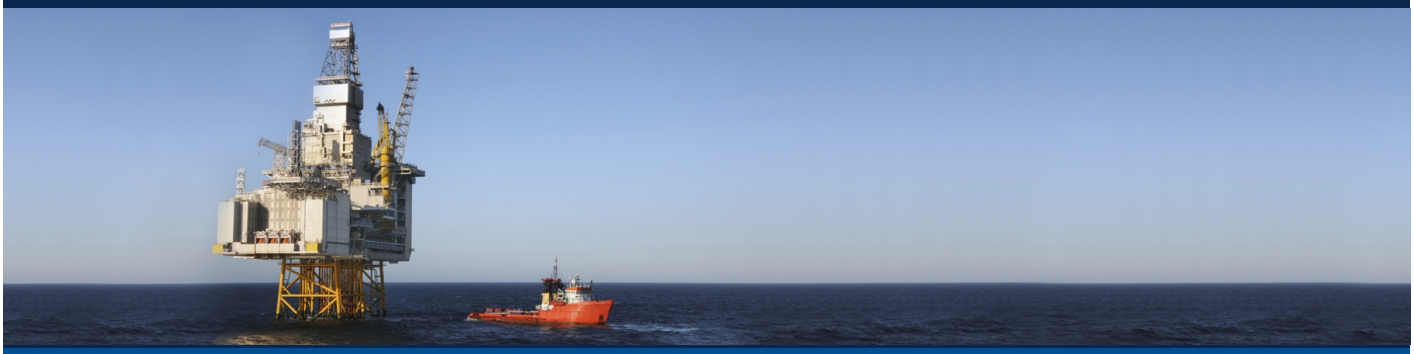
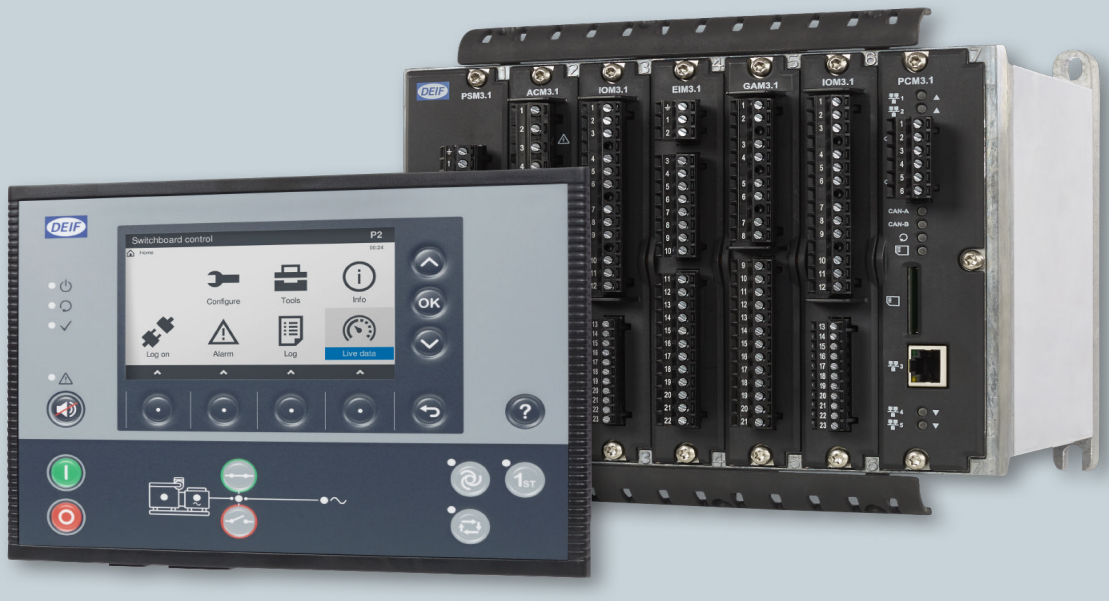
# INSTALLATION INSTRUCTIONS



## Protection and Power Management
## PPM 300




DEIF A/S · Frisenborgvej 33 · DK-7800 Skive
Tel.: +45 9614 9614 · Fax: +45 9614 9615
Info@deif.com · www.deif.com

Document no.: 4189340909B

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# 1. Introduction

## 1.1 About the Installation instructions

### 1.1.1 General purpose

These are the installation instructions for DEIF's Protection and Power Management controller, PPM 300. The installation instruction provide information for the correct installation of PPM 300. The primary focus of these instructions is the physical installation of the equipment.

**DANGER!**
**Read these instructions before you install the PPM 300 controllers, to avoid personal injury and damage to the equipment.**

The information in the installation instructions is for default configurations. If the system deviates from the default configuration, record the differences, and communicate this information as part of the system documentation.

The data sheet includes all the hardware and system technical specifications. Design information is included in the designer's handbook, while commissioning information is included in the commissioning guidelines.

**INFO**
The installation instructions include nominal hardware ratings. Refer to the data sheet for the most accurate and complete specifications.

### 1.1.2 Intended users of the Installation instructions

The Installation instructions are primarily for the people who mount and wire up the controllers and display units. The Installation instructions can be used during commissioning to check the installation. Designers may also find it useful to refer to the Installation instructions when developing the system's wiring diagrams. Operators may find it useful to refer to the Installation instructions while troubleshooting.

### 1.1.3 Technical support

You can read about service and support options on the DEIF website, www.deif.com. You can also find contact details on the DEIF website.

You have the following options if you need technical support:

- Help: The display unit includes context-sensitive help.
- Technical documentation: Download all the product technical documentation from the DEIF website: www.deif.com/documentation
- Training: DEIF regularly offers training courses at the DEIF offices worldwide.
- Support: DEIF offers 24-hour support. See www.deif.com for contact details. There may be a DEIF subsidiary located near you. You can also e-mail support@deif.com.
- Service: DEIF engineers can help with design, commissioning, operating and optimisation.

### 1.1.4 List of technical documentation for PPM 300

| Document | Contents |
|---|---|
| Data sheet | • System description and functions<br>• Technical specifications<br>• Each controller type<br>◦ Applications, hardware, functions and protections<br>• Hardware modules, display unit, and accessories<br>• Ordering information |
| Designer's handbook | • System principles<br>• AC configuration and nominal settings<br>• Protections and alarms<br>• Breakers, synchronisation and de-loading<br>• Regulation<br>• Power management<br>• Each controller type<br>◦ Principles, sequences, functions and protections<br>• Hardware characteristics<br>• PICUS (PC software)<br>• CustomLogic<br>• Communication protocols |
| Installation instructions | • Tools and materials<br>• Mounting<br>• Minimum wiring for each controller type<br>• Wiring for hardware module terminals<br>• Wiring for controller functions<br>• Wiring communication<br>• Wiring the display unit |
| Commissioning guidelines | • Tools, software and information required<br>• Controller, system and equipment checks<br>• Regulator tuning<br>• System testing<br>• Troubleshooting |
| Operator's manual | • Controller equipment (push-buttons and LEDs)<br>• Operating the system<br>• Alarms and log<br>• Using the display unit<br>• Troubleshooting and maintenance |

# 1.2 Warnings and safety

## 1.2.1 Safety during installation and operation

Installing and operating the equipment may require work with dangerous currents and voltages. The installation must only be carried out by authorised personnel who understand the risks involved in working with electrical equipment.

**DANGER!**
**Hazardous live currents and voltages. Do not touch any terminals, especially the AC measurement inputs and the relay terminals. Touching the terminals could lead to injury or death.**

## 1.2.2 Disable the breakers

Disconnect or disable the breakers BEFORE connecting the controller power supply.

Do not enable the breakers until AFTER the wiring and controller operation are thoroughly tested.

**DANGER!**
**Unintended breaker closing can cause dangerous or deadly situations.**

## 1.2.3 Disable the engine start

Disconnect or disable or block the engine start (the crank, and, if present, the run coil) BEFORE connecting the controller power supply.

Do not enable the engine start until AFTER the wiring and controller operation are thoroughly tested.

**DANGER!**
**Unintended engine starts can cause dangerous or deadly situations.**

## 1.2.4 Metal fragments and other objects

Do not allow metal fragments or other objects to fall into the controller rack or display unit. Be especially careful during installation, for example, when shortening wires.

To prevent metal fragments from falling into the controller rack, it is recommended to place cover over the top ventilation holes of the controller rack. The controller is supplied with a disposable cover to protect it from metal fragments and other objects during the first installation.

**CAUTION**
Keep metal fragments out of the controller. Metal fragments can damage the controller.

**CAUTION**
Remember to remove the cover for the controller rack ventilation holes after work has been completed. Failure to do so can damage the controller.

### 1.2.5 Electrostatic discharge

You must protect the equipment terminals from static discharge during handling, including installation and dismounting. Once the equipment is correctly installed and the frame ground is connected, it is no longer necessary to protect the terminals from static discharge.

### 1.2.6 Controller power supply

If the controller has no power supply, it is OFF and does not provide any protection to the system. The controller cannot enforce any trips, shutdowns or latches when it is off. The controller does not provide any control or power management. All the controller relays de-energise.

The controller must have a reliable power supply, which must include a backup power supply. In addition, the switchboard design must ensure that the system is sufficiently protected if the controller power supply fails.

### 1.2.7 Switchboard control

The controllers are designed to normally run under power management system control. When switchboard control is activated, the controller functions as follows:

- It responds if an alarm situation arises, and carries out the alarm action, since the protections are still active.
- It does not respond to a blackout.
- It does not provide any power management.
- It does not prevent any operator actions.

The switchboard design must therefore ensure that the system is sufficiently protected when the controller is under switchboard control.

### 1.2.8 Factory settings

The controller is delivered pre-programmed from the factory with a set of default settings. These settings are based on typical values and may not be correct for your system. You must therefore check all parameters before using the controller.

### 1.2.9 Automatic and remote-controlled starts

The power management system automatically starts gensets when more power is needed. It can be difficult for an inexperienced operator to predict which gensets will start. In addition, gensets can be started remotely (for example, by using an Ethernet connection, or a digital input). To avoid personal injury, the genset design, the layout, and maintenance procedures must take this into account.

## 1.3 Legal information

### 1.3.1 Disclaimers

DEIF takes no responsibility for the installation or operation of the **genset**. Contact the **genset company** if you have any doubt about how to install or operate the genset.

**CAUTION**
The DEIF equipment must not be opened by unauthorised personnel. If opened, the warranty is void.

**INFO**
You may remove, replace, or add a hardware module to the controller rack without losing the warranty. However, you must follow DEIF's procedure.

**Disclaimer**
DEIF A/S reserves the right to change any of the contents of this document without prior notice.

## 1.3.2 Open source software

This product contains open source software licensed under, for example, the GNU General Public License (GNU GPL) and GNU Lesser Public License (GNU LGPL). The source code for this software can be obtained by contacting DEIF at support@deif.com. DEIF reserves the right to charge for the cost of the service.

## 1.3.3 Trademarks

DEIF, power in control and the DEIF logo are trademarks of DEIF A/S.

EtherCAT® is a registered trademark and patented technology, licenced by Beckhoff Automation GmbH, Germany.

Modbus is a registered trademark of Schneider Automation Inc.

Windows is a registered trademark of Microsoft Corporation in the United States and other countries.

All trademarks are the properties of their respective owners.

## 1.3.4 Copyright

# 2. Preparing for the installation

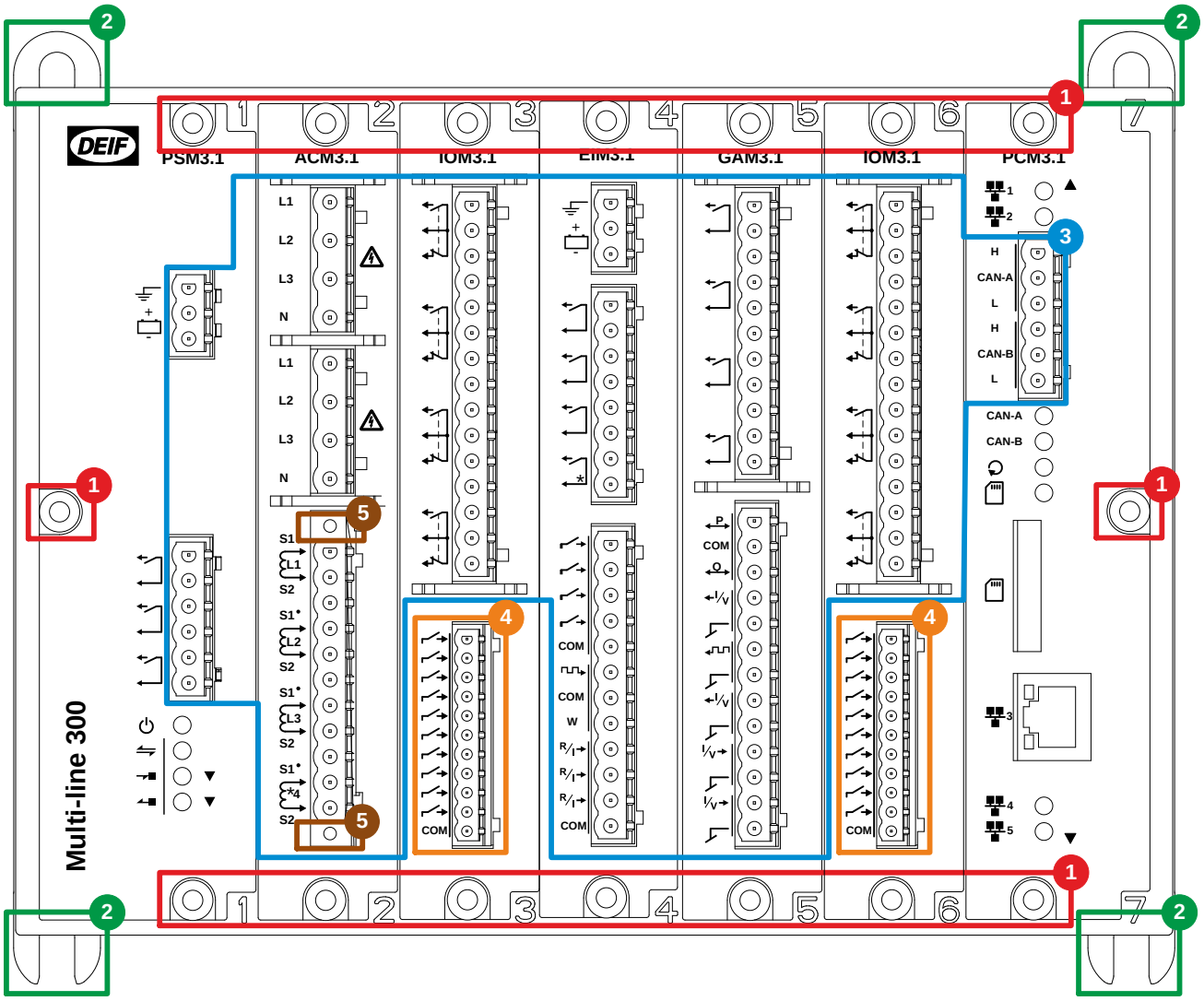
## 2.1 Tools

### 2.1.1 Tools required for mounting and installation

| Tool | Attachment | Torque | Used to | Diagram |
|---|---|---|---|---|
| Safety equipment | - | - | Personal protection, according to local standards and requirements. | - |
| Conducting wrist strap | - | - | Prevent electrostatic discharge damage to modules during mounting. | - |
| **Optional**: Torque screwdriver | TX20 bit | 0.5 N·m (4.4 lb-in) | Remove modules, or screw extra modules into the rack. Not required if the required modules are already mounted in the rack. | 1 (red) |
| **Optional**: Torque screwdriver | TX10 bit | 0.5 N·m (4.4 lb-in) | Remove, or remount the cable strain relief plates. The rack is delivered with the cable strain relief plates already mounted. | - |
| Torque wrench | 10 mm (0.4 in) hex socket (for 6 mm (0.25 in) nuts) | 5 N·m (44 lb-in) | Tighten the nuts on the rack mounting bolts. | 2 (green) |
| Torque screwdriver | PH2 bit or a 5 mm (0.2 in) flat-bladed bit | 0.15 N·m (1.3 lb-in) | Tighten the display unit fixing screw clamps. | - |
| Torque screwdriver | 3.5 mm (0.14 in) flat-bladed bit | 0.5 N·m (4.4 lb-in) | Connect the wiring to all the 2.5 mm² terminals. | 3 (blue) |
| Torque screwdriver | 2.5 mm (0.1 in) flat-bladed bit | 0.25 N·m (2.2 lb-in) | Connect the wiring to the 1.5 mm² terminals. | 4 (orange) |
| **Optional**: Torque screwdriver | 3.5 mm (0.14 in) flat-bladed bit | 0.5 N·m (4.4 lb-in) | Remove or secure the current measurement terminal block to the ACM3.1 module faceplate. ACM3.1 is delivered with the current measurement terminal block already secured. | 5 (brown) |
| Wire stripper, pliers and cutters | - | - | Prepare wiring<br>Trim cable ties | - |

**CAUTION**
Do not use power tools during the installation. Too much torque will damage the equipment.

**Figure 2.1** Tools required to install a GENSET controller




## 2.2 Materials

### 2.2.1 Materials required

The following materials are required to install the controllers and display units.

| Installation step | Materials | Purpose | More information |
|---|---|---|---|
| Mounting | Four fasteners per rack | Mount the controller rack | See **Mounting the rack** in this document for more information. |
| | Grounding wire | Ground the controller rack | See **Grounding the rack** in this document for more information |

| Installation step | Materials | Purpose | More information |
|---|---|---|---|
| Wiring | Wires | Wire the measurement points, switchboard and/or third party equipment to the controller/display unit terminals | See the **Data sheet** for the wiring specifications for each terminal<br>See the drawings from the system designer |
| | Ethernet cables | Connect the controller communication to:<br>• The display unit<br>• Between controllers<br>• External systems | See the **Data sheet** for the Ethernet cable specifications<br>See the communication drawings from the system designer |
| | Cable ties | Secure the rack wiring and Ethernet cables<br>Secure the display unit wiring and Ethernet cables | See **Rack cable strain relief** and **Display unit cable strain relief** in this document for more information |

# 3. Mounting the equipment

## 3.1 Introduction

### 3.1.1 Introduction to mounting the equipment

The controller rack should be delivered from the factory with all the required hardware modules. However, if you need to mount an additional hardware module, or to replace a hardware module, read this chapter.

**INFO**
Hardware modules are standardised, replaceable printed circuit boards that are mounted in the rack. For example, PSM3.1 is a hardware module that supplies power to the rest of the rack.

The controller rack is mounted in an enclosure, while the display unit is mounted in a panel.

This chapter describes how to mount or replace hardware modules, as well as mount the rack and display unit.

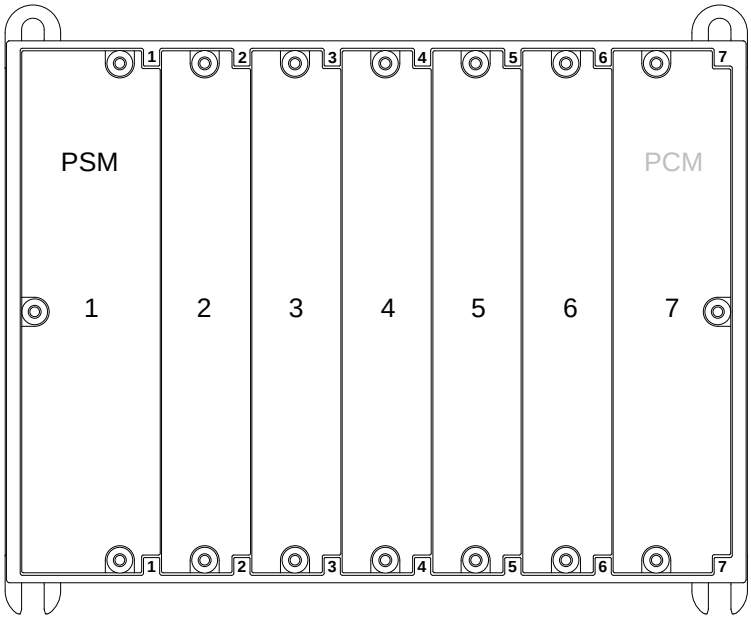
**Deviating from the default configuration**
You can mount the hardware modules in a different order from that recommended in these instructions. If you choose to do this, DEIF recommends that you document where you have chosen to deviate from the default configuration and ensure that this information is included in the system documentation. Record the following for each hardware module:

- Module name
- Module's rack slot number in the default configuration
- Module's rack slot number in your customised configuration

## 3.2 Mounting modules

### 3.2.1 Rack slots and their requirements

The following diagram shows the slot numbering in the rack. The power supply module (PSM) is always mounted in slot 1. If a processor and communication module (PCM) is present, it is always mounted in slot 7.




The controller hardware modules can be arranged in any order in the rack, as long as they comply with these requirements:

- Apart from PSM and PCM, the hardware modules are slotted into the rack from slot 2 onwards, without leaving any empty slots between the hardware modules.
- If a PCM is not present, slot 7 may be used for other hardware modules.
- "Blind" modules (these consist of the module faceplates only) must be installed over empty slots, to protect the controller electronics.

**INFO**
If there are one or more empty slots between the hardware modules in the rack, the hardware modules after the empty slot(s) will not be able to communicate with the PCM module. The software will not be able to recognise or communicate with these hardware modules either.

**INFO**
If you rearrange the order of the hardware modules, you may lose some/all of the module configuration information. You should therefore always make a backup of the configuration before rearranging the hardware modules.

## 3.2.2 Mounting hardware modules in the rack

The controller will normally be supplied with the hardware modules already mounted. However, it may occasionally be necessary for you to add or replace a hardware module. If you need to add a hardware module, you can use the first empty slot from the left of the rack.

### Legal

**INFO**
The manufacturer's warranty will not apply if the rack has been opened by unauthorised persons. However, you are allowed to replace or add hardware modules (dedicated printed circuit boards) supplied by DEIF. To retain the warranty, each hardware module must be mounted by a qualified person, in accordance with these written instructions.

### Safety: Hazardous live currents and voltages

**DANGER!**
**Hazardous live currents and voltages may be present in a rack that is already installed. Contact with these could kill you. Only authorised personnel, who understand the precautions needed and the risks involved in working with live electrical equipment, may do this work.**

### Safety: Disrupting control

**DANGER!**
**Working on the rack may disrupt the control of the generator, busbar or connection. Take the necessary precautions.**

### Protecting equipment: No hot swapping

**CAUTION**
Disconnect all power supplies before removing or adding a hardware module. The hardware modules are not designed for hot swapping.

### Electrostatic precautions when mounting hardware modules

**CAUTION**
Protect the hardware modules against static discharge during installation. Protect the rack against static discharge if it has not yet been mounted and the frame ground has not yet been connected.

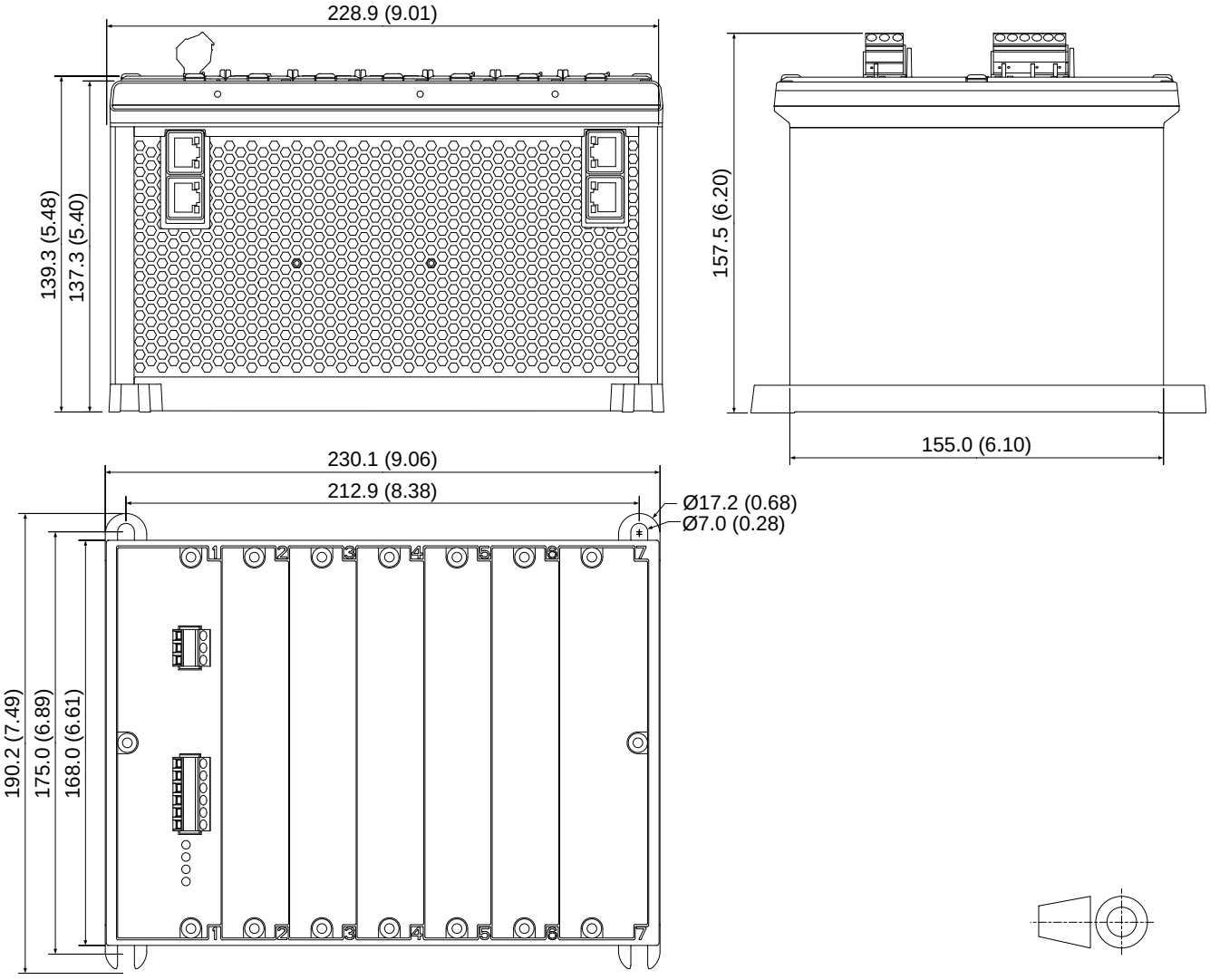
### Physical mounting of hardware modules

1. Disconnect all power supplies (that is, the PSM and, if present, other modules with independent power supplies), to protect the hardware modules and personnel.
2. Test the resistance of the wrist strap and the resistance of the wrist strap connection. Do not continue if the wrist strap connection is faulty. Use the wrist strap at all times while installing or uninstalling the hardware modules to protect them against static discharge.
3. If applicable, remove the hardware module to be replaced from the rack:
   a. Remove the terminal blocks, and make sure that there are no wires in the way of removing the hardware module.
      • Where relevant, disconnect the Ethernet cables from the top and bottom of the hardware module.
   b. Loosen the hardware module faceplate screws using a screwdriver with a TX20 bit.
      • Do not force the screws to unscrew completely. The screws are built-in and therefore normally remain attached to the faceplate.
   c. Use pliers or your fingers to pull the faceplate screws, and carefully slide the hardware module out of the rack.
      • Only pull the screws. Do not pull any other part of the faceplate.
   d. If you want to re-use the hardware module, or send it in for testing, be careful to only handle it by its faceplate. Put the hardware module in ESD protective packaging after removing it.
4. To install the new hardware module:
   a. Open the ESD protective packaging, and remove the new hardware module, holding it only by its faceplate.
   b. Make sure that the hardware module is the right way up, and slide it into the correct slot. The hardware module should slide in easily.
   c. Tighten the screws on the hardware module faceplate using a screwdriver with a TX20 bit, and 0.5 N·m (4.4 lb-in) of torque.
   d. Replace all the terminal blocks, including any Ethernet cables to the module.
5. If the rack has not yet been mounted, return the rack to its protective packaging.

# 3.3 Mounting the controller rack

## 3.3.1 Rack dimensions

The following drawing shows a first-angle projection of the rack, with dimensions. Dimensions are in mm (followed by approximate dimensions in inches). The rack is supplied with the cable strain relief plates mounted (not shown on the drawing).



### 3.3.2 Rack drilling drawing

A drilling template with the correct dimensions for the four bolt holes required to mount the rack can be downloaded from the DEIF homepage. The download is available as either an AutoCAD file or a stp file.

The diagram below can be used to make a drilling template for the four bolt holes required to mount the rack. Dimensions are in mm (followed by approximate dimensions in inches).


**CAUTION**
This drilling drawing is given as a guideline, and the dimensions will not be correct when printed. Use the dimensions given to create your drilling template.

### 3.3.3 Mounting the rack

The rack is designed to be mounted in an enclosure.

For UL/cUL listing, the rack must be mounted on a flat surface of a type 1 enclosure. For UL/cUL listing, the rack must be installed in accordance with the NEC (US) or the CEC (Canada). See the **Data sheet** for more details.

**CAUTION**
Dust accumulation may damage the controller or cause overheating. DEIF recommends mounting the rack in a cabinet with a filter on the air supply.

**CAUTION**
Protect the controller terminals from static discharge during installation, especially while the frame ground is not connected.

### Ventilation requirements and spacing

For ventilation, there must be a minimum of 20 mm (0.8 in) free space above and below the rack frame.

### Cable requirements and spacing

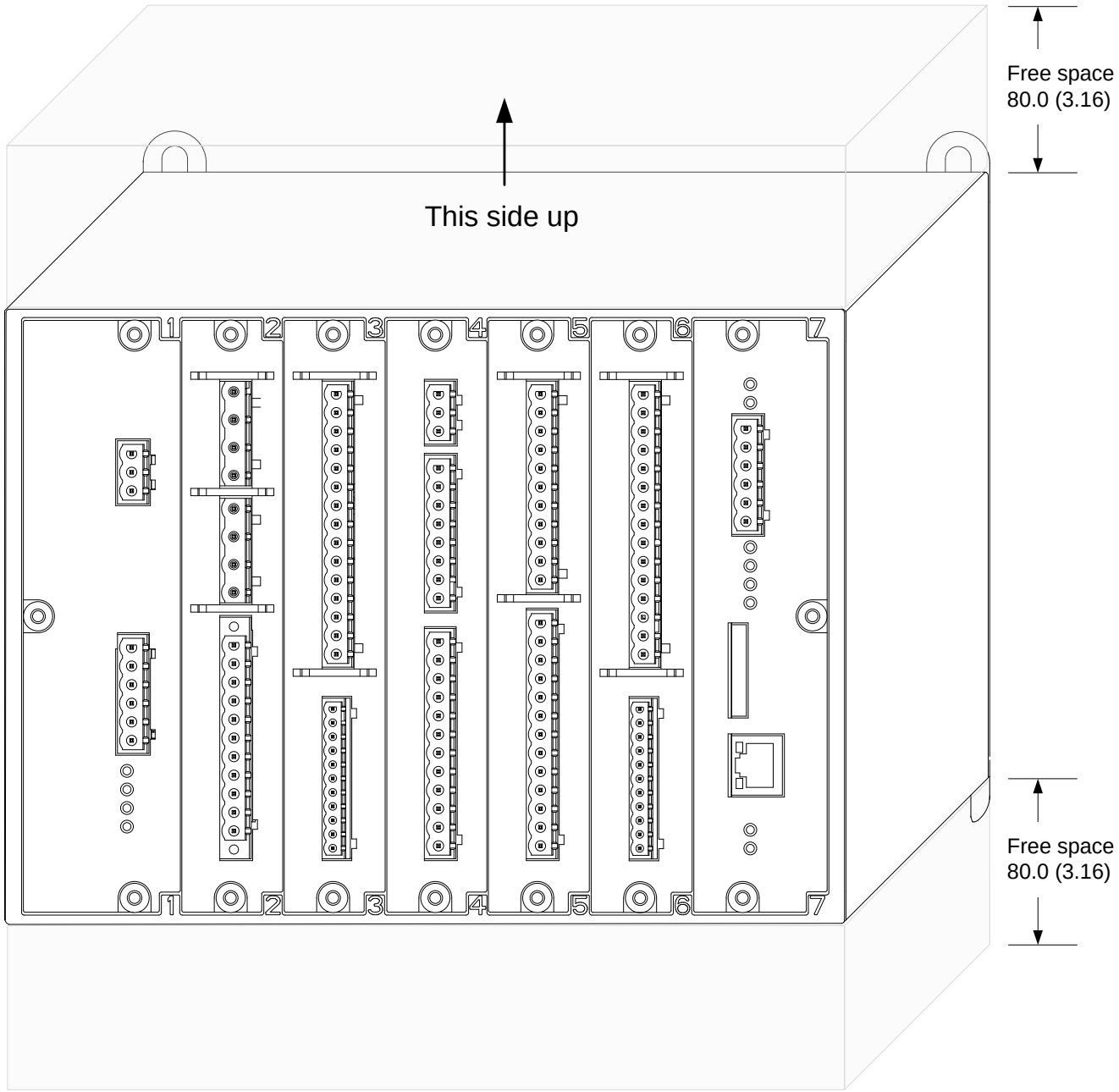
Ensure that there is enough space in front of, above and below the rack for the cables.

**INFO**
DEIF recommends that you always follow the cable manufacturer's bend radius requirements. As a guideline, Ethernet cables may require a minimum bend radius of around 40 mm (1.6 in). Load sharing and CAN bus cables may require a minimum bend radius of around five times the cable radius.

### Ethernet cables

Allow enough space for the Ethernet cable plug and the Ethernet cable minimum bend radius. In addition, allow enough working space above and below the rack to connect the Ethernet cables.

**Figure 3.1** Example of the minimum space above and below the rack for an Ethernet cable (plug = 40 mm, cable bend radius = 40 mm)




### Fasteners for mounting the rack

Fasteners for mounting the rack are **not** supplied with the rack. The rack fasterners must be able to support the weight of the rack and the wiring.

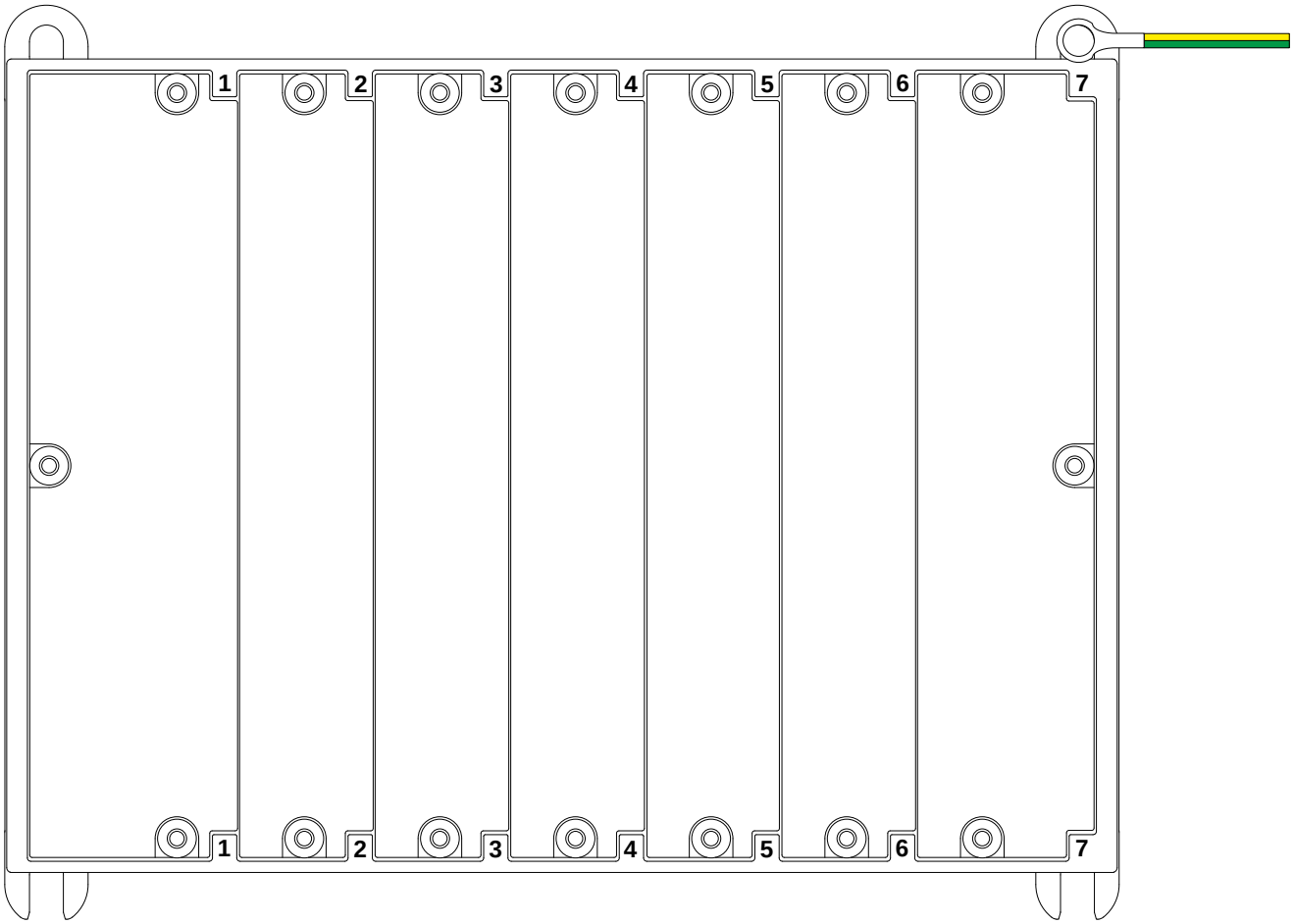
You can, for example, mount the rack using four Ø6 mm (1/4 in) bolts, four nuts and eight Ø6 mm (1/4 in) washers.

| | |
|---|---|
| **Example** | For bolts, the minimum length is 12 mm (0.47 in) for the rack mounting loop. Length is also needed for the washer thickness (typically 1.5 mm), the nut (typically 4 mm) and the cabinet back plate thickness.<br><br>If the cabinet back plate is 2.5 mm (0.10 in) thick, then the minimum bolt length is 20 mm (0.79 in). For grounding, a slightly longer bolt is required. |

### Mounting the rack

To mount the rack (using bolts, nuts and washers):

1. Check the rack orientation.
2. Check that the free space required for ventilation and cables is available.
3. Drill the holes required in the vertical surface on which the rack will be mounted. The rack must be mounted with its back vertical, and its long axis horizontal. The writing on the modules must be horizontal.
4. Mount the four bolts on the vertical surface that the rack will be mounted on, and put a washer on each bolt.
5. Slide the rack onto the bolts, and put a washer on three of the bolts.
6. Screw the nuts onto the three bolts, and tighten them, using 4 N·m (35 lb-in) of torque.
7. Put a toothed lock washer on the remaining bolt, teeth facing the rack mounting loop. The washer must cut into the rack mounting loop, to ensure there is a good galvanic connection.
8. Put one end of the grounding wire on the bolt.
9. Screw the nut onto the bolt, and tighten it, using 4 N·m (35 lb-in) of torque.
10. Galvanically connect the other end of the grounding wire to the cabinet.




## 3.3.4 Rack cable strain relief

Use the cable strain relief plates or the cable tie slots to secure cables and wiring.

### Cable strain relief

You can use the cable strain relief plates mounted at the top and bottom of the front of the rack to hold cables in place. Thread cable ties through the slots in the plates and secure cables to these.

The rack is delivered with cable strain relief plates already mounted.

- You can remove a cable strain relief plate by unscrewing the three 3 mm screws using TX 10 screwdriver.
- You can remount the cable strain relief plate using the three 3 mm TX 10 screws and 0.5 N·m (4.4 lb-in) of torque.

### Cable tie slots

There are six cable tie slots at the top of the rack, and six at the bottom of the rack, as shown in the following figure. The maximum cable tie width is 2.5 mm (0.1 in).

The cable ties and cable routing must not block more than 20 % of the ventilation holes.

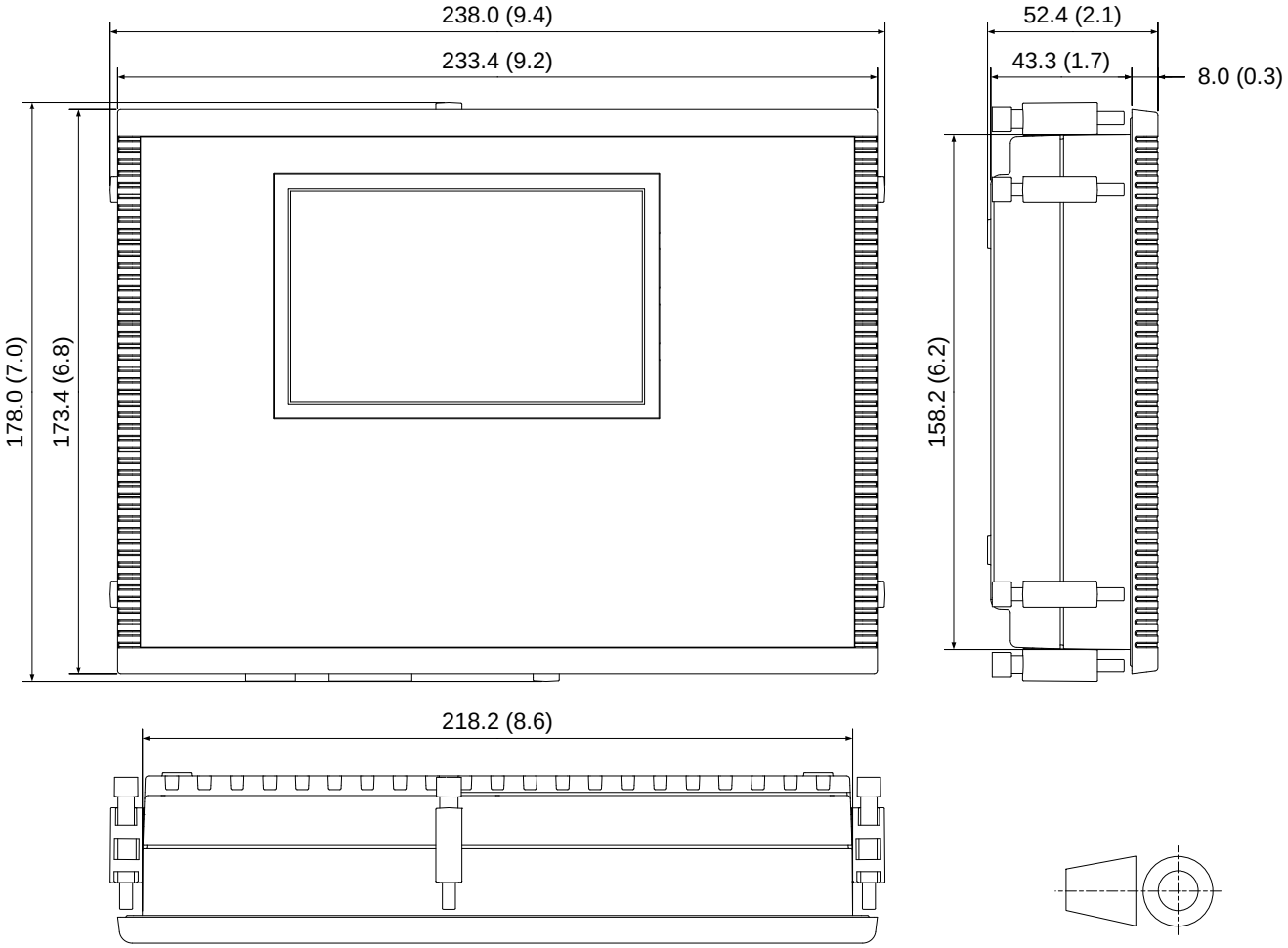
**Figure 3.2** Cable tie slot positions shown by red cable ties (top of rack on the left; bottom of rack on the right, with an Ethernet cable example)

**INFO**
The cable tie slots are inside the rack's aluminium frame. Only use them if the class society rules allow the wiring to be secured directly to metal. Alternatively, you can use extra insulation between the rack's frame and the wire.

# 3.4 Mounting the display unit

## 3.4.1 Display unit dimensions

The diagram below shows a first-angle projection of the display unit, with dimensions. Dimensions are in mm (followed by approximate dimensions in inches).

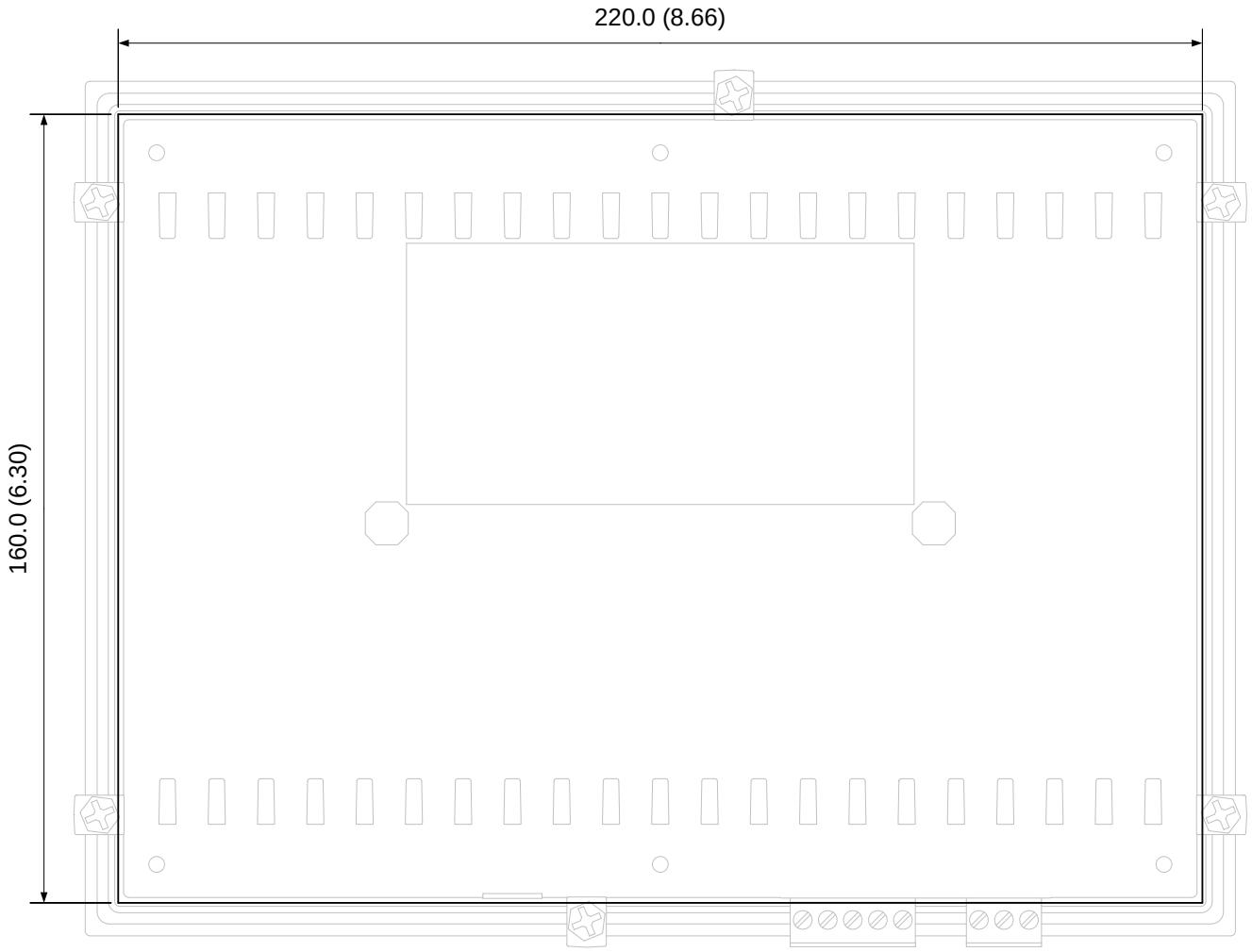



## 3.4.2 Display unit panel cutout

The panel cutout required is L 220.0 mm × H 160.0 mm, with tolerance +0.4 mm and -0.0 mm (L 8.66 in × H 6.30 in, +0.02 in and -0.00 in).

A panel cutout with the correct dimensions for the display unit can be downloaded from the DEIF homepage. The download is available as either an AutoCAD file or a stp file.

The following drawing shows the panel cutout with a shadow of the display unit as viewed from the back (that is, from inside the panel).




**CAUTION**
This panel cutout drawing is given as a guideline, and the dimensions will not be correct when printed. Use the dimensions given to create your panel cutout template.

### 3.4.3 Mounting the display unit

The display unit is designed to be mounted in a panel, with its back in an enclosure.

For UL/cUL listing, the display unit must be mounted on a flat surface of a type 1 enclosure. For UL/cUL listing, the display unit must be installed in accordance with the NEC (US) or the CEC (Canada). See the **Data sheet** for more details.

The display unit is mounted using six fixing screw clamps (supplied with the display unit).

**CAUTION**
The back of the display unit is not protected against dust. Dust accumulation may damage the display unit or lead to overheating. DEIF recommends mounting the display unit so that its back is in a cabinet with a filter on the air supply.

**CAUTION**
Protect the display unit terminals from static discharge during installation. Protecting the terminals is very important while the frame ground is not connected.

### Ventilation requirements and spacing

For proper ventilation, the display unit must be mounted with its back vertical, and its long axis horizontal. The writing on the front of the display unit must be horizontal. Inside the cabinet, there must be a minimum of 20 mm (0.8 in) free space above, below and behind the display unit.

### Cable requirements and spacing

For the Ethernet cables, the bends must not be tighter than the minimum bend radius specified by the cable manufacturers. You must therefore ensure that there is enough space to the right of the display unit (as seen from the front) for the Ethernet cables.

**INFO**
DEIF recommends that you always follow the cable manufacturer's bend radius requirements. As a guideline, Ethernet cables may require a minimum bend radius of around 40 mm (1.6 in).

### Cable strain relief

You can use the two "+" shaped slots on the back of the display units for cable strain relief and hold cables in place. Thread a cable tie (maximum 4 mm (0.15 in) wide) through the horizontal or vertical slot.

The cable routing must not block more than 20 % of the ventilation holes.

### Mounting the display unit

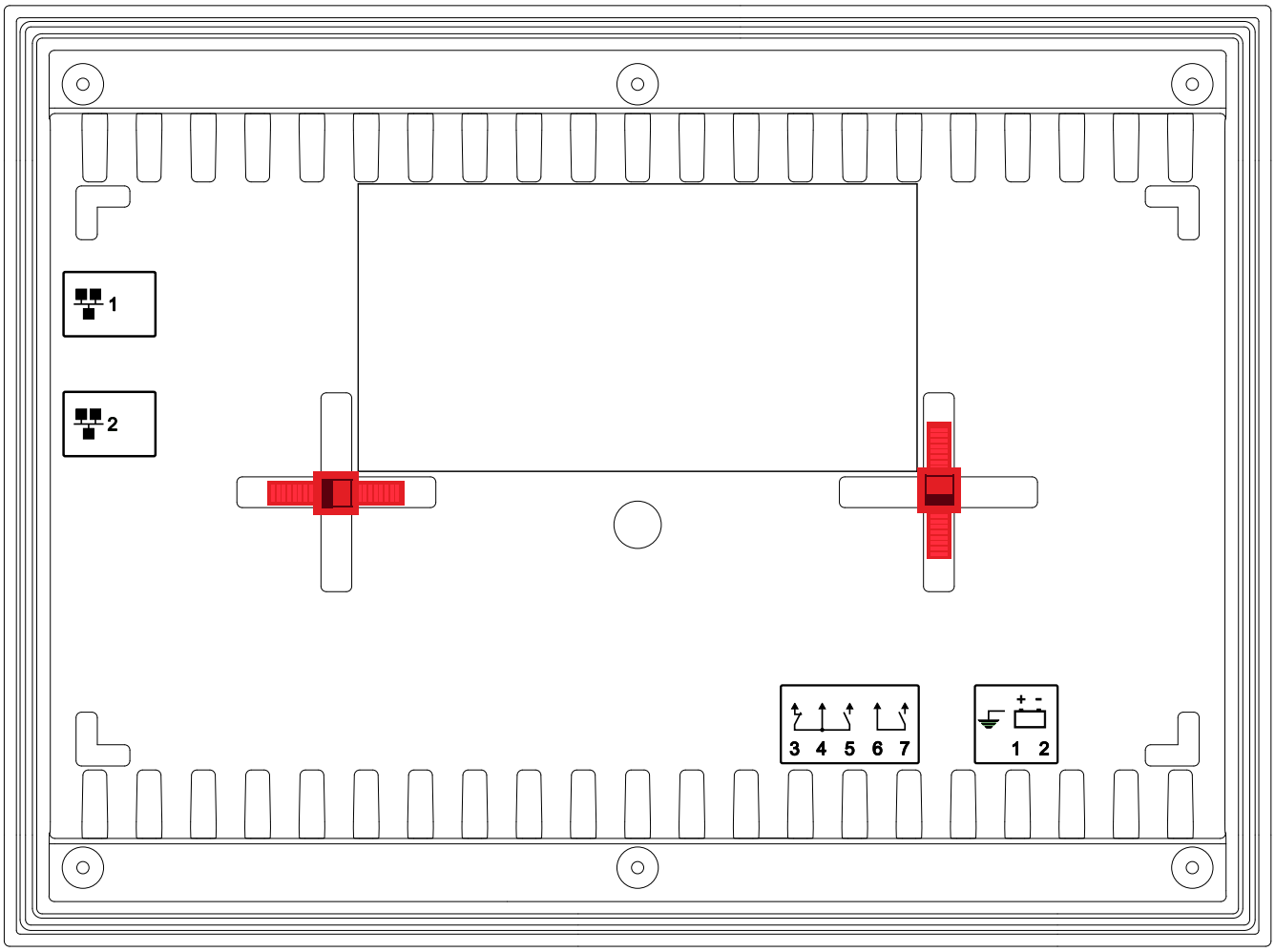
To mount the display unit:

1. Check that a correctly sized panel cutout is available.
2. Check that there is enough space for the display unit.
   - The display unit extends 44 mm (1.7 in) behind the panel.
   - The wiring to the display unit terminals may also require some space.
   - Ventilation space is required, as described above.
3. Flush mount the display unit using the six fixing screw clamps, which are included with the display unit.
   a. Place the display unit in the panel cutout.
   b. Hook and click a screw clamp into the screw clamp holes at the right-top position of the display unit. Turn the screw until the display unit is secure.
   c. Repeat step 3b for the three remaining screw clamp positions.
   d. If necessary, use your fingers or a screwdriver to tighten the screws. However, be careful not to exceed the recommended torque (0.15 N·m (1.3 lb-in)).
4. Position the terminal connection blocks correctly, then press them firmly into the terminal connection slots.
   - The terminal connection blocks are keyed to prevent incorrect mounting.
   - The two terminal connection blocks are included in the box with the display unit.

## 3.4.4 Display unit cable strain relief

Use the cable tie slots on the display unit for cable strain relief.

The back of the display unit has four 4 mm wide cable tie slots. The cable ties can either be placed horizontally or vertically in the cable tie slots, as shown in the figure below.




To use a slot: Bend the end of the cable tie, then slide it through the slot.

# 4. Default wiring for controller types

## 4.1 Introduction

### 4.1.1 Introduction to default wiring

This chapter provides tables listing the terminals and the default wiring for each controller type. The default terminal connections are shown using a *. Other connections that you might want to use are listed in the tables for each controller type. Note that these other connections are optional and/or configurable. Some of the default terminal connections are also optional, configurable, or the function may be achieved using other terminals.

#### Wiring

The **Wiring the controller** chapter contains detailed information for each terminal of the hardware modules, including examples of how these terminals can be connected to external hardware.

**DANGER!**
**Only use the terminal blocks supplied by DEIF. Do not use substitutes.**

#### Specifications

The **Data sheet** contains the authoritative list of technical specifications for each set of terminals. For ease of use, some simplified specifications are listed in this chapter.

#### Default configuration

This section also provides drawings of the default wiring for the relevant hardware modules for each controller type. The drawing symbols are included in the glossary. Drawings are not given for the hardware modules with no default wiring.

#### Custom configurations

You can connect the inputs and outputs to terminals other than the terminals specified in the default configuration. DEIF recommends that you keep a record of where the wiring deviates from the default configuration.

In addition to the default wiring, the designer may specify inputs and outputs, according to the specific system's requirements. These may use the available configurable connections in the basic controller type's hardware, and/or the additional connections made available by installing additional modules. These additional connections are not included in these default wiring drawings, since they are specific to the system. These connections must be shown on the designer's drawings for the system.

If there is space in the rack, you can mount additional modules for additional inputs and outputs. These inputs and outputs are not described in these **Installation instructions**. The details of these connections are specific to the installation, and must be included in the system designer's drawings.

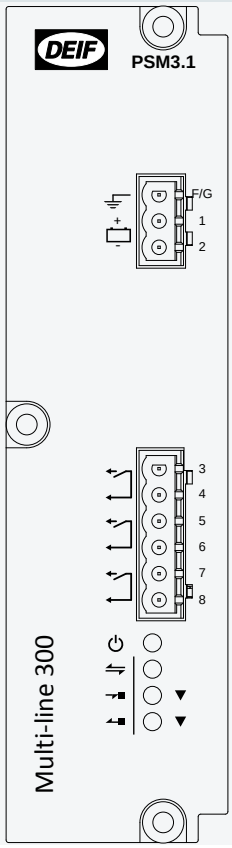
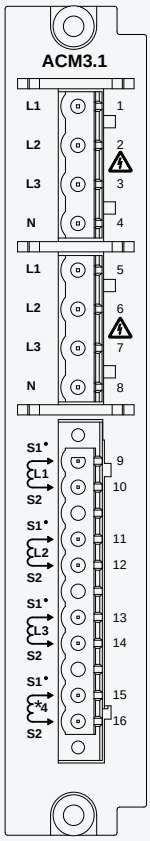
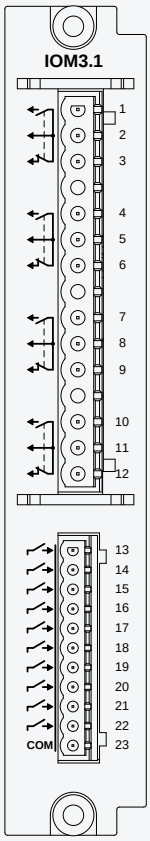
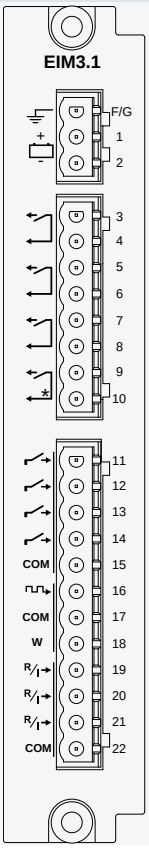
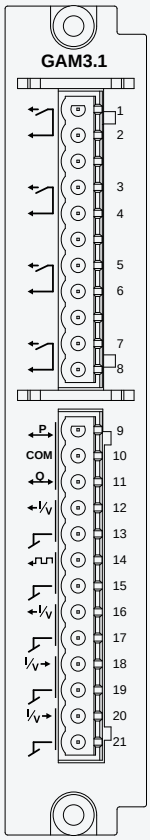
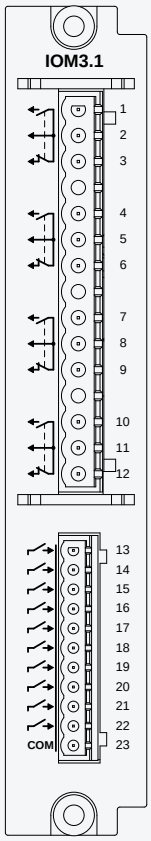
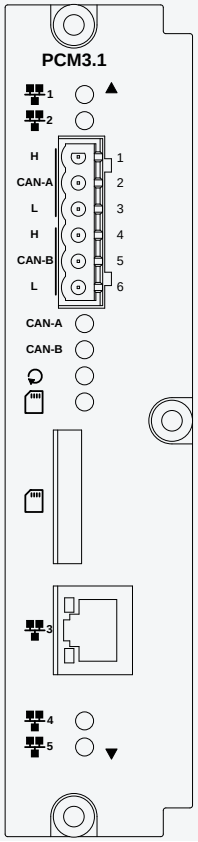
#### Wire up the controller rack from right to left

DEIF recommends that you wire up the controller rack from right to left, because of the 45º terminal blocks.

# 4.2 Hardware configurations

## 4.2.1 GENSET controller hardware configuration

**Table 4.1** GENSET controller default hardware configuration

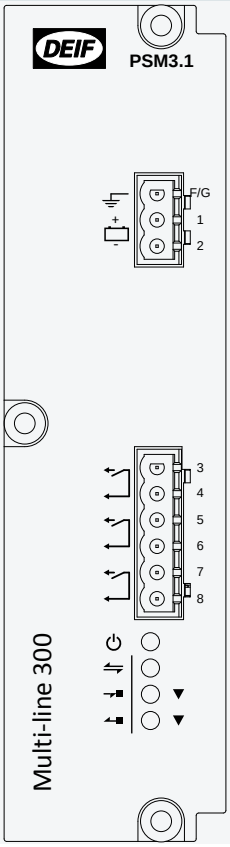
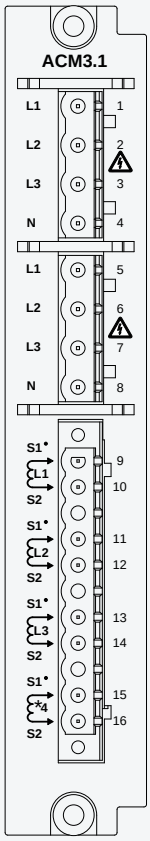
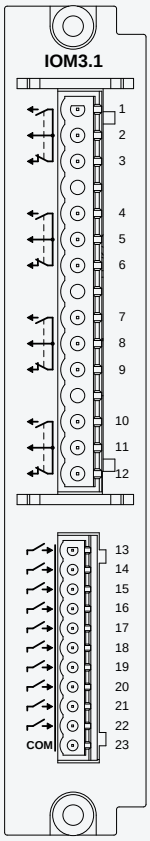
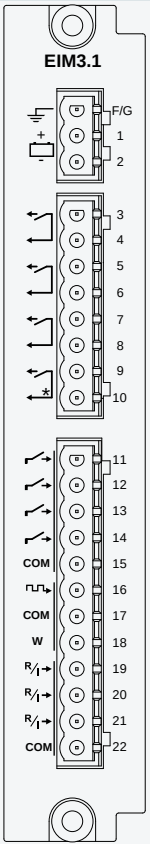
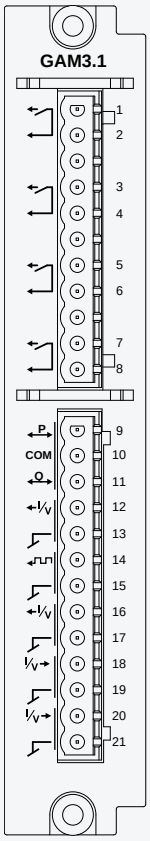
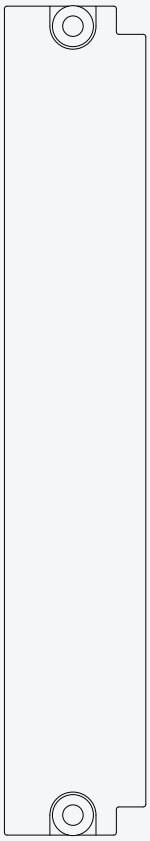
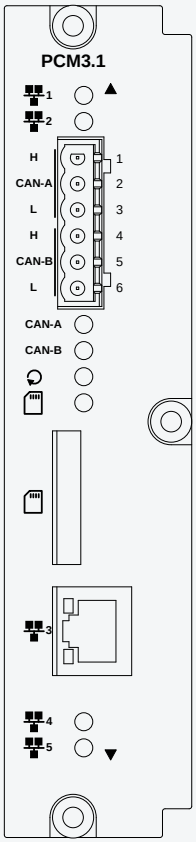
| Slot 1 | Slot 2 | Slot 3 | Slot 4 | Slot 5 | Slot 6 | Slot 7 |
|---|---|---|---|---|---|---|
| PSM3.1 | ACM3.1 | IOM3.1 | EIM3.1 | GAM3.1 | IOM3.1 | PCM3.1 |
| Power supply module | Alternating current module | Input output module | Engine interface module | Governor and AVR module | Input output module | Processor and communication module |
|  |  |  |  |  |  |  |



| | |
|---|---|
| **Weight** | Controller and display unit: 3808 g (8.4 lb)<br>Controller (including the default hardware modules): 2973 g (6.5 lb)<br>Display unit: 835 g (1.8 lb) |

## 4.2.2 EMERGENCY genset controller hardware configuration

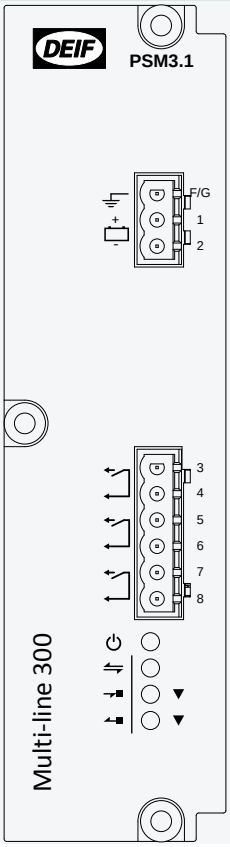
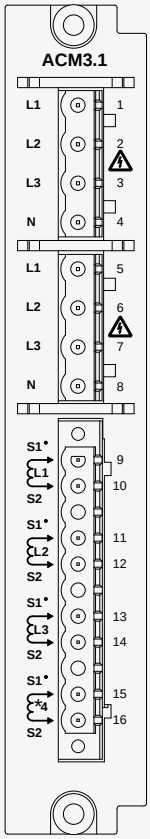
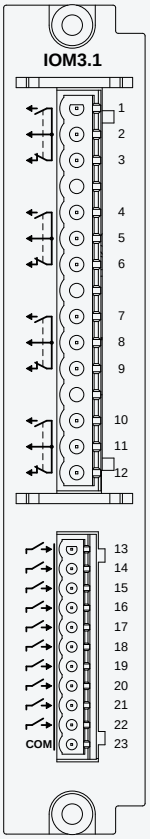
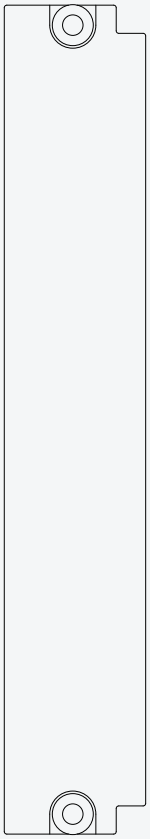
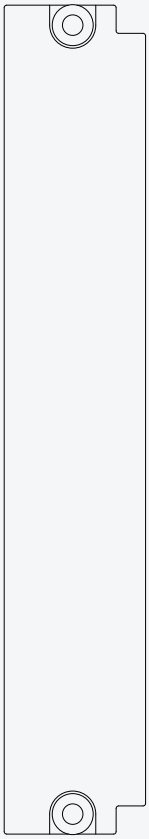
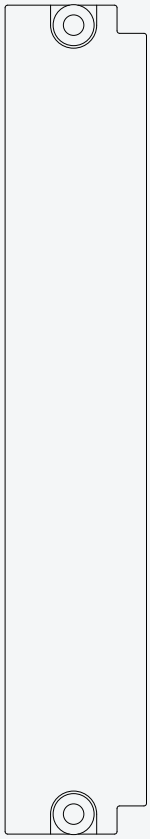
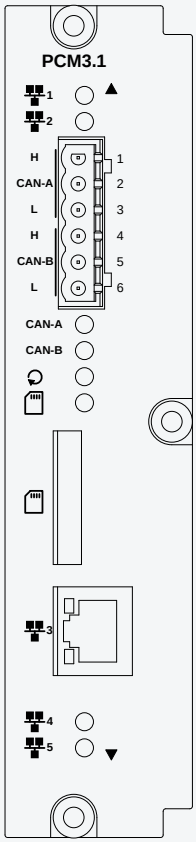
**Table 4.2** EMERGENCY genset controller default hardware configuration

| Slot 1 | Slot 2 | Slot 3 | Slot 4 | Slot 5 | Slot 6 | Slot 7 |
|---|---|---|---|---|---|---|
| PSM3.1 | ACM3.1 | IOM3.1 | EIM3.1 | GAM3.1 | Blind module | PCM3.1 |
| Power supply module | Alternating current module | Input output module | Engine interface module | Governor and AVR module | | Processor and communication module |
|  |  |  |  |  |  |  |

| | |
|---|---|
| **Weight** | Controller and display unit: 3626 g (8.0 lb)<br>Controller (including the default hardware modules): 2791 g (6.1 lb)<br>Display unit: 835 g (1.8 lb) |

## 4.2.3 SHAFT generator controller hardware configuration

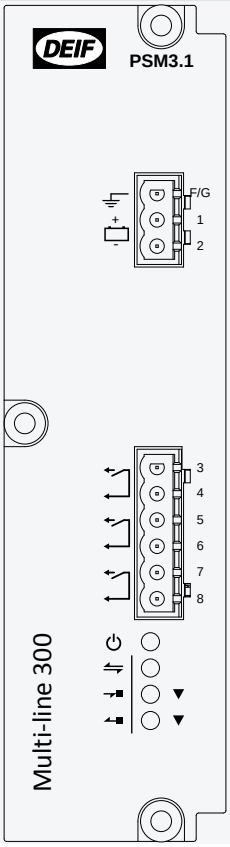
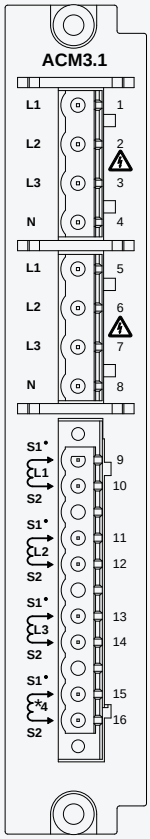
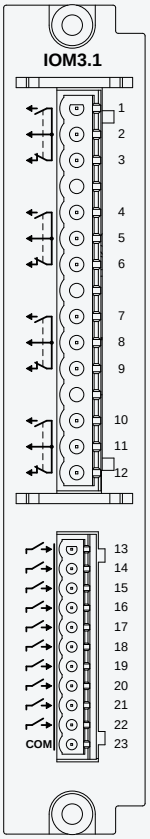
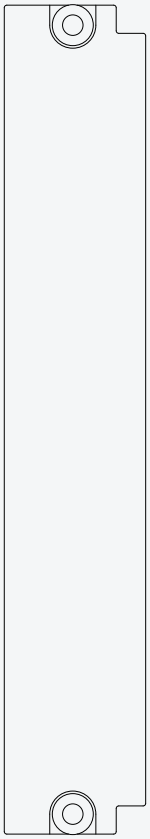
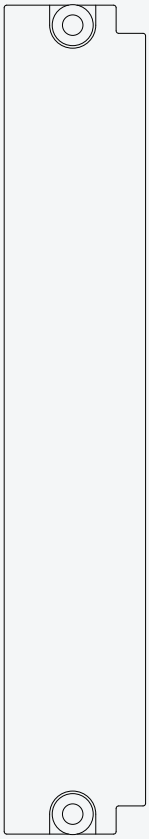
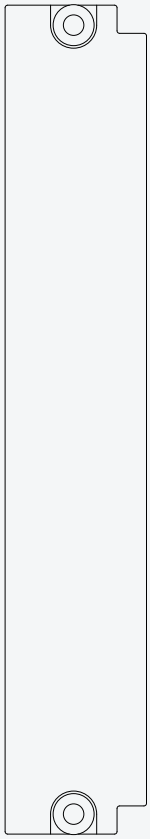
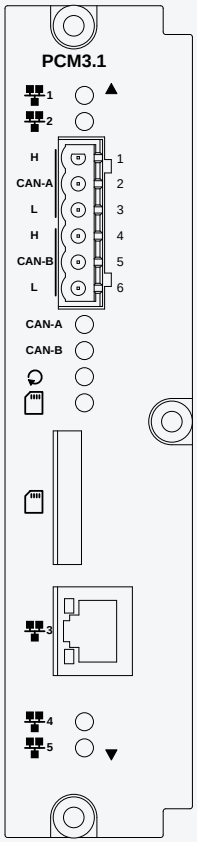
**Table 4.3** SHAFT generator controller default hardware configuration

| Slot 1 | Slot 2 | Slot 3 | Slot 4 | Slot 5 | Slot 6 | Slot 7 |
|---|---|---|---|---|---|---|
| PSM3.1 | ACM3.1 | IOM3.1 | Blind module | Blind module | Blind module | PCM3.1 |
| Power supply module | Alternating current module | Input output module | | | | Processor and communication module |
|  |  |  |  |  |  |  |

| | |
|---|---|
| **Weight** | Controller and display unit: 3180 g (7.0 lb)<br>Controller (including the default hardware modules): 2345 g (5.2 lb)<br>Display unit: 835 g (1.8 lb) |

## 4.2.4 SHORE connection controller hardware configuration

**Table 4.4** SHORE connection controller default hardware configuration

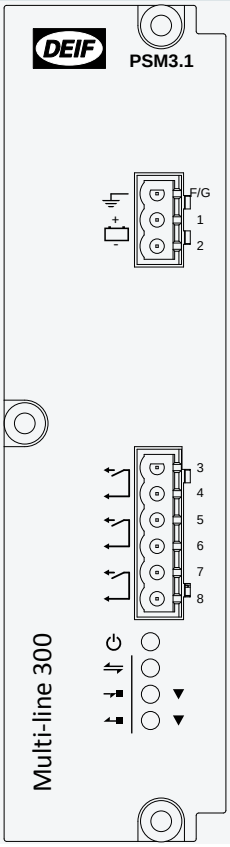
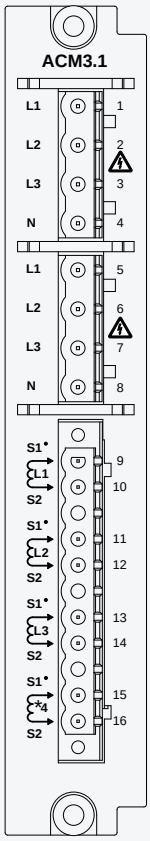
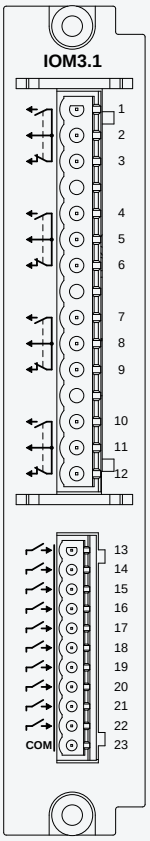
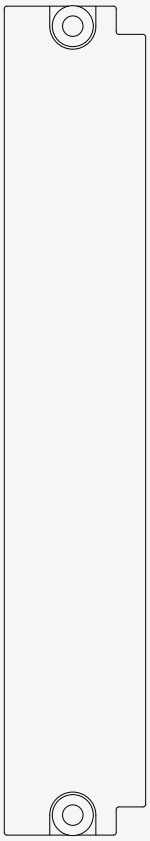
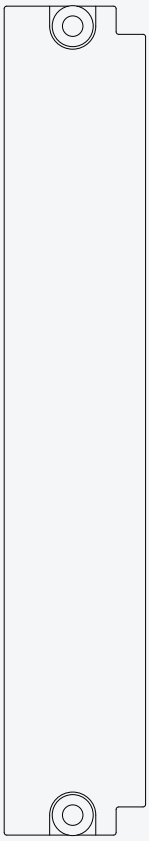
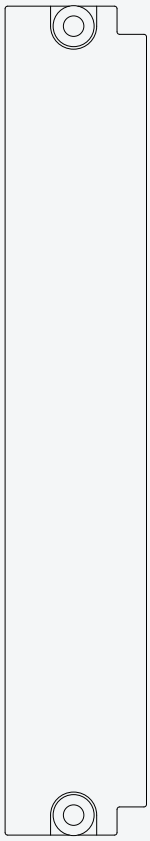
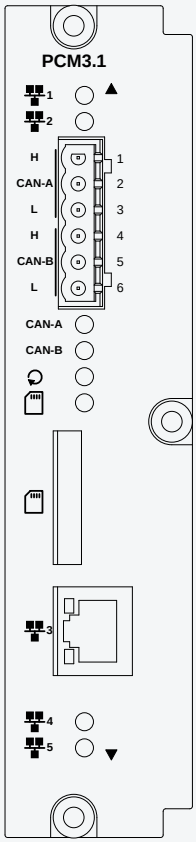
| Slot 1 | Slot 2 | Slot 3 | Slot 4 | Slot 5 | Slot 6 | Slot 7 |
|---|---|---|---|---|---|---|
| PSM3.1 | ACM3.1 | IOM3.1 | Blind module | Blind module | Blind module | PCM3.1 |
| Power supply module | Alternating current module | Input output module | | | | Processor and communication module |
|  |  |  |  |  |  |  |



| | |
|---|---|
| **Weight** | Controller and display unit: 3180 g (7.0 lb)<br>Controller (including the default hardware modules): 2345 g (5.2 lb)<br>Display unit: 835 g (1.8 lb) |

## 4.2.5 BUS TIE breaker controller hardware configuration

**Table 4.5** BUS TIE breaker controller default hardware configuration

| Slot 1 | Slot 2 | Slot 3 | Slot 4 | Slot 5 | Slot 6 | Slot 7 |
|---|---|---|---|---|---|---|
| PSM3.1 | ACM3.1 | IOM3.1 | Blind module | Blind module | Blind module | PCM3.1 |
| Power supply module | Alternating current module | Input output module | | | | Processor and communication module |
|  |  |  |  |  |  |  |

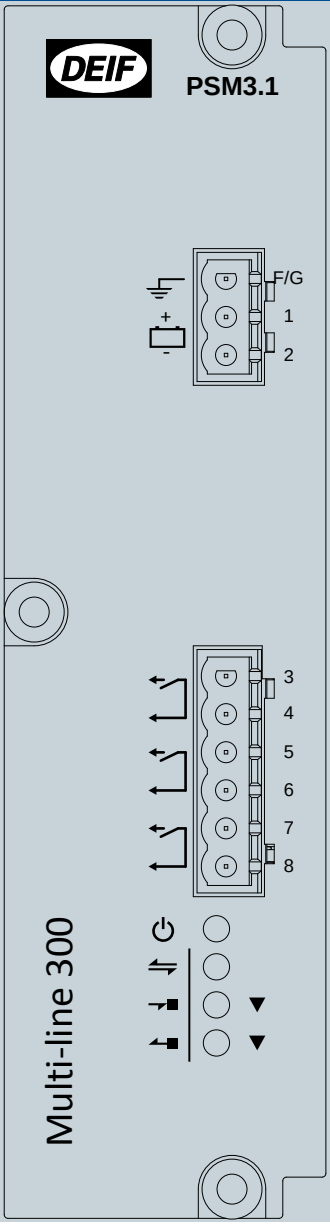
| | |
|---|---|
| **Weight** | Controller and display unit: 3180 g (7.0 lb)<br>Controller (including the default hardware modules): 2345 g (5.2 lb)<br>Display unit: 835 g (1.8 lb) |

# 4.3 PSM3.1 terminal connections and default wiring

## 4.3.1 PSM3.1 terminal connections

This is a default module for:

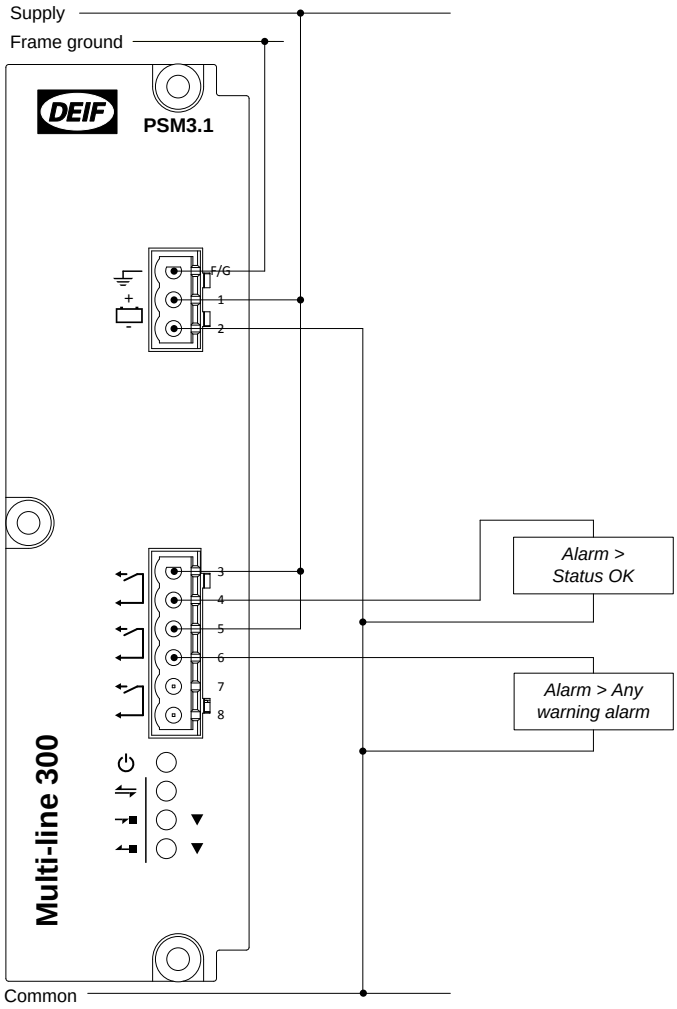
- GENSET controller
- EMERGENCY genset controller
- SHAFT generator controller
- SHORE connection controller
- BUS TIE breaker controller




| Terminal | Symbol | Name | Type | Function |
|---|---|---|---|---|
| F/G | | F/G | Ground | Frame ground* |
| 1 | | + | 12 or 24 V DC (nominal) | Power supply* |
| 2 | | - | 0 V DC | |
| 3 | | Common | Relay output (30 V DC and 1 A) | Status |
| 4 | | Normally open | | |
| 5 | | Common | | Warning* |
| 6 | | Normally open | | |
| 7 | | Common | | Alarm |
| 8 | | Normally open | | |
| EtherCAT input | | IO extension | RJ45 (bottom of module) | DEIF EtherCAT connection for future use |
| EtherCAT output | | IO extension | RJ45 (bottom of module) | DEIF EtherCAT connection for future use |

* Shows the default terminal connections.

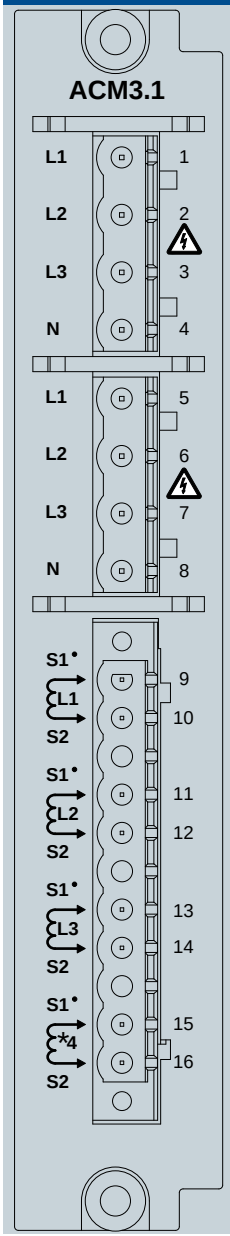
### 4.3.2 Default wiring for controller PSM3.1




## 4.4 ACM3.1 terminal connections and default wiring

### 4.4.1 ACM3.1 terminal connections

| This is a default module for: | GENSET controller | EMERGENCY genset controller | SHAFT generator controller | SHORE connection controller | BUS TIE breaker controller |
|---|---|---|---|---|---|

| | Terminal | Symbol | Name | Type | Function |
|---|---|---|---|---|---|
|  | 1 | L1 | L1 voltage | Voltage**<br>100 to 690 V AC phase-to-phase (nominal) | [Busbar] L1* |
| | 2 | L2 | L2 voltage | | [Busbar] L2* |
| | 3 | L3 | L3 voltage | | [Busbar] L3* |
| | 4 | N | N voltage | | [Busbar] N (optional) |
| | 5 | L1 | L1 voltage | Voltage**<br>100 to 690 V AC phase-to-phase (nominal) | [Controlled equipment] L1* |
| | 6 | L2 | L2 voltage | | [Controlled equipment] L2* |
| | 7 | L3 | L3 voltage | | [Controlled equipment] L3* |
| | 8 | N | N voltage | | [Controlled equipment] N (optional) |
| | 9 | S1 S2 | Current in (European: S1; US: ·) | Current<br>1 or 5 A AC (nominal) | [Controlled equipment] L1* |
| | 10 | | Current out (European: S2) | | |
| | 11 | S1 S2 | Current in (European: S1; US: ·) | Current<br>1 or 5 A AC (nominal) | [Controlled equipment] L2* |
| | 12 | | Current out (European: S2) | | |
| | 13 | S1 S2 | Current in (European: S1; US: ·) | Current<br>1 or 5 A AC (nominal) | [Controlled equipment] L3* |
| | 14 | | Current out (European: S2) | | |
| | 15 | S1 S2 | Current in (European: S1; US: ·) | Current<br>1 or 5 A AC (nominal) | [Controlled equipment] N, or configurable (4th current measurement for future use) |
| | 16 | | Current out (European: S2) | | |

* Shows the default terminal connections.

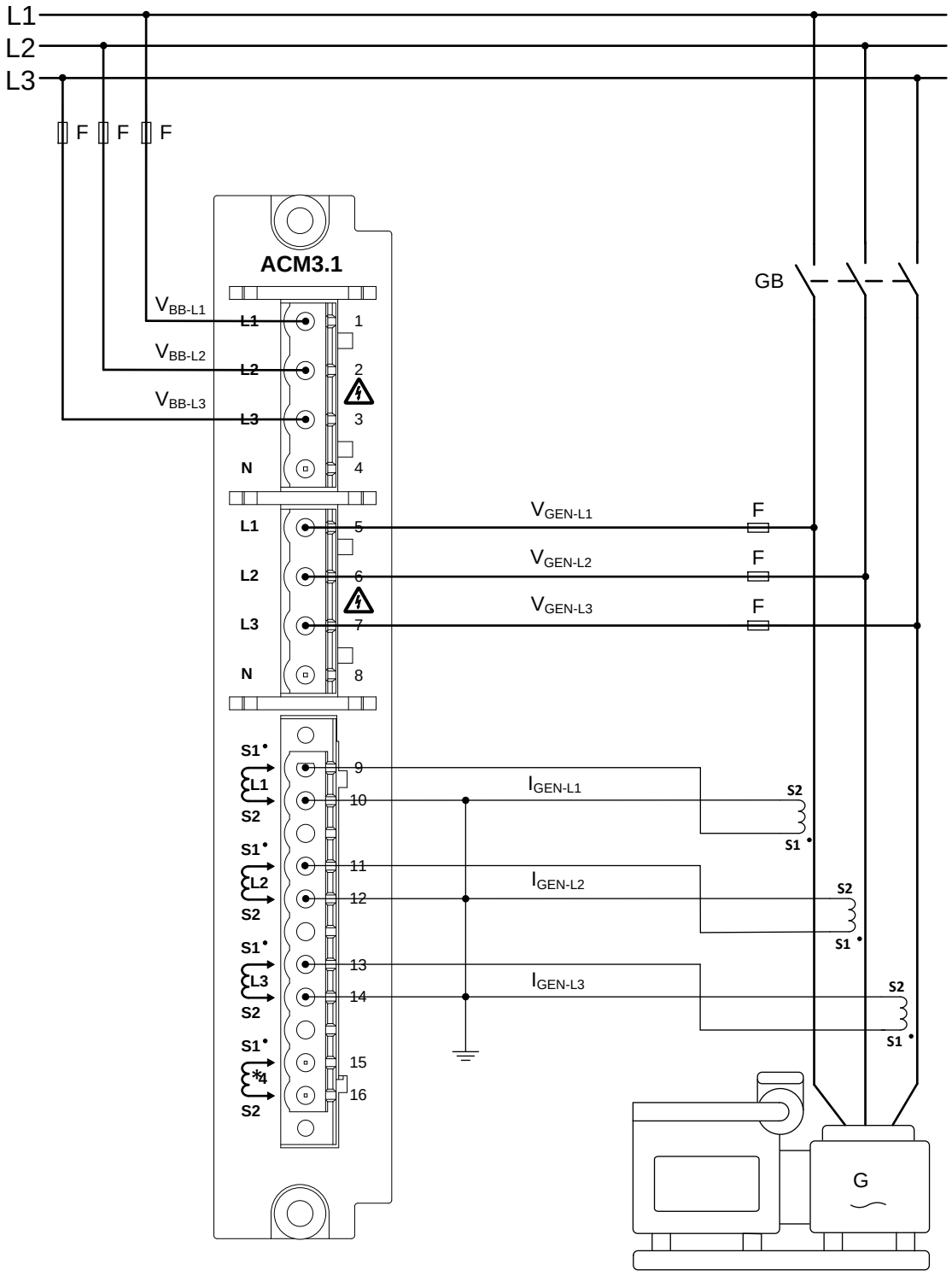
**These two sets of voltage measurements must not be swapped around. The controller uses the second set of voltage measurements together with the current measurements in a number of very important calculations.

**DANGER!**
**The current measurement terminal block MUST always be screwed onto the module. Do not connect or disconnect any current transformer (CT) while there is current in the line.**

**Table 4.6** Controller specific function names

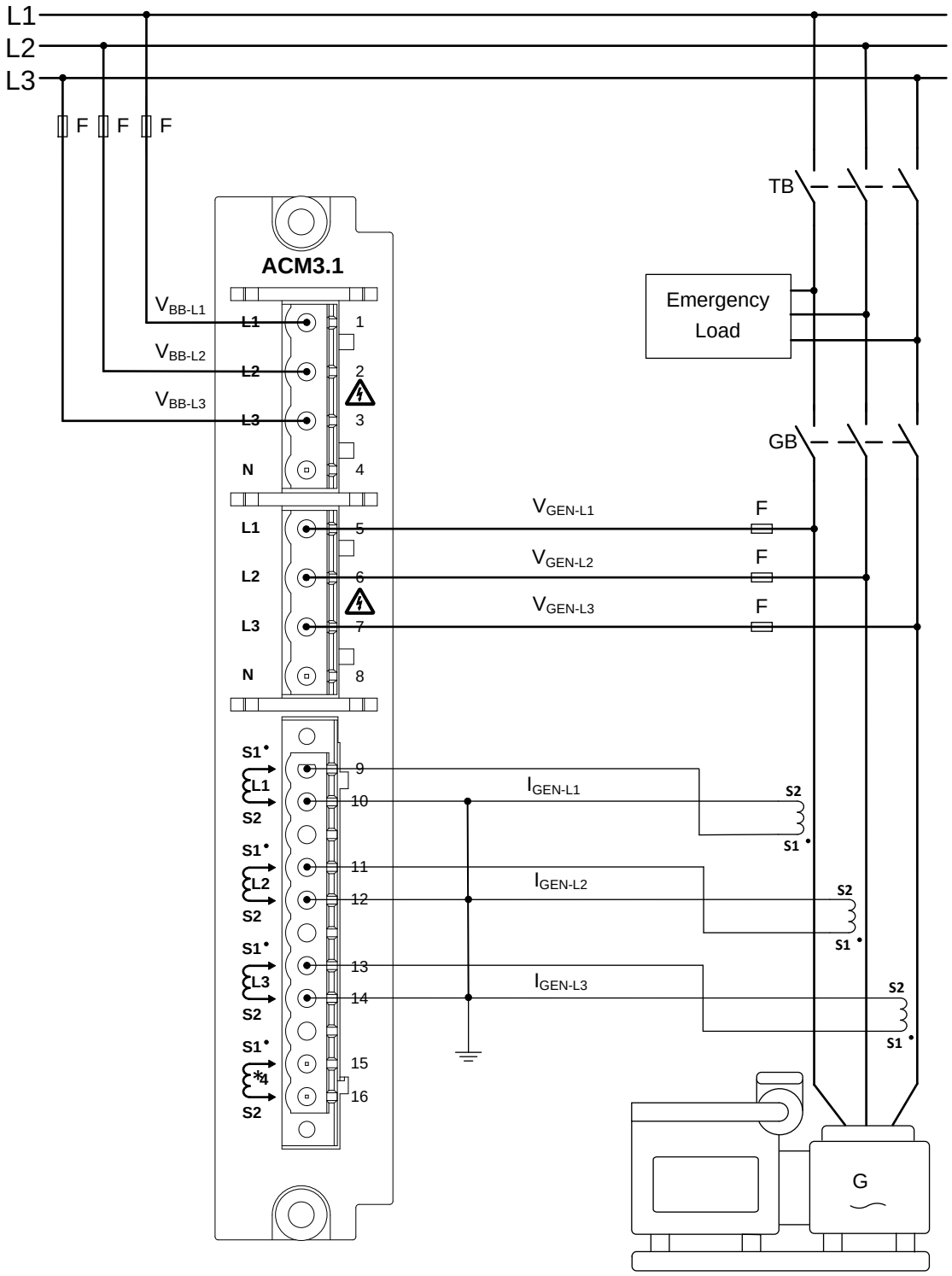
| Function |  |  |  |  |  |
|---|---|---|---|---|---|
| [Busbar] | Busbar | Busbar | Busbar | Ship busbar | Busbar B |
| [Controlled equipment] | Generator | Generator | Generator | Shore busbar | Busbar A |

## 4.4.2 Default wiring for GENSET controller ACM3.1



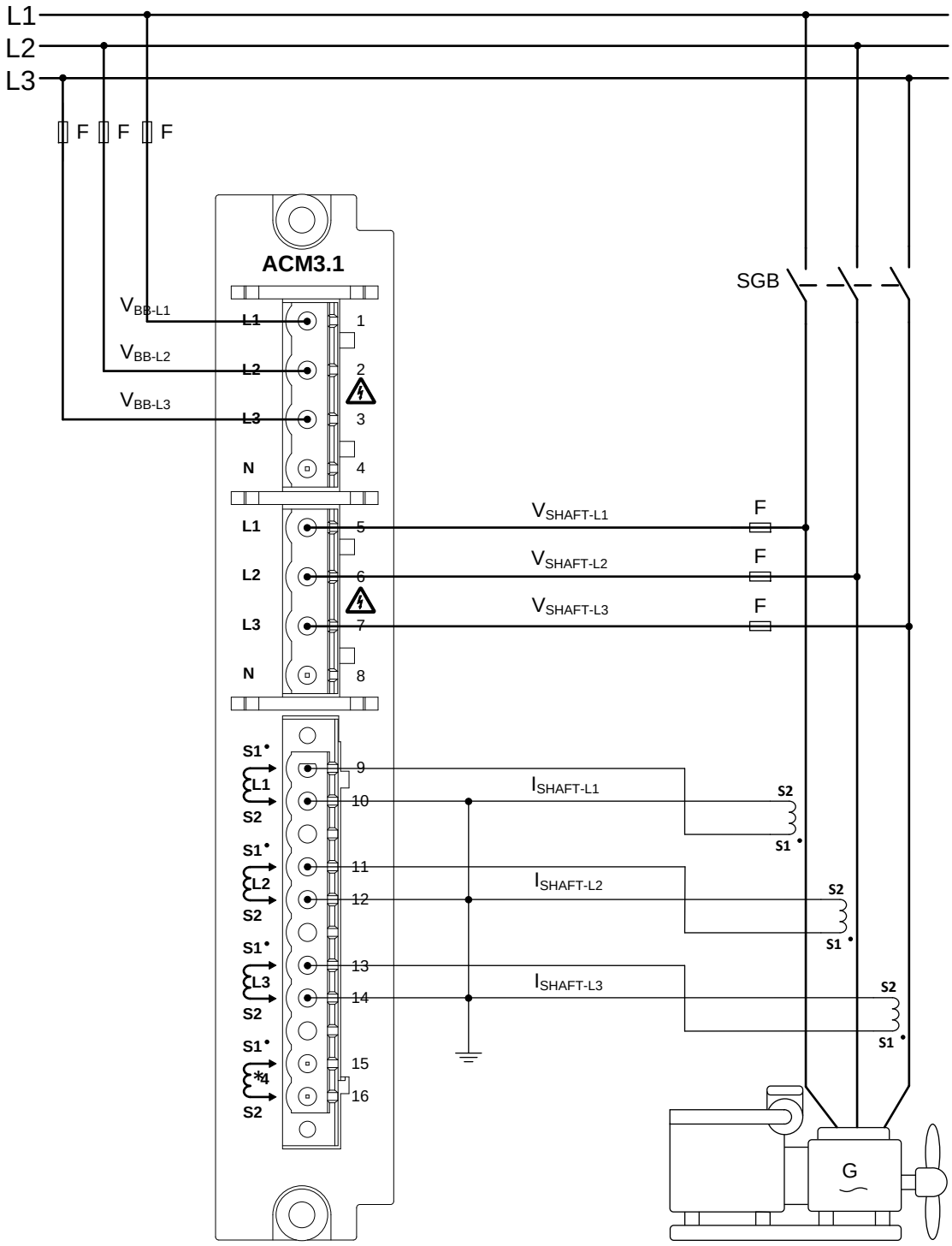

**INFO**
Alternatively, you can ground the S1 side of the current transformers, instead of S2 as shown.

## 4.4.3 Default wiring for EMERGENCY genset controller ACM3.1



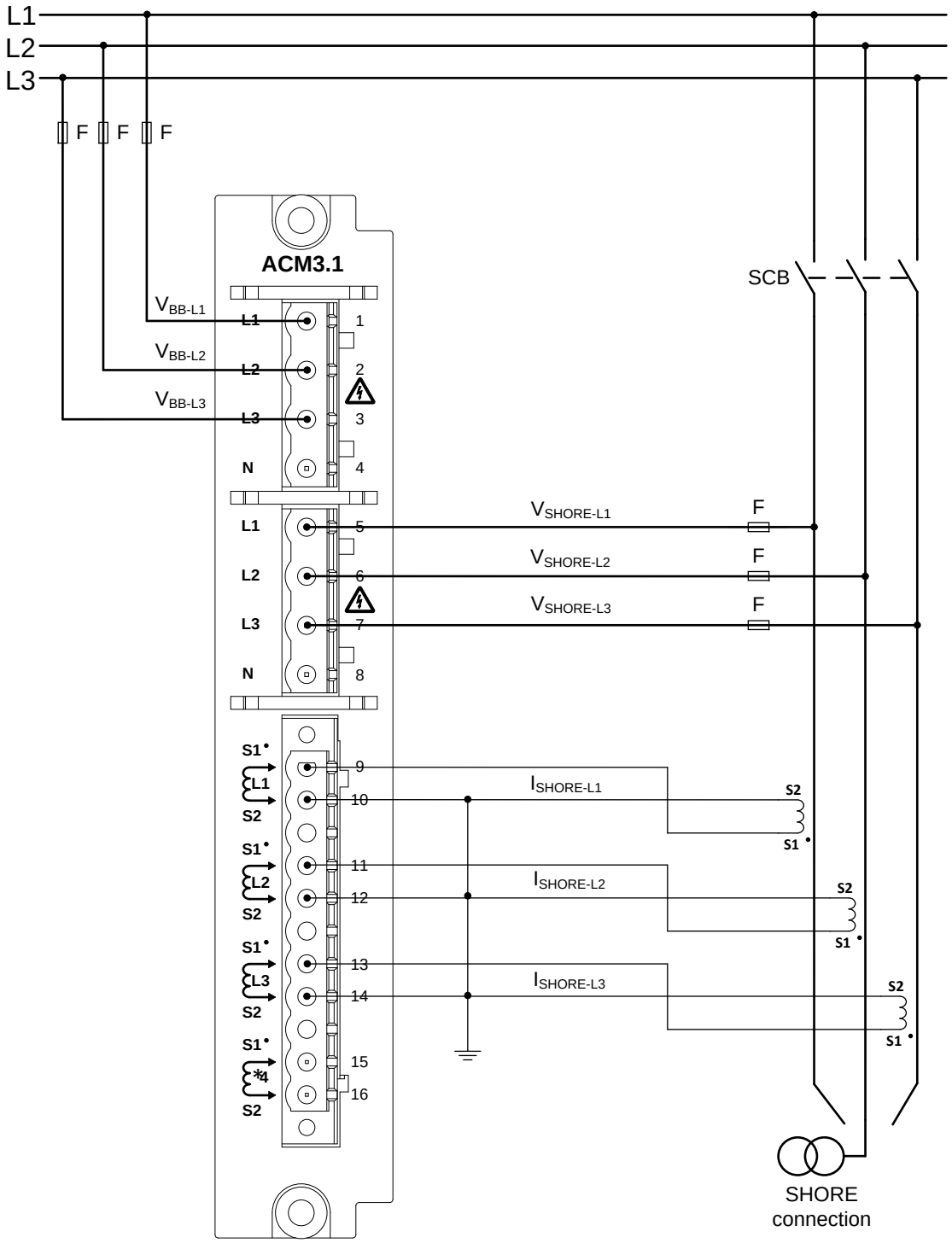

**INFO**
Alternatively, you can ground the S1 side of the current transformers, instead of S2 as shown.

## 4.4.4 Default wiring for SHAFT generator controller ACM3.1



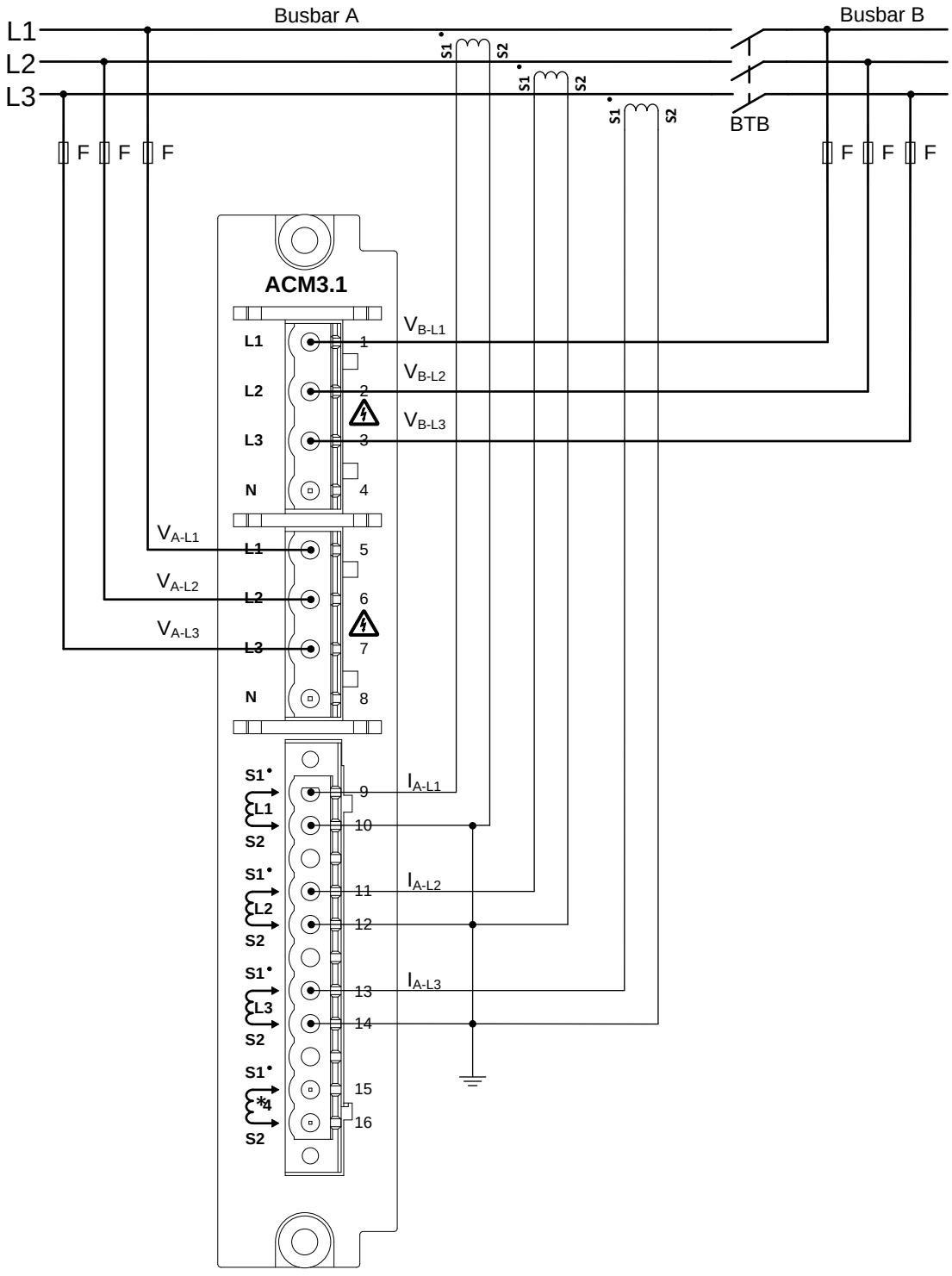

**INFO**
Alternatively, you can ground the S1 side of the current transformers, instead of S2 as shown.

## 4.4.5 Default wiring for SHORE connection controller ACM3.1




**INFO**
Alternatively, you can ground the S1 side of the current transformers, instead of S2 as shown.

## 4.4.6 Default wiring for BUS TIE breaker controller ACM3.1



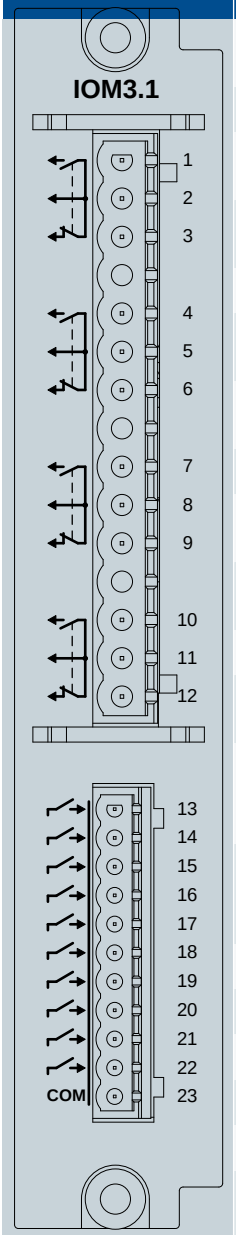

**INFO**
Alternatively, you can ground the S1 side of the current transformers, instead of S2 as shown.

# 4.5 IOM3.1 terminal connections and default wiring

## 4.5.1 IOM3.1 slot 3 terminal connections

This is a default module for:

- GENSET controller
- EMERGENCY genset controller
- SHAFT generator controller
- SHORE connection controller
- BUS TIE breaker controller




| Terminal | Symbol | Name | Type | Function |
|---|---|---|---|---|
| 1 | | Normally open | Relay output (250 V AC or 30 V DC, and 6 A) | *[Breaker] > Control > Close**, or configurable |
| 2 | | Common | | |
| 3 | | Normally closed | | |
| 4 | | Normally open | | *[Breaker] > Control > Open**, or configurable |
| 5 | | Common | | |
| 6 | | Normally closed | | |
| 7 | | Normally open | | *[Function 1]*, or configurable |
| 8 | | Common | | |
| 9 | | Normally closed | | |
| 10 | | Normally open | | *[Function 2]*, or configurable |
| 11 | | Common | | |
| 12 | | Normally closed | | |
| 13 | | | Digital input (OFF: 0 to 2 V DC, ON: 8 to 36 V DC, Impedance: 4.7 kΩ) | *[Breaker] > Feedback > Open**, or configurable |
| 14 | | | | *[Breaker] > Feedback > Closed**, or configurable |
| 15 | | | | Configurable |
| 16 | | | | Configurable |
| 17 | | | | Configurable |
| 18 | | | | Configurable |
| 19 | | | | Configurable |
| 20 | | | | Configurable |

| | Terminal | Symbol | Name | Type | Function |
|---|---|---|---|---|---|
| | 21 | | | | *[Breaker] > Feedback > Short circuit*, or configurable |
| | 22 | | | | *Mode > Switchboard control**, or configurable |
| | 23 | COM | | Digital input | Common* |

*Shows the default terminal connections.

**Table 4.7** Controller specific function names

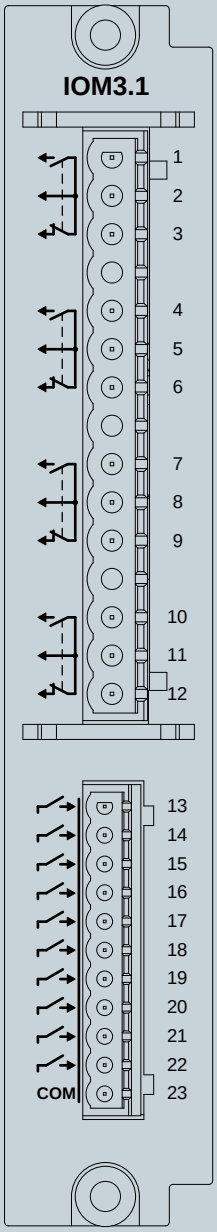
| Function | | | | | |
|---|---|---|---|---|---|
| [Breaker] | Generator breaker | Generator breaker | Shaft generator breaker | Shore connection breaker | Bus tie breaker |
| [Function 1] | *Non-essential load trip 1*** | *Tie breaker > Control > Close** | *Non-essential load trip 1*** | *Non-essential load trip 1*** | *Non-essential load trip 1*** |
| [Function 2] | *Non-essential load trip 2*** | *Tie breaker > Control > Open** | *Non-essential load trip 2*** | *Non-essential load trip 2*** | *Non-essential load trip 2*** |

*Shows the default terminal connections.

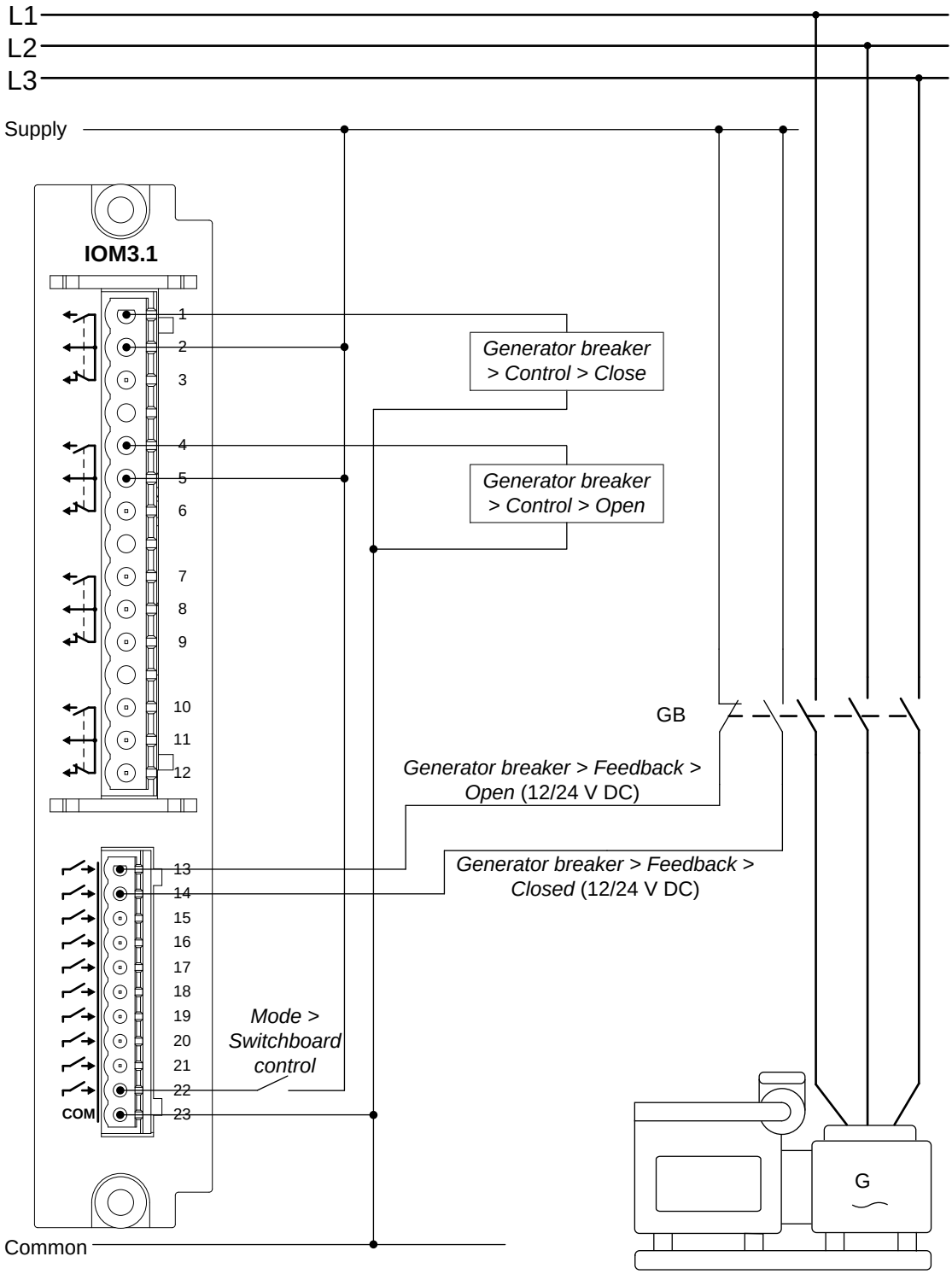
**Each non-essential load should be connected to a controller that controls the non-essential load. The non-essential loads should also be connected to all of the other controllers that control power sources. This allows any power-supplying controller to trip the non-essential loads.

## 4.5.2 IOM3.1 slot 6 terminal connections

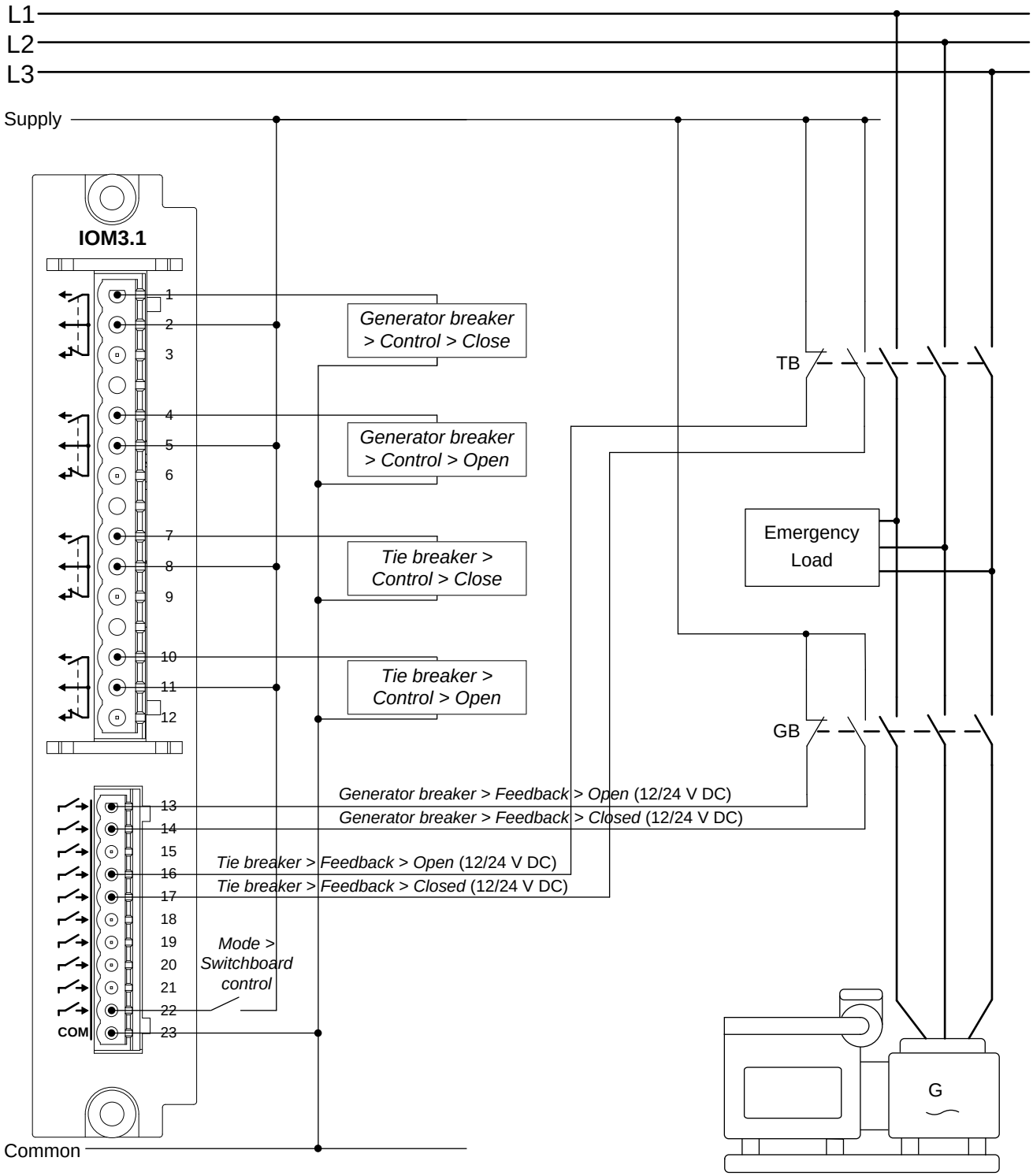
| | |
|---|---|
| This is a default module for: | GENSET controller |

| | Terminal | Symbol | Name | Type | Function |
|---|---|---|---|---|---|
|  | 1 |  | Normally open | Relay output (250 V AC or 30 V DC, and 6 A) | *Heavy consumer 1* > *Acknowledge*, or configurable |
| | 2 | | Common | | |
| | 3 | | Normally closed | | |
| | 4 |  | Normally open | | *Heavy consumer 2* > *Acknowledge*, or configurable |
| | 5 | | Common | | |
| | 6 | | Normally closed | | |
| | 7 |  | Normally open | | *Heavy consumer 3* > *Acknowledge*, or configurable |
| | 8 | | Common | | |
| | 9 | | Normally closed | | |
| | 10 |  | Normally open | | *Heavy consumer 4* > *Acknowledge*, or configurable |
| | 11 | | Common | | |
| | 12 | | Normally closed | | |
| | 13 |  | | Digital input (OFF: 0 to 2 V DC, ON: 8 to 36 V DC, Impedance: 4.7 kΩ) | *Heavy consumer 1* > *Request*, or configurable |
| | 14 |  | | | *Heavy consumer 2* > *Request*, or configurable |
| | 15 |  | | | *Heavy consumer 3* > *Request*, or configurable |
| | 16 |  | | | *Heavy consumer 4* > *Request*, or configurable |
| | 17 |  | | | *Heavy consumer 1* > *Feedback*, or configurable |
| | 18 |  | | | *Heavy consumer 2* > *Feedback*, or configurable |
| | 19 |  | | | *Heavy consumer 3* > *Feedback*, or configurable |
| | 20 |  | | | *Heavy consumer 4* > *Feedback*, or configurable |
| | 21 |  | | | Configurable |
| | 22 |  | | | Configurable |
| | 23 | COM | | Digital input | Common |

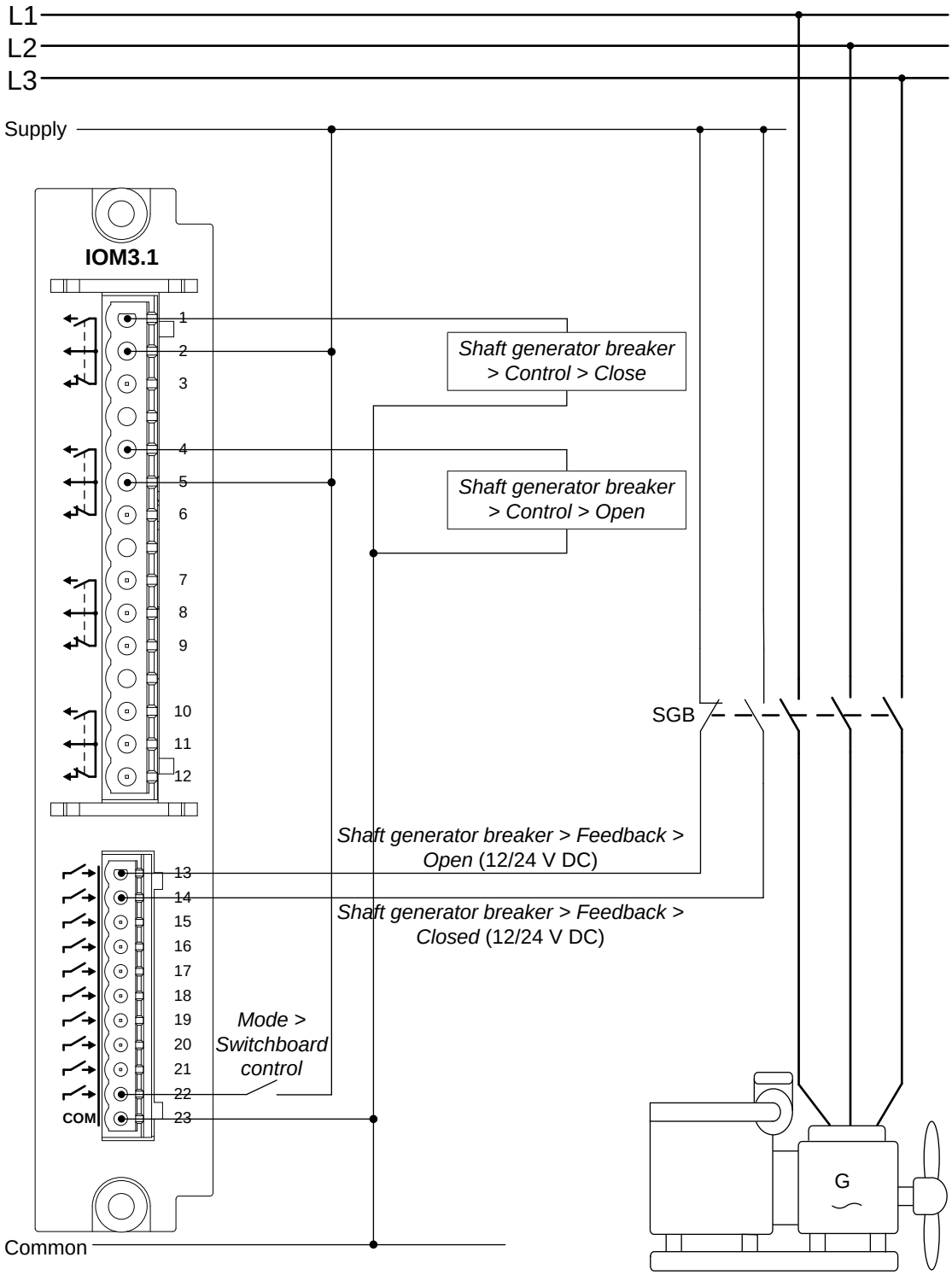
## 4.5.3 Default wiring for GENSET controller IOM3.1



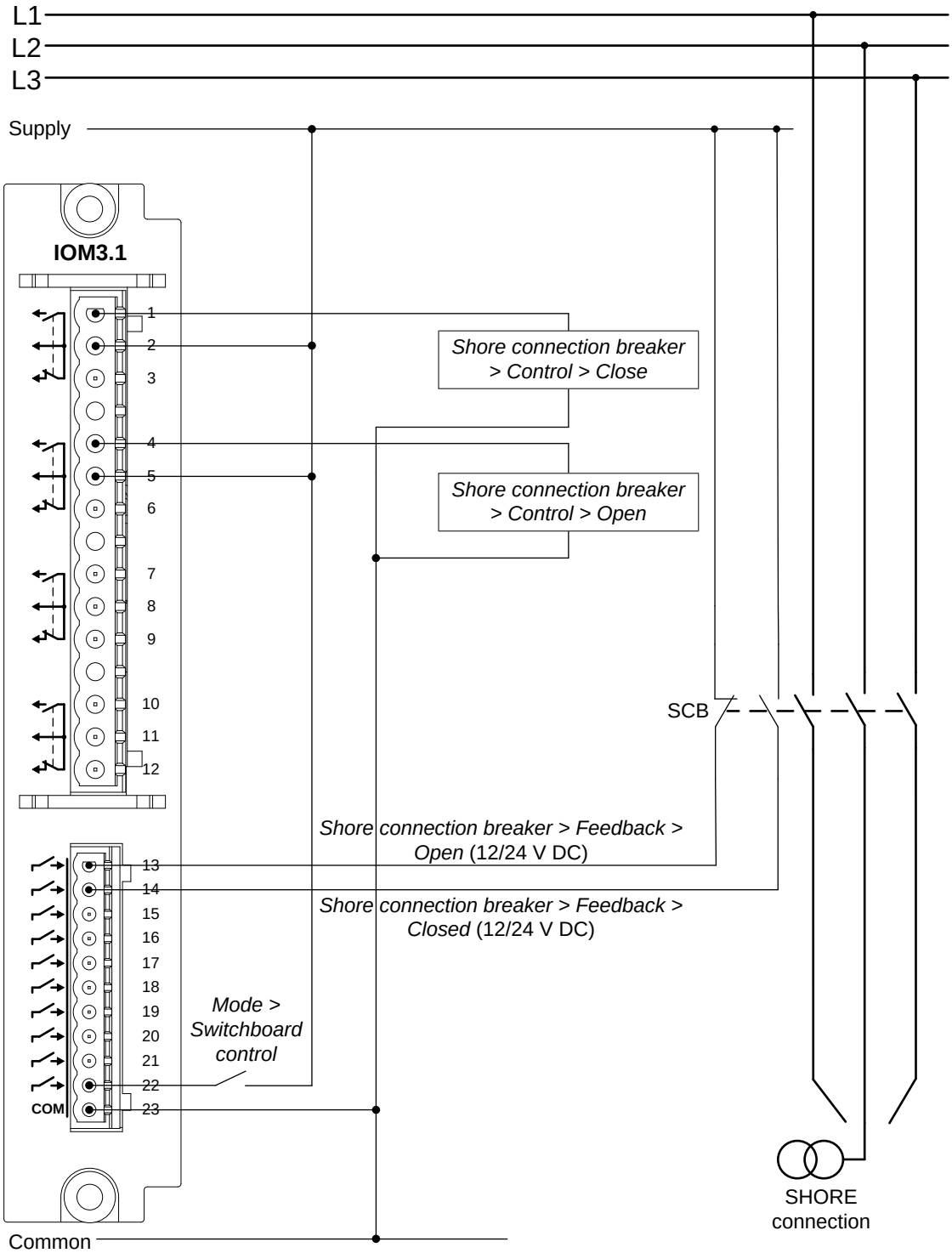
## 4.5.4 Default wiring for EMERGENCY genset controller IOM3.1



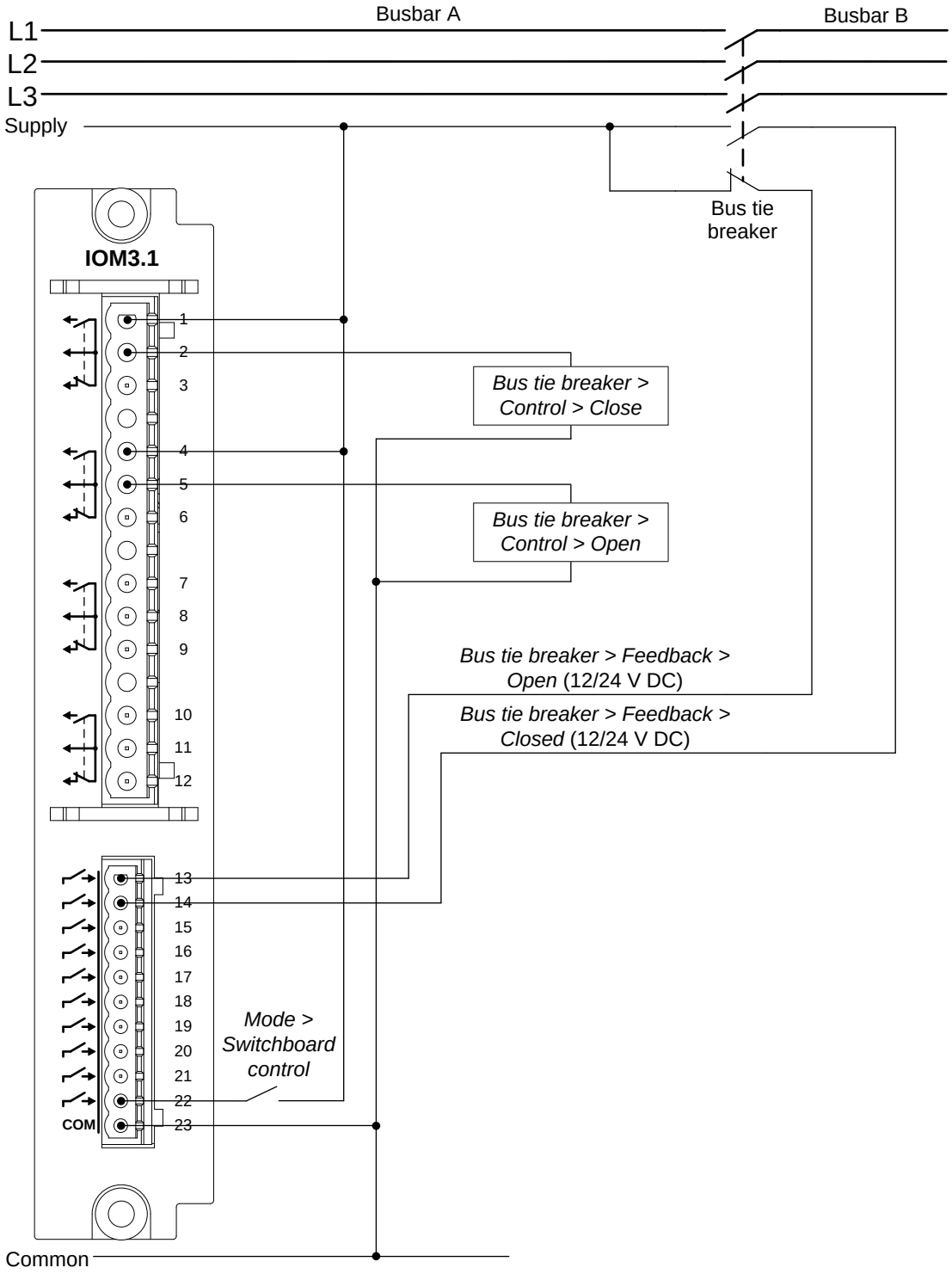
## 4.5.5 Default wiring for SHAFT generator controller IOM3.1



## 4.5.6 Default wiring for SHORE connection controller IOM3.1



## 4.5.7 Default wiring for BUS TIE breaker controller IOM3.1



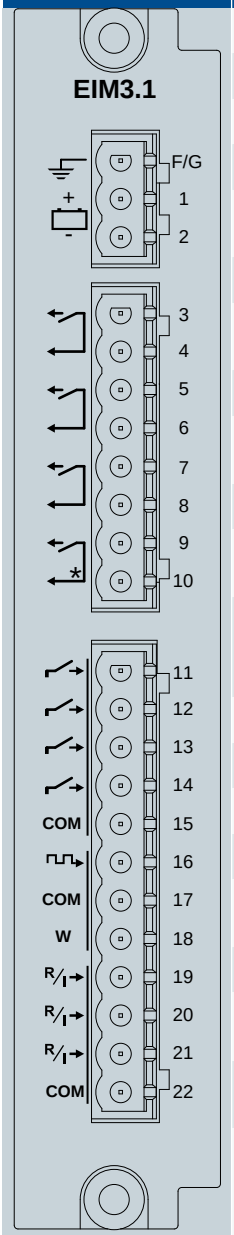
# 4.6 EIM3.1 terminal connections and default wiring

## 4.6.1 EIM3.1 terminal connections

This is a default module for:

GENSET controller

EMERGENCY genset controller



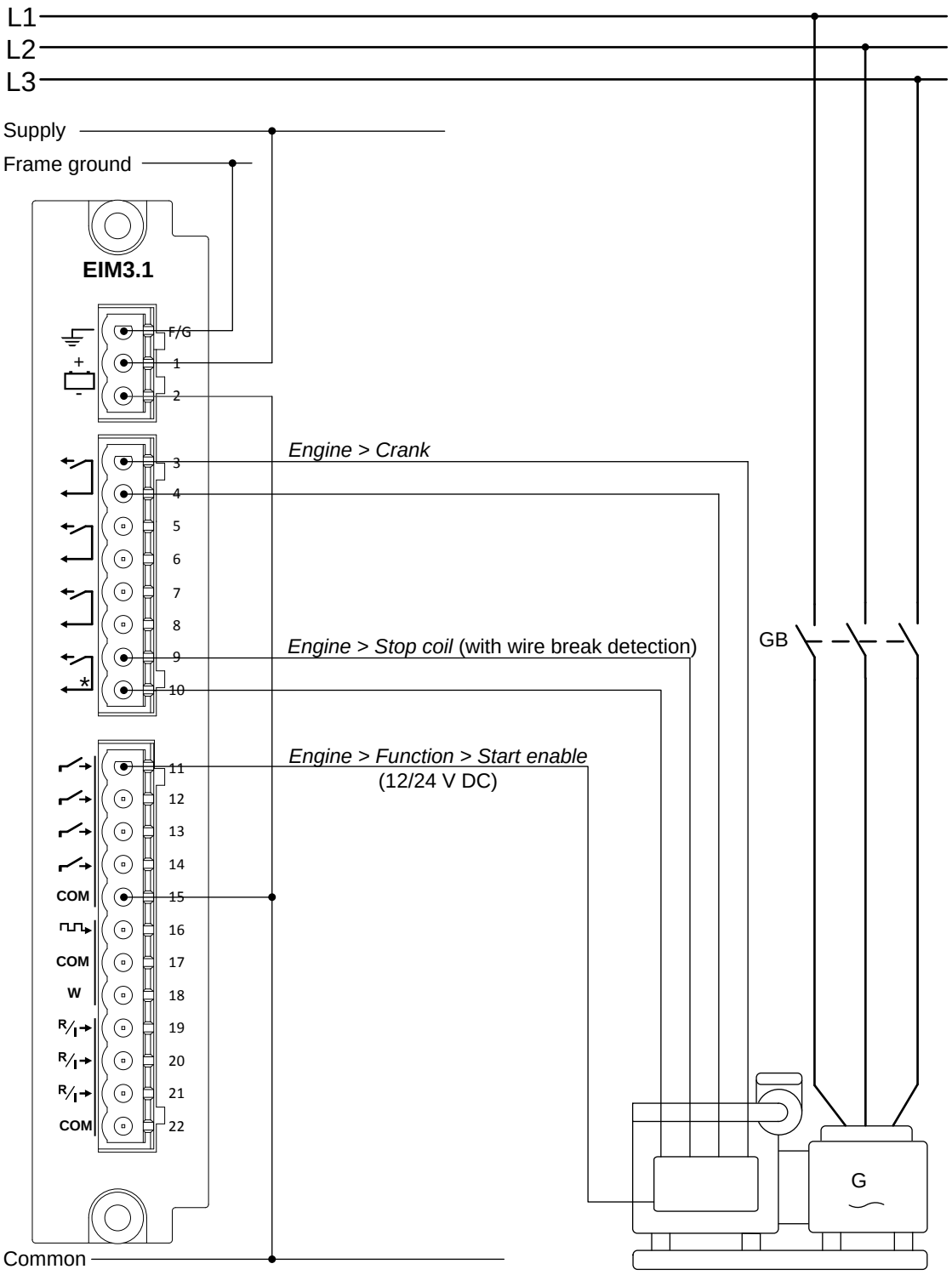

| Terminal | Symbol | Name | Type | Function |
|---|---|---|---|---|
| F/G | | F/G | Ground | Frame ground* |
| 1 | + | + | 12 or 24 V DC (nominal)** | Power supply* |
| 2 | - | - | 0 V DC | |
| 3 | | Common | Relay output (30 V DC and 6 A) | *Engine* > *Crank**, or configurable |
| 4 | | Normally open | | |
| 5 | | Common | | *Engine* > *Start prepare*, or configurable |
| 6 | | Normally open | | |
| 7 | | Common | | *Engine* > *Run coil*, or configurable |
| 8 | | Normally open | | |
| 9 | * | Common | Relay output with wire break detection (30 V DC and 6 A) | *Engine* > *Stop coil**, or configurable |
| 10 | * | Normally open | | |
| 11 | | | Digital input (OFF: 0 to 2 V DC, ON: 8 to 36 V DC, Impedance: 4.7 kΩ) | *Engine* > *Function* > *Start enable**, or configurable |
| 12 | | | | Configurable |
| 13 | | | | Configurable |
| 14 | | | | Configurable |
| 15 | COM | | Digital input | Common* |
| 16 | | | MPU input (Voltage: 2 to 70 V AC peak, Frequency: 2 to 20,000 Hz) | Magnetic pickup |
| 17 | COM | Common | MPU or W input | |
| 18 | W | | W input (Voltage: 8 to 36 V AC, Frequency: 2 to 20,000 Hz) | Alternator tacho or NPN/PNP sensor |
| 19 | R/I | | Analogue current or resistance measurement input (RMI) (Current input: 0 to 20 mA, or 4 to 20 mA; Pt100/1000:-40 to 250 ºC; Resistance measurements: 0 to 2.5 kΩ; | *Engine* > *Oil*, or configurable |
| 20 | R/I | | | *Engine* > *Coolant water*, or configurable |

| | Terminal | Symbol | Name | Type | Function |
|---|---|---|---|---|---|
| | 21 | R/I→ | | Digital inputs (dry contact with cable supervision): maximum 330 Ω for ON detection;<br>Minimum current rating for connected relays: 2.5 mA) | Configurable |
| | 22 | COM | Common | Analogue input | |

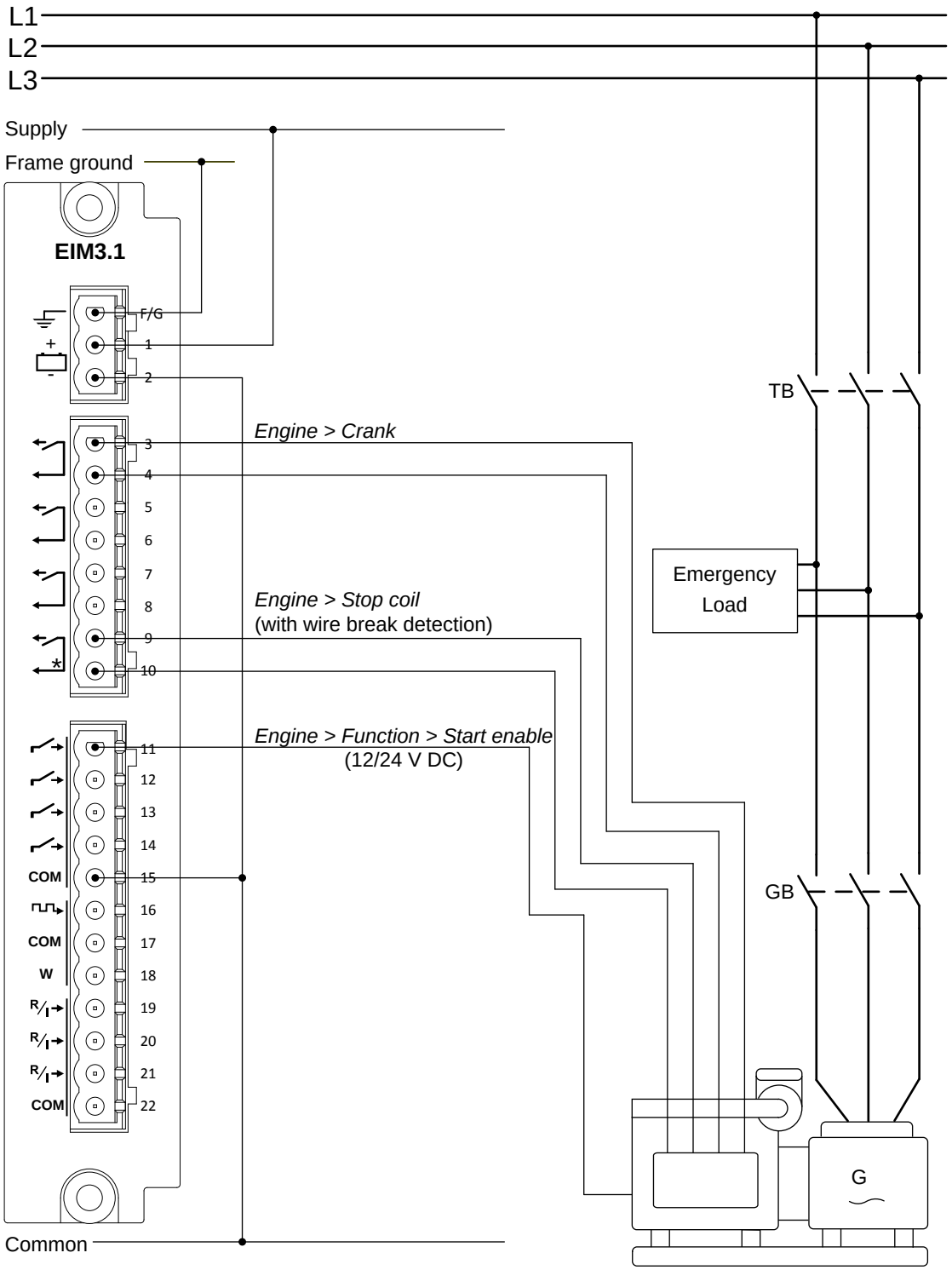
*Note: Shows the default terminal connections.

**Note: Class societies require an independent power supply for the EIM. The EIM must therefore not be connected to the same power supply source as the PSM.

## 4.6.2 Default wiring for GENSET controller EIM3.1



## 4.6.3 Default wiring for EMERGENCY genset controller EIM3.1



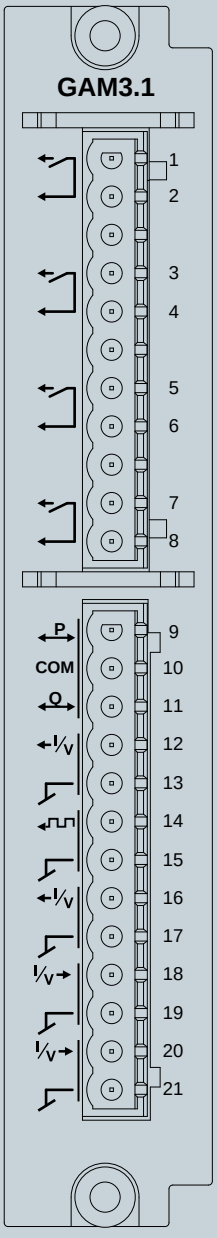
# 4.7 GAM3.1 terminal connections and default wiring

## 4.7.1 GAM3.1 terminal connections

This is a default module for:

GENSET controller

EMERGENCY genset controller

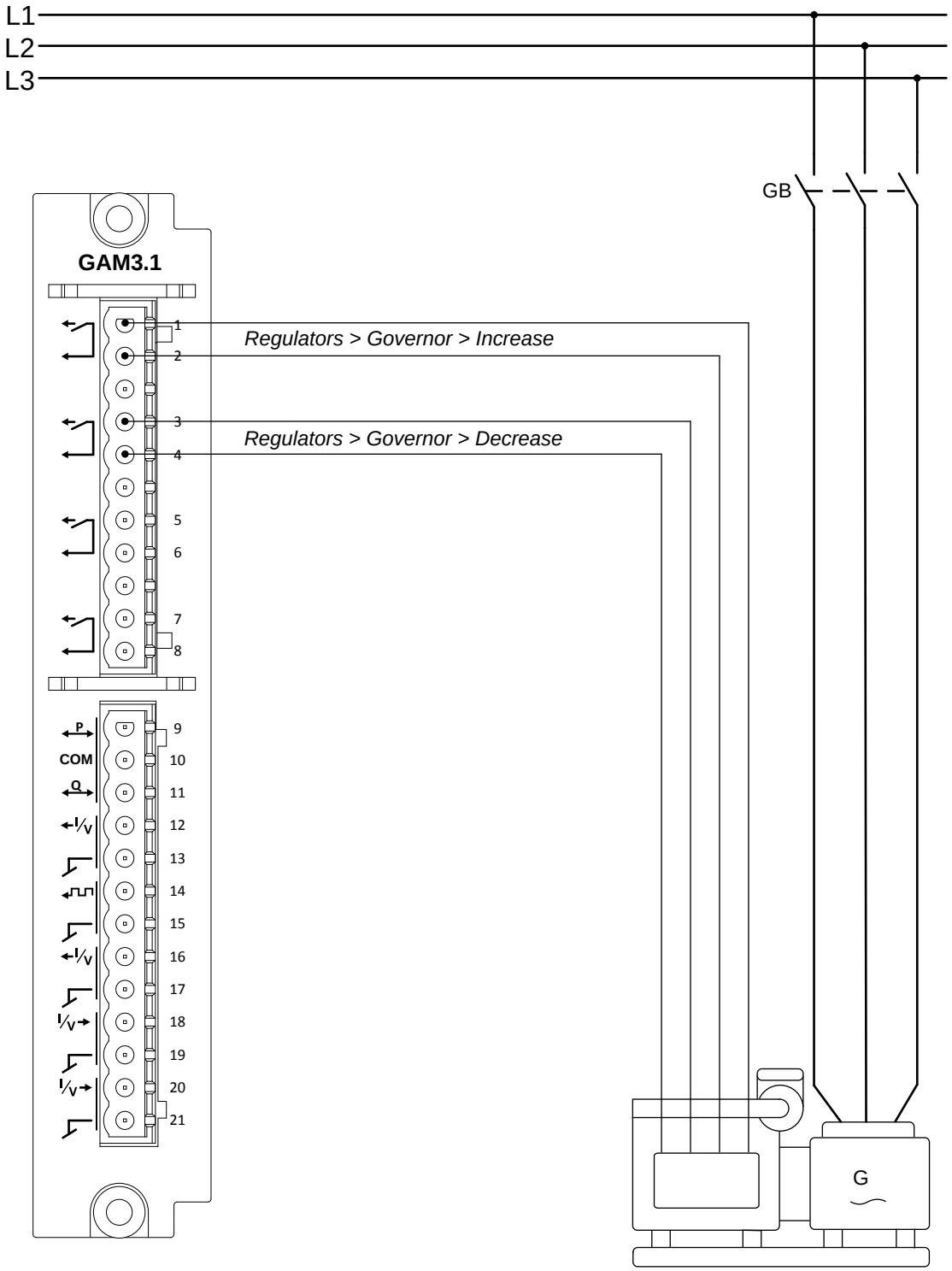



| Terminal | Symbol | Name | Type | Function |
|---|---|---|---|---|
| 1 | | Common | Relay output (250 V AC or 30 V DC, and 6 A) | *Regulators* > *Governor* > *Increase**, or configurable** |
| 2 | | Normally open | | |
| 3 | | Common | | *Regulators* > *Governor* > *Decrease**, or configurable** |
| 4 | | Normally open | | |
| 5 | | Common | | Configurable |
| 6 | | Normally open | | |
| 7 | | Common | | Configurable |
| 8 | | Normally open | | |
| 9 | P | Active (P) load | Voltage output: -5 to 5 V DC, Impedance: 23.5 kΩ | Load sharing for future use to perform analogue load sharing |
| 10 | COM | Common | | |
| 11 | Q | Reactive (Q) var | | |
| 12 | I/V | Output | Analogue current or voltage output (Current: 0 to 20 mA, 4 to 20 mA, or -20 to 20 mA; Voltage (DC): 0 to 10 V, -10 to 10 V, 0 to 5 V, 0 to 3 V, -3 to 3 V, 0 to 1 V) | *Regulators* > *Governor* > *Output*, *Regulators* > *AVR* > *Output*, or transducer configurable |
| 13 | | Common | | |
| 14 | | PWM output | Frequency: 500 Hz ±50 Hz, Resolution: 48,000 levels, Voltage: 0.05 to 14 V ±2 V | Pulse width modulation (PWM) output |
| 15 | | Common | | |
| 16 | I/V | Output | Analogue current or voltage output (Current: 0 to 20 mA, 4 to 20 mA, or -20 to 20 mA; Voltage (DC): 0 to 10 V, -10 to 10 V, 0 to 5 V, 0 to 3 V, -3 to 3 V, 0 to 1 V) | *Regulators* > *Governor* > *Output*, *Regulators* > *AVR* > *Output*, or transducer configurable |
| 17 | | Common | | |
| 18 | I/V | Input | Analogue current or voltage input (Current: 0 to 20 mA, or 4 to 20 mA; Voltage (DC): -10 to 10 V, 0 to 10 V) | Configurable |
| 19 | | Common | | |
| 20 | I/V | Input | | Configurable |
| 21 | | Common | | |

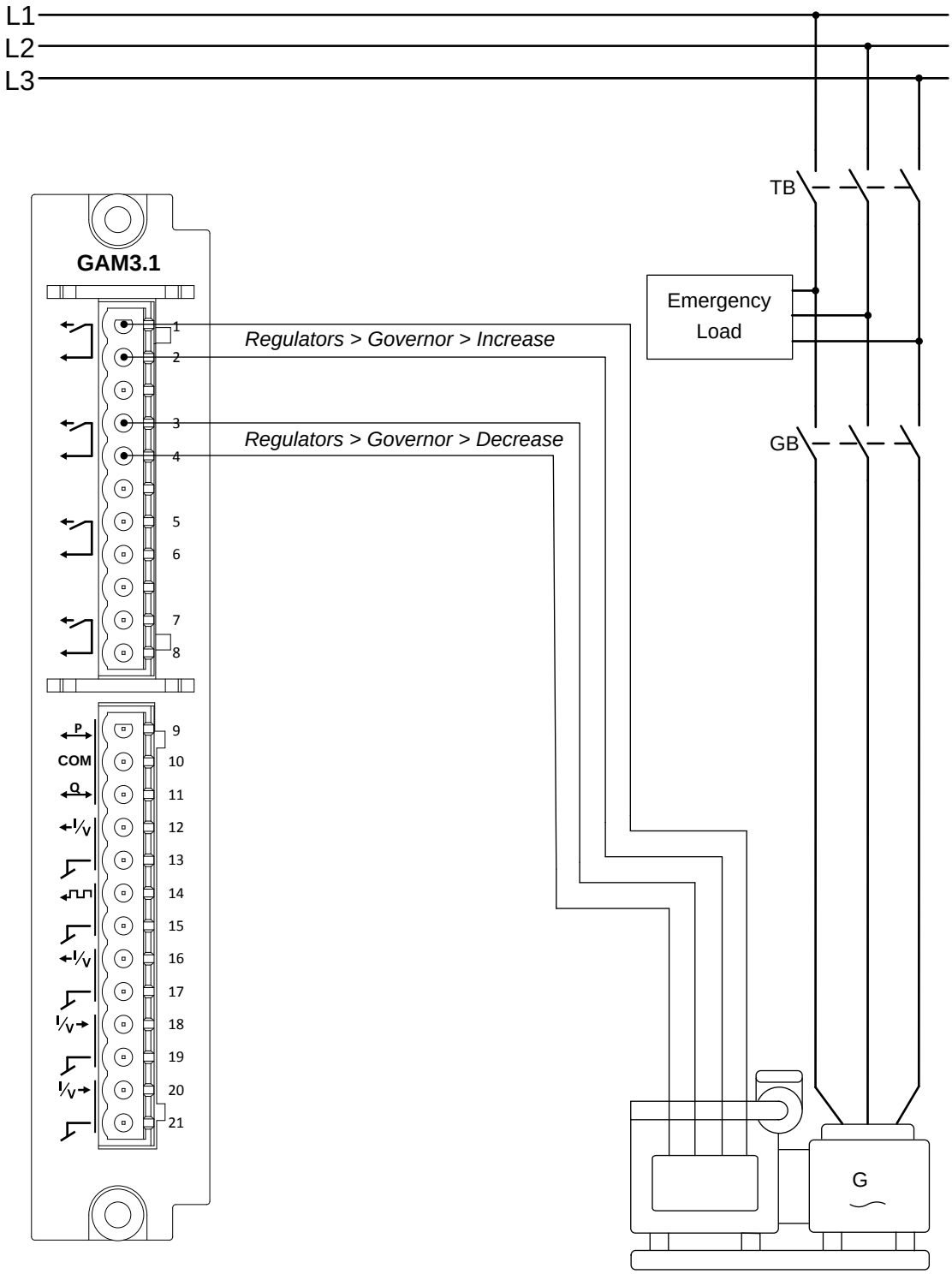
* Shows the default terminal connections.

**The default terminal connections use relay connections for governor control. However, the governor can also be controlled using an analogue output (terminals 12 and 13, and terminals 16 and 17), or pulse width modulation (terminals 14 and 15). You can read more about these terminals in the chapter on **Wiring the controller unit**, and in the **Designer's handbook**.

## 4.7.2 Default wiring for GENSET controller GAM3.1



## 4.7.3 Default wiring for EMERGENCY genset controller GAM3.1

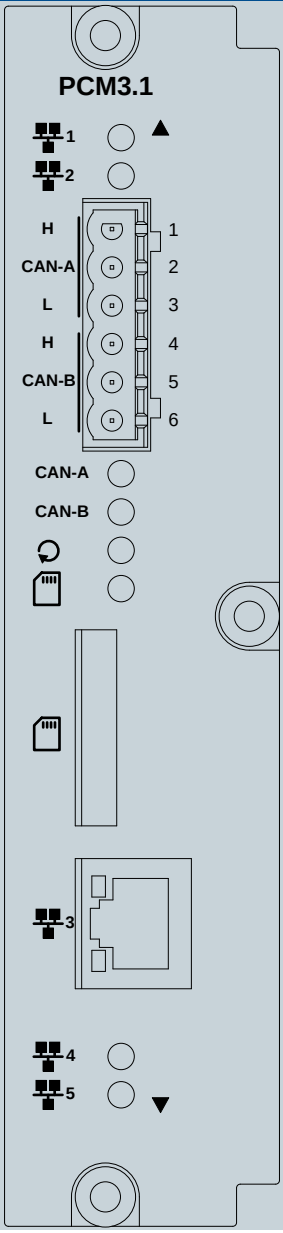


# 4.8 PCM3.1 terminal connections and default wiring

## 4.8.1 PCM3.1 terminal connections

This is a default module for:

| GENSET controller | EMERGENCY genset controller | SHAFT generator controller | SHORE connection controller | BUS TIE breaker controller |
|---|---|---|---|---|




| Terminal | Symbol | Name | Function |
|---|---|---|---|
| 1 | H | CAN high | CAN bus A (for future use) |
| 2 | CAN-A | CAN cable shield | |
| 3 | L | CAN low | |
| 4 | H | CAN high | CAN bus B (for future use) |
| 5 | CAN-B | CAN cable shield | |
| 6 | L | CAN low | |
| - | | SD card | External memory |

### 4.8.2 PCM3.1 Ethernet connections

| Ethernet port number | Position | Recommended default connections |
|---|---|---|
| 1 | Top of rack, back port | Previous controller in the DEIF network* |
| 2 | Top of rack, front port | Next controller in the DEIF network |
| 3 | Front of rack, on the module faceplate | Service PC |
| 4 | Bottom of rack, front port | Display unit* |
| 5 | Bottom of rack, back port | Modbus TCP IP |

*Shows the default minimum Ethernet connections.

The Ethernet ports on the controllers are not assigned to a particular service. The controllers detect the equipment connected to the port. You therefore do not have to follow the list above. However, we recommend that you use the default connections to simplify testing and troubleshooting.

See **Wiring the controller, PCM3.1 Ethernet connections** in this document for more information.

**INFO**
The Ethernet lines must not be longer than 100 metres, point-to-point.

# 5. Wiring the controller hardware modules

## 5.1 Introduction

This chapter describes the wiring for each of the controller hardware modules in detail. Each terminal's wiring is described, with examples. Wiring the CAN bus communication to a genset is also included in this chapter. However, wiring the system communication (including the connection to the display unit) is described in another chapter.

The **Data sheet** contains all the technical specifications for all the terminals.

The default wiring for the controller type is described in the chapter **Default wiring for controller types**.

**DANGER!**
**You must only use the terminal blocks supplied with the controller and display unit. Do not use substitutes.**

## 5.2 Power supply module PSM3.1

### 5.2.1 PSM3.1 terminal overview

| Terminal | Symbol | Name | Type | Function |
|---|---|---|---|---|
| F/G | | F/G | Ground | Frame ground |
| 1 | | + | 12 or 24 V DC (nominal) | Power supply |
| 2 | | - | 0 V DC | |
| 3 | | Normally open | Relay output (30 V DC and 1 A) | Alarm > Status OK (fixed)* |
| 4 | | Common | | |
| 5 | | Normally open | | Alarm > Any warning alarm(configurable) |
| 6 | | Common | | |
| 7 | | Normally open | | Alarm (configurable) |
| 8 | | Common | | |

* The first relay (terminals 3, 4) is reserved for the *Alarm* > *Status OK* output and cannot be reconfigured.

**Table 5.1** PSM3.1 EtherCAT connections

| Connection | Symbol | Type | Name |
|---|---|---|---|
| Bottom of rack, front | | EtherCAT input | EtherCAT input connection for future use to connect several extension racks. |
| Bottom of rack, back | | EtherCAT output | EtherCAT output connection for future use to connect several extension racks. |

**INFO**
EtherCAT connections are for future use to connect several extension racks together. These are not to be used for the DEIF Ethernet network connections.

## 5.2.2 Frame ground wiring

Connect the frame ground terminal to ground/earth.

**INFO**
DEIF recommends that both the frame ground terminal and the equipment casing are connected to the cabinet.

**INFO**
Connection of the frame ground is required by JEM-TR177.

## 5.2.3 Power supply wiring

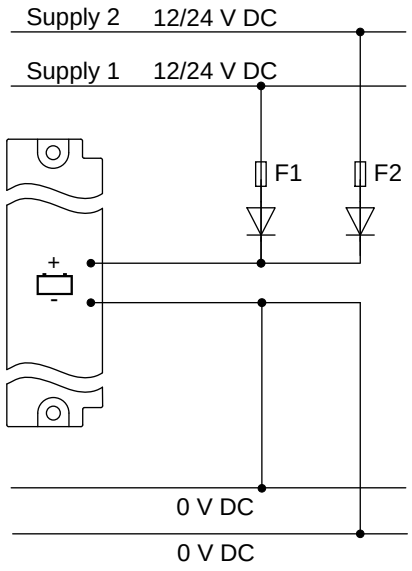
Connect the power supply (+) to the 12 or 24 V DC power supply.

Connect the power supply (-) to the 0 V DC power supply.

### Backup power supply

The DEIF equipment does not contain a backup power supply. The power supply source must therefore include the power backup needed.

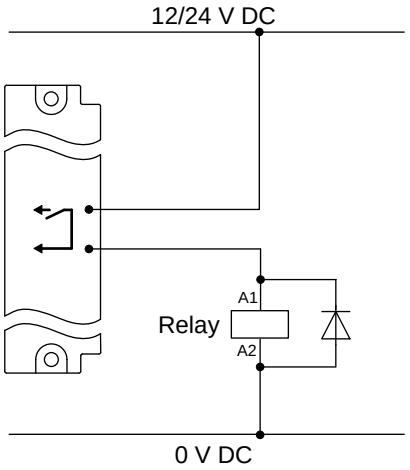
**Figure 5.1** Example of a power supply and backup connected to the power supply terminals




**INFO**
DEIF recommends that a 2A slow blow fuse is used for F1 and F2, and that the diodes are rated 50V or higher.

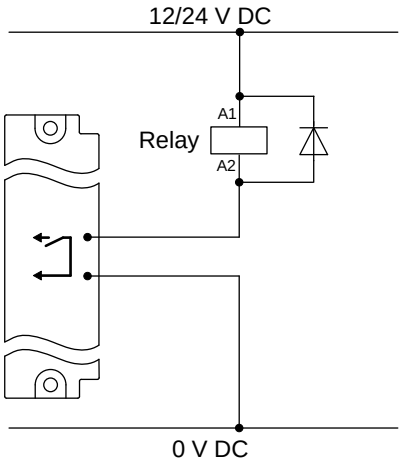
## 5.2.4 Relay output wiring

The following diagram shows the connection of the relay output to an external relay. For the wiring shown, there is no voltage on the external relay when the controller relay is open.




**INFO**
Use a diode size as recommended by the relay supplier.

The terminal connections can be switched around without affecting the performance.




**INFO**
Remember to install the freewheeling diode ( ). This diode prevents a sudden voltage spike across the inductive load when the voltage source is removed.

## 5.2.5 EtherCAT connections

For future use.

**INFO**

Do not try to use these connections for Ethernet communication (for example, over the DEIF network to other controllers, or to a service PC). There will be no communication, since these connections are dedicated to DEIF EtherCAT communication.

# 5.3 Alternating current module ACM3.1

## 5.3.1 ACM3.1 terminal overview

| Terminal | Symbol | Name | Type | Function |
|---|---|---|---|---|
| 1 | L1 | L1 voltage | Voltage<br>100 to 690 V AC phase-to-phase (nominal) | [Busbar] L1 |
| 2 | L2 | L2 voltage | | [Busbar] L2 |
| 3 | L3 | L3 voltage | | [Busbar] L3 |
| 4 | N | N voltage | | [Busbar] N |
| 5 | L1 | L1 voltage | Voltage<br>100 to 690 V AC phase-to-phase (nominal) | [Controlled equipment] L1 |
| 6 | L2 | L2 voltage | | [Controlled equipment] L2 |
| 7 | L3 | L3 voltage | | [Controlled equipment] L3 |
| 8 | N | N voltage | | [Controlled equipment] N |
| 9 |  | Current in (European: S1; US: ·) | Current<br>1 or 5 A AC (nominal) | [Controlled equipment] L1 |
| 10 | | Current out (European: S2) | | |
| 11 |  | Current in (European: S1; US: ·) | Current<br>1 or 5 A AC (nominal) | [Controlled equipment] L2 |
| 12 | | Current out (European: S2) | | |
| 13 |  | Current in (European: S1; US: ·) | Current<br>1 or 5 A AC (nominal) | [Controlled equipment] L3 |
| 14 | | Current out (European: S2) | | |
| 15 |  | Current in (European: S1; US: ·) | Current<br>1 or 5 A AC (nominal) | [Controlled equipment] N, or configurable |
| 16 | | Current out (European: S2) | | |

## 5.3.2 Voltage measurements wiring

The connection of the terminals depend on the equipment that the controller is controlling. Please refer to the description of the controller types for more details on the controlled equipment.

**DANGER!**

**DEIF recommends that you install fuses (2 A rating) on the voltage measurement lines, as close to the busbar as possible. These fuses protect the voltage measurement lines. The DEIF controller does not need these fuses, since it has its own internal protection.**

### 5.3.3 Current measurements wiring

The terminal connections depend on the equipment that the controller is controlling. For more details on the controlled equipment, refer to the descriptions of the controller types.

**INFO**
The current inputs are galvanically separated.

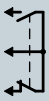
**INFO**
Mount each current transformer and connect it to the controller terminals so that each measurement current flows through the controller in the correct direction. Incorrect mounting and wiring will result in incorrect current measurements. See the controller wiring diagrams for the correct mounting direction and wiring.

**DANGER!**
**Do not connect or disconnect any current transformer (CT) while there is current in the line. If a CT is disconnected when there is current in the line, a high voltage is generated across the secondary of the CT. This can cause arcing, personal injury or death, or damage to the controller.**

**DANGER!**
**The current measurement terminal block MUST always be screwed onto the module. If for some reason the terminal block is unscrewed, secure it using a 0.5 N·m (4.4 lb-in) torque screwdriver with a 3.5 mm (0.14 in) flat-bladed bit.**

# 5.4 Input output module IOM3.1

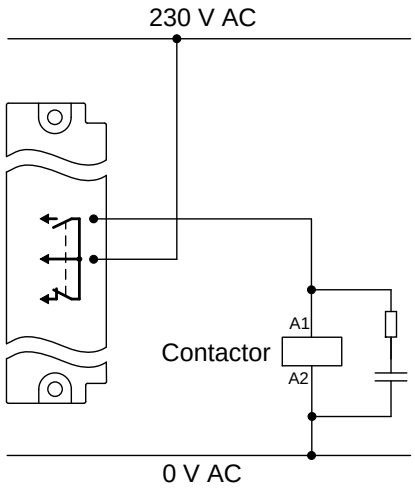
## 5.4.1 IOM3.1 terminal overview

| Terminal | Symbol | Name | Type |
|---|---|---|---|
| 1 |  | Normally open | Relay output (250 V AC or 30 V DC, and 6 A) |
| 2 | | Common | |
| 3 | | Normally closed | |
| 4 |  | Normally open | |
| 5 | | Common | |
| 6 | | Normally closed | |
| 7 |  | Normally open | |
| 8 | | Common | |
| 9 | | Normally closed | |
| 10 |  | Normally open | |
| 11 | | Common | |
| 12 | | Normally closed | |
| 13 |  | Bi-directional input | Digital input (OFF: 0 to 2 V DC, ON: 8 to 36 V DC, Impedance: 4.7 kΩ) |
| 14 |  | Bi-directional input | |
| 15 |  | Bi-directional input | |
| 16 |  | Bi-directional input | |
| 17 |  | Bi-directional input | |
| 18 |  | Bi-directional input | |
| 19 |  | Bi-directional input | |
| 20 |  | Bi-directional input | |
| 21 |  | Bi-directional input | |
| 22 |  | Bi-directional input | |
| 23 | COM | | Digital input common |

## 5.4.2 Relay output wiring

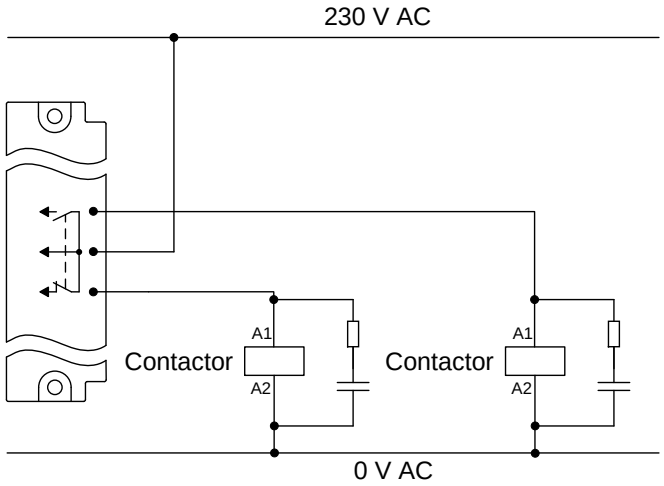
This relay has three terminals: normally closed, common and normally open (changeover switch). You can connect wiring to all three terminals. Alternatively, you can connect wiring to only the common and normally open terminals, or only the common and normally closed terminals.

For example, you can connect equipment to the normally closed terminal and the common. The following diagram shows an example of a relay output where the normally open relay terminal is connected to an 230 V AC contactor. For this example, the terminal connections can be switched around without affecting the performance.




Similarly, you can connect equipment to the normally closed terminal and the common.

You can also connect equipment to both the normally open and the normally closed terminals, as shown in the following diagram. For this configuration, current will flow through the equipment connected to the normally closed terminal when the relay is de-energised. The current will flow through the equipment connected to the normally open terminal when the relay is energised.




**INFO**
For 230 V AC contactors, DEIF strongly recommends that you use an RC snubber for noise suppression across the contactor.

## 5.4.3 Digital inputs wiring

The digital inputs are bi-directional inputs. This means that wiring to the input and common terminals may be swapped around without affecting their operation.

However, all the digital inputs on a module share a common terminal. The digital input common for a module may be either low (connected to 0 V), or high (connected to 12 or 24 V). If the common is low, all the digital input signals connected to the module must be high (connected to 12 or 24 V). Similarly, if the common is high, all the digital input signals connected to the module must all be low (connected to 0 V).

The digital input common does not act as the common for any of the other terminals on the same module. The digital input common is also not affected by the digital input commons on other modules.

The digital inputs are designed for a nominal voltage of 12 to 24 V DC.

**Figure 5.2** Example of digital input wiring (common = 0 V)

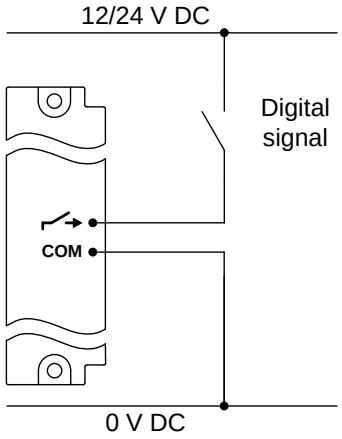
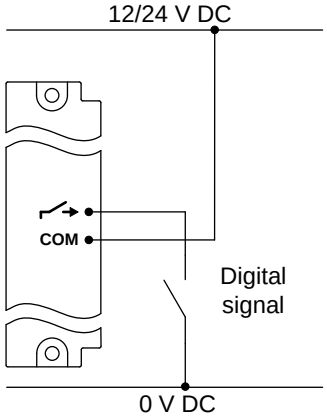



**Figure 5.3** Example of digital input wiring (common = 12 or 24 V)



# 5.5 Engine interface module EIM3.1

## 5.5.1 EIM3.1 terminal overview

| Terminal | Symbol | Name | Type | Function |
|---|---|---|---|---|
| F/G | | F/G | Ground | Frame ground |
| 1 | | + | 12 or 24 V DC (nominal)* | Power supply (+) |
| 2 | | - | 0 V DC | Power supply (-) |
| 3 | | Normally open | Relay output (30 V DC and 6 A) | Configurable |
| 4 | | Common | | |
| 5 | | Normally open | | Configurable |
| 6 | | Common | | |
| 7 | | Normally open | | Configurable |
| 8 | | Common | | |
| 9 | | Normally open | Relay output with wire break detection (30 V DC and 6 A) | Configurable |
| 10 | | Common | | |
| 11 | | Bi-directional input | Digital input (OFF: 0 to 2 V DC, ON: 8 to 36 V DC, Impedance: 4.7 kΩ) | Configurable |
| 12 | | Bi-directional input | | Configurable |
| 13 | | Bi-directional input | | Configurable |
| 14 | | Bi-directional input | | Configurable |
| 15 | COM | Common | Digital input | Common |
| 16 | | | MPU input (Voltage: 2 to 70 V AC peak, Frequency: 2 to 20,000 Hz) | Magnetic pickup |
| 17 | COM | Common | MPU or W input | |
| 18 | W | | W input (Voltage: 8 to 36 V AC, Frequency: 2 to 20,000 Hz) | Alternator tacho or NPN/PNP sensor |
| 19 | | | Analogue current or resistance measurement input (RMI)<br>(Current input: 0 to 20 mA, or 4 to 20 mA;<br>Pt100/1000:-40 to 250ºC;<br>Resistance measurements: 0 to 2.5 kΩ;<br>Digital inputs (dry contact with cable supervision): maximum 330 Ω for ON detection;<br>Minimum current rating for connected relays: 2.5 mA) | Configurable |
| 20 | | | | Configurable |
| 21 | | | | Configurable |
| 22 | COM | Common | Analogue input common | Common |

*Note: Class societies require an independent power supply for the EIM. The EIM must therefore not be connected to the same power supply source as the PSM.

### 5.5.2 Frame ground wiring

Connect the frame ground terminal to ground/earth.

**INFO**
DEIF recommends that both the frame ground terminal and the equipment casing are connected to the cabinet.

**INFO**
Connection of the frame ground is required by JEM-TR177.

### 5.5.3 Power supply wiring

Connect the power supply (+) to the DC +12 or 24 V power supply. Connect the power supply (-) to the DC 0 V power supply.

If the EIM power supply fails or is not connected, the PSM will supply power to the EIM.

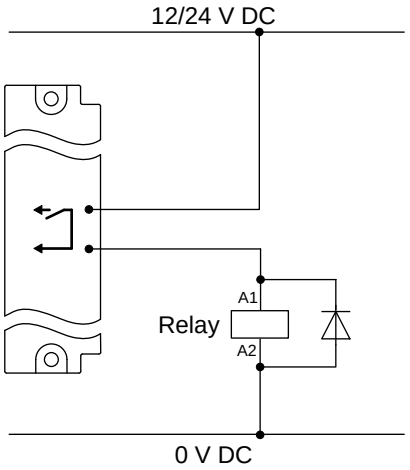
If the PSM power supply fails, the EIM will run on its independent power supply. However, the EIM will not supply power to the PSM.

**INFO**
The DEIF equipment does not contain a backup power supply. The power supply source must therefore include the power backup needed.

**INFO**
Class societies require an independent power supply for the EIM. The EIM must therefore not be connected to the same power supply source as the PSM.

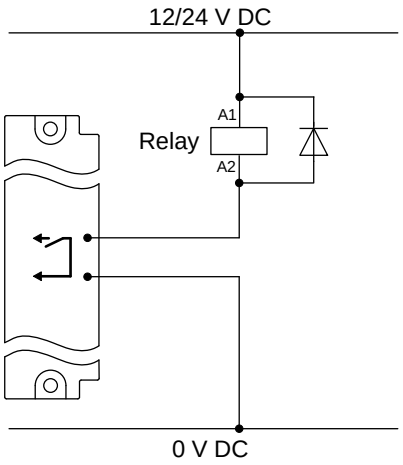
### 5.5.4 Relay output wiring

The following diagram shows the connection of the relay output to an external relay. For the wiring shown, there is no voltage on the external relay when the controller relay is open.



**INFO**
Use a diode size as recommended by the relay supplier.

The terminal connections can be switched around without affecting the performance.

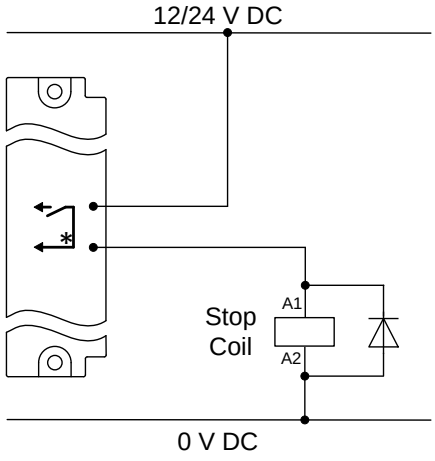



**INFO**
Remember to install the freewheeling diode ( ). This diode prevents a sudden voltage spike across the inductive load when the voltage source is removed.

## 5.5.5 Relay output with wire break detection

The diagram below shows an example of the wiring for this output.

**Figure 5.4** Example of stop coil relay with wire break detection




**CAUTION**
Do not connect the terminals to an alternating current supply. Alternating current will destroy the wire break detection.

**CAUTION**
The relay with wire break detection uses a small, constant current for wire break detection. This current can activate small relays, and cannot be turned off.

**INFO**
Remember to install the freewheeling diode (  ). This diode prevents a sudden voltage spike across the inductive load when the voltage source is removed.

### Checking the relay size

The wire break detection current leak does not activate the relay if this formula is true:

$$V_{release} > (V_{supply} - 4.5\ V) / (3900\ \Omega + R_{coil}) \times R_{coil}$$

| | |
|---|---|
| $V_{release}$ | The release voltage for the relay (see the relay's data sheet). |
| $V_{supply}$ | The supply voltage that the relay is connected to (12 or 24 V). |
| $R_{coil}$ | The relay coil resistance (see the relay's data sheet). |

**CAUTION**
This formula does not include a safety factor.

If the calculation shows that the relay is too small, use a relay with a higher release voltage and/or a smaller coil resistance.

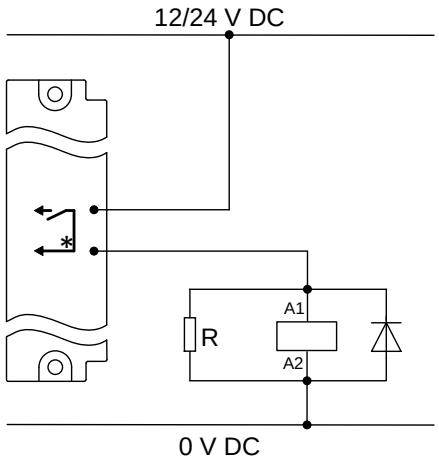
| | |
|---|---|
| **Example** | For a 24 V supply, a relay with a 7.5 V release voltage and a 630 ohm coil is proposed.<br><br>The right side of the equation is then (24 V - 4.5 V) / (3900 Ω + 630 Ω) × 630 Ω = 2.7 V.<br><br>The release voltage (7.5 V) is more than 2.7 V. The wire break detection current leak will not activate this relay. |

| | |
|---|---|
| **Example** | For a 12 V supply, a relay with a 0.6 V release voltage and a 848 ohm coil is proposed.<br><br>The right side of the equation is then (12 V - 4.5 V) / (3900 Ω + 848 Ω) × 848 Ω = 1.3 V.<br><br>The release voltage (0.6 V) is less than 1.3 V. The wire break detection current leak will activate this relay. Use a bigger relay, or use an external resistor to prevent relay activation. |

### Using an external resistor to prevent relay activation

If you do not need wire break detection, you can install an external resistor to stop the wire break detection current leak from activating the relay.

**Figure 5.5** Wiring example for external resistor to stop the wire break current leak from activating the relay




Use the following formula to calculate the maximum resistor size (in ohms):

$$R_{resistor} < R_{coil} \times V_{release} \times (2 \times R_{coil} + 7800) / (2 \times R_{coil} \times V_{supply} - 9 \times R_{coil} - 7800 \times V_{release} - 2 \times R_{coil} \times V_{release})$$

**CAUTION**
This formula does not include a safety factor.

**INFO**
If you get a negative result on the right side, then you do not need a resistor.

| | |
|---|---|
| **Example** | For a 24 V supply, a relay with a 1.2 V release voltage and a 3390 ohm coil is proposed. The wire break detection current will activate this relay, and so an external resistor is required.<br><br>The external resistor must be smaller than:<br><br>3390 × 1.2 × (2 × 3390 + 7800) / (2 × 3390 × 24 - 9 × 3390 - 7800 × 1.2 - 2 × 3390 × 1.2) = 517 Ω<br><br>Use a 470 Ω resistor to stop the wire break detection current leak from activating this relay. |

**INFO**
Using an external resistor prevents wire break detection.

## 5.5.6 Digital inputs wiring

The digital inputs are bi-directional inputs. This means that wiring to the input and common terminals may be swapped around without affecting their operation.

However, all the digital inputs on a module share a common terminal. The digital input common for a module may be either low (connected to 0 V), or high (connected to 12 or 24 V). If the common is low, all the digital input signals connected to the module must be high (connected to 12 or 24 V). Similarly, if the common is high, all the digital input signals connected to the module must all be low (connected to 0 V).

The digital input common does not act as the common for any of the other terminals on the same module. The digital input common is also not affected by the digital input commons on other modules.

The digital inputs are designed for a nominal voltage of 12 to 24 V DC.

**Figure 5.6** Example of digital input wiring (common = 0 V)

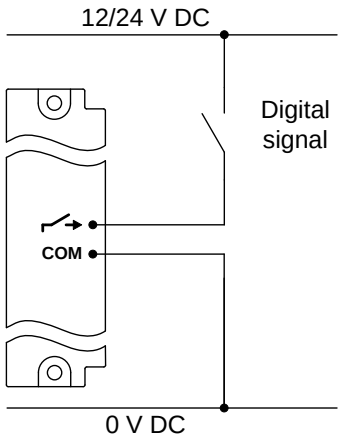
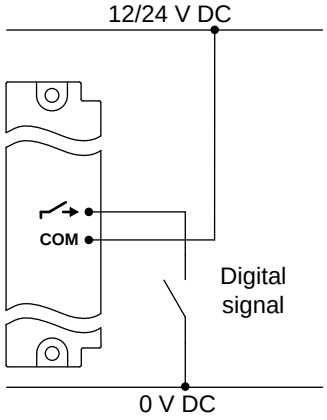


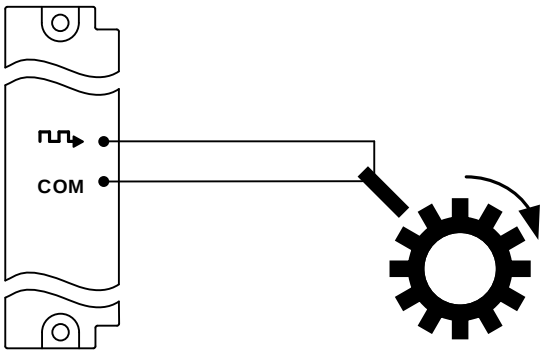

**Figure 5.7** Example of digital input wiring (common = 12 or 24 V)



## 5.5.7 Magnetic pickup unit (MPU) input wiring

**INFO**
If you use the MPU input, you cannot also use the W input. Connecting both the MPU and W inputs at the same time will lead to incorrect readings.

The MPU input wiring is shown in the following diagram. The MPU terminal connections on the DEIF equipment can be switched around without any problem. If an MPU is used, a wire break can be detected.

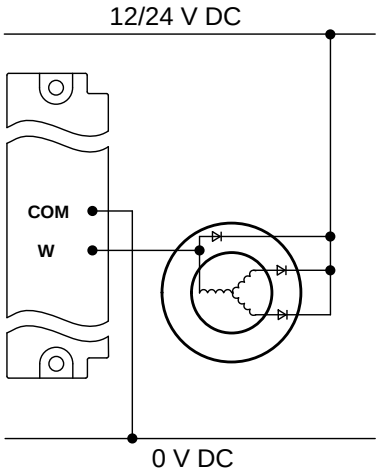



## 5.5.8 W input wiring

The W input can be used for a signal from one of the phases of the genset alternator, or for an NPN or PNP input.

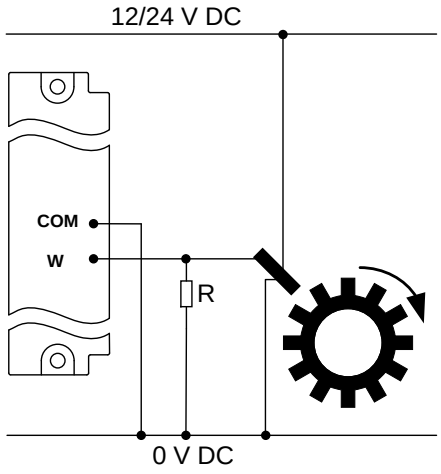
**INFO**
If you use the W input, you cannot also use the MPU input. Connecting both the MPU and W inputs at the same time will lead to incorrect readings.

The connection of the W output from the alternator is shown below.



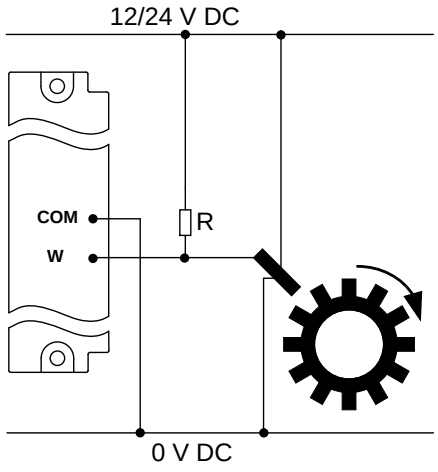
### PNP input to W terminal

The connection of a PNP input, with a pull-down resistor, is shown below. The resistor, with resistance as recommended by the PNP supplier, should be placed close to the controller module.




### NPN input to W terminal

The connection of an NPN input, with a pull-up resistor, is shown below. The resistor, with resistance as recommended by the NPN supplier, should be placed close to the controller module.



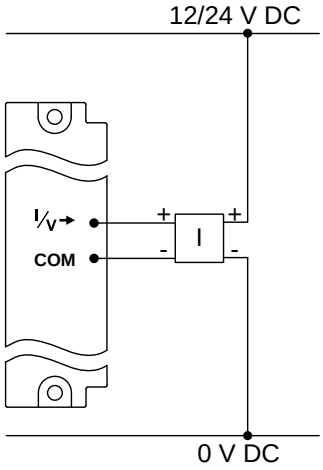

## 5.5.9 Analogue current or resistance inputs wiring

The DEIF controller settings are used to select whether the input is current or resistance, and to configure other information about the input.

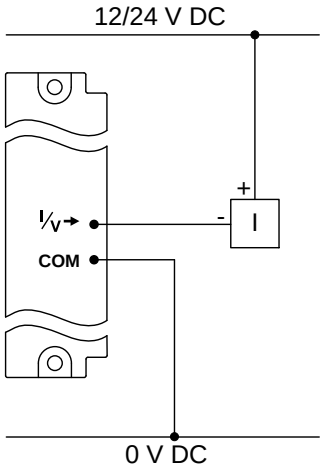
### Current input

The current input may be either active or passive, and a combination of active and passive inputs may be used.

The following diagram shows the connection of an active transducer.




The following diagram shows the connection of a passive transducer.

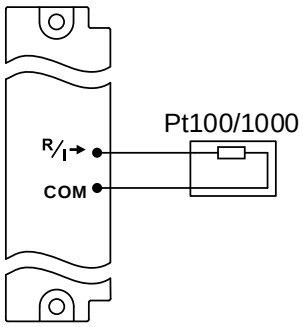



### Resistance input

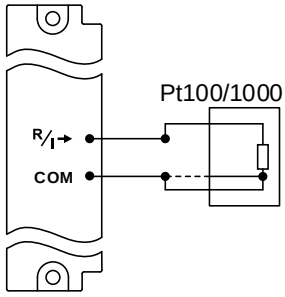
The resistance inputs are always passive inputs. The controller sends a small current through the external equipment and measures the resistance.

**INFO**
Note that there is no software compensation for the wire length to the resistance input. Errors due to wire length can be adjusted by creating a custom graph for the analog input in PICUS.

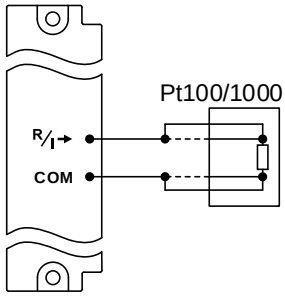
The following diagram shows the connection of a 2-wire Pt100/1000 sensor.



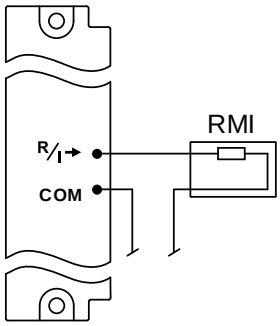

The following diagram shows the connection of a 3-wire Pt100/1000 sensor. You do not have to connect the third wire (shown by the dashed line). If you want to connect the third wire, connect it to the common, as shown in the diagram.



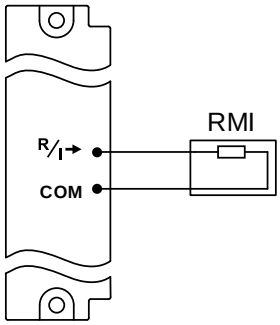

The following diagram shows the connection of a 4-wire Pt100/1000 sensor. You do not have to connect the third and fourth wires (shown by the dashed lines). If you want to connect them, connect them as shown in the diagram.



The following diagram shows the connection of a 1-wire resistance measurement input (RMI).




The following diagram shows the connection of a 2-wire resistance measurement input (RMI).



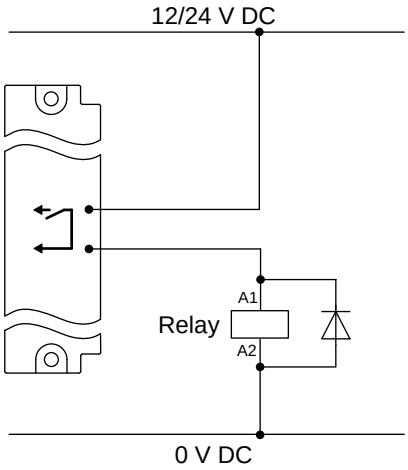
# 5.6 Governor and AVR module GAM3.1

## 5.6.1 GAM3.1 terminal overview

| Terminal | Symbol | Name | Type |
|---|---|---|---|
| 1 |  | Normally open | Relay output (250 V AC and 8 A, or 30 V DC and 5 A) |
| 2 | | Common | |
| 3 |  | Normally open | |
| 4 | | Common | |
| 5 |  | Normally open | |
| 6 | | Common | |
| 7 |  | Normally open | |
| 8 | | Common | |
| 9 |  | Active (P) load | Load sharing for future use to perform analogue load sharing. (Voltage output: -5 to 5 V DC, Impedance: 23.5 kΩ) |
| 10 | COM | Common | |
| 11 |  | Reactive (Q) var | |
| 12 |  | Output | Analogue current or voltage output<br>(Current: 0 to 20 mA, 4 to 20 mA, or -20 to 20 mA;<br>Voltage (DC): 0 to 10 V, -10 to 10 V, 0 to 5 V, 0 to 3 V, -3 to 3 V, or 0 to 1 V) |
| 13 |  | Common | |
| 14 |  | PWM output | Pulse width modulation (PWM) output<br>(Frequency: 500 Hz ±50 Hz, Resolution: 48,000 levels, Voltage: 0.05 to 14 V ±2V) |
| 15 |  | Common | |
| 16 |  | Output | Analogue current or voltage output<br>(Current: 0 to 20 mA, 4 to 20 mA, or -20 to 20 mA;<br>Voltage (DC): 0 to 10 V, -10 to 10 V, 0 to 5 V, 0 to 3 V, -3 to 3 V, or 0 to 1 V) |
| 17 |  | Common | |
| 18 |  | Input | Analogue current or voltage input<br>(Current: 0 to 20 mA, or 4 to 20 mA;<br>Voltage (DC): -10 to 10 V, 0 to 10 V) |
| 19 |  | Common | |
| 20 |  | Input | |
| 21 |  | Common | |

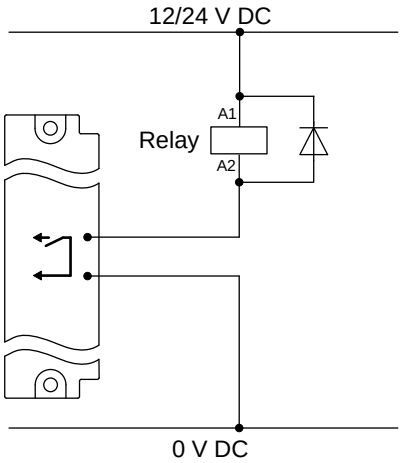
## 5.6.2 Relay output wiring

The following diagram shows the connection of the relay output to an external relay. For the wiring shown, there is no voltage on the external relay when the controller relay is open.




**INFO**
Use a diode size as recommended by the relay supplier.

The terminal connections can be switched around without affecting the performance.



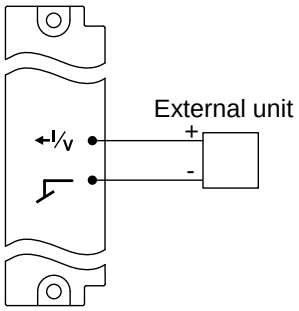

**INFO**
Remember to install the freewheeling diode ( ). This diode prevents a sudden voltage spike across the inductive load when the voltage source is removed.

## 5.6.3 Load sharing wiring

The active (P) and reactive (Q) load sharing terminals on the GAM3.1 module are reserved for future use for analogue load sharing.

## 5.6.4 Analogue current or voltage outputs wiring

The diagram below shows the connection of an external controller to the DEIF controller's analogue current or voltage output. The DEIF controller settings are used to select whether the output is current or voltage.

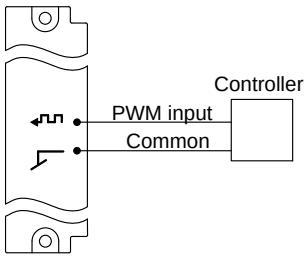



**CAUTION**
These outputs are active outputs. Do not connect an external power supply to these terminals. Connecting an external power supply may damage the terminals.

**INFO**
The PWM output is galvanically connected to the first analogue output (terminals 12 and 13) on GAM3.1. This means that wiring errors or noise on either output can affect the other output.

## 5.6.5 Pulse width modulation (PWM) output wiring

Pulse width modulation (PWM) output is normally used to control a governor. The PWM could also be used as an input for another controller, as shown in the diagram below.




**INFO**
The PWM output is galvanically connected to the first analogue output (terminals 12 and 13) on GAM3.1. This means that wiring errors or noise on either output can affect the other output.

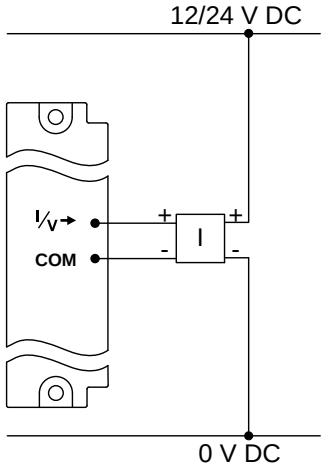
## 5.6.6 Analogue current or voltage input wiring

The DEIF controller settings are used to select whether the input is current or voltage, and to configure other information about the input.

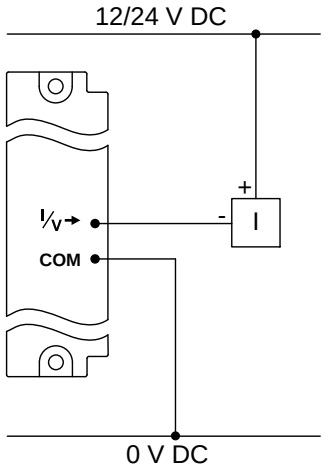
### Current input

The current input may be either active or passive.

The following diagram shows the connection of an active transducer.




The following diagram shows the connection of a passive transducer.

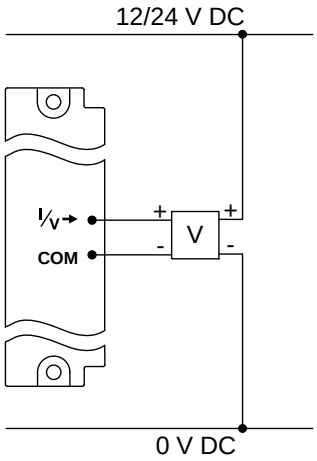



**INFO**

The two analogue inputs on GAM3.1 are galvanically connected. You therefore cannot use the analogue inputs on GAM3.1 in series with each other, for example, if you wanted a back-up measurement. If you need two analogue inputs in series, you can use an analogue input on another module in series with an analogue input on GAM3.1, since the modules are galvanically isolated from each other.

### Voltage input

The following diagram shows the connection for voltage input.




# 5.7 Processor and communication module PCM3.1

## 5.7.1 PCM3.1 terminal overview

| Terminal | Symbol | Type | Name |
|---|---|---|---|
| 1 | H | CAN high | CAN bus A (Future use for engine communication) |
| 2 | CAN-A | CAN signal ground | |
| 3 | L | CAN low | |
| 4 | H | CAN high | CAN bus B (Future use for engine communication) |
| 5 | CAN-B | CAN signal ground | |
| 6 | L | CAN low | |

**Table 5.2** PCM3.1 Recommended Ethernet connections

| Connection | Symbol | Type | Name |
|---|---|---|---|
| 1 | | RJ45 | DEIF network to another controller |
| 2 | | RJ45 | DEIF network to another controller |
| 3 | | RJ45 | Service PC |
| 4 | | RJ45 | Display unit |
| 5 | | RJ45 | Modbus TCP/IP |

The Ethernet connections listed above are the recommended defaults, to help troubleshooting. The Ethernet ports are in fact fully interchangeable.

**INFO**
Only one display unit may be connected to each controller rack. DEIF recommends mounting the display unit close to the controller rack.

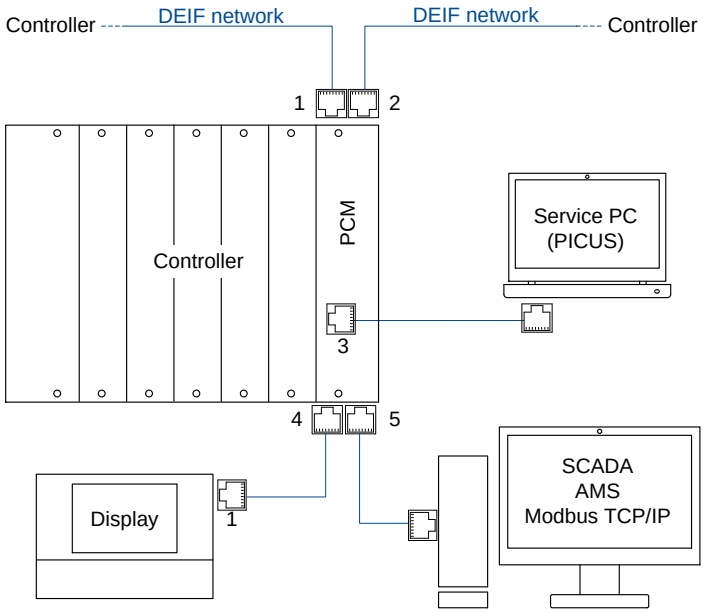
## 5.7.2 CAN bus communication wiring

The CAN bus terminals on the PCM3.1 module are reserved for future use for communication with a Engine Control Unit (ECU) or a digital Automatic Voltage Regulator (AVR).

## 5.7.3 Ethernet connections

As a minimum, only one connection from the controller to another controller in the DEIF network is required.

The following diagram shows the recommended default connection of the Ethernet cables. The controller is connected to adjacent controllers using the DEIF network connection.




See **Wiring the communication** in this document for more information.

# 6. Wiring for controller functions

## 6.1 Introduction

This chapter includes wiring diagrams for a variety of controller functions.

See the **Designer's handbook** for more information about each controller function.

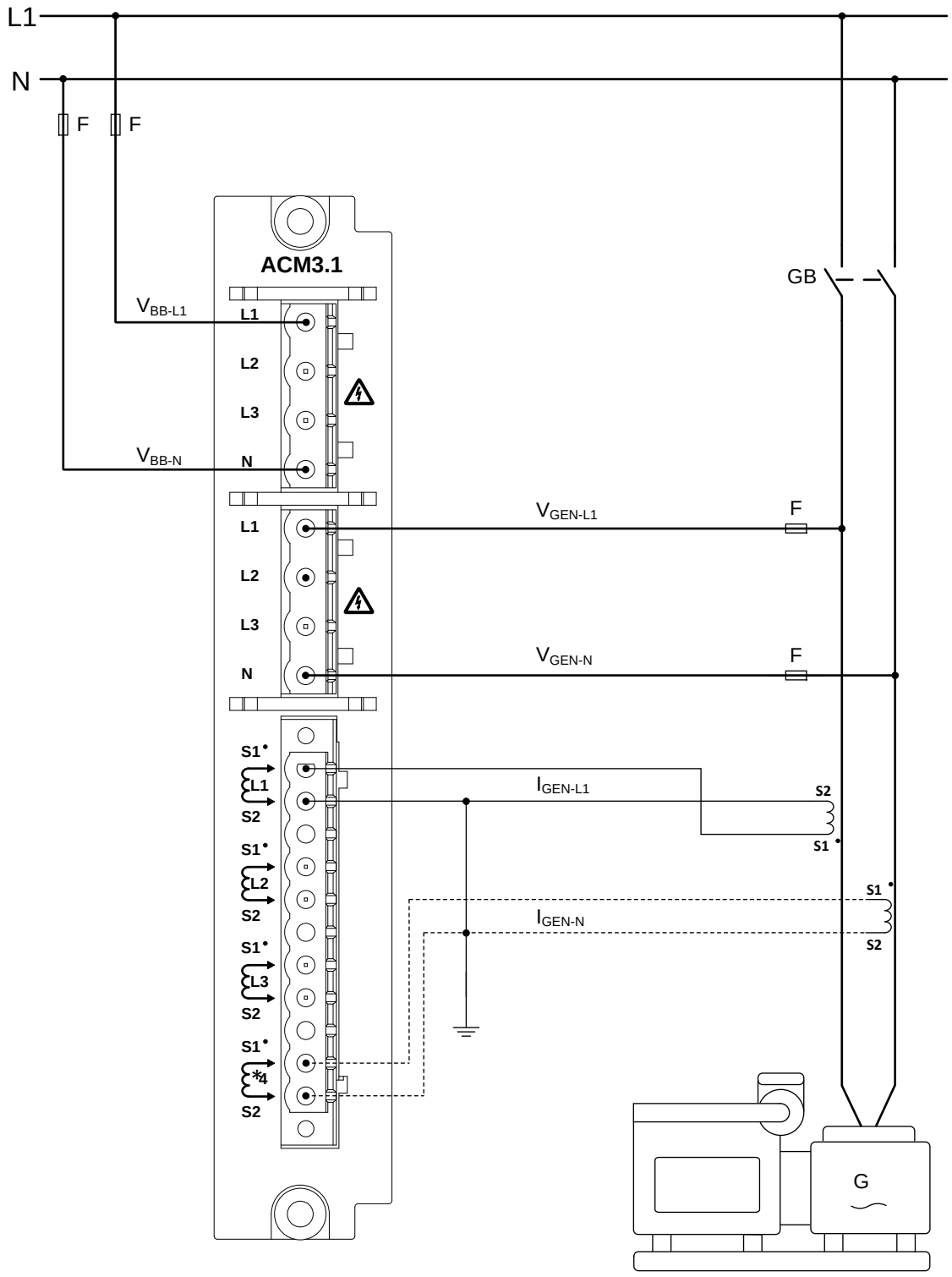
## 6.2 AC measurement wiring

### 6.2.1 System AC configuration

See **AC configuration and nominal settings**, **AC configuration**, **System** in the **Designer's handbook** for information about setting the parameters for these configurations.

## Single-phase wiring

**Figure 6.1** Example of single-phase L1 AC wiring

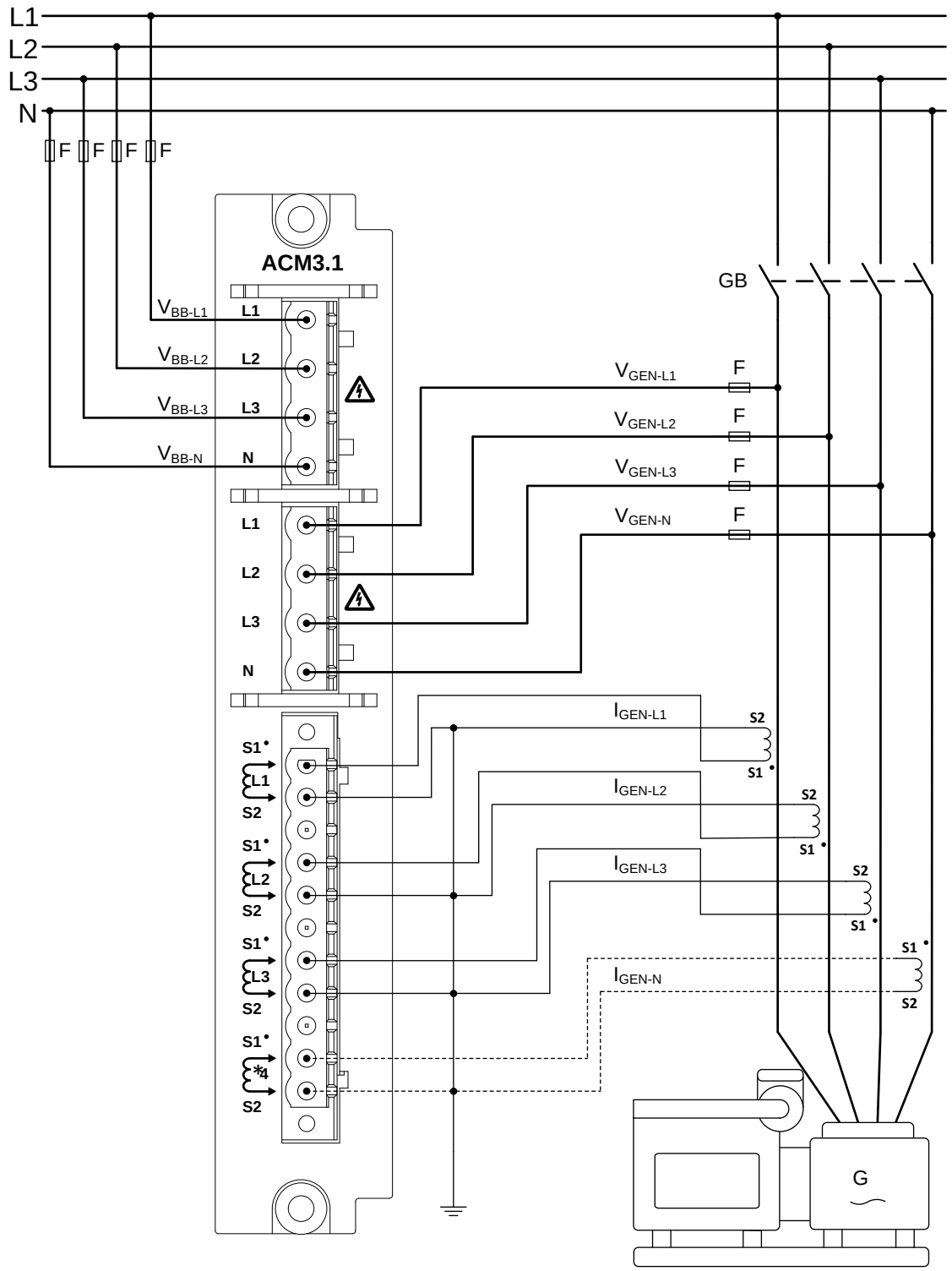


**INFO**
Single-phase does NOT mean split-phase (where the waveforms are offset by a half-cycle (180 degrees) from the neutral wire). Split-phase is NOT possible with PPM 300.

**INFO**
Alternatively, you can ground the S1 side of the current transformers, instead of S2 as shown.

## Wiring phase-neutral voltage measurements

**Figure 6.2** Example of wiring required for the phase-neutral voltage measurements

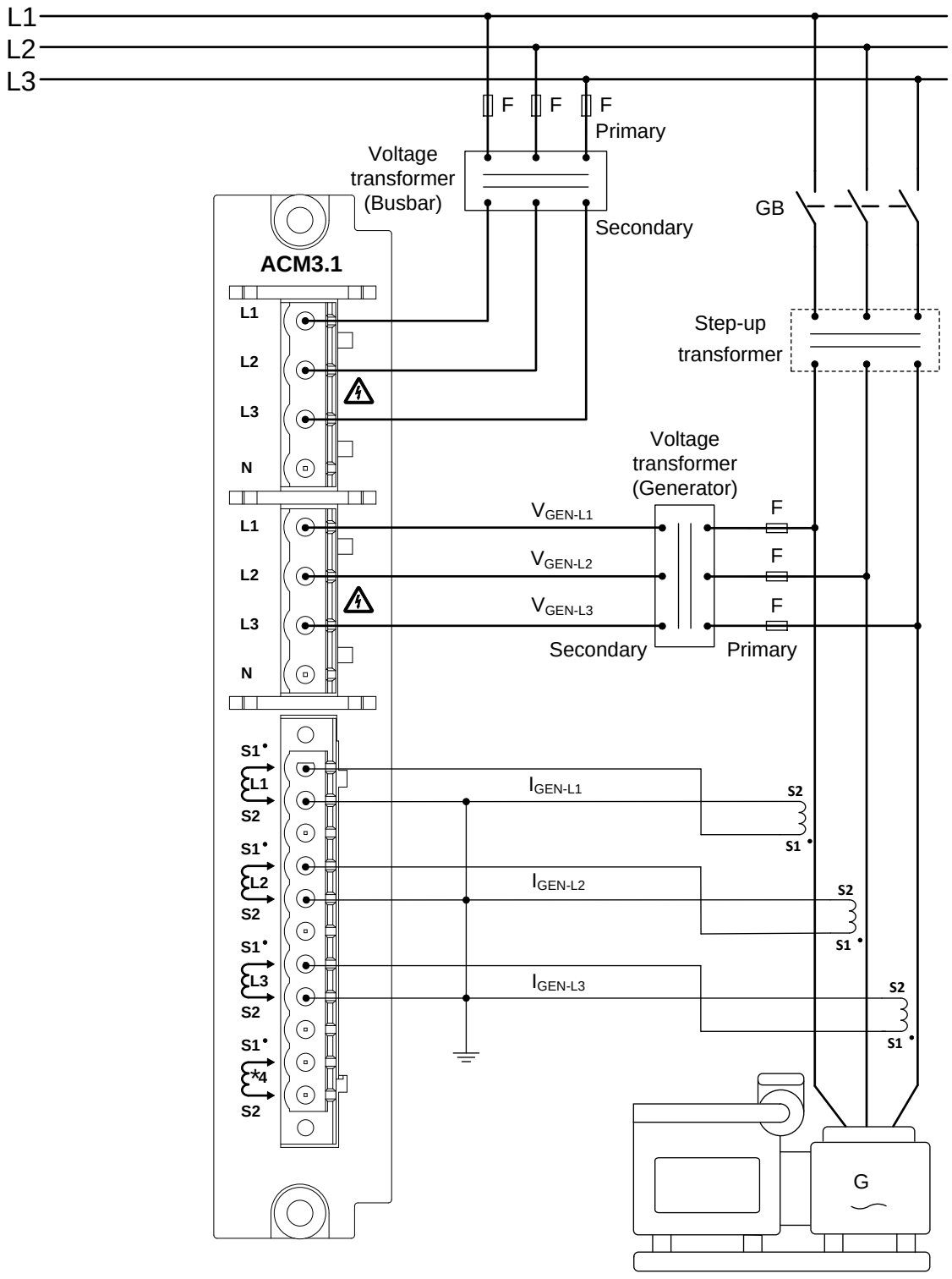


**INFO**
Alternatively, you can ground the S1 side of the current transformers, instead of S2 as shown.

### 6.2.2 [Controlled equipment] AC configuration

See **AC configuration and nominal settings**, **AC configuration**, **[Controlled equipment]** in the **Designer's handbook** for information about setting the parameters for this configuration.

**Figure 6.3** Example of generator voltage transformer wiring

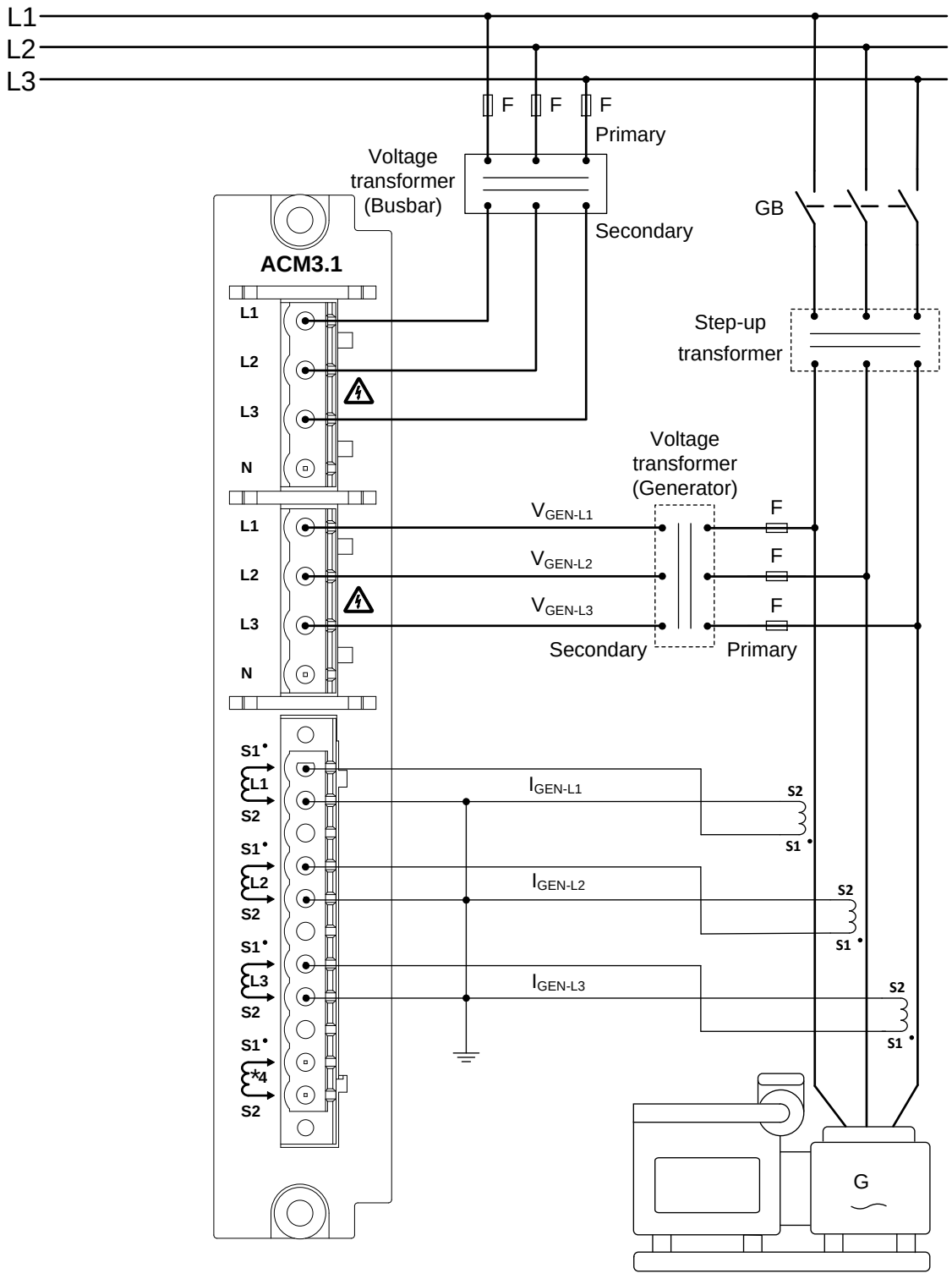



**INFO**
Alternatively, you can ground the S1 side of the current transformers, instead of S2 as shown.

### 6.2.3 [Busbar] AC configuration

See **AC configuration and nominal settings**, **AC configuration**, **[Busbar]** in the **Designer's handbook** for information about setting the parameters for this configuration.

**Figure 6.4** Example of busbar voltage transformer wiring



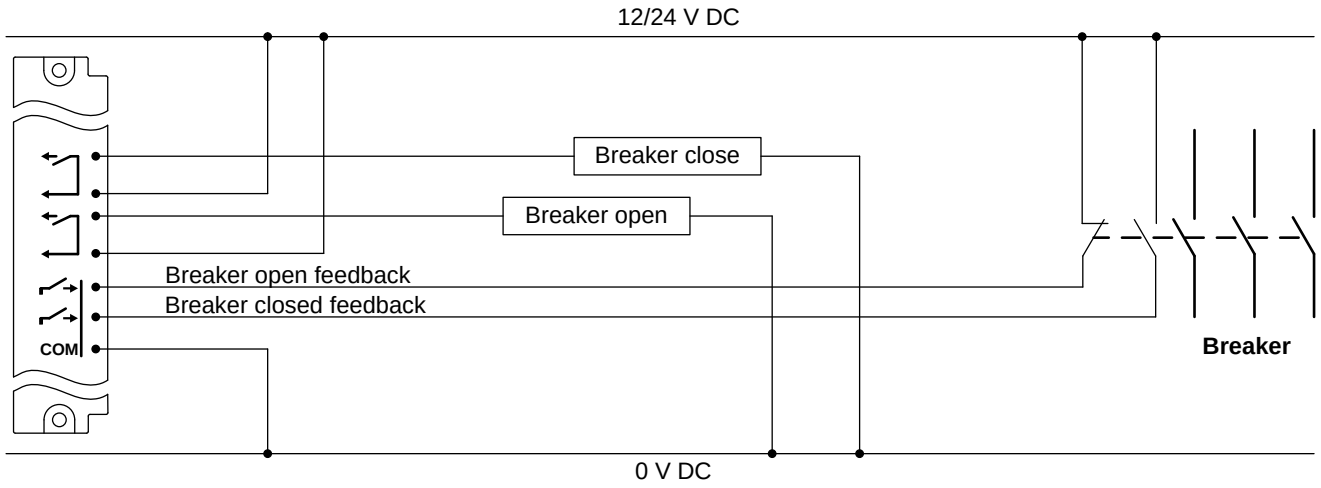

**INFO**
Alternatively, you can ground the S1 side of the current transformers, instead of S2 as shown.

# 6.3 Breaker wiring

## 6.3.1 Pulse breaker

See **Breakers, synchronisation and de-loading**, **Pulse breaker** in the **Designer's handbook** for information about setting the parameters for this configuration.

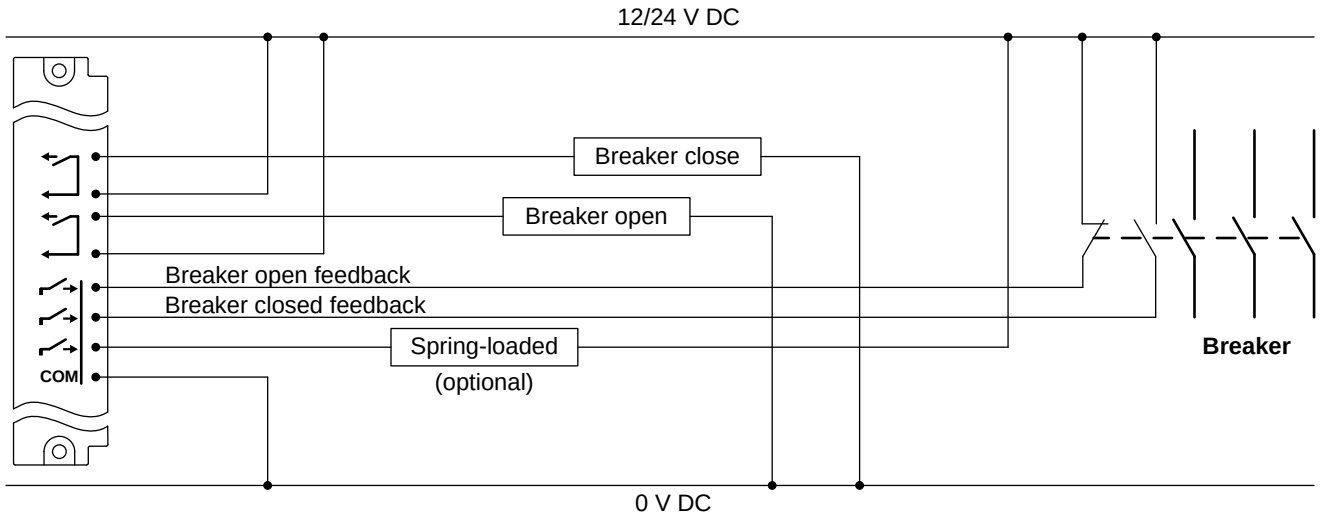
**Figure 6.5** Example of pulse breaker wiring




## 6.3.2 Compact breaker

See **Breakers, synchronisation and de-loading**, **Compact breaker** in the **Designer's handbook** for information about setting the parameters for this configuration.

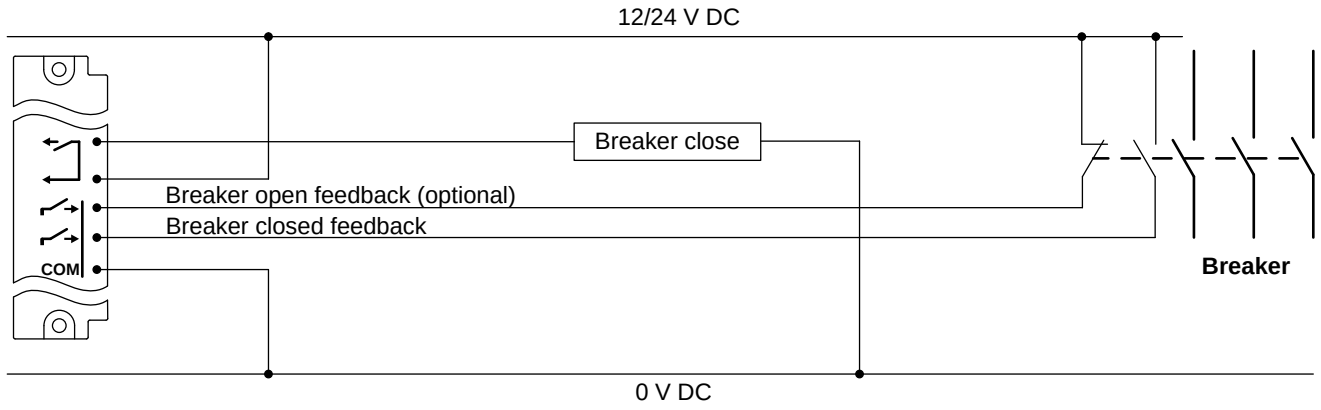
**Figure 6.6** Example of compact breaker wiring




## 6.3.3 Continuous breaker

See **Breakers, synchronisation and de-loading**, **Continuous breaker** in the **Designer's handbook** for information about setting the parameters for this configuration.

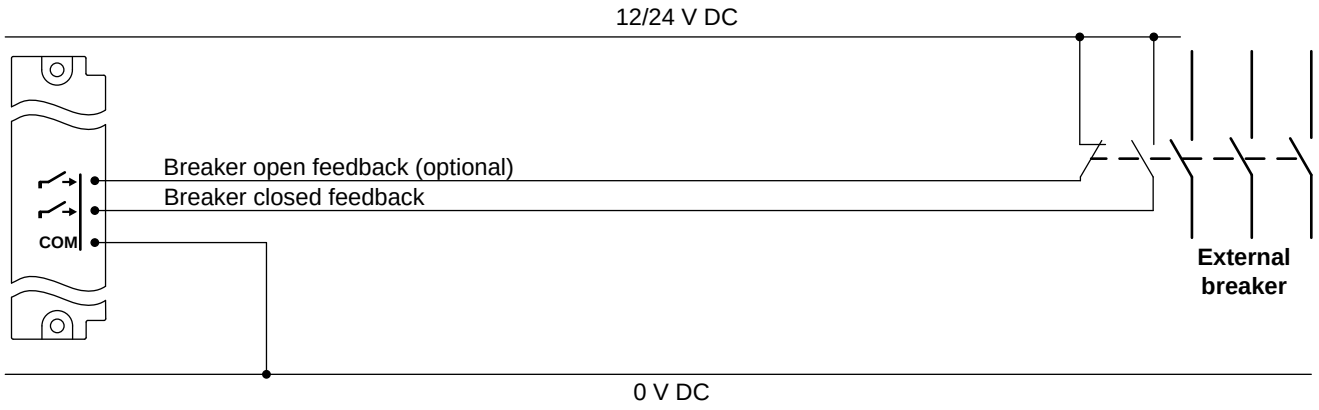
**Figure 6.7** Example of continuous breaker wiring




## 6.3.4 External breaker

See **Breakers, synchronisation and de-loading**, **External breaker** in the **Designer's handbook** for information about setting the parameters for this configuration.

**Figure 6.8** Example of external breaker wiring



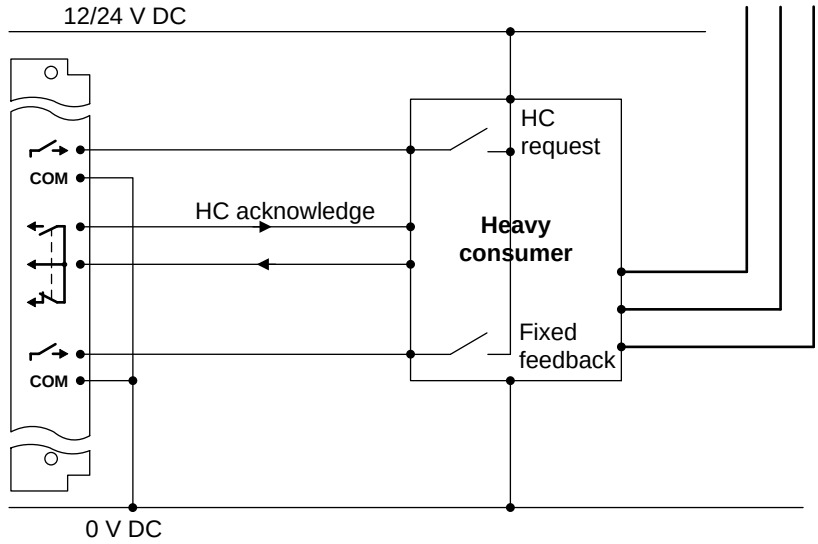

# 6.4 Power management wiring

## 6.4.1 Heavy consumer

See **Power management**, **Heavy consumer function** in the **Designer's handbook** for information about setting the parameters for these configurations.

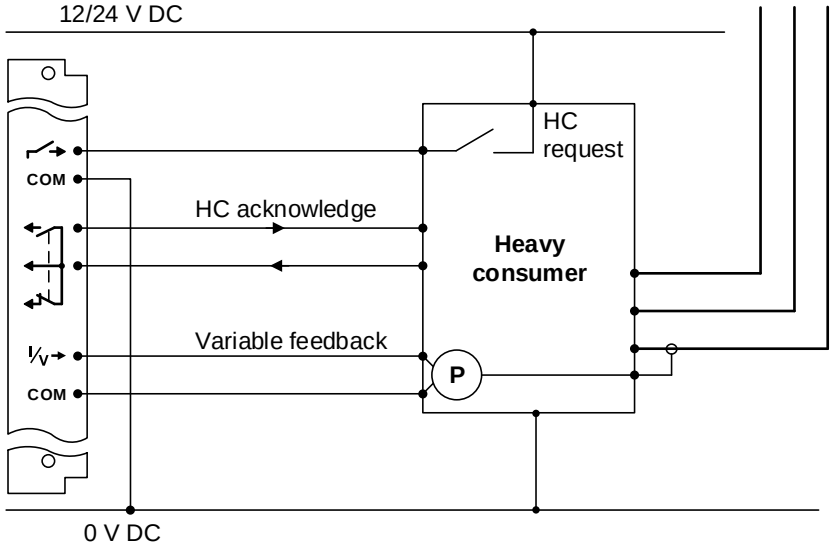
### Heavy consumer with fixed feedback

**Figure 6.9** Example of how the inputs and outputs of the controller may be connected to a heavy consumer with fixed feedback



## Heavy consumer with variable feedback

**Figure 6.10** Example of how the inputs and outputs of the controller may be connected to a heavy consumer with variable feedback



# 7. Wiring the communication

## 7.1 DEIF Ethernet network communication

### 7.1.1 Communication

The DEIF network is an Ethernet network that allows the controllers to communicate with each other to manage the system.

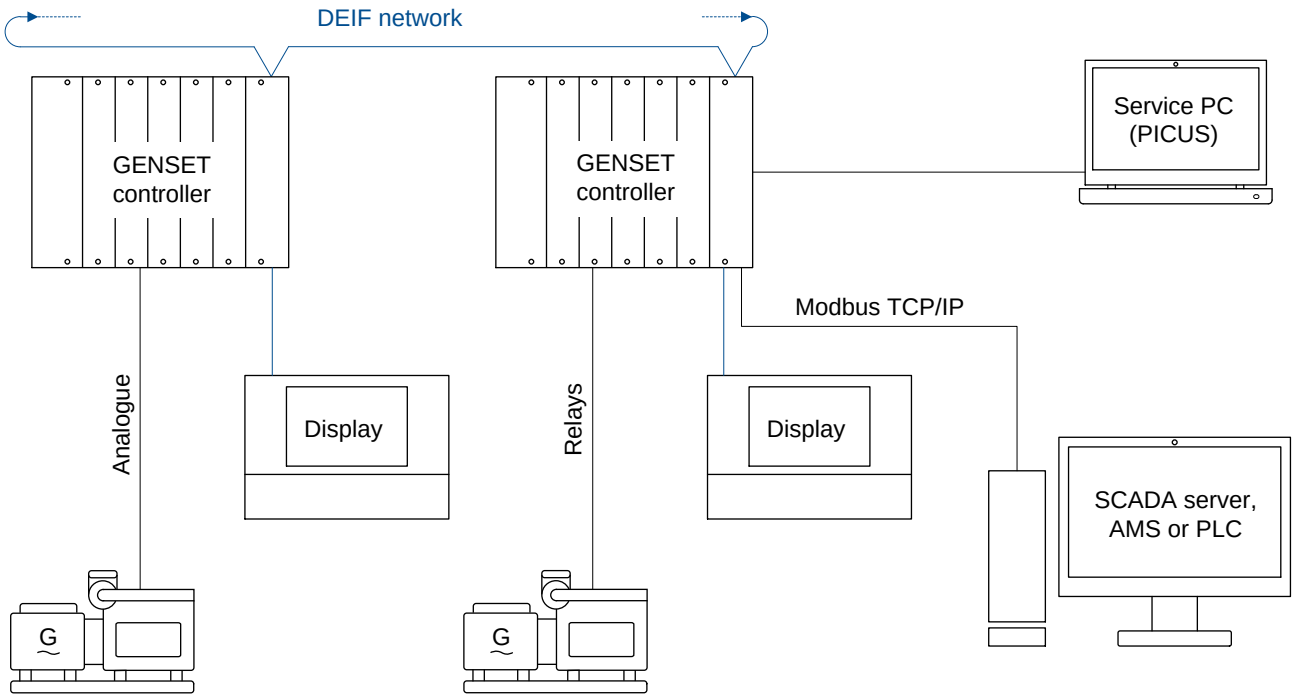
For communication redundancy, the controllers can be interleaved or connected in a ring. If there is a disruption or failure, the DEIF proprietary ring protocol changes the communication path within 100 milliseconds.

**INFO**
Communication should only be connected with either *Network chain* or *Network ring* configuration. It is not possible in the first release to configure *Star* or *Top ring* connections.

**Table 7.1** DEIF network characteristics

| Category | Details |
|---|---|
| **Specifications** | • Supports Internet Protocol version 6 (IPv6) and Internet Protocol version 4 (IPv4)<br>• Up to 64 controllers per system |
| **Functions** | • Power management communication, including load-dependent start/stop, and de-loading<br>• Power management inputs and outputs may be connected to any controller<br>• Load sharing communication<br>• Authentication (non-DEIF equipment cannot disrupt communication)<br>• Connects the controller(s) to:<br>◦ Controller display unit<br>◦ PICUS<br>◦ SCADA server, Alarm management server (AMS) and/or PLC (using Modbus TCP/IP) |

**Figure 7.1** Recommended controller system communication topology for genset control (single network ring)




The controllers receive inputs from, and send outputs to the controlled equipment. For the GENSET controller, the outputs include regulation outputs, using analogue signals, and/or relays.

## 7.1.2 Connecting the communication

### Restrictions

- Up to 64 controllers can be connected to each other in each network ring. Display units can be connected to the controllers without having any effect on the maximum number of controllers in the network ring.
- The Ethernet lines must not be longer than 100 metres, point-to-point.
- The Ethernet lines must meet or exceed the SF/UTP CAT5e specification.

**INFO**
For marine applications, a marine-approved managed switch should be used to connect the DEIF network to your own network. (An ordinary Ethernet switch is not recommended).

**CAUTION**
The switch must support and be enabled for Rapid Spanning Tree Protocol (RSTP) otherwise a broadcast storm will occur.

### Ethernet port connections

The Ethernet ports on the controllers are not assigned to a particular service. The controllers detect the equipment connected to the port. You can therefore use any port for any service.

However, the recommended default connection of the controllers is as follows:

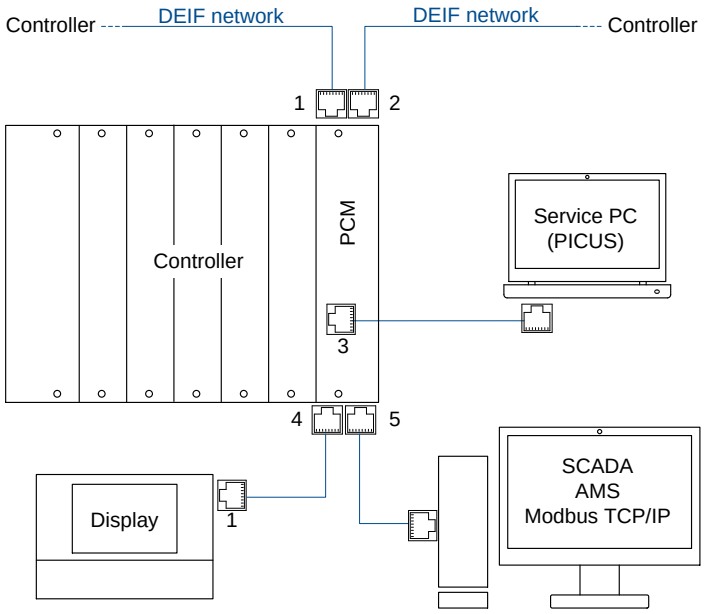
**Table 7.2** Recommended default controller connection to the rack

| Connection | Symbol | Ethernet port position | Recommended default connection |
|---|---|---|---|
| 1 | | Top of rack, back port | DEIF network |
| 2 | | Top of rack, front port | DEIF network |
| 3 | | Front of rack | Service PC / PICUS |
| 4 | | Bottom of rack, front port | Display unit |
| 5 | | Bottom of rack, back port | DEIF network / SCADA / AMS / Modbus TCP/IP |

**Table 7.3** Recommended default display unit connection to the controller

| Connection | Symbol | Ethernet port position | Recommended default connection |
|---|---|---|---|
| 1 | | Right side, top port | Controller |
| 2 | | Right side, bottom port | For future use |

The following diagram shows the recommended default connection for the Ethernet cables.




## Cable bend radius

Bends in the Ethernet cables must not be tighter than the minimum bend radius specified by the cable manufacturers.

**INFO**

DEIF recommends that you always follow the cable manufacturer's bend radius requirements. As a guideline, Ethernet cables may require a minimum bend radius of 40 mm (1.6 in).

### Redundancy and routing

Each controller can be connected so that there is redundant communication (that is, two independent Ethernet connections) to other controllers. If you need redundant communication, you should route the Ethernet cables for redundancy. A single failure (for example, damage to a cable rack) should not damage both of the Ethernet connections to the other controllers.

See **DEIF Ethernet network communication**, **Topology examples** in this document for more information.

### Wiring the Ethernet cable

The controllers and display units use any type of Ethernet cable, provided it meets or exceeds SF/UTP CAT5e specification.

**CAUTION**
Modifying Ethernet cables improperly may cause loss of network connectivity and EMC problems.

**Table 7.4** Ethernet wire colours

| Cable colour | Description | Notation |
|---|---|---|
|  | White / Green | g |
|  | Green | G |
|  | White / Orange | o |
|  | Orange | O |
|  | White / Blue | b |
|  | Blue | B |
|  | White / Brown | br |
|  | Brown | BR |

**Figure 7.2** T-568A "Straight-through" Ethernet cable wiring

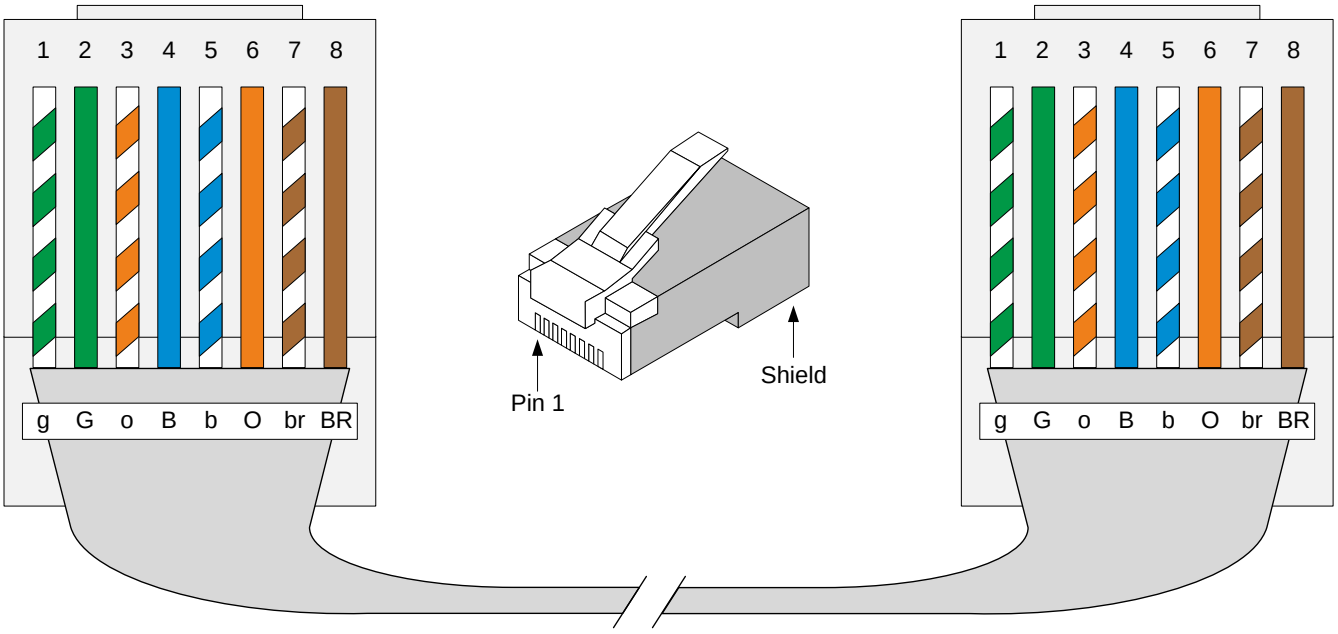



**Figure 7.3** T-568B "Straight-through" Ethernet cable wiring

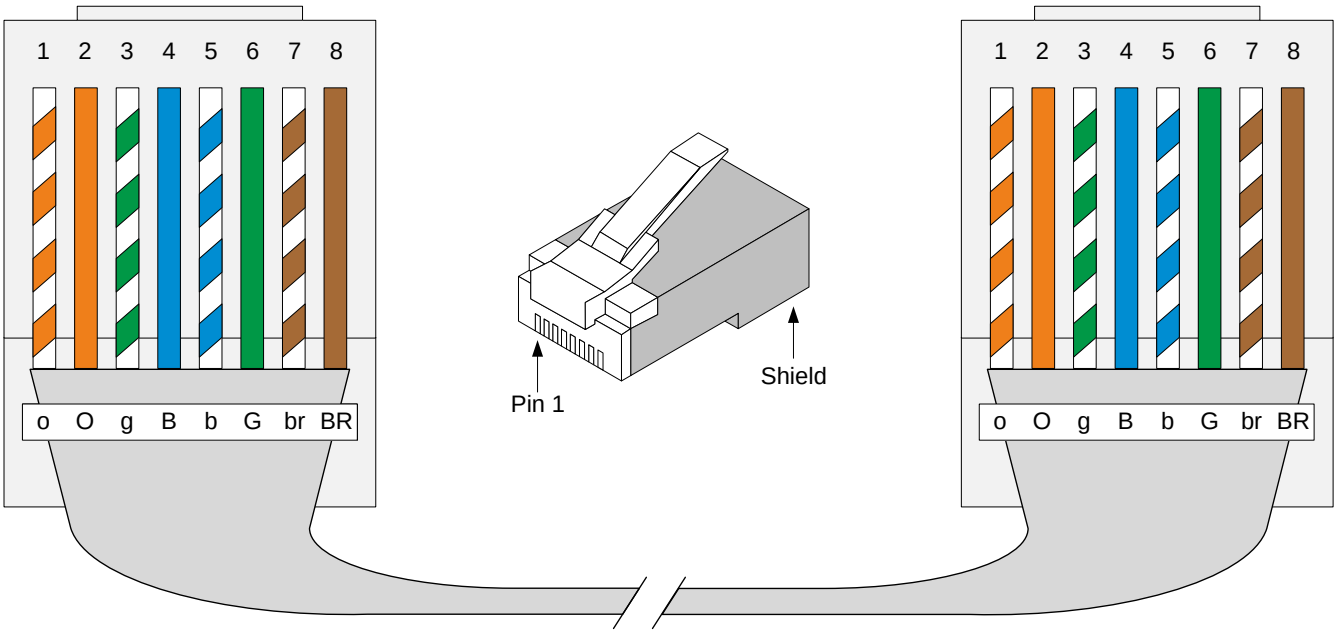
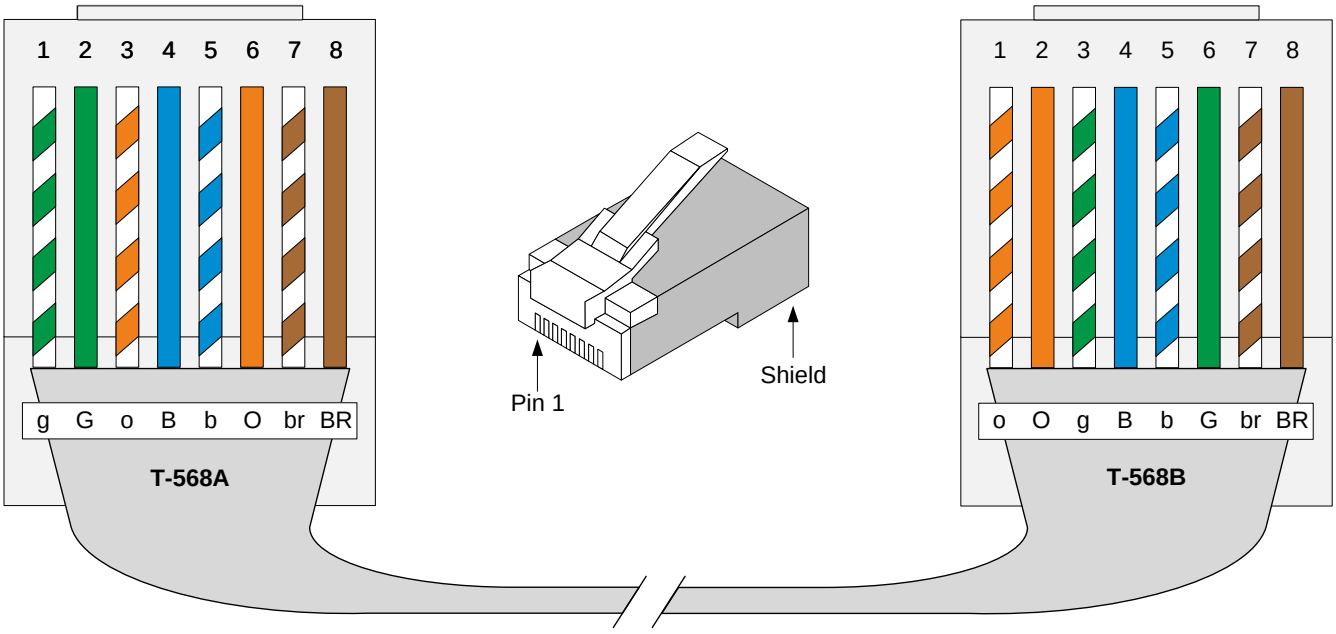


**Figure 7.4** RJ-45 "Crossover" Ethernet cable wiring



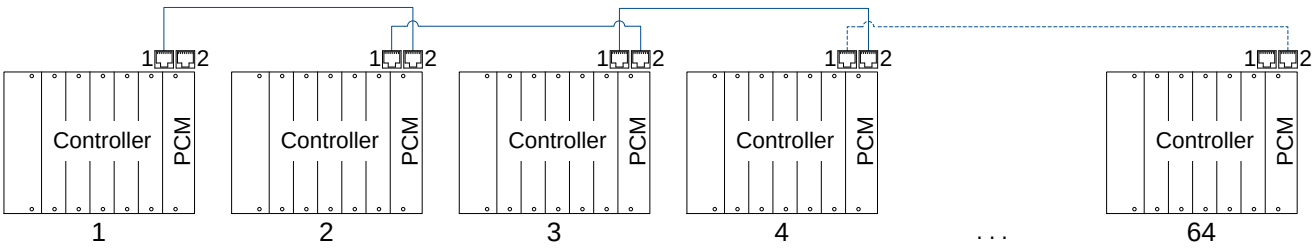

## 7.1.3 Communication topology examples

These examples show possible configurations for the controller Ethernet system.

**CAUTION**
The DEIF controllers do not include a firewall or other Internet security measures. It is the customer's own responsibility to protect the network. DEIF therefore recommends only connecting the controllers to local networks.

### Network chain

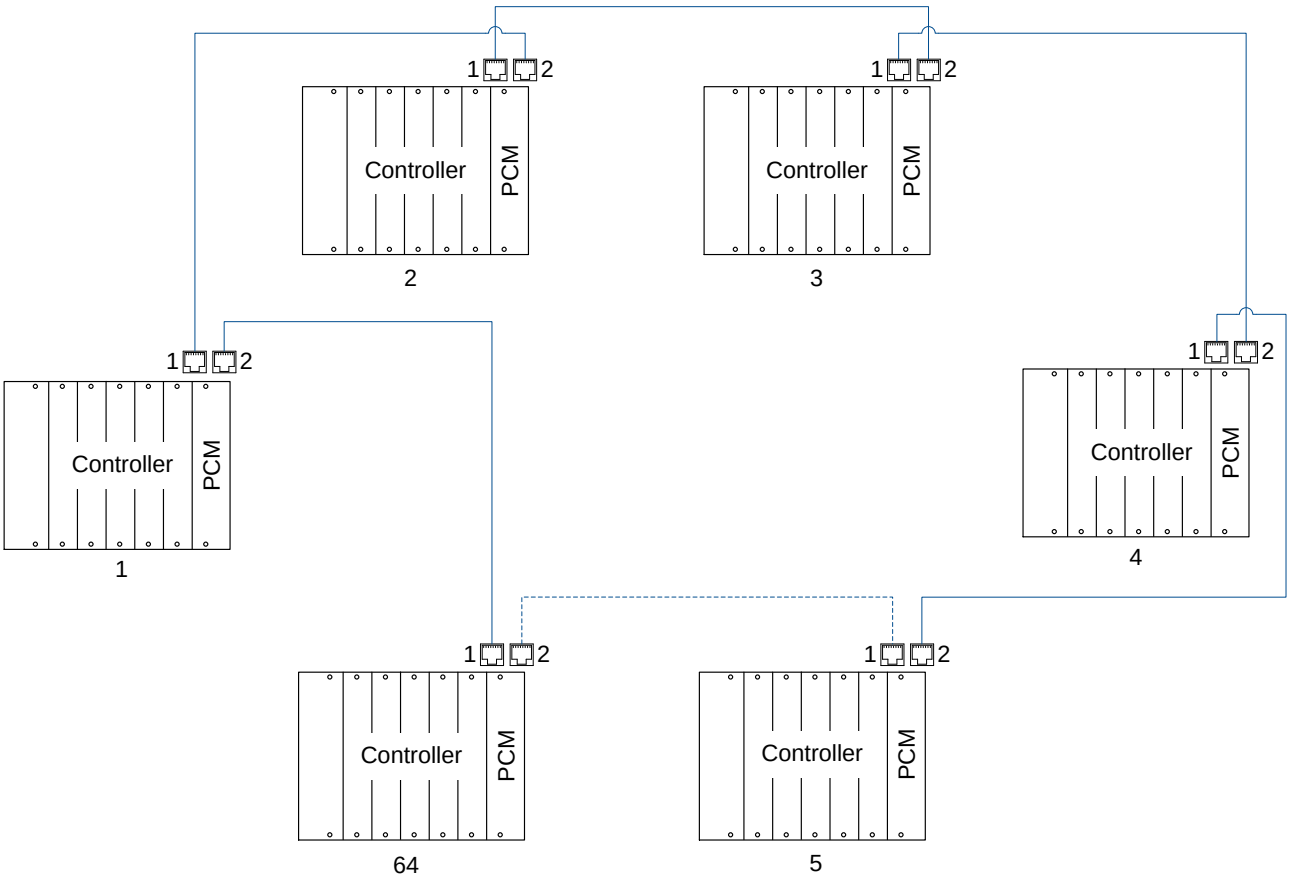
Up to 64 controllers can be connected to each other in a network chain, as shown in the following diagram.



## Network ring

Up to 64 controllers can be connected to each other in a network ring.

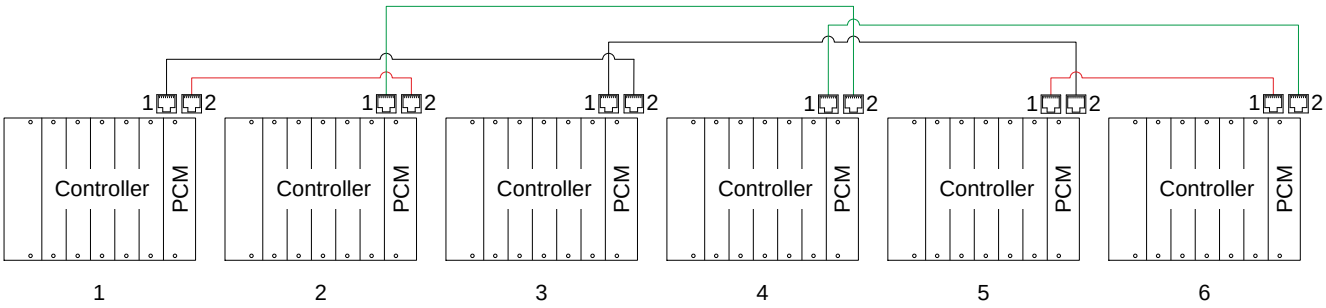
The network rings can be connected to a SCADA server, an alarm management system (AMS) or a service PC.




## Interleaving

To avoid a long return connection for a long row of controllers, you can "interleave" the controller connections.

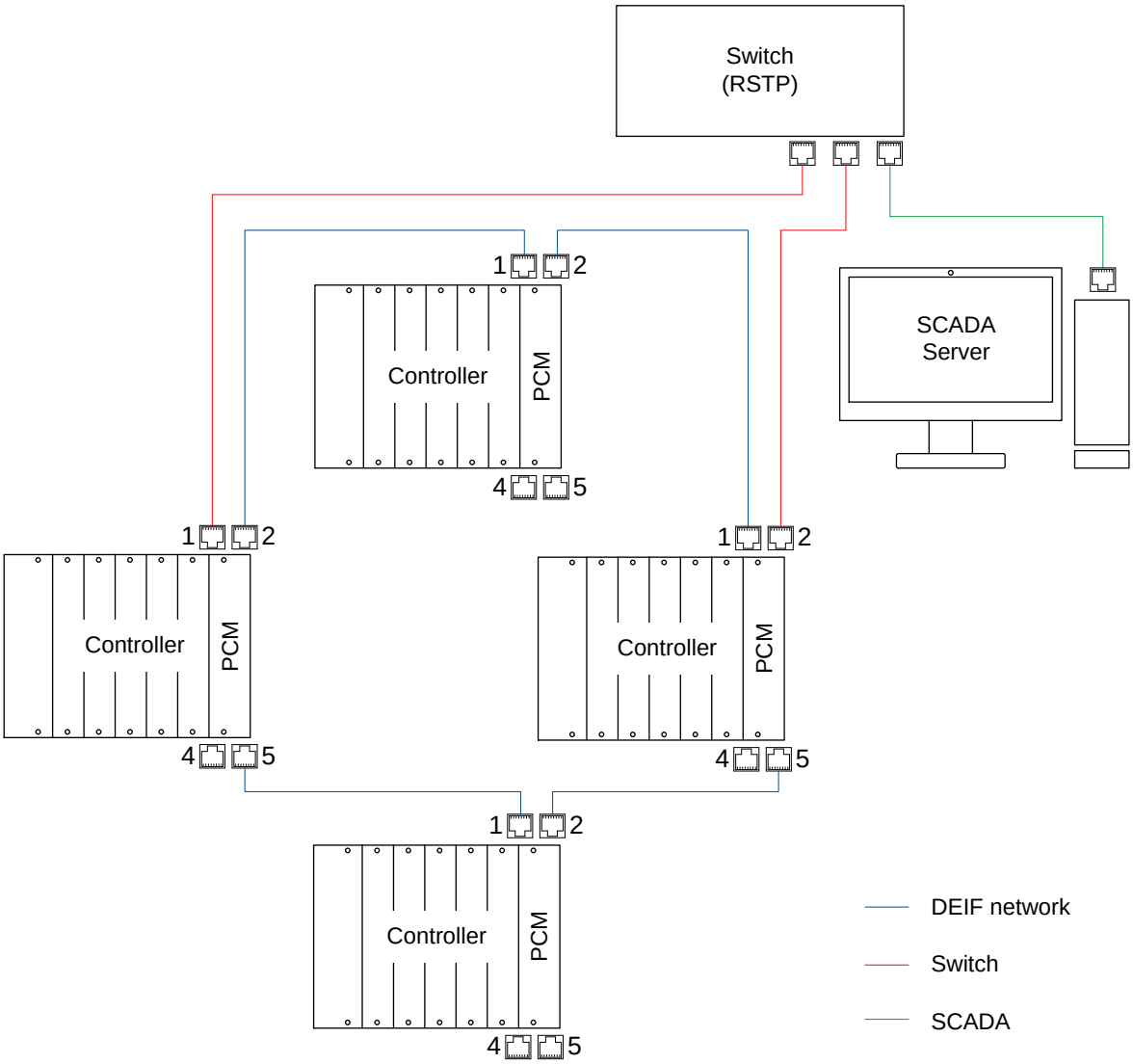
1. Connect each controller to the controller one controller away. In other words, connect 1 and 3, 2 and 4, 3 and 5, 4 and 6, and so on. The drawing shows these connections in black and green. Make sure that the cable paths are separated so that you minimise the risk of damaging two cables at the same time.
2. Connect the first two controllers to each other. Connect the last two controllers to each other. The drawing shows these connections in red.




## Redundant connection to SCADA or AMS

The network rings can be connected to a SCADA server, or an alarm management system (AMS), using a redundant connection to two different base units. This requires a switch that supports and has enabled Rapid Spanning Tree Protocol (RSTP).

A SCADA server example is shown in the following diagram:



# 8. Wiring the display unit

## 8.1 Display unit overview and wiring

### 8.1.1 Display unit terminal overview

**Figure 8.1** Back of display unit DU 300, with the terminal positions

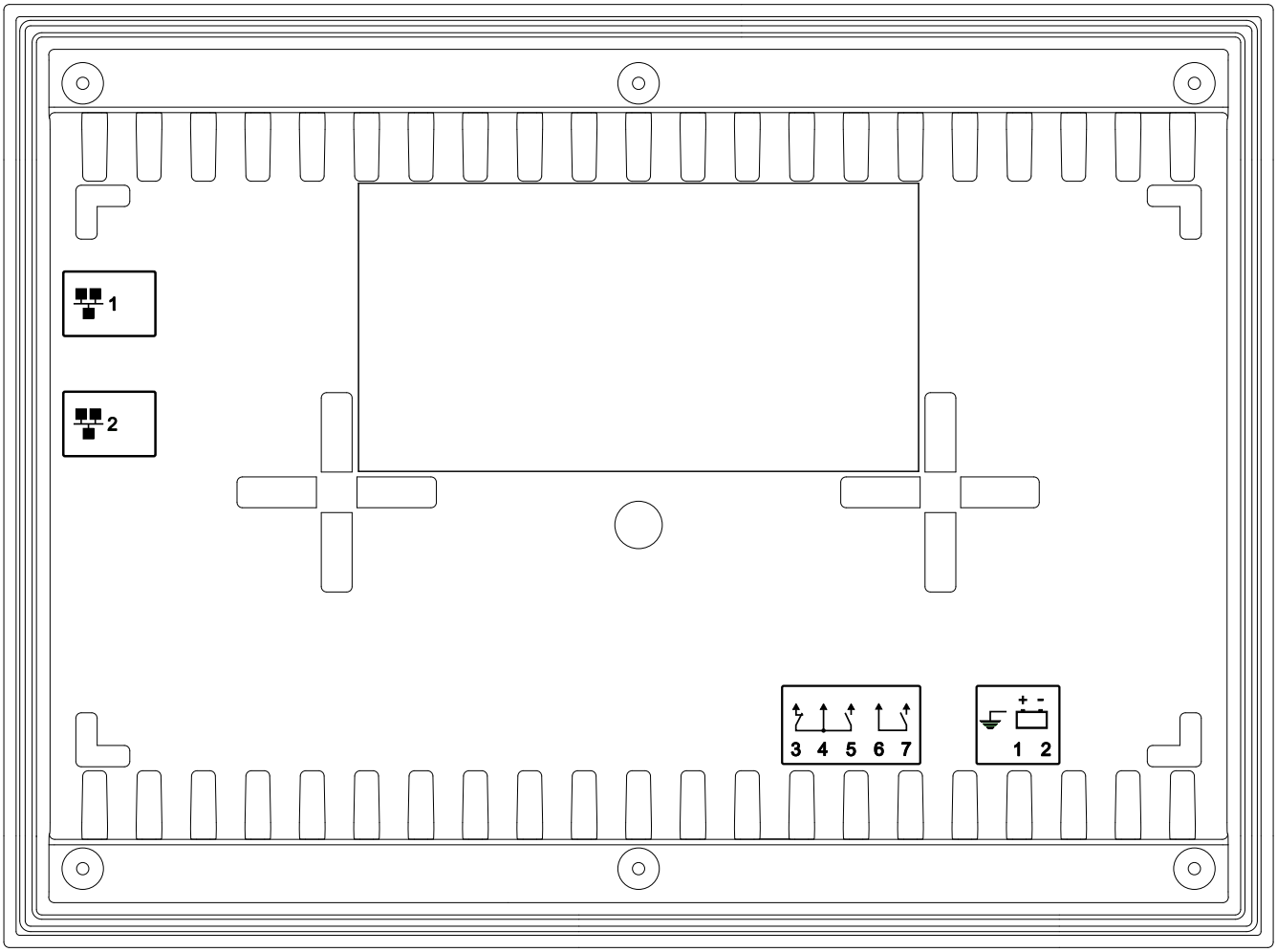



**Table 8.1** Display unit electrical terminals

| Terminal | Symbol | Type | Name |
|---|---|---|---|
| F/G | | Ground | Frame ground |
| 1 | + - | 12 or 24 V DC (nominal) | Power supply (+) |
| 2 | | 0 V DC | Power supply (-) |
| 3 | | Relay output (30 V DC and 1 A) | Future use |
| 4 | | | |

| Terminal | Symbol | Type | Name |
|---|---|---|---|
| 5 | | | |
| 6 |  | Relay output (30 V DC and 1 A) | Status OK (+) |
| 7 | | | Status OK (-) |

**Table 8.2** Display unit Ethernet connections

| Connection | Symbol | Type | Name |
|---|---|---|---|
| 1 |  | RJ45 | DEIF network Ethernet connection to controller (default connection) |
| 2 |  | RJ45 | Ethernet future use for additional display units. |

**CAUTION**
The first time a display unit is connected to a controller, it becomes paired to that specific controller for operation. If you later unplug the display unit and plug this into a different controller, the display will continue to be paired to the original controller. To remove this pairing, power the display unit off, connect the Ethernet cable to the required controller, and power the display back on again.

## 8.1.2 Frame ground wiring

Connect the frame ground terminal to ground/earth.

**INFO**
Connection of the frame ground is required by JEM-TR177.

## 8.1.3 Power supply wiring

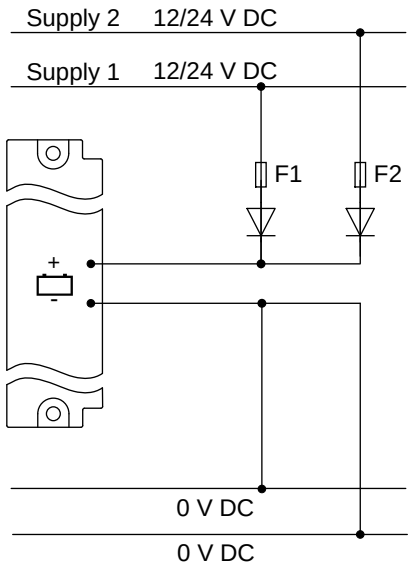
Connect the power supply (+) to the 12 or 24 V DC power supply.

Connect the power supply (-) to the 0 V DC power supply.

### Backup power supply

The DEIF equipment does not contain a backup power supply. The power supply source must therefore include the power backup needed.

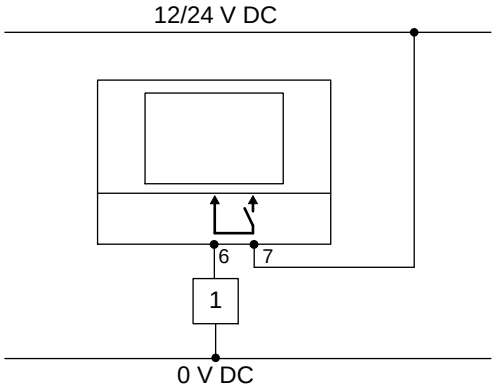
**Figure 8.2** Example of a power supply and backup connected to the power supply terminals




**INFO**
DEIF recommends that a 2A slow blow fuse is used for F1 and F2, and that the diodes are rated 50V or higher.

## 8.1.4 Relay output wiring

The following diagram shows how the display unit status OK relay can be connected to a third party device ("1"). This could be an alarm monitoring system (AMS), a horn or a light.




**INFO**
The diagram shows the relay terminals as seen from the back of the display unit.

**INFO**
It is not currently possible to configure the relay state. Therefore the relay is state is *Normally open (NO)* and in a *De-energised*.

## 8.1.5 Ethernet connections

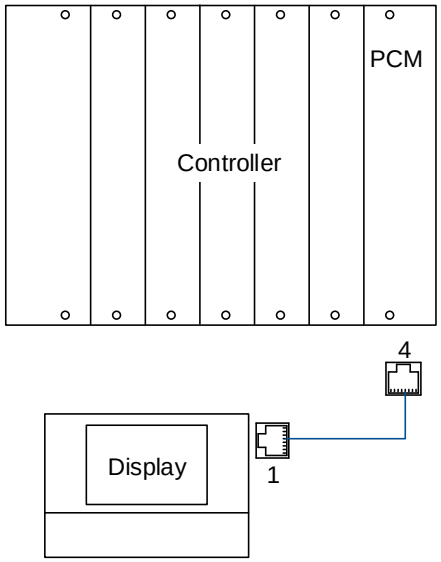
**INFO**
Please refer to **Wiring the communication** for information regarding the specification of Ethernet cabling type and wiring examples.

### Connections

**Table 8.3** Recommended default display unit connection to the controller

| Connection | Symbol | Ethernet port position | Recommended default connection |
|---|---|---|---|
| 1 | | Right side, top port | Controller |
| 2 | | Right side, bottom port | Future use for connecting additional display unit(s) |

The following diagram shows the recommended connection of the DEIF display unit to the controller.



# 9. Glossary

## 9.1 Terms and abbreviations

| Term | Abbreviation | Explanation |
|---|---|---|
| Alarm monitoring system | AMS | Third party equipment used to monitor the controller system's alarms, for example, by using Modbus TCP/IP communication. |
| Alternating current | AC | |
| Alternating current module 3.1 | ACM3.1 | A replaceable PCB with voltage and current measurement inputs. Used in the DEIF controller. |
| Alternator tacho (measurement/output) | W | An alternator tacho measurement. This can be used as a backup measurement for generator speed. |
| Analogue input | AI | Terminals on a controller hardware module that the controller uses to measure an analogue input. The analogue input type and range are typically selected during commissioning from a list of pre-configured voltage, current, and resistance measurement input ranges. A pre-configured analogue input function or alarm can also be assigned to the input. |
| Analogue output | AO | Terminals on a controller hardware module that the controller uses to send an analogue output. The analogue output type and range are typically selected during commissioning from a list of pre-configured voltage and current output ranges. A pre-configured analogue output function can also be assigned to the output. |
| Automatic voltage regulator | AVR | Regulates the genset voltage. The AVR is third-party equipment. The AVR can have a fixed voltage set point. Alternatively, the DEIF controller can control the AVR. |
| Bi-directional input | | The wiring to a controller's digital input and common terminals may be swapped around without affecting the input's operation. |
| Blind module | | A hardware module that consists of only a module faceplate. These are installed over empty slots, to protect the controller electronics. |
| Breaker | | A mechanical switching device that closes to connect power sources to the busbar, or to connect busbar sections. The breaker opens to disconnect the power sources or to split the busbar. |
| Busbar | | The copper conductors which connect the power sources to the power consumers. Represented on the single-line diagram as the line that connects all the power sources and power consumers. If the bus tie breaker is open, there are two separate and independent busbar sections. Similarly, if the bus tie breaker is closed, there is only one busbar. |
| Bus tie breaker | BTB | Physically disconnects two main busbars from each other, so that they operate as two separate (split) busbars. Also reconnects split busbars so that they operate as one busbar. |
| BUS TIE breaker controller | | Controls and protects a bus tie breaker. The controller ensures that opening the bus tie breaker does not lead to a blackout. The controller also ensures that the two busbars are synchronised before closing the bus tie breaker. |
| Canadian Electrical Code | CEC | A standard published for the installation and maintenance of electrical equipment in Canada. |
| Commissioning | | The careful and systematic process that takes place after installation and before the system is handed over to the operator. Commissioning must include checking and adjusting the controller. |

| Term | Abbreviation | Explanation |
|---|---|---|
| Common terminal | COM | This is generally connected to either a power source, or the supply return. See the wiring examples for more information. |
| Configuration | | Assigning input and output functions to terminals, and setting parameters, so that the controller is suitable for the application where it is installed. |
| Connected | | A generator is connected to the system if it is running, synchronised with the busbar, and its breaker is closed. |
| Controller | | DEIF equipment that measures system conditions and then uses outputs to make the system respond appropriately. |
| Current transformer | CT | |
| Digital input | DI | Terminals on a controller hardware module that the controller uses to measure a digital input. A pre-configured digital input function or alarm can be assigned to the input. |
| EMERGENCY genset controller | | Controls and protects the emergency genset (normally a diesel generator). If the system loses power, the controller ensures that the emergency genset supplies power to the emergency busbar. |
| Electrostatic discharge | ESD | |
| Engine interface module 3.1 | EIM3.1 | A replaceable PCB, with its own power supply. This module includes 4 relay outputs, 4 digital inputs, an MPU and W input, and 3 analogue inputs. Used in some of the DEIF controller types. |
| Generator breaker | GB | The breaker between a generator (for example, a genset) and the busbar. |
| GENSET controller | | Controls and protects a genset (normally a diesel generator). The Power Management System can automatically start and stop gensets to ensure that the required power is available. |
| Governor | GOV | Regulates the engine speed. |
| Governor and AVR module 3.1 | GAM3.1 | A replaceable PCB, which includes load sharing capability. This module also includes 4 relay outputs, 2 analogue current or voltage outputs, a pulse width modulation output, and 2 analogue current or voltage inputs. Used in some of the DEIF controller types. |
| Ground | | A connection between the equipment and earth. For marine applications, a ground is a connection to the ship's frame. |
| Heavy consumer | HC | When a request is made, the power management system reserves and manages the power required by the heavy consumer(s). |
| Hot swapping | | NOT recommended. Changing hardware modules while the equipment is powered, which may damage the equipment. |
| Input output module 3.1 | IOM3.1 | A replaceable PCB, with four relay outputs, and 10 digital inputs. Used in the DEIF controller. |
| Internet Protocol version 4 | IPv4 | A protocol for communication across networks. IPv4 currently routes the most traffic on the Internet, but will gradually be replaced by IPv6. |
| Internet Protocol version 6 | IPv6 | A protocol for communication across networks. Among other things, IPv6 has a much larger address space than IPv4. |
| | JEM-TR177 | Japan Electrical Manufacturers Association's noise standard. |
| Light emitting diode | LED | Used to show the controller and equipment status and alarms. |
| Load sharing | | The controllers adjust the gensets so that that each genset supplies the right amount of the total power. For symmetrical load sharing, each genset supplies the same proportion of its nominal power. |
| Magnetic pickup | MPU | Measures the genset speed (that is, RPM). This sensor is normally located at the genset flywheel. |

| Term | Abbreviation | Explanation |
|---|---|---|
| Module | | A standardised, replaceable printed circuit board that is mounted in the rack. For example, PSM3.1 is a module that supplies power to the rest of the rack. |
| National Electrical Code | NEC | A standard for the safe installation of electrical wiring and equipment in the United States. |
| Neutral | N | The neutral line in a three-phase electrical system. |
| Non-essential load | NEL | A load that is not critical to the system. These may be disconnected by the controller in the event of over-load, over-current, or busbar under-current. |
| | NPN | A type of transistor. |
| Parameter | | A value, or set point, used to determine the controller's operation. Parameters include nominal values, the configuration options for the configurable inputs and outputs, and alarm settings. The same set of parameters can be uploaded to several controllers. |
| Phase L1 | L1 | The power line for one phase of a three-phase electrical system. Corresponds to R in Germany, Red in the UK and Pacific, Red in New Zealand, Black in the USA, and U on electrical machine terminals. The above colour codes are for guidance only. If uncertain perform a phase measurement. |
| Phase L2 | L2 | The power line for one phase of a three-phase electrical system. Corresponds to S in Germany, Yellow in the UK and Pacific, White in New Zealand, Red in the USA, and V on electrical machine terminals. The above colour codes are for guidance only. If uncertain perform a phase measurement. |
| Phase L3 | L3 | The power line for one phase of a three-phase electrical system. Corresponds to T in Germany, Blue in the UK and Pacific, Blue in New Zealand, Blue in the USA, and W on electrical machine terminals. The above colour codes are for guidance only. If uncertain perform a phase measurement. |
| Pigtail | | The twisting together point contact of the shield. |
| Power | P | The 3-phase active power, measured in kW. |
| Power in Control Utility Software | PICUS | The DEIF utility software, used to design, configure, troubleshoot and monitor a system. |
| Power management system | PMS | The controllers share information and work together to ensure enough power to supply the load. |
| Power supply module 3.1 | PSM3.1 | A replaceable PCB that powers the controller. This module includes three relay outputs for status signals. Used in the DEIF controller. |
| Printed circuit board | PCB | Supports and electrically connects components. |
| Processor and communication module 3.1 | PCM3.1 | A replaceable PCB, which contains the controller processor, as well as the CAN bus connections and Ethernet communication connections. Used in the DEIF controller. |
| Programmable logic controller | PLC | A digital computer used for the automation of electromechanical processes. |
| Protection and Power Management | PPM | A versatile controller consisting of several modules and display unit designed for marine use. |
| Pt100, Pt1000 | | Platinum temperature sensors |
| Pulse width modulation | PWM | Terminals with an output that uses variable pulse widths, and behaves as an analogue output. |
| | PNP | A type of transistor. |
| Rapid spanning tree protocol | RSTP | |
| Resistance measurement input | RMI | Variable resistance device, used for some of the input terminals on genset controllers. |

| Term | Abbreviation | Explanation |
|---|---|---|
| SD card | | External memory (future use) |
| Shaft generator | SG | A generator installed on the ship's main shaft that produces electricity. |
| Shaft generator breaker | SGB | The breaker between the shaft generator and the main busbar/switchboard. |
| SHAFT generator controller | | Controls and protects the power supply from the shaft generator. |
| Shore connection | SC | The ship is supplied with electricity from land while in harbour through the shore connection. |
| Shore connection breaker | SCB | The breaker between the shore connection and the main busbar/switchboard. |
| SHORE connection controller | | Controls and protects the power supply from the shore connection. |
| Shutdown | | An emergency or fast stop of the genset engine. No cooldown time is allowed. |
| Single-phase | | A system where the load is connected between one of the phases and the neutral. Note: Single-phase does NOT mean a 3-wire single-phase distribution system, where the waveforms are offset by a half-cycle (180 degrees) from the neutral wire. |
| Supervisory control and data acquisition system | SCADA | |
| Switchboard | | The cabinet where the power sources are connected to the power consumers. See Busbar too. |
| Switchboard control | SWBD control | A controller operating mode. Power management and operator commands to the controller are disabled. The operator controls the system using the switchboard. The controller monitors operation and the controller protections are active (that is, if an operating value activates an alarm, the controller does the alarm action). |
| System | | The gensets, the other power sources, all breakers, the busbars, and all their controllers. Within the system, the DEIF controllers work together to supply the power required safely and efficiently. |
| Third-party equipment | | Equipment other than the DEIF controller. For example: The genset, the genset engine control system, the wiring, the busbars, and the switchboard. |
| Tie breaker | TB | Used to connect/disconnect the emergency busbar from the main busbar. (The breaker between two main busbars is called a bus tie breaker.) |
| Time | t | |
| Transmission control protocol/internet protocol | TCP/IP | |
| Trip | | An emergency or fast opening of a breaker. No attempt is made to deload the breaker before it opens. |
| Voltage | V | Electrical potential difference. U is used as an abbreviation for voltage in most of Europe, Russia and China. |
| Voltage transformer | VT | |

## 9.2 Units

The table below lists the units used in the documentation, as well as the US units where these are different. In the documentation, the US units are given in brackets, for example, 80 °C (176 °F).

**Table 9.1** Units used in the documentation

| Unit | Name | Measures | US unit | US name | Conversion | Alternative units |
|---|---|---|---|---|---|---|
| A | ampere | Current | | | | |
| bar | bar | Pressure | psi | pounds per square inch | 1 bar = 14.5 psi | 1 bar = 0.980665 atmosphere (atm)<br><br>1 bar = 100,000 Pascal (Pa) |
| ºC | degrees Celsius | Temperature | ºF | Fahrenheit | T[ºC] = (T[ºF] - 32 º) × 5 / 9 | T[ºC] = T[Kelvin (K)] - 273.15 |
| dB | decibel | Noise or interference (a logarithmic scale) | | | | |
| g | gram | Weight | oz | ounce | 1 g = 0.03527 oz | |
| *g* | gravitational force | Gravity, *g* = 9.8 m/s$^2$ | ft/s$^2$ | | *g* = 32.2 ft/s$^2$ | |
| h | hour | Time | | | | |
| Hz | hertz | Frequency (cycles per second) | | | | |
| kg | kilogram | Weight | lb | pound | 1 kg = 2.205 lb | |
| kPa | kilopascal | Pressure | psi | pounds per square inch | 1 kPa = 0.145 psi | |
| m | metre | Length | ft | foot (or feet) | 1 m = 3.28 ft | |
| mA | milliampere | Current | | | | |
| mm | millimetre | Length | in | inch | 1 mm = 0.0394 in | |
| ms | millisecond | Time | | | | |
| N·m | newton metre | Torque | lb-in | pound-force inch | 1 N·m = 8.85 lb-in | |
| RPM | revolutions per minute | Frequency of rotation (rotational speed) | | | | |
| s | second | Time | | | | |
| V | volt | Voltage | | | | |
| V AC | volt (alternating current) | Voltage (alternating current) | | | | |
| V DC | volt (direct current) | Voltage (direct current) | | | | |
| W | watt | Power | | | | |
| Ω | ohm | Resistance | | | | |

# 9.3 Symbols

## 9.3.1 Symbols for notes

**DANGER!**
**This highlights dangerous situations. If the guidelines are not followed, these situations could result in death, serious personal injury, and equipment damage or destruction.**

**CAUTION**
This highlights potentially dangerous situations. If the guidelines are not followed, these situations could result in personal injury or damaged equipment.

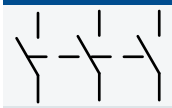
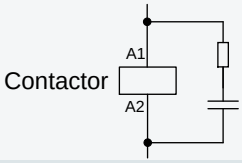
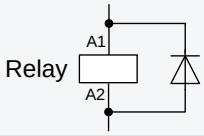
**INFO**
This highlights general information.

This highlights where to find more information.

## 9.3.2 Drawing symbols

The drawings use EU symbols. The US alternative is shown where applicable.

**Table 9.2** Electrical symbols

| Symbol | Symbol name |
|---|---|
|  | 3-phase breaker |
|  | Capacitor |
|  | Contactor with RC snubber |
| • | Connector dot |
|  | Current transformer (S1 and · show "current in"; S2 shows "current out") |
|  | Diode |
|  | Fuse |
| Ω | Ohmmeter |
|  | Relay with freewheeling diode |
|  | Resistor (IEC-60617) |

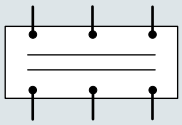
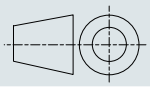
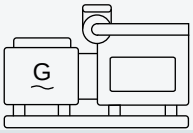
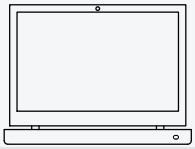
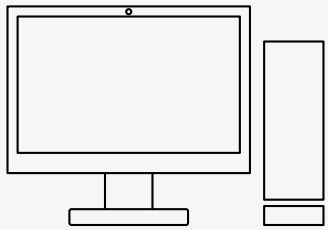
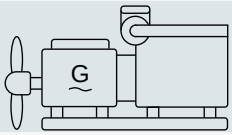
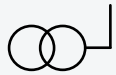
| Symbol | Symbol name |
|---|---|
|  | Single line drawing closed breaker |
|  | Single line drawing open breaker |
| ○ | Temporary connection dot (for example, connection to a meter) |
|  | Voltage transformer. This is a generic voltage transformer, without any information about the transformer connections. These could for example be: open delta, star-star, closed delta, and so on. |

**Table 9.3** Icons used in drawings

| Symbol | Symbol name |
|---|---|
|  | Display unit DU 300 |
|  | First-angle projection |
|  | Genset |
|  | Heavy consumer |
|  | Laptop |
|  | Non-essential load |
|  | Part of a module faceplate, to show examples of terminal wiring |
|  | Rack R7 |

| Symbol | Symbol name |
|---|---|
|  | Server or desktop PC |
|  | Shaft generator |
|  | Shore connection |

## 9.3.3 Module faceplate symbols

**Table 9.4** Terminals

| Symbol | Symbol name |
|---|---|
|  | Frame ground |
|  | Power supply |
| L1, L2, L3 and N | Three-phase voltage measurements |
|  | Current transformer |
| COM | Common |
|  | Digital input |
|  | Relay output (normally open) |
|  | Relay with wire break detection (normally open) |
|  | Relay output (changeover relay, with normally open and normally closed terminals) |
|  | Analogue current or voltage input |
|  | Analogue current or resistance measurement input (RMI) |
|  | Magnetic pickup (MPU) |
| W | W input (for an alternator tacho output or NPN/PNP sensor) |
|  | Analogue current or voltage output |
|  | Pulse width modulation (PWM) output |
|  | Analogue input ground<br>Analogue output ground<br>Pulse width modulation (PWM) ground |
|  | Active P load sharing |
|  | Reactive Q load sharing |
| H, CAN-#, L | CAN bus connection |

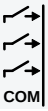
**Table 9.5** LEDs

| Symbol | Symbol name |
|---|---|
| CAN-# | CAN bus |
|  | DEIF network |
|  | EtherCAT in |
|  | EtherCAT out |
|  | EtherCAT status |
|  | Power supply status (PSM) |
|  | System status (PCM) |

**Table 9.6** Other

| Symbol | Symbol name |
|---|---|
| ▲ | RJ45 connections at the top of the hardware module |
| ▼ | RJ45 connections at the bottom of the hardware module |
|  | SD card |

**Table 9.7** Terminal sets

| Example | Explanation |
|---|---|
|   | The vertical line to the right of the symbols shows terminal sets. In the example, the digital inputs have the same common. |