Bussmann series PV Combiner box

Contents

FAT•N

Powering Business Worldwide

⚠ DANGER!

HAZARDOUS VOLTAGE—WILL CAUSE SEVERE INJURY OR DEATH. WORKING ON OR NEAR ENERGIZED CIRCUITS POSES A SERIOUS RISK OF ELECTRICAL SHOCK. DE-ENERGIZE ALL CIRCUITS BEFORE INSTALL-ING OR SERVICING THIS EQUIPMENT AND FOLLOW ALL PRESCRIBED SAFETY PROCEDURES.

Important

These procedures do not claim to cover all possible details or variations encountered with the combiner box. Nor do they provide for all possible conditions that may be encountered. If further information is desired or needed to address any particular issue not covered in this document, contact your Eaton representative. The information in this document does not relieve the user from exercising good judgment, nor from using sound safety practices.

Note: Because Eaton has a policy of continuous product improvement, we reserve the right to change design specifications without notice. Should a conflict arise between the general information in this document and the contents of drawings or supplementary material, or both, the latter shall take precedence. For the latest version of this Instruction Leaflet, download "Instruction Leaflet" from the Eaton's Bussmann series website at: www.eaton.com/bussmannseries.

The contents of this Instruction Leaflet are not part of, nor do they modify, any prior or existing agreement, commitment or relationship. The Eaton terms and conditions of sale constitute the entire obligation of Eaton. The warranty in the terms and conditions of sale is the sole warranty of Eaton. Any statements in this document do not create new warranties or modify any existing warranty.

This manual contains important instructions for all Eaton's Bussmann series combiner box models that must be followed during the installation and use of the combiner boxes.

The combiner boxes are designed and tested according to IEC61439-1 & 2 and international safety requirements, but as with all electrical and electronic equipment, certain precautions must be observed when installing the combiner boxes.

In the instance where a combiner box is supplied without a disconnect switch, additional precautions must be taken to ensure that the unit is isolated from all other components in the PV system, and that there is no danger present to anyone working on the unit. The combiner box is then opened at the users risk.

To reduce the risk of personal injury and to ensure the safe installation and operation of the combiner boxes, you must carefully read and follow all instructions and warnings in this Technical Manual.

Introduction

Specifications are subject to change without notice. Every attempt has been made to make this document complete, accurate and up-to-date. Users are cautioned, however, that Eaton reserves the right to make changes without notice and shall not be responsible for any damages, caused by reliance on the material presented, including, but not limited to, omissions, typographical errors, arithmetical errors or listing errors in the content material.

Signal words used in this manual

The signal words "DANGER," "WARNING," "CAUTION" and "NOTICE" (along with their assigned symbol) throughout this manual indicate the degree of hazard the user may encounter. These symbols and words are defined as:

⚠ DANGER
INDICATES A HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, WILL RESULT IN DEATH OR SERIOUS INJURY.

⚠ WARNING
INDICATES A HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY.

⚠ CAUTION
INDICATES A HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN MINOR OR MODERATE INJURY.

NOTICE
INDICATES A HAZARDOUS SITUATION WHICH, IF NOT AVOIDED, COULD RESULT IN PROPERTY DAMAGE.

Skilled worker definitions

The following definitions apply as electrically instructed, skilled or competent people. Where in this manual an instructed, skilled or competent person is referred to, it is intended that they meet the description provided below for that definition.

Electrically instructed person

Person adequately advised or supervised by electrically skilled persons to enable him or her to perceive risks and to avoid hazards which electricity can create.

Electrically skilled person

Person with relevant education and experience to enable him or her to perceive risks and to avoid hazards which electricity can create.

Skills of qualified persons

A skilled person must possess the following:

- Knowledge of the subject equipment and the hazards involved with their application, use, administration and maintenance
- Training and authorization to de-energise, clear, ground and tag circuits and equipment in accordance with established safety practices
- Training in the proper care and use of personal protective equipment such as rubber gloves, hard hat, safety glasses or face shields. Arc-flashing clothing, etc. in accordance with established safety practices
- Trained to render first aid
- Has received safety training to recognise and avoid the hazards involved
- The skills and knowledge pertaining to the construction and operation of this equipment and its installation

Competent person

Person having appropriate training, skill, knowledge and experience to prevent danger or injury arising from work within the scope of the Regulations.

Safety precautions

It is assumed the combiner box user will follow standard safety precautions for working in an electrical environment. For more information on safety precautions and procedures, consult the following sources:

International Electrotechnical Commission (IEC): www.iec.ch.

Safety according to the International Electrotechnical Commission (IEC): http://www.iec.ch/about/values/safety.htm

National Fire Protection Association (NFPA): www.nfpa.org.

Anatomy of an Eaton's Bussmann series combiner box

PV Surge Protection Device (SPD) – T1/T2 or T2

Optional 240Vac SPD for internal
power supply (monitored units)

240Vac/24Vdc or
PV 1000/24Vdc power
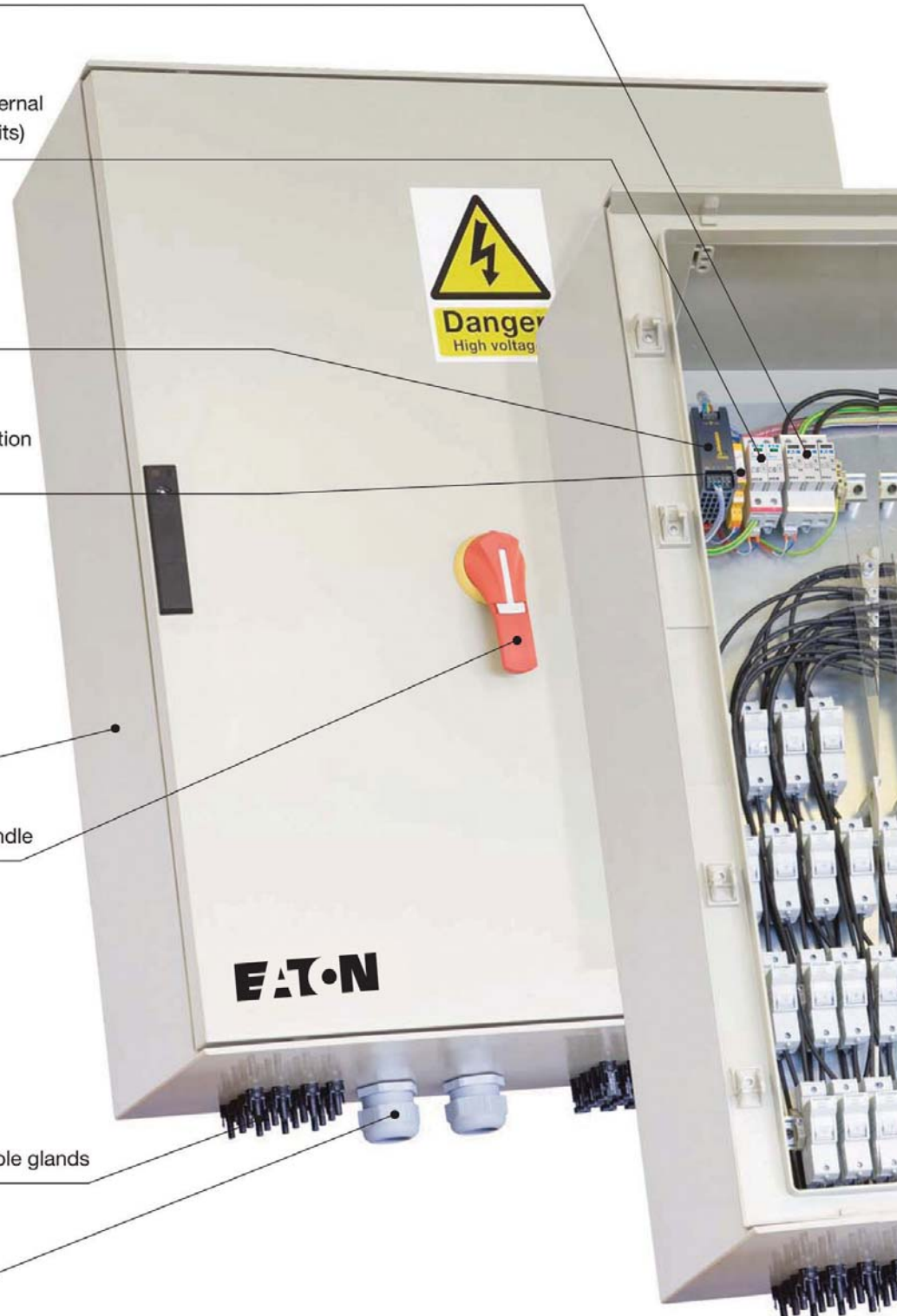supply (for monitored units)

Optional SPD for 2-wire
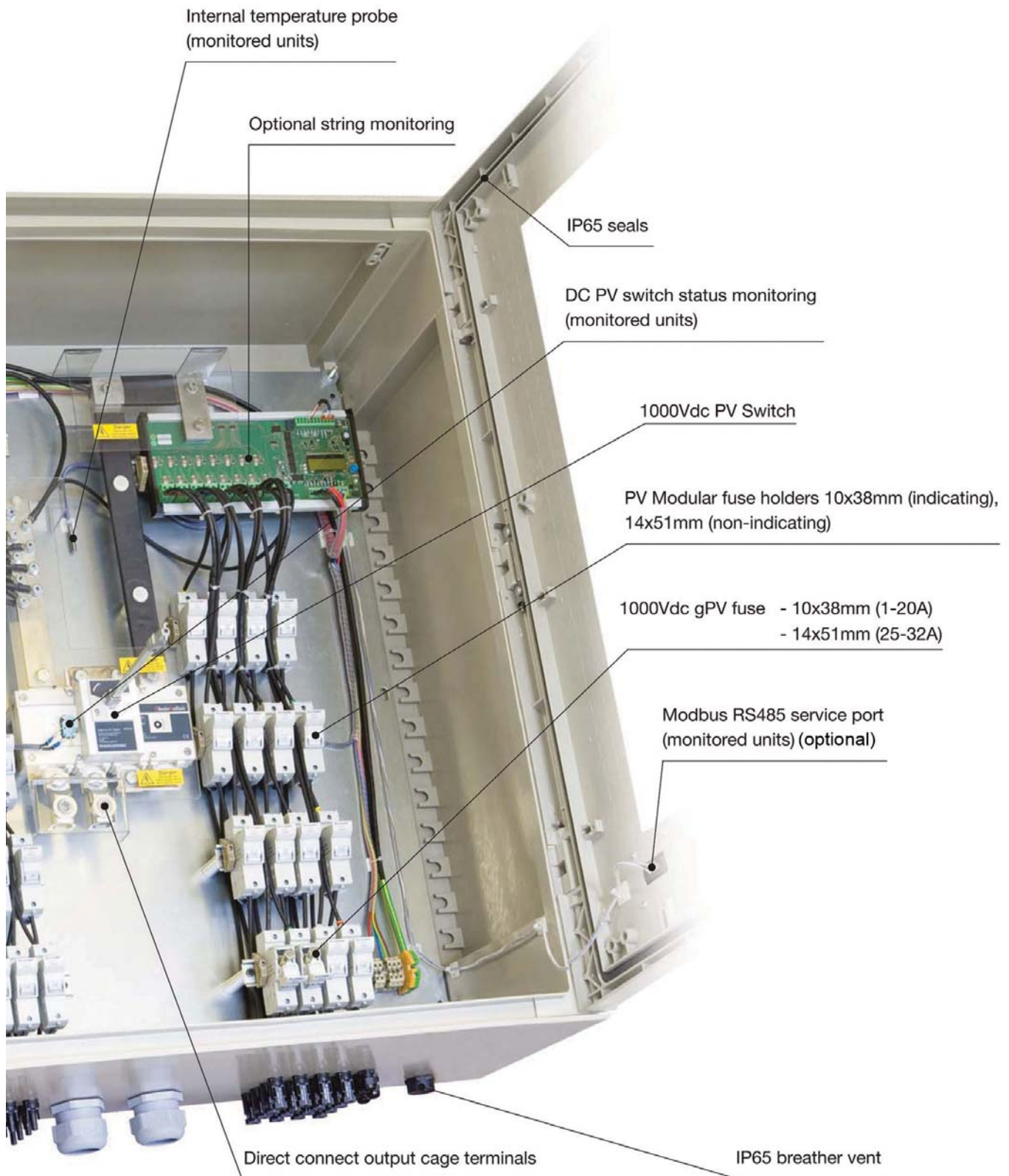Modbus RS485 communication
(monitored units)

IP65 GRP, painted steel or
stainless steel enclosure

External interlock switch handle

PV string inputs, MC4 or cable glands

PV output cable glands

Internal temperature probe
(monitored units)

Optional string monitoring

IP65 seals

DC PV switch status monitoring
(monitored units)

1000Vdc PV Switch

PV Modular fuse holders 10x38mm (indicating),
14x51mm (non-indicating)

1000Vdc gPV fuse - 10x38mm (1-20A)
                  - 14x51mm (25-32A)

Modbus RS485 service port
(monitored units) **(optional)**

Direct connect output cage terminals

IP65 breather vent

The PV combiner box

Eaton has introduced a new line of monitored combiner boxes designed for use with all module and inverter combinations.

Combiner box features include:

- Designed and tested to the requirements of IEC 61439-1 and 2.
- Compact, low-cost and highly flexible design.
- Easy to connect input and output cabling via MC4 connectors or IP65 rated glands.
- Available in IP65 rated fibre-glass reinforced polyester (GRP), IP65 powder-coated galvanised steel enclosures and IP65 rated stainless steel in a range of sizes.
- Internals are "touch safe" to IP20.
- Design options include integrated load disconnects, monitoring solutions, surge protection devices, self-powered or externally powered solutions and wireless communication.
- External wired modbus connection port.

Product description

For specific details regarding your combiner box design, please see the documentation included in your order. This should provide a detailed assembly layout and wiring diagram.

The product description is demonstrated through the Part Number Breakdown and Rating Plate. Please ensure that careful attention is paid to the information that is represented on the rating plate to ensure that you are aware of the specifications of your individual combiner box design.

Standard configurable products

Part numbers for projects outside the standard configurable products will be determined by an individual project part number.

Cenn-xxAyypsh-vmm

Product series = C (combiner box)	
Enclosure type (e):	
G =	GRP
T =	GRP with transparent polycarbonate window
M =	Painted steel enclosure
S =	Stainless steel
Number of strings (nn):	
Any number of strings, 01, 02 ... 12, 13 etc. maximum 24 strings	
Fuse current rating (xxA):	
01A, 02A, 03A, 04A, 05A, 06A, 08A, 10A, 12A, 15A, 20A, 25A, 32A	
System voltage (yy):	
06 =	600 VDC
08 =	800 VDC
10 =	1,000 VDC
12 =	1,200 VDC
15 =	1,500 VDC
String protection type (p) Indicated fuse holders:	
P =	Positive only fuse protection
N =	Negative only fuse protection
B =	Both positive and negative fuse protection
String protection type (p) Non-indicating fuse holders:	
Q =	Positive only fuse protection
M =	Negative only fuse protection
C =	Both positive & negative fuse protection
Switch disconnect (s):	
D =	Disconnect switch
F =	Fixed, no disconnect switch

Cenn-xxAyypsh-vmm

PV string input / output connection type (h)	
G =	Bottom entry glands / standard output glands
M =	Bottom entry MC4s / standard output glands
S =	Left and right side entry glands / standard output glands
T =	Left and right side entry MC4s / standard output glands
U =	Bottom entry glands / armoured output glands
W =	Bottom entry MC4s / armoured output glands
X =	Left and right side entry glands / armoured output glands
Y =	Left and right side entry MC4s / armoured output glands
Over voltage protection (SPD) (v):	
A =	No SPD
B =	T1 PV SPD
C =	T2 PV SPD
D =	T2 PV SPD with remote
E =	T1 PV SPD + T2 TN 240VAC SPD with remote*
F =	T1 PV SPD + T2 TT 240VAC SPD with remote*
G =	T1 PV SPD + T2 TN 240VAC SPD with remote + C2/D1 modbus SPD*
H =	T1 PV SPD + T2 TT 240VAC SPD with remote + C2/D1 modbus SPD*
J =	T1 PV SPD + C2/D1 modbus SPD*
K =	T2 PV SPD with remote + T2 TN 240VAC SPD with remote*
L =	T2 PV SPD with remote + T2 TT 240VAC SPD with remote*
M =	T2 PV SPD with remote + T2 TN 240VAC SPD with remote + C2/D1 modbus SPD*
N =	T2 PV SPD with remote + T2 TT 240VAC SPD with remote + C2/D1 Modbus SPD*
*P =	T2 PV SPD with remote + C2/D1 modbus SPD*
Q =	T1/T2 PV SPD
R =	T1/T2 PV SPD with remote *
S =	T1/T2 PV SPD with remote + T2 TN 240VAC SPD with remote *
T =	T1/T2 PV SPD with remote + T2 TT 240VAC SPD with remote *
U =	T1/T2 PV SPD with remote + T2 TN 240VAC SPD with remote + C2/D1 Modbus SPD *
V =	T1/T2 PV SPD with remote + T2 TT 240VAC SPD with remote + C2/D1 Modbus SPD *
W =	T1/T2 PV SPD with remote + C2/D1 Modbus SPD *
Monitoring system (mm):	
M1 =	Shunt monitoring unit with 240VAC power supply – wired modbus
M2 =	Shunt monitoring unit with no power supply – wired modbus
M3 =	Shunt monitoring unit with PV power (self powered) – with modbus
Z1 =	Shunt monitoring unit with 240VAC power supply – wireless zigbee
Z2 =	Shunt monitoring unit with no power supply – wireless Zigbee
Z3 =	Shunt monitoring unit with PV power (self powered) – wireless zigbee
W1 =	Shunt monitoring unit with 240VAC power supply – industrial wireless (EL-245U-E-A-EU)
W2 =	Shunt monitoring unit with no power supply – industrial wireless (EL-245U-E-A-EU)
W3 =	Shunt monitoring unit with PV power (self powered) – industrial wireless (EL-245U-E-A-EU)

Cenn-xxAyypsh-vmm

*Monitored combiner box only

Custom designs

Where customer requirements fall outside the structure options, the existing process of assigning a project number will be used with the part number becoming the following:

CBnn-xxACBnnnnn

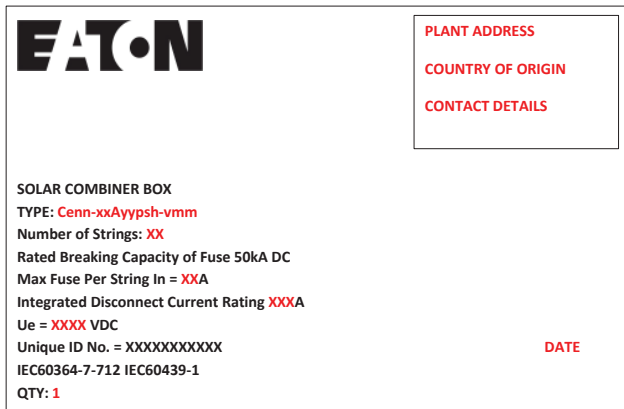|	
Product Series = CB (combiner box special)	
Number of strings (nn):	
Any number of strings, 01, 02 ... 12, 13 etc. Maximum 24 strings	
Fuse current rating (xxA):	
01A, 02A, 03A, 04A, 05A, 06A, 08A, 10A, 12A, 15A, 20A, 25A, 32A	
Project number (CBnnnnn)	
Number assigned by applications engineering or product management	

Rating plate

A rating plate is supplied with each combiner box, and details the following information –

EAT•N

PLANT ADDRESS

COUNTRY OF ORIGIN

CONTACT DETAILS

SOLAR COMBINER BOX
TYPE: Cenn-xxAyypsh-vmm
Number of Strings: XX
Rated Breaking Capacity of Fuse 50kA DC
Max Fuse Per String In = XXA
Integrated Disconnect Current Rating XXXA
Ue = XXXX VDC
Unique ID No. = XXXXXXXXXX   DATE
IEC60364-7-712 IEC60439-1
QTY: 1

Details shown in red are variable for each product. The top right corner of the label states the details of the plant and country of origin of the combiner box. Rating plate details are correct at time of print.

Supplied components

The following are included in every combiner box order as standard. The parts contained within the combiner box unit will vary dependent upon the request and design. Where the design of a component may vary dependent on enclosure size, a suitable item will have been included for the individual combiner box design

Supplied components

Ref#	Item	Quantity	Notes
1	Combiner box unit	1	Design may vary dependent on enclosure size
2	Wall mounting brackets	4	
3	Enclosure key	1	Design may vary dependent on enclosure size. Not included in designs with transparent covers
4	**Technical manual**	1	Specific to the part supplied
5	GA layout and wiring diagrams	1	
6	Technical specification	1	Specific to the part supplied

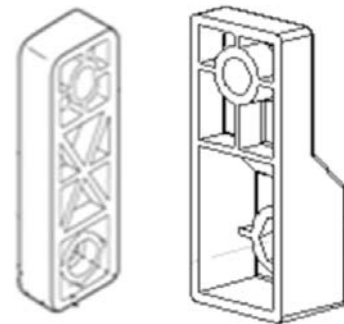Combiner box unit. Internal components will vary based upon individual requirements

Figure 1. Wall mounting brackets: left: 1050 x 850 enclosures, right: all other sizes

Enclosure key top: design a (1050 x 850 x 350 enclosures) bottom: design b (all other enclosures without screw top covers)

NOTICE

Maintaining the IP rating

Eaton's Bussmann series combiner box is IP 65 rated, please do not tamper with or change any of the seals, IP68 rated glands, IP66 rated breather drain or IP67 rated MC4 connectors where these are installed. If MC4 connectors are installed, the IP rating is lowered to IP20 whilst disconnected. Therefore, these must only be disconnected when necessary.
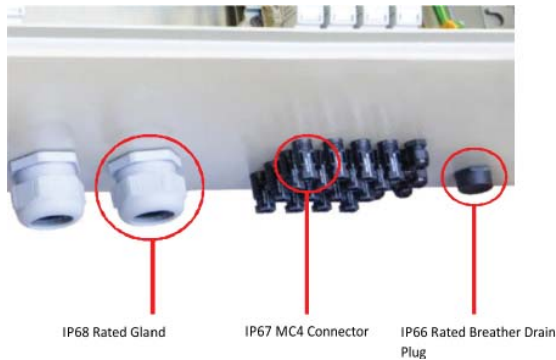
Eaton assumes no liability for lack of ingress protection due to disconnected MC4 connectors after initial installation.

Any door or cover used has an IP65 seal in order to maintain the IP ingress of the box. This seal must not be damaged or altered in anyway. If an external switch disconnect handle is fitted, it has been done so with an IP65 rated seal. Do not remove or replace the switch handle as this will compromise the IP rating of the combiner box.

Please ensure that the enclosure edge is clear of obstruction before closing the door or cover.

Where P55 rated vents and or air filters are present in the product please regularly check and maintain any seals and filters to ensure correct IP rating and necessary airflow.

It is the end user responsibility to determine the necessary frequency to check and maintain any IP rating seals and/or air filters dependant on the environment in which the product is installed. Eaton assumes no liability for the lack of appropriate user maintenance measures.

IP65 rated seal present around enclosure door

IP68 Rated Gland IP67 MC4 Connector IP66 Rated Breather Drain Plug

IP65 rated seals

IP55 rated Air Filter present on side of the enclosure

⚠ DANGER!

Handle operation

The switch handle may be either contained internally or externally to the enclosure.

When the switch handle is located within the enclosure (internally), a key is required to unlock and open the enclosure door or cover. All internal conductive parts are shielded so that the switch can be safely turned off with minimal risk to the operator. These shields must not be removed or tampered with, and are rated to IP20. Failure to adhere to this warning could cause an accident resulting in serious injury or death. It is a requirement that all live internals are shielded for safety purposes.

Where an external handle is present, an interlocking system is in place so that the enclosure cannot be opened whilst the combiner box is on. Any attempts to override this system are done so at the users own risk, as per interlocking door and switch, page 10.

The handle must be in the off position before the combiner box may be opened, using the supplied key. The handle is off in the vertical position, and the horizontal position when the system is on.
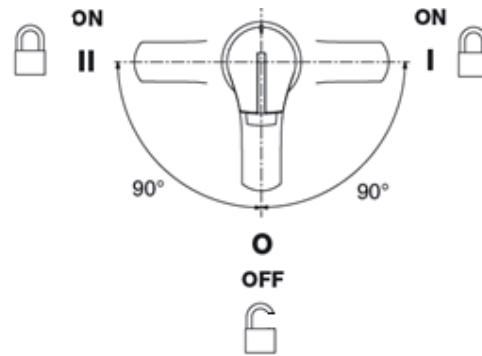
Figure 2. Switch handle positions

⚠ DANGER!

Safety Instructions

Electric shock

Eaton's Bussmann series combiner box operates at extremely high voltages and its internal components are live. Whilst every effort has been made to ensure the internals are completely shielded and IP20 touch safe, work must only be carried out on the combiner box if the switch disconnect is in the OFF position and the combiner box is no longer under load. Even then work must only be carried out by an electrically skilled person. Please be aware that during daylight hours, even whilst disconnected from load, 1000VDC potential may be present within the combiner box.

Operating a damaged combiner box may cause fatal injury from electric shock.

- Ensure the combiner box receives regular maintenance.
- Ensure that any safety equipment is accessible at all times, ensure that it is in good working condition on a regular basis.

In the event of a ground fault, assume that grounded PV plants are still live. Ensure no voltage is present before touching the combiner box components.

⚠ CAUTION!

Burn hazards

The combiner box and its components can become hot during operation.

- Please ensure personal safety protection is worn at all times when working on the combiner box.

NOTICE

Damage to the Eaton's Bussmann series combiner box

To ensure that the combiner box is not damaged by untrained personnel:

- Ensure the combiner box is locked and the keys removed and stored in a safe place.

Electrostatic discharge

Electrostatic discharge can destroy the sensitive electronic components within the Eaton's Bussmann series combiner box.

- Observation of the ESD safety regulations and wearing protective gloves will prevent damage.
- Conduct any electrostatic charges away from the electronic components before touching them. This is done by touching the unpainted, grounded parts of the enclosure.

⚠ WARNING!

Product warning labels

Hazard and warning labels are applied internally and externally to the combiner box. On the outside of the combiner box, a vinyl or sticky back 'Danger – High Voltage' label is applied. Internally, labels are used to state the hazard presented by the live parts of the combiner box. This label is highly visible on all shrouding within the combiner box.

The word 'Danger' is defined as a "hazardous situation which, if not avoided, will result in death or serious injury." This indicates the level of hazard which could be encountered, should the maintenance engineer fail to adhere to these warnings. These labels are typically applied to areas which are IP20 "touch safe", but also experience high voltages and currents. Failure to adhere to these warnings could therefore result in death or serious injury.

Example warning labels

⚠ DANGER!

Service and maintenance

During any service or maintenance of the Eaton's Bussmann series combiner box all safety instructions, notices, and warning labels must be observed and followed at all times. Any work carried out must only be carried out by an electrically skilled person, following local laws and regulations. As a minimum the following steps should be followed:

1. Where present the combiner box switch disconnector should be in the OFF position.

2. If no combiner box switch disconnector is present then steps must be taken to safely isolate the combiner box from any system load. Ensure all system switch disconnectors are in the OFF position. Ensure the inverter or inverters are ether off or isolated from the combiner box.

3. Follow all necessary 'Tag out, Lock out' safety procedures.

4. DO NOT OPEN FUSE HOLDERS UNDER LOAD.

5. Use appropriate and calibrated test equipment to safely ensure current is zero and confirm the combiner box is fully isolated from any system load.

6. ONLY when the combiner box is 100% isolated can the fuse holders be opened.

7. Open ALL fuse holders to remove voltage potential from within the combiner box.

8. Complete any maintenance or service continuing to observe all safety instructions, notices and warning labels.

9. Do not remove or alter any safety covers installed within the combiner box.

10. ONLY when any maintenance or service is complete and ensuring the combiner box is still 100% isolated can the fuse holders be closed.

11. Follow all necessary 'Tag out, Lock out', safety procedures and system re-energisation procedures before re-connecting the combiner box to the system load.

12. Finally ensure all safety covers, doors and locks are closed and secure.

## ⚠ WARNING!

Interlocking door and switch

The combiner box is designed to be disconnected from load before allowing the door to be opened. Failure to disconnect the switch prior to opening the combiner box could result in death or serious injury. The door must only be opened using the key provided once the switch has been turned to the off position.
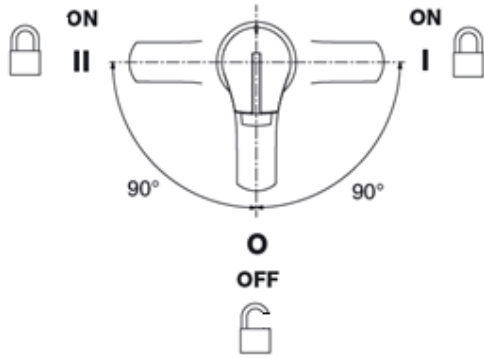
Figure 3. Switch handle positions

A lockout/tagout feature is present for the combiner box and should be used as per the image below.

Padlocking the handle
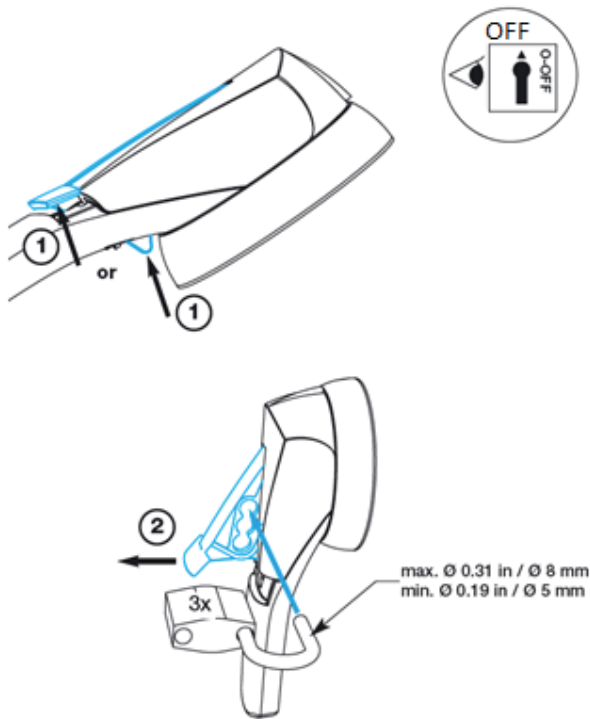
Figure 4. Fitting of lockout/tagout padlock

The interlock may be overridden using the feature on the handle as per the image on the left. This will allow the combiner box to be opened whilst the internal electrical components are still live. Therefore this feature should only be used at your own risk.

Defeating the interlock in ON position

⚠ **DANGER**

- Disconnect all power before servicing.

- Be sure enclosure is closed securely before operating device.

- Testing of live equipment should only be performed by qualified service personnel in accordance with local regulations.

Failure to follow these instructions will result in death or serious injury.
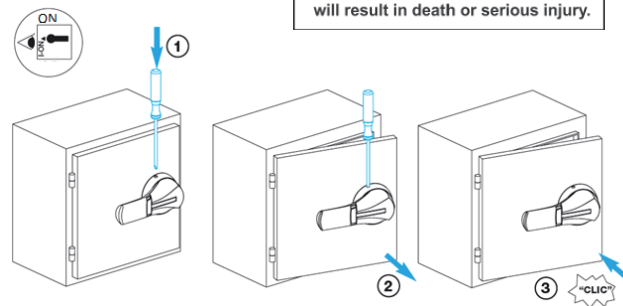
Figure 5. Overriding the interlock

Installation instructions

Please be advised that the unit may weigh up to 75kg. Please take extra precaution when unpacking.

NOTICE

Unpacking and inspection

All Eaton's Bussmann series combiner boxes are thoroughly checked before they are packed and shipped. Although they are shipped in sturdy packaging, damage can still occur during shipping and delivery. It is important to carefully inspect the shipping container and contents prior to installation. If you detect any external damage after unpacking, report the damage immediately to Eaton and the shipping company that delivered the unit.

If you require assistance in dealing with a damaged unit, please contact Eaton on +44(0)1509 882699.

Electrical connections

Bottom entry

Example bottom end view of a combiner box fitted with MC4 connectors. Positioning on this face may vary dependent on individual design. If the design was fitted with glands, these would occupy the same area as the MC4 Connectors shown in the diagram. Positive and negative inputs and outputs will be marked accordingly on the outside of the combiner box.
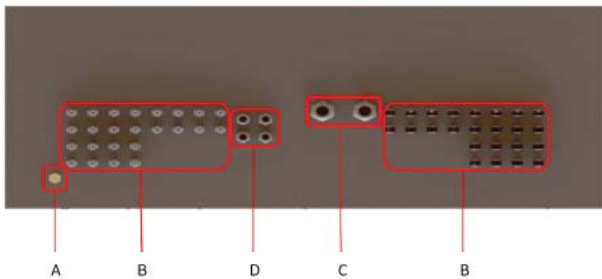
End view

Connection points for bottom entry

Position	Item	Notes
A	IP65 rated breather drain	Relieves internal condensation
B	MC4 connectors or IP65 rated glands	To connect PV string cables
C	Output connection IP65 rated glands	For customer output cables
D	IP65 rated ancillary connection glands	One gland per connection where applicable. May be used for wired communication entry points, PV DC earthing and AC mains PSU where required.

Side entry

Example side entry view of a combiner box fitted with cable glands. Positioning on this face may vary dependent on individual design. If the design was fitted with MC4 connectors, these would occupy the same area as the glands shown in the diagram.
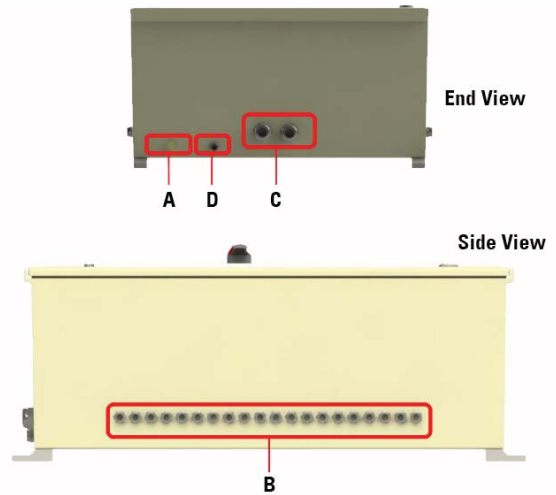
⚠ CAUTION!

Connection points for side entry

Position	Item	Notes
A	IP65 Rated Breather Drain	Relieves internal condensation
B	MC4 Connectors or IP65 Rated Glands	To connect PV string cables
C	Output Connection IP65 Rated Glands	For customer output cables
D	IP65 Rated Ancillary Connection Glands	One gland per connection where applicable. May be used for wired communication entry points, PV DC Earthing and AC Mains PSU where required.

Wiring preparation for gland inputs

In order to install PV cable where glands are specified, PV cable must be stripped for a distance defined by the component of which it is to be connected. This length is specified in the table below.

Component	Wire strip length (mm)
10x38 modular fuse holder (up to and including 20A fuse rating)	9
14x51 modular fuse holder (25A, 32A fuse rating)	12

Once the cable has been stripped to the required length, it may then be inserted through the gland and into the associated modular fuse holder. The modular fuse holder must then be tightened to the required torque specified on page 12 – Torque values.

MC4 connectors

Where a connection must be made use MC4 connectors, it must be noted that the male connectors are mounted on the negative input side and female connectors on the positive input side. This is to match the PV panel MC4 output cables.

⚠ CAUTION!

Torque values

The following torque ratings must be applied to the assembly where the stated components are used. If this is not adhered to, cabling may become loose or remove itself from the connected component, causing potential injury and damage to the combiner box.

Component	Torque value (Nm)	Screw thread diameter	Max. Cable diameter	Tool required
MFH				
10x38 indicating/non-indicating	3	M6	4mm²	PH2 screw driver
14x51 indicating/non-indicating	4	M6	6mm²	PH2 screw driver
DC switch (cage terminals not for use with aluminum cable)				
Input cage terminals (500A switch)	45	N/A	300mm²	M20 allen key
Input cage terminals (315 - 400A switch)	45	N/A	240mm²	M20 allen key
Input cage terminals (200 - 250A switch)	25	N/A	185mm²	M16 allen key
Input cage terminals (up to 160A switch)	14	N/A	95mm²	M12 allen key
Cable lug (no cage terminals supplied)	43	N/A	N/A	M17
External connection				
Mains AC live	0.75	M3	4mm²	0.5 x 0.3
Mains AC neutral	0.75	M3	4mm²	0.5 x 0.3
Mains AC earthing terminal	0.75	M3	4mm²	0.5 x 0.3
Modbus A & B	0.75	M3	4mm²	0.5 x 0.3
PV DC earthing terminal	3	M5	4mm²	0.5 x 6

NOTICE

PV string connections

Gland input

Insert the PV string cable into the combiner box through the gland as shown in the image below.

Connecting PV strings into glands

Ensure the cable meets either the 10 x 38 modular fuse holders or the 14 x 51 modular fuse holders, and is fully inserted so that no bare cable core is exposed. Tighten the modular fuse holders using adequate torque as stated in the table in Torque values, above.

NOTICE

MC4 connections

Positive (+) strings

Insert the positive (+) MC4 connectors. Insert into negative (-) connectors and push together until you hear an audible tactile click. The MC4 connector should not become loose, or wobble.
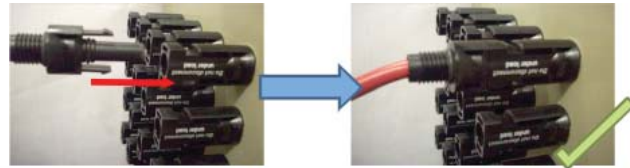
Connecting PV strings + MC4 connectors

Negative (-) Strings

Insert the Negative (-) MC4 connectors. Insert into Positive (+) connectors and push together until you hear an audible tactile click. The MC4 Connector should not become loose, or wobble.
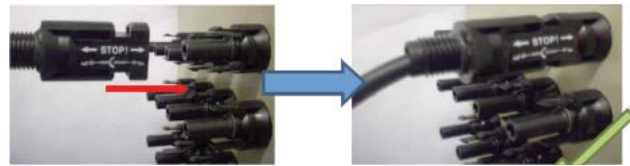
Connecting PV strings - MC4 connectors

Ancillary cable connections

Insert the ancillary cable into the combiner box through the gland as shown in the image below.

Connecting ancillary cables into glands

Your combiner box contains a bank of up to five terminal blocks which are used to connect an AC power supply (where applicable) and the modbus communication connections (monitored solutions only). A typical bank is shown in the image below. Please check your unique combiner box labelling to ensure that the correct connections are made to the correct, corresponding terminal.
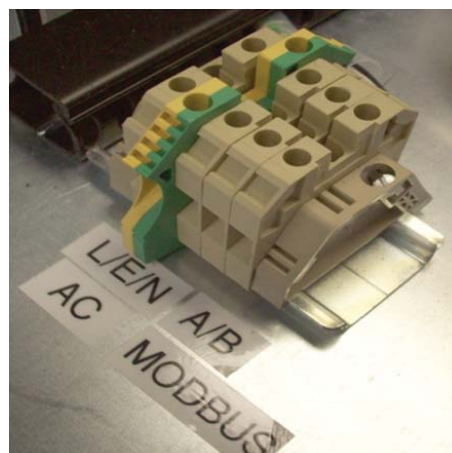
Ancillary cable terminal blocks

⚠ WARNING!

Mounting

The box may be wall or stand mounted using a set of mounting brackets designed for the selected enclosure. These are supplied with the required screws in every combiner box, and must be used if the box is to be wall or stand mounted. If the combiner box has an external door, the enclosure must be mounted so that the hinges are in the vertical plane.

Location of mounting brackets during shipment

Mounting brackets

The following guidelines should be adhered to when mounting your combiner box. Mounting the combiner box is done so at your own risk.

• Ensure the combiner box is mounted so that the connection face is facing downwards.

• Do not mount the combiner box in an inclined position.

• Only the supplied mounting brackets may be used.

• Ensure there at least 2 people available to mount the combiner box – it may weigh up to 75kg.

• Before installing the combiner box, ensure that none of the exterior cable glands or plugs have been damaged in transit. If this is the case, please contact Eaton bulesales@eaton.com..

Mounting location requirements

The following guidelines should be adhered to when mounting your combiner box. Mounting the combiner box is done so at your own risk, as is customer selection of a mounting location.

• The mounting location should be in a well-ventilated area and should not be a living area or office.

• The mounting locations should be safely accessible at all times to aid any required servicing.

• No escape routes should be blocked as a result of the mounting.

• The location should be load bearing and suitable for both the weight and the dimensions of the combiner box.

• The mounting location must not be exposed to direct sun light.

Take wall properties into account when mounting the combiner box.

1. Mark the position of the drill holes on the wall or stand.

2. Drill holes on the marked positions.

3. If necessary, insert the screw anchors.

4. Attach the mounting brackets with the screw supplied.

5. Fasten the combiner box to the wall or stand using suitable screws and washers.

⚠ CAUTION!

Mounting the combiner box

The combiner box may be wall or stand mounted using the supplied kit. Different size combiner boxes have mounting brackets which are applied in different manners, as per the diagrams below.

For external dimensions 1050 x 850 sized combiner boxes –

For all other sizes of combiner boxes -
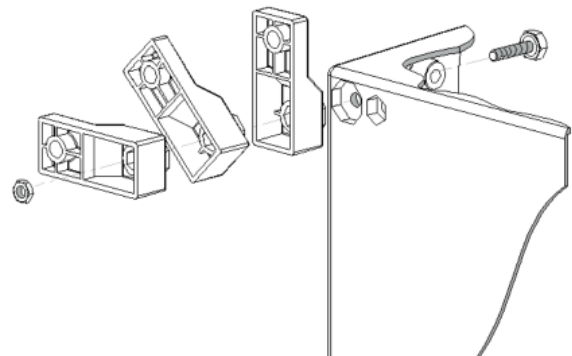
Figure 6. Fitting mounting brackets

Monitoring solutions

The following chapter details specific operations and programming parameters of the monitoring system contained within the combiner box. This chapter contains the list of interface parameters, the list of available registers with the relevant functions and the explanation of the advantages and disadvantages of particular functions.

After applying the supply voltage for about 5 seconds, the manufacturer information, then the module name and the software version, e.g. Eaton, are displayed. Next, the main screen appears.
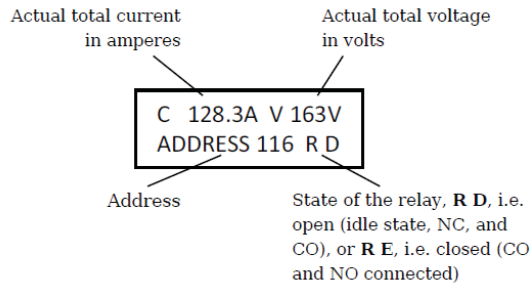
Figure 7. Example display screen

Press the button near the LCD display to view the available information on the display. Each press of the button switches to the display of the next current up to the current in the eighth string; then further system parameters will be displayed whenever you press the button: The display does not jump back to the main screen, the last viewed screen remains displayed. Please note that in EcoMode the backlight is turned off.

Connecting multiple interfaces

Cables

Use twisted-wire cables, with a screen if possible. Connect all bus devices as a chain, one behind the other. For the chain configuration the modules have doubled, internally linked through-connections (top and bottom): You use one bus connection as input, the other as output to the next bus device. The order of top or bottom is unimportant here.
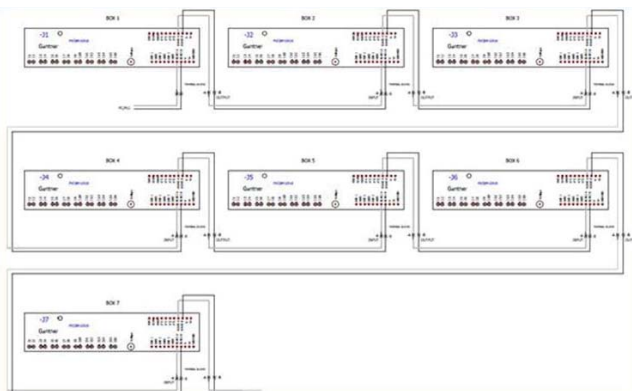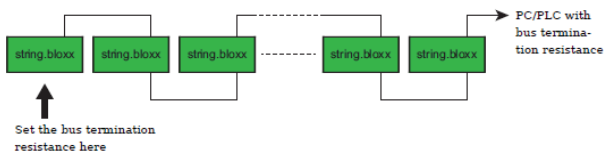
Bus wiring for RS-485 or Modbus

Connect the screen of the bus cable flat with screen terminals (no point contact). We recommend that the screens are only earthed at one point and between the modules are only connected one to the other.

Bus termination

To prevent signal reflections on the interface lines each section (bus segment) must be terminated at its physical start and end with a certain resistance. To do this, a terminating resistance is connected between the bus lines A and B. The line A is then connected via a pull-up resistor to +5 V and line B is connected via a pull-down resistor to 0 V. This cascade of three resistors ensures interference-free data transmission and defined potentials (voltage levels) when no data is being transmitted over the bus (the interface). The Type S1 string monitoring units PVCBM-GRI6 already have these resistors built in. You activate the resistors via both DIP switches; in this way both bus lines are connected to the resistance circuit: Push the switches in the diagram on the right upwards. The DIP switches must always be both actuated, i.e. both set to **on** or both set to **off**.

DIP swTitches for activating the bus termination resistances; current setting: OFF (down, default setting).

8 string monitoring units

Interface parameters

The type S1 string monitoring module PVCBM-GR8 supports the modbus RTU protocol with the following interface parameters:

Baud rate	19.2 …115.2 Kb/s
Format	8n1, 8e1 or 8o1
Maximum cable length	1.2km
Unit Load	1/8
Byte order	MSbit-LSBit
Word order	LSByte-MSByte
Address range	1 – 247
Max. frame length	256 bytes

The following function codes are supported:

03	Read contents of a holding register
04	Read contents of an input register
06	Write contents of a R/W register (preset single register)

For reading the registers it holds:

	Address basis	Function code for reading	Function code for writing
Input register	30001	0x04	-
Holding register	40001	0x03	0x06

List of registers and functions

Abbreviations used	Explanation
UINT16	Data type unsigned integer. 16 bit
UINT32	Data type unsigned integer. 32 bit
Float32	Data type float, 32 bit
R	Only read access possible (read only)
R/W	Read and write access possible (read/write)

Register (integer)	Data type	Channel (description)	Possible values	Unit	R/W
0000	UINT16	Digital input 01 (Main switch)	0: OFF 1: ON		R
0001	UINT16	Digital input 02 (1000V DC surge protection	0: NOK 1: OK		R
0003	UINT16	Digital input 03	0, 1		R
0004, 0005	Float32	Current I_1	-20.00 … +20.00	A	R
0006, 0007	Float32	Current I_2	-20.00 … +20.00	A	R
0008, 0009	Float32	Current I_3	-20.00 … +20.00	A	R
0010, 0011	Float32	Current I_4	-20.00 … +20.00	A	R
0012, 0013	Float32	Current I_5	-20.00 … +20.00	A	R
0014, 0015	Float32	Current I_6	-20.00 … +20.00	A	R
0016, 0017	Float32	Current I_7	-20.00 … +20.00	A	R
0018, 0019	Float32	Current I_8	-20.00 … +20.00	A	R
0020, 0021	Float 32	Voltage	0 … 1000.0	V	R
0028, 0029	Float32	Power	0 … 160000	W	R
0036, 0037	Float32	Temperature 1	-40.0 … +160.0	°C	R
0038, 0039	Float32	Temperature 2	-40.0 … +160.0	°C	R
0042, 0043	Float32	Total current	-160.00 … +160.00	A	R
0044, 0045	UINT32	Date of the firmware	0xDDMMYYYY Example: 0x040507DB 04.05.2011		R
0046, 0047	UINT32	Software version	0xBBBBMMNN Example: 0x12510102 V1.02.1251		R
0048	UINT16	Error code	1: OK ≠1: NOK		R

Register (integer)	Data type	Channel (description)	Possible values	Unit	R/W
0059	UINT16	Sync ID[1]	User code of reg. 0302		R
0060, 0061	Float32	Sync_current I_1[1]	-20.00 … +20.00	A	R
0062, 0063	Float32	Sync_current I_2	-20.00 … +20.00	A	R
0064, 0065	Float32	Sync_current I_3	-20.00 … +20.00	A	R
0066, 0067	Float32	Sync_current I_4	-20.00 … +20.00	A	R
0068, 0069	Float32	Sync_current I_5	-20.00 … +20.00	A	R
0070, 0071	Float32	Sync_current I_6	-20.00 … +20.00	A	R
0072, 0073	Float32	Sync_current I_7	-20.00 … +20.00	A	R
0074, 0075	Float32	Sync_current I_8	-20.00 … +20.00	A	R
0076, 0077	Float32	Sync_voltage	0 … 1000.0	V	R
0078, 0079	Float32	Sync_power	0 … 160000	W	R
0080, 0081	Float32	Sync_temperature 1	-40.0 … +160.0	°C	R
0082, 0083	Float32	Sync_temperature 2	-40.0 … +160.0	°C	R
0084, 0085	Float32	Sync_total_current	-160.00 … +160.00	A	R
0099	UINT16	Relay status	0: OFF 1: ON		R/W
0200	UINT16	Device ID	e.g. 2005		R
0202	UINT16	Serial number low	e.g. 14148		R
0203	UINT16	Serial number high	e.g. 4		R
0205	UINT16	Modbus address	1 … 254		R/W
0206	UINT16	Type of current measurement[1]	0: OFF (Factory setting) 1: Fast, 20ms		R
0208	UINT16	Response delay in ms[3]	0 … 250		R/W
0300	UINT16	EcoMode[4]	0: OFF (Factory setting) 1: ON		R/W
0302	UINT16	Sync register[1]	User code Write: Trigger sync		R/W

Setting	Specified value (decimal)
No parity (8n1)	0 … 5
Even parity (8e1)	100 … 105
Odd parity (8o1)	200 … 205
1200Bd	0	100	200
2400Bd	1	101	201
4800Bd	2	102	202
9600Bd	3	103	203
19.2kBd	4	104	204
38.4kBd	5	105	205

16 string monitoring units

Interface parameters

The type S1 string monitoring module PVCBM-GR16 supports the modbus RTU protocol with the following interface parameters:

Baud rate	1200 to 38400 Bd
Format	8n1, 8e1 or 8o1
Max. cable length	1.2km
Unit load	1/8
Byte order	MSBit-LSBit
Word order	LSByte-MSByte
Address range	1 – 247
Max. frame length	256 Bytes

The following are supported as function codes:

03	Read contents of a holding register
04	Read contents of an input register
06	Write contents of a R/W register (preset single register)

	Address basis	Function code for reading	Function code for writing
Input register	30001	0x04	-
Holding register	40001	0x03	0x06

List of registers and functions

Abbreviations used	Explanation
UINT16	Data type unsigned integer. 16 bit
UINT32	Data type unsigned integer. 32 bit
Float32	Data type floating, 32 bit
R	Only read access possible (read only)
R/W	Read and write access possible (read/write)

Register (integer)	Data type	Channel (description)	Possible values	Unit	R/W
0000	UINT16	Digital input 01 (main switch)	0: OFF 1: ON		R
0001	UINT16	Digital input 02 (1000V DC overvoltage protection	0: NOK 1: OK		R
0003	UINT16	Digital input 03	0, 1		R
0004, 0005	Float32	Current I_1	-30.00 … +30.00	A	R
0006, 0007	Float32	Current I_2	-30.00 … +30.00	A	R
0008, 0009	Float32	Current I_3	-30.00 … +30.00	A	R
0010, 0011	Float32	Current I_4	-30.00 … +30.00	A	R
0012, 0013	Float32	Current I_5	-30.00 … +30.00	A	R
0014, 0015	Float32	Current I_6	-30.00 … +30.00	A	R
0016, 0017	Float32	Current I_7	-30.00 … +30.00	A	R
0018, 0019	Float32	Current I_8	-30.00 … +30.00	A	R
0020, 0021	Float 32	Current I_9	-30.00 … +30.00	A	R
0022, 0023	Float32	Current I_{10}	-30.00 … +30.00	A	R
0024, 0025	Float32	Current I_{11}	-30.00 … +30.00	A	R
0026, 0027	Float32	Current I_{12}	-30.00 … +30.00	A	R
0028, 0029	Float32	Current I_{13}	-30.00 … +30.00	A	R
0030, 0031	Float32	Current I_{14}	-30.00 … +30.00	A	R
0032, 0033	Float32	Current I_{15}	-30.00 … +30.00	A	R
0034, 0035	Float32	Current I_{16}	-30.00 … +30.00	A	R
0036, 0037	Float32	Summed current	-480.00 … +480.00	A	R
0038, 0039	Float32	Voltage	0 … 1000.0	V	R
0040, 0041	Float32	Power	0 … 480.000	W	R
0042, 0043	Float32	Temperature 1	-40.0 … +160.0	°C	R
0044, 0045	Float32	Temperature 2	-40.0 … +160.0	°C	R
0050, 0051	UINT32	Firmware date	0xDDMMYYYY Example: 0x040507DB 04.05.2011		R

Register (integer)	Data type	Channel (description)	Possible values	Unit	R/W
0052, 0053	UINT32	Software version	0xBBBBMMNN Example: 0x12510102 V1.02.1251		R
0054	UINT16	Error code	1: OK ≠1: NOK		R
0055	UINT16	Calibration status	1: OK 2: Busy >2: Error number		R
0059	UINT16	Sync ID[1]	User code of Reg. 0302		R
0060, 0061	Float32	Sync_current I_1[1]	-30.00 … +30.00	A	R
0062, 0063	Float32	Sync_current I_2	-30.00 … +30.00	A	R
0064, 0065	Float32	Sync_current I_3	-30.00 … +30.00	A	R
0066, 0067	Float32	Sync_current I_4	-30.00 … +30.00	A	R
0068, 0069	Float32	Sync_current I_5	-30.00 … +30.00	A	R
0070, 0071	Float32	Sync_current I_6	-30.00 … +30.00	A	R
0072, 0073	Float32	Sync_current I_7	-30.00 … +30.00	A	R
0074, 0075	Float32	Sync_current I_8	-30.00 … +30.00	A	R
0076, 0077	Float32	Sync_current I_9	-30.00 … +30.00	A	R
0078, 0079	Float32	Sync_current I_{10}	-30.00 … +30.00	A	R
0080, 0081	Float32	Sync_current I_{11}	-30.00 … +30.00	A	R
0082, 0083	Float32	Sync_current I_{12}	-30.00 … +30.00	A	R
0084, 0085	Float32	Sync_current I_{13}	-30.00 … +30.00	A	R
0086, 0087	Float32	Sync_current I_{14}	-30.00 … +30.00	A	R
0088, 0089	Float32	Sync_current I_{15}	-30.00 … +30.00	A	R
0090, 0091	Float32	Sync_current I_{16}	-30.00 … +30.00	A	R
0092, 0093	Float32	Sync_summed_current	-480 … +480	A	R
0094, 0095	Float32	Sync_voltage	0 … 1000.0	V	R
0096, 0097	Float32	Sync_power	0 … 480.000	W	R
0098, 0099	Float32	Sync_temperature 1	-40.0 … +160.0	°C	R
0100, 0101	Float32	Sync_temperature 2	-40.0 … +160.0	°C	R
0200	UINT16	Device identification	e.g. 2006		R
0202	UINT16	Serial number low	e.g. 14148		R
0203	UINT16	Serial number high	e.g. 4		R
0205	UINT16	Modbus address	1 … 254		R/W
0208	UINT16	Response delay in ms[3]	0 … 250		R/W
0209	UINT16	Baud rate and parity	For values refer to table on Page…		R/W
0300	UINT16	EcoMode[4]	0: OFF (Factory setting) 1: ON		R/W
0302	UINT16	Sync register[1]	User code Write: Trigger sync		R/W

Setting	Specified value (decimal)
No parity (8n1)	0 … 5
Even parity (8e1)	100 … 105
Odd parity (8o1)	200 … 205
1200 Bd	0 | 100 | 200
2400 Bd	1 | 101 | 201
4800 Bd	2 | 102 | 202
9600 Bd	3 | 103 | 203
19.2 kBd	4 | 104 | 204
38.4 kBd	5 | 105 | 205

For even parity and a baud rate of 9600 Bd enter 103 as the value. The number of stop bits cannot be changed (always 1). The factory setting is: no parity, 19.2 kBd

24 string monitoring units

Interface parameters

The type S1 string monitoring module PVCBM-GR24 supports the modbus RTU protocol with the following interface parameters:

Baud rate	1200 to 38400 Bd
Format	8n1, 8e1 or 8o1
Max. cable length	1.2km
Unit load	1/8
Byte order	MSBit-LSBit
Word order	LSByte-MSByte
Address range	1 – 247
Max. frame length	256 Bytes

The following are supported as function codes:

03	Read contents of a holding register
04	Read contents of an input register
06	Write contents of a R/W register (preset single register)

For reading the registers the following therefore arises:

	Address basis	Function code for reading	Function code for writing
Input register	30001	0x04	-
Holding register	40001	0x03	0x06

List of registers and functions

Abbreviations used	Explanation
UINT16	Data type unsigned integer. 16 bit
UINT32	Data type unsigned integer. 32 bit
Float32	Data type floating, 32 bit
R	Only read access possible (read only)
R/W	Read and write access possible (read/write)

Register (integer)	Data type	Channel (description)	Possible values	Unit	R/W
0000	UINT16	Digital input 01 (main switch)	0: OFF 1: ON		R
0001	UINT16	Digital input 02 (1000V DC overvoltage protection	0: NOK 1: OK		R
0003	UINT16	Digital input 03	0, 1		R
0004,0005	Float32	Current I_1	-30.00 … +30.00	A	R
0006, 0007	Float32	Current I_2	-30.00 … +30.00	A	R
0008, 0009	Float32	Current I_3	-30.00 … +30.00	A	R
0010, 0011	Float32	Current I_4	-30.00 … +30.00	A	R
0012, 0013	Float32	Current I_5	-30.00 … +30.00	A	R
0014, 0015	Float32	Current I_6	-30.00 … +30.00	A	R
0016, 0017	Float32	Current I_7	-30.00 … +30.00	A	R
0018, 0019	Float32	Current I_8	-30.00 … +30.00	A	R
0020, 0021	Float 32	Current I_9	-30.00 … +30.00	A	R
0022, 0023	Float32	Current I_{10}	-30.00 … +30.00	A	R
0024, 0025	Float32	Current I_{11}	-30.00 … +30.00	A	R
0026, 0027	Float32	Current I_{12}	-30.00 … +30.00	A	R
0028, 0029	Float32	Current I_{13}	-30.00 … +30.00	A	R
0030, 0031	Float32	Current I_{14}	-30.00 … +30.00	A	R
0032, 0033	Float32	Current I_{15}	-30.00 … +30.00	A	R
0034, 0035	Float32	Current I_{16}	-30.00 … +30.00	A	R
0036, 0037	Float32	Current I_{17}	-30.00 … +30.00	A	R
0038, 0039	Float32	Current I_{18}	-30.00 … +30.00	A	R
0040, 0041	Float32	Current I_{19}	-30.00 … +30.00	A	R
0042, 0043	Float32	Current I_{20}	-30.00 … +30.00	A	R
0044, 0045	Float32	Current I_{21}	-30.00 … +30.00	A	R
0046, 0047	Float32	Current I_{22}	-30.00 … +30.00	A	R
0048, 0049	Float32	Current I_{23}	-30.00 … +30.00	A	R

Register (integer)	Data type	Channel (description)	Possible values	Unit	R/W
0050, 0051	Float32	Current I_{24}	-30.00 … +30.00	A	R
0052, 0053	Float32	Summed current	-480.00 … +480.00	A	R
0054, 0055	Float32	Voltage	0 … 1000.0	V	R
0056, 0057	Float32	Power	0 … 480,000	W	R
0058, 0059	Float32	Temperature 1	-40.0 … +160.0	°C	R
0060, 0061	Float32	Temperature 2	-40.0 … +160.0	°C	R
0062, 0063	UINT32	Firmware date	0xDDMMYYYY Example: 0x040507DB 04.05.2011		R
0064, 0065	UINT32	Software version	0xBBBBMMNN Example: 0x12510102 V1.02.1251		R
0066	UINT16	Error code	1: OK ≠1: NOK		R
0067	UINT16	Calibration status	1: OK 2: Busy >2: Error number		R
0069	UINT16	Sync ID[1]	User code of Reg. 0302		R
0070, 0071	Float32	Sync_current I_1,[1]	-30.00 … +30.00	A	R
0072, 0073	Float32	Sync_current I_2	-30.00 … +30.00	A	R
0074, 0075	Float32	Sync_current I_3	-30.00 … +30.00	A	R
0076, 0077	Float32	Sync_current I_4	-30.00 … +30.00	A	R
0078, 0079	Float32	Sync_current I_5	-30.00 … +30.00	A	R
0080, 0081	Float32	Sync_current I_6	-30.00 … +30.00	A	R
0082, 0083	Float32	Sync_current I_7	-30.00 … +30.00	A	R
0084, 0085	Float32	Sync_current I_8	-30.00 … +30.00	A	R
0086, 0087	Float32	Sync_current I_9	-30.00 … +30.00	A	R
0088, 0089	Float32	Sync_current I_{10}	-30.00 … +30.00	A	R
0090, 0091	Float32	Sync_current I_{11}	-30.00 … +30.00	A	R
0092, 0093	Float32	Sync_current I_{12}	-30.00 … +30.00	A	R
0094, 0095	Float32	Sync_current I_{13}	-30.00 … +30.00	A	R
0096, 0097	Float32	Sync_current I_{14}	-30.00 … +30.00	A	R
0098, 0099	Float32	Sync_current I_{15}	-30.00 … +30.00	A	R
0100, 0101	Float32	Sync_current I_{16}	-30.00 … +30.00	A	R
0102, 0103	Float32	Sync_current I_{17}	-30.00 … +30.00	A	R
0104, 0105	Float32	Sync_current I_{18}	-30.00 … +30.00	A	R
0106, 0107	Float32	Sync_current I_{19}	-30.00 … +30.00	A	R
0108, 0109	Float32	Sync_current I_{20}	-30.00 … +30.00	A	R
0110, 0111	Float32	Sync_current I_{21}	-30.00 … +30.00	A	R
0112, 0113	Float32	Sync_current I_{22}	-30.00 … +30.00	A	R
0114, 0115	Float32	Sync_current I_{23}	-30.00 … +30.00	A	R
0116, 0117	Float32	Sync_current I_{24}	-30.00 … +30.00	A	R
0118, 0119	Float32	Sync_summed_current	-480 … +480	A	R
0120, 0121	Float32	Sync_voltage	0 … 1000.0	V	R
0122, 0123	Float32	Sync_power	0 … 480.000	W	R
0124, 0125	Float32	Sync_temperature 1	-40.0 … +160.0	°C	R
0126, 0127	Float32	Sync_temperature 2	-40.0 … +160.0	°C	R
0149	UINT16	Relay output	0: OFF 1: ON		R/W
0200	UINT16	Device identification	2008 (124) 2007 (208) 2006 (116) 2005 (108)		R
0202	UINT16	Serial number low	e.g. 14148		R
0203	UINT16	Serial number high	e.g. 4		R
0205	UINT16	Modbus address	1 … 254		R/W
0206	UINT16	Configuration for current measurement register[2]	0: default 1: fast		R/W

Register (integer)	Data type	Channel (description)	Possible values	Unit	R/W
0208	UINT16	Response delay in ms[3]	0 … 250		R/W
0209	UINT16	Baud rate and parity	For values refer to table below		R/W
0300	UINT16	EcoMode[4]	0: OFF (Factory setting) 1: ON		R/W
0302	UINT16	Sync register[1]	User code Write: Trigger sync		R/W

Setting	Specified value (decimal)
No parity (8n1)	0 … 5
Even parity (8e1)	100 … 105
Odd parity (8o1)	200 … 205
1200Bd	0 | 100 | 200
2400Bd	1 | 101 | 201
4800Bd	2 | 102 | 202
9600Bd	3 | 103 | 203
19.2kBd	4 | 104 | 204
38.4kBd	5 | 105 | 205

For even parity and a baud rate of 9600 Bd enter 103 as the value. The number of stop bits cannot be changed (always 1). The factory setting is: no parity, 19.2 kBd

Advanced configuration options

To adapt the type S1 string monitoring module optimally to your needs, you can use several parameters to control the behavior. The following table provides an overview of the available options.

Mode	Property	Explanation	Register
Measurement modes			
Default	Low noise, good noise suppression	The values are written into the registers every second. Due to the longer measurement time, however, the response time of the modbus communication is about 20ms.	206 = 0
Fast	High measuring rates	The values are written into the registers every 100ms.	206 = 1
Operating modes			
Default	Fast measuring value update	The type S1 string monitoring module is permanently and fully operational. Power consumption 1.4W.	300 = 0
Eco	Minimal power consumption, power supply possible from PV system	The metrological part is turned on only once per minute to perform the measurement and write the values into the registers. The display backlight is switched off. The communication part is permanently active. Power consumption 0.1W.	300 = 1
Data collection modes			
Default	Simple communication	With several type S1 string monitoring modules on one bus, the data are collected sequentially, i.e. with a time lag.	-
Sync	Synchronous measured values from all modules in the system	In the synchronized mode, the controller sends a broadcast value to all modules (register 302) these store the current measured values simultaneously in special registers. Then the values are transmitted sequentially. Thus, all values will be collected simultaneously even in large systems.	302
Delay			
Default	Short response times	Requests from the bus master will be answered as quickly as possible.	-
Delayed	Adaptation to PLC reaction time	Requests from the bus master will be answered only after the specified time.	208

You can carry out the measurement of the input currents and the total voltage in two different ways:

1. In the default setting all the inputs are measured over about one second (1000 ms) and this value is transferred to the registers. Due to this relatively long measuring time, over which averaging of the individual measurements of the ND converter occurs, the noise content in the signal is low and you obtain good interference suppression.

2. In the Fast mode (register 206 = 1) measurement takes place only over about 100 ms (milliseconds). This means that you obtain a high sample rate or refresh rate and the reaction time on the Modbus interface (Response delay, refer also to Section 5.4.4) is reduced from approx. 20 ms to approx. 5 to 8 ms .

Monitoring unit configurations

EcoMode

Activating the EcoMode (register 300 = 1) enables you to drastically reduce the type S1 string monitoring module power demand: from approx. 0.9 W to only 0.2 W.

To do this the measurement section in the type S1 string monitoring module is switched off completely after each measurement and also the display illumination. Every minute the measurement section is activated for a new measurement and then switched off again. The module communication section (modbus interface) is however always active, i.e. the measurements can be read out any time. New measurements are however only produced once per minute.

Synchronization of modules (data acquisition modes)

A problem with larger solar power systems arises due to the serial transmission of data and the limited transmission speed of the modbus link: The values of each PV string are normally interrogated individually and sequentially. Consequently a time offset arises between the data of the first (t1) and the last PV string (tn), which can be in the range of several seconds. The measurements are therefore not acquired synchronously and cannot be directly compared. (With the type S1 string monitoring modules all PV strings are acquired simultaneously within a module.)

The type S1 string monitoring modules offer you the possibility of preventing this time delay in that you send a special command simultaneously to all modules (broadcast) to "freeze" the current measurements of all PV strings of all modules simultaneously. Then you can interrogate and transmit these values consecutively from all type S1 string monitoring modules. Although the data here arrive at the controller with a time offset, the values themselves have been acquired simultaneously and synchronously.
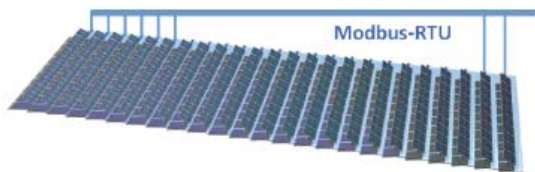
Time offset due to serial communication in standard PV systems
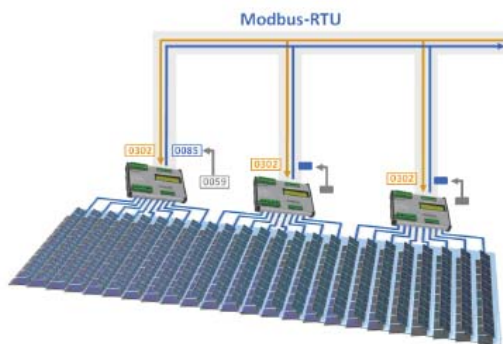
Synchronous aquisition of all measurements of all PV strings with type S1 string monitoring modules

Procedure

1. Send a broadcast message by writing a value in register 302 (sync register) via the modbus address 0 (broadcast address). Thus, in each module, the actual measured values are written into the (internal) registers 60 to 101 and the broadcast value is transferred to register 59.

2. Now read out sequentially from all modules the measured values of the individual strings from registers 60 to 101 and the value of register 302 from register 59.

Since the modules transfer the measured values of the individual strings simultaneously into the sync registers 60 to 101, this method delivers synchronously acquired measurements of all PV strings.

Using the response delay

Depending on the measurement mode for the current and voltage measurements the response time for a query (request) through the modbus interface is between 5 and 20 milliseconds. You can use register 208 to extend the time up to the response if this is too fast for the modbus master used and, therefore, there is a risk that responses are not recognized, because they were already available on the bus shortly after the request. Specify the additionally desired delay in milliseconds in register 208 as a numerical value.
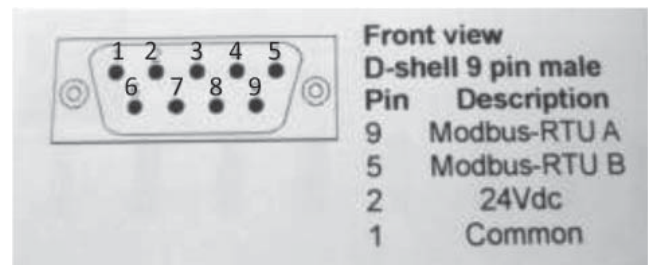
Optional external connection port

Your Eaton's Bussmann series combiner box is maybe fitted with an external 9 pin male D-Sub connection port, to interrogate modbus A and B commands at your convenience without opening the enclosure. This connector is IP65 rated, achieved using a seal around the inside edge of the connector. When the connector is not in use, the IP65 rated cover must be replaced on the socket to both protect it and maintain the ingress rating.

Optional external connection port

The pins of the connector are mapped as below –

Pin configuration for optional external connection port

Optional wireless communications

Your Eaton's Bussmann series combiner box may be fitted with either a Eaton's Bussmann series industrial wireless or zigbee wireless communications unit, enabling remote connection to the combiner box without the need for additional communication wiring. Please refer to the specific wireless instruction manuals relevant to the type of wireless unit installed in your combiner box.

NOTICE

Replaceable parts

Fuses

Eaton recommends replacing blown PV Fuses with Eaton's Bussmann series PV Fuse links. Fuse links must be of the same rating as that which is being replaced, and must be for the same system voltage. A complete list of Eaton's Bussmann series PV fuse links for 600VDC and 1000VDC systems is shown below.

System Voltage	Fuse Size	Current Rating	Part No.	Description
1000 VDC	10 x 38	1A	PV-1A10F	10x38 1000VDC 1A gPV Fuse
		2A	PV-2A10F	10x38 1000VDC 2A gPV Fuse
		3A	PV-3A10F	10x38 1000VDC 3A gPV Fuse
		3.5A	PV-3-5A10F	10x38 1000VDC 3.5A gPV Fuse
		5A	PV-5A10F	10x38 1000VDC 5A gPV Fuse
		6A	PV-6A10F	10x38 1000VDC 6A gPV Fuse
		8A	PV-8A10F	10x38 1000VDC 8A gPV Fuse
		10A	PV-10A10F	10x38 1000VDC 10A gPV Fuse
		12A	PV-12A10F	10x38 1000VDC 12A gPV Fuse
		15A	PV-15A10F	10x38 1000VDC 15A gPV Fuse
		20A	PV-20A10F	10x38 1000VDC 20A gPV Fuse
	14 x 51	25A	PV-25A14F	14x51 1000VDC 25A gPV Fuse
		32A	PV-32A14F	14x51 1000VDC 32A gPV Fuse
600 VDC	10 x 38	4A	PVM-4	10x38 600VDC 4A gPV Fuse
		5A	PVM-5	10x38 600VDC 5A gPV Fuse
		6A	PVM-6	10x38 600VDC 6A gPV Fuse
		7A	PVM-7	10x38 600VDC 7A gPV Fuse
		8A	PVM-8	10x38 600VDC 8A gPV Fuse
		9A	PVM-9	10x38 600VDC 9A gPV Fuse
		10A	PVM-10	10x38 600VDC 10A gPV Fuse
		12A	PVM-12	10x38 600VDC 12A gPV Fuse
		15A	PVM-15	10x38 600VDC 15A gPV Fuse
		20A	PVM-20	10x38 600VDC 20A gPV Fuse
		25A	PVM-25	10x38 600VDC 25A gPV Fuse
		30A	PVM-30	10x38 600VDC 30A gPV Fuse

SPD modules

Your Eaton's Bussmann series combiner box may contain a number of surge protection devices (SPD) to protect against damaging over voltage conditions. There are three types of SPD available for your combiner box, PV T1, PV T1/T2, PV T2; IEC mains T2 and Modbus RS-485 communications C2/D1. Each type of SPD is designed to safely shunt damaging overvoltage surges to ground, minimising the risk of harm to the equipment and personnel.

Each SPD consists of a base and module. When a voltage surge occurs, Eaton's SPDs are designed so that only the module needs to be replaced. Replacement module part numbers are as per the table below.

BSPS31000PV	PV SPD, T1, 1000V DC
Replacement module	N/A
SPPVT12-06-2-PE SPPVT12-06-2-PE-AX	PV SPD, T1/T2, 600V DC (-AX with remote)
Replacement module	SPPVT12-06
SPPVT12-10-2-PE SPPVT12-10-2-PE-AX	PV SPD, T1/T2, 1000V DC (-AX with remote)
Replacement module	SPPVT12-10
SPPVT2-06-2-PE SPPVT2-06-2-PE-AX	PV SPD, T2, 600V DC (-AX with remote), Iscpv = 160A
Replacement module	SPPVT2-06

SPPVT2-10-2-PE SPPVT2-10-2-PE-AX	PV SPD, T2, 1000V DC (-AX with remote), Iscpv = 160A
Replacement module	SPPVT2-10
SPPVT2H-06-2-PE SPPVT2H-06-2-PE-AX	PV SPD, T2, 600V DC (-AX with remote), Iscpv = 1000A
Replacement module	SPPVT2H-06
SPPVT2H-10-2-PE SPPVT2H-10-2-PE-AX	PV SPD, T2, 1000V DC (-AX with remote), Iscpv = 1000A
Replacement module	SPPVT2H-10
SPCT2-280-2	IEC T2, 230V AC, 2 Pole
Replacement module	SPCT2-280
SPCT2-280-1-NPE	IEC T2, 230V AC, 1 Pole + 1 NPE Pole
Replacement module	SPCT2-280 SPCT2-NPE60
BSPD5DINLHF	RS-485 SPD for date communications
Replacement module	N/A

PV T2 SPD

IEC T2 2-pole SPD

Service items

In addition to fuses and SPD modules, there are service items for which replacements are available from Eaton. These include –

- IP68 rated glands (input and output)
- IP66 rated breather drains
- IP65 rated cover for external communications port
- Combiner box key

If you require any of these components please contact Eaton on +44 (0)1509 882699, with your product number and unique ID number ready.

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