas cover are identified.

Procedure

- 1. Remove the four wing nuts holding the Plexiglas cover (Fig. 3-14).
- 2. Remove the Plexiglas cover. For this, the switch disconnector must in the 0 (Off) position.
- 3. Pass the positive cables of the PV strings through the left M16 cable glands (4 ... 10 mm cable diameter).
- → Do not tighten the union nuts on the cable glands yet.
- 4. Pass the negative cables of the PV strings through the right M16 cable glands.
- 5. Make sure that the cables are long enough to be able to connect them to the fuse-holder terminals.
- 6. Strip off about 18mm of cable insulation.
- 7. Insert the cables into the fuse-holder terminals. The terminals are of the push-in type; you need a screwdriver to release the connection when using litz wire.
- → We recommend that you start with the cables located in the row the furthest towards the back and with the glands located at the center of the DC Combiner Box. Lead these cables to the lowermost fuse-holder terminals. Then continue with the other cables of the back row and connect them to the nearest fuse-holder terminals, continuing from the bottom to the top. Then, connect the next row in the same sequence, etc.
- 8. If necessary, correct the cable length within the DC Combiner Box and tighten the union nuts on the cable glands to a torque of 3Nm.
- 9. Close off the cable glands which that are not required with blanking plugs.
- → Do not yet replace the Plexiglas cover. This occurs only after the installation of the field bus connections.

3.3.3

Connecting the inverter







The cables to be connected may be carrying voltages of up to 1500 volts!

Before connection, make sure that no voltage is present on the cables to the inverter. The cables must not be connected to the inverter yet and the switch disconnector must be in the 0 (Off) position.



Adhesive label with details about the switch disconnector.

Fig. 3-15 Fully wired DC Combiner Box with 32 PV strings; the cable lugs on the disconnector for the cables to the inverter are identified.

Procedure

- 1. Screw the connecting plates with the enclosed mounting kit onto the two switch disconnector connections. In each case place a washer under the screw and one on the screw before the nut. Use the torque stated for the disconnector on the adhesive label (for position see Fig. 3-15).
- 2. Pass the positive cable to the inverter through the left cable gland (M50 22 ... 29mm cable diameter).
- → Do not tighten the union nuts on the cable glands yet.

3.3.4



- 3. Pass the negative cable to the inverter through the right cable gland (M50 22 ... 29mm cable diameter).
- 4. Strip off about 18mm of cable insulation.
- 5. Slide the V type terminal clamps over the connecting plates and insert the connection cables into the connecting terminals.
- 6. Tighten the screws of the connecting terminals to 30Nm or with aluminum cables to 24Nm.
- 7. Push the insulating cap onto the V type terminal clamps.
- 8. If necessary, correct the cable length within the DC Combiner Box and tighten the union nuts on the cable glands to 15 Nm.

Connecting the field bus

When connecting the field bus, use cable with a twisted pair of wires for the RS-485 communication. Use two parallel-switched pairs of wires for the power supply. With longer cables, we recommend that unused cores are used additionally for the power supply.

Recommendation

Li2YCYv (TP), $4 \times 2 \times 0.5$, i.e. with $0.5\,\text{mm}^2$ cross-sectional area per conductor and four wire pairs.

The screened cable has a low interconnect capacitance and is suitable for RS-485 interfaces with data rates up to 10Mbit/s. It has twisted pairs of cores with PE insulation of the individual cores and a reinforced cable sheath.

Color coding for LiYY and LiYCY cables¹⁾

Color	Function	Color	Function
White	RS-485 A	Brown	RS-485 B
Green	Power supply 0V	Yellow	Power supply 0V
Grey	Free/reserve	Pink	Free/reserve
Blue	Supply voltage +18 36V _{DC}	Red	Supply voltage +18 36V _{DC}

Connect the DCBs in a series configuration (Fig. 3-16). We recommend that not more than 25 RS-485 interfaces are connected together and no cable lengths longer than 500m are used. With longer cables, check whether the supply voltage at the end of the chain is still sufficiently high. Approx. 1W of power is needed per DC Combiner Box.

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¹⁾ Coding to DIN 47 100

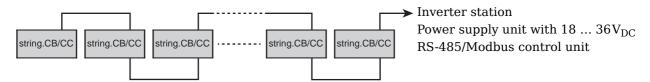


Fig. 3-16 Series configuration of several DC Combiner Boxes.

The terminals in the upper section of the DC Combiner Box are implemented double, so that a cable from the previous DC Combiner Box and the cable to the next one can be connected. Use at least one pair of cores each for the positive and one for the negative (0V) supply voltage (Fig. 3-17).

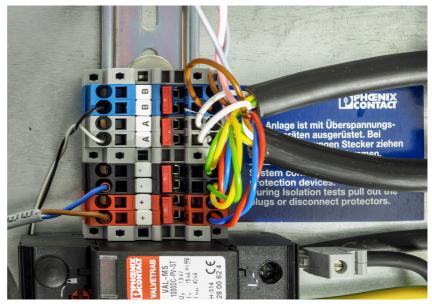


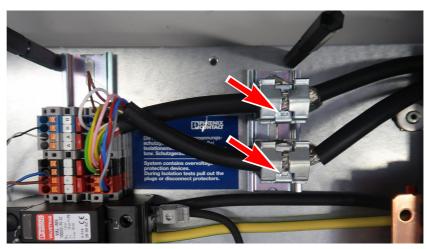
Fig. 3-17 Connection of the supply voltage and the RS-485 interface.

With longer cables use the two free wires (gray/pink) additionally for the supply voltage (refer also to Fig. 3-18).

An important point for interference-free data transfer is the screening. For this, two points are specially provided, to which the cable screen can be connected flat (Fig. 3-18).

Remove the cable sheath at the appropriate points, press the spring clamp downwards at the indentation using a screwdriver (refer to the arrow in Fig. 3-18) and push the cable in between.





Flat connection for the cable screens.

Further information on the operation of the interface (terminating resistance, baud rate, etc.) can be found in the operating manual of your string.bloxx module.

Procedure

- 1. Connect the fieldbus cable to the terminals A and B as described above (Fig. 3-17, Fig. 3-18).
- 2. Connect the power supply to the + and terminals (Fig. 3-17).
- 3. Connect the cable screens to the points provided using a flat connection (Fig. 3-18)
- 4. Replace the Plexiglas cover.
- 5. Screw down the wing nuts (Fig. 3-14).
- 6. Connect the power cable to the inverter and the PV strings to the cables leading to the DC Combiner Box.
- 7. Switch the disconnector to position 1 (On).
- 8. Close the DC Combiner Box.

Maintenance

Once each year check the DC Combiner Box for damage (visual inspection) and check the tightening torques of the fasteners on the disconnector. We also recommend a check in running operation with a thermal imaging camera to find faults due to increased contact resistance.

If the rubber seal on the door has become defective after approx. 15 years, then it should be replaced.

DANGER

The cables may be carrying voltages of up to 1500 volts!





Work on the DC Combiner Box may only be carried out with suitable protective measures in place and with the appropriate tool. Before working on the wiring or the string.bloxx module, remove the fuses to the PV strings and set the switch disconnector to 0 (Off).

4.1

Removal/replacement of a fuse

Before working on the DC Combiner Box the lever on the fuses must be opened (raise the lever, Fig. 4-1).

In the same way, a defective fuse can also be replaced. The type of fuse used for the system is stated on the circuit diagram which is located in the transparent sleeve on the inside of the door (refer also to Fig. 3-1 on the right on page 13).



Fig. 4-1 Fuse holder with open lever for inserting a new fuse.

Procedure for replacing a fuse

- 1. Unlock the fuses using the locking lever. The fuse remains held in the holder.
- 2. Withdraw the fuse.
- 3. Insert the new fuse (Fig. 4-1).
- 4. Press down the locking lever.



4.2 Replacing the elements for surge arrester

When the red "defekt" indicator is displayed, the element is defective and must be replaced (Fig. 4-2). If the base element is defective, then the whole surge arrester must be replaced.



Fig. 4-2 Plug-in element of the surge arrester OK (left) or defective (right).

Procedure

- 1. Turn the lock anticlockwise to the open position (Fig. 4-3) with a screwdriver (4mm).
- 2. Replace the plug-in element for a plug-in element of the same type.
- 3. Remove the small coding plate (Fig. 4-4)
- 4. Insert the new plug-in element (Fig. 4-4).
- 5. Turn the lock clockwise into the closed position with a screw-driver to obtain firm seating of the plug-in element (Fig. 4-3).



Fig. 4-3 Lock on the surge arrester.

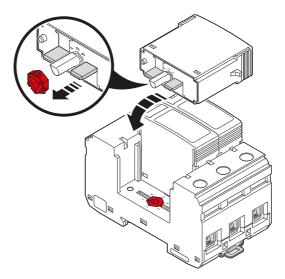
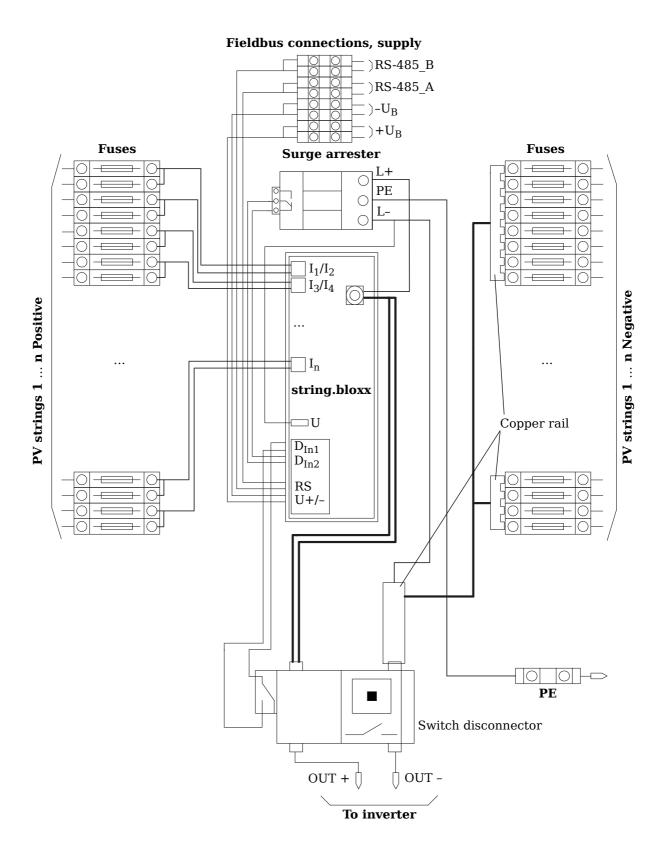


Fig. 4-4 Remove small coding plate and insert new plug-in element



Block diagram





The circuit diagram shows the basic wiring. Depending on the version, PV strings of different sizes can be connected. Similarly, the type of string.bloxx module used depends on the fuses, the switch disconnector and the overvoltage protection of the version. The circuit diagram, which is located in the transparent sleeve on the inside of the door (refer to illustration on the right in Fig. 3-1 on page 13), contains the exact type designations. The switch disconnector data is provided on the adhesive label inside the DC Combiner Box (Fig. 3-15 on page 23).

6

Declaration of Conformity



Konformitätserklärung – Declaration of Conformity – Déclaration de Conformité

The undersigned, representing:

Certificate Ref No:

160801JS-01

Gantner Instruments Environment Solutions GmbH Am Mühlgraben 8 – 08297 Zwönitz /Germany tel: +49 /37754-3351-0 – www.gantner-environment.com

herewith declares, that the product:

Gantner DC Combiner type

string.CC XX (housing outdoor stand-alone cabinet)

string.CB XX (wall-mounting enclosure outdoor)

is in conformity with the following EC directive(s), including all applicable amendments:

- IEC 61439-2: switchgear-controlgear assemblies (IEC 61439-2: Energie-Schaltgerätekombinationen)

This declaration is based upon the respective technical documentation held by the manufacturer.

 ϵ

Zwönitz, 01th June 2016

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