

Manual for Charging Rectifier type PRM3



SAFETY INSTRUCTIONS



You must read this manual **before** installation, use or work on the product.



This product contains dangerous voltage that when touched can cause electric shock, burns or death.

The product must be installed by qualified personnel and according to the installation instructions. The equipment may only be opened by authorised service personnel.

The power must always be disconnected in a safe way before starting any service/maintenance.

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We reserve the right to make changes to the content of this manual without prior notification.

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- [A DIMENSION DIAGRAM](#)
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1 PRESENTATION

PRM3 is a family of charging rectifier modules in three phase configuration designed for 19" frame mounting. Together with monitoring unit PCM2 they form a complete charging rectifier.

The rectifier modules can be used in parallel which gives flexible matching of output power and redundancy. They can also be swapped during operation (hot swap) providing simple maintenance and high availability. Low noise level due to speed controlled and monitored fans. This, together with the clear display and well-arranged system of menus of the monitoring unit make it easy and pleasant to work with.

This description primarily deals with all installation, commissioning, service, maintenance and technical data and is principally aimed at the personnel who are responsible for these areas.

Operation is handled primarily via the monitoring unit described in the *Manual for monitoring unit type PCM2*. This is therefore chiefly aimed at the personnel that have the day to day responsibility for the plant, but also to other personnel who have cause to work with the charging rectifier.

For a complete description, this manual is to be used together with the description for the monitoring unit, *Manual for monitoring unit type PCM2*.

In most cases, PRM3 is provided as a part of a complete system. For comprehensive information, see the possible system manual.

The term "charging rectifier" is replaced henceforth with the shorter term "rectifier".

2 SAFETY INSTRUCTIONS



This product contains dangerous voltage that when touched can cause electric shock, burns or death.

For safety reasons the affected personnel are classified according to the following requirements for specific skills.

Authorised service personnel:

- Have electrical training and adequate experience in avoiding the dangers that electricity can cause.
- Are certified to meet authority requirements for the work in question.
- Have linguistic skills that ensure the content in this description cannot be misunderstood.
- Have undergone a product specific training programme for authorised service personnel that are approved by Kraftelektronik AB.

Qualified personnel:

- Have electrical training and adequate experience to avoid the dangers that electricity can cause.
- Are certified to meet authority requirements for the work in question.
- Have linguistic skills that ensure the content in this description cannot be misunderstood.

Installation, service, maintenance and fault tracing may only be carried out by authorised personnel and in accordance with the installation instructions.

The equipment may only be opened by authorised service personnel.

3 TECHNICAL DATA

3.1 ELECTRICAL DATA

3.1.1 Design

PRM3 is a three phase rectifier module. Up to eight modules can work together in parallel to increase output power and/or create redundancy. PRM3 is aimed for cooperation with the monitoring unit PCM2.

3.1.2 Common electrical input data

Rated voltage380/400/415 V_{AC} 3-phase
 Input voltage range340-440 V_{AC}
 Overvoltage protection> 580 V_{AC}, the rectifier module is stopped
 Undervoltage protection< 300 V_{AC}, the rectifier module is stopped
 Frequency45 – 65 Hz
 Power factor.....> 0.97 (at 3x400 V_{AC}, full load)
 Mains power.....10.6 kVA (type at 3x400 V_{AC}, full load)
 Mains current.....18 A_{RMS} (type at 3x400 V_{AC}, full load)
 Connection screw terminal block.....0.5 – 10 mm²

3.1.3 Common electrical output data

Output power9 kW
 Voltage regulation (static).....<±0.5 % of nominal output voltage
 Voltage regulation (dynamic)<±1 % within 3 seconds, 0-100/100-10 % load change
 Current regulation<±1 % of rated current
 Setting range, current limit0 – 100 % of rated current
 Ripple voltage<0.2 %_{RMS}
 Ripple current<1 % of rated current
 Efficiency, typical.....>92 % at 3x400 V_{AC}
 Connection screw terminal block.....10 - 25 mm² (4 - 25 mm² with crimp ferrule)

3.1.4 Model dependant electrical data

Model designation, PRM3	Output data		
	U _{NOM} (V _{DC})	U _{MAXIMUM} * (V _{DC})	I _{RATED} (A)
110/70	110	145	70
220/35	220	270	35
440/18	440	500	18

* maximum at 3x340 V_{AC}

3.2 ENVIRONMENTAL DATA

Class of enclosureIP20 as per EN 60529
 CoolingTemperature controlled fans
 Ambient temperature (specified data applies).....0 to +45 °C
 Storage temperature-40 to +70 °C
 Humidity<90 % RH, non-condensed
 Altitude above sea level<2000 m
 Noise level at +20 °C, full load<50 dBA

3.3 MECHANICAL DATA

Design.....	For 19" frame mounting
Arrangement	Indoors in dry, clean room
Weight	20 kg
Dimensions.....	177/483/360 mm (h/w/d), see also dimension diagram Appendix A
Colour.....	RAL 7035 light grey (front panel)
Cable inlets	From behind, via screw terminals

3.4 CONFORMITY WITH STANDARDS

EN 60529.....	Class of enclosure IP20
EN 50178.....	LVD. Electronic equipment, including power electronics in electrical power installations.
EN 61000-6-2	EMC. Immunity for industrial electronics
EN 61000-6-3	EMC. Emission standard for commercial and light-industrial environments

4 FUNCTIONAL DESCRIPTION

4.1 GENERAL

PRM3 is a rectifier module with three-phase input power and aimed for parallel operation. Up to eight modules in parallel provides, together with monitoring unit PCM2, a complete charging rectifier.

Most functions are handled by the monitoring unit and are described in the *Manual for monitoring unit PCM2*. Only the functions that feature at a general rectifier level are described here.

4.2 RECTIFIER MODULE FUNCTIONS

4.2.1 General

Here, only functions specific for the rectifier module itself are described. For comprehensive information, see *Manual for monitoring unit PCM2*.

4.2.2 Manoeuvring and Indications

The front panel holds pushbuttons for manoeuvring and a number of indication lamps.

The module lacks built-in mains breaker. Instead there are an ON-button and a STBY-button, where STBY means that the module is turned off by being put into standby mode. The ON and STBY states are saved in a non-volatile memory which means that even after a total main outage, the module will return to the state that was present at the moment of the outage.



For more information about the front panel functions, see section 5.

4.2.3 Voltage control

At normal operation, the rectifier module will regulate the output voltage according to a set-point provided by the monitoring unit.

The voltage reported from the module to the monitoring unit is measured on the “inside” of the module output blocking diode. Due to the diode voltage drop, it will therefore be slightly higher than expected. The difference is current dependant, but its size is about 1 V. The output voltage however, will always be correct because the monitoring unit measures the voltage directly in the battery distribution board. By regulation of the set-point, voltage drop in both output diode and cables are compensated.

In case of an interruption of the communication between the module and the monitoring unit, the module will continue with the last valid set-point value.

After a cold-start of a rectifier module, it will begin with nominal voltage (110, 220, 440V) until the communication with the monitoring unit is established.

In the monitoring unit there is a parameter holding the level for the overvoltage protection (HVSD). No matter the level of the requested set-point, the output voltage of the module will be limited to maximum 1% below existing HVSD level.

4.2.4 Current control

At normal operation the rectifier module will regulate according to the set-point (current limit) provided from the monitoring unit.

Also the functions temperature control, output power control and load-sharing use the current limit as a tool.

4.2.5 Temperature control

To protect the rectifier module from overheating, the current limit is lowered gradually as the internal temperature gets close to a critical level. Should the temperature after all rise above the critical level, the module will turn off and be kept turned off until the temperature has reached down to a reasonable level. Meantime the cooling fans will run with full speed.

4.2.6 Output power control

At high output voltages, the output power will be limited to rated power by lowering the current limit.

4.2.7 Fan control

In order to reduce the noise level to a minimum and to extend the lifetime of the fans, the fan speed is regulated by the internal temperature of the module. The fan speed is continuously monitored in order to provide an early warning if any of the three fans shows sign of being worn out. Note that the fans by design are meant to last for the whole lifetime of the module.

Directly after start the cooling fans are working at full speed for about half a minute before temperature controlled speed begins.

At stop the cooling fans continues to run for about half a minute in order to cool off the remaining heat.

4.2.8 Load-sharing

In case of more than one (up to maximum 8) rectifier modules are working in parallel, they will share the load by so called active load-sharing. The load-sharing is in operation at currents between about 10 – 90 % of rated current.

4.2.9 Overvoltage DC (HVSD)

In order to protect the system from harmful overvoltage, each rectifier module is equipped with an overvoltage protection called HVSD (High Voltage Shut Down). The level is set via a parameter in the monitoring unit.

If the rectifier output voltage exceeds the HVSD level, the rectifier will turn off within about 100 ms. Since the voltage is measured on the "inside" of the blocking diode, the HVSD function is selective, i.e. only the module that is responsible for the overvoltage will trip. Initially, the ALARM-lamp turns on and the ON-lamp will start to flash slowly. With an interval of five seconds, three restart attempts will be performed. If also the third attempt fails, the module will be turned off for good while both the ON- and STBY-lamps are turned off and the ALARM-lamp continues to shine.

Restart after tripped HVSD can be done by keeping the ON-button pressed for at least 5 seconds or by turning off the AC power for a short while.

4.2.10 Over-/Undervoltage AC

The rectifier module has a built-in self protection that will stop the module when exceeding harmful high or low voltages on the AC power feeding. For trip levels, see section 3.1.2. The module will go back to normal operation as soon as the voltage returns within permissible limits.

4.2.11 External blocking

The rectifier modules can also be turned off remotely via a digital input found on the monitoring unit. The function is called "External blocking". The output voltage will be turned off, the ON-lamp will flash slowly and the STBY-lamp is off. When the blocking condition ceases, the module returns to normal operation.

Even during blocking condition, the module can be turned off "for real" using the STBY-button. In this way the module will remain off when the blocking condition ceases.

4.2.12 Hot swap

Connection of a rectifier module to a DC system during operation (hot swap) is not entirely straightforward. Without certain measures you will get a heavy inrush current due to charging of capacitors on the rectifier DC output. Except sparking at the point of connection, you may get a short system voltage drop with possible consequences.

With PRM3, this problem is eliminated due to a built-in output diode that prevents charging of the capacitors from the outside. An extra advantage with the diode is that it eliminates the risk of sinking the whole DC system due to an internal module fault (short circuit). PRM3 modules may consequently without problem be replaced during operation which to a great extent simplifies maintenance and service and will also extend the availability of the DC system.

4.3 COMPLETE CHARGING RECTIFIER FUNCTIONS

4.3.1 General

Here, only the most considerable functions are described. For more information, see *Manual for monitoring unit PCM2*.

4.3.2 Float charging

Float charging is the normal operating mode determined by the battery. The voltage level is to be set according to the battery manufacturer instructions.

For more information, see the *Manual for monitoring unit PCM2*.

4.3.3 Equalizing charging

Equalizing charging means charging with raised voltage level during a limited period. It is used partly for the initial charge, and partly for equalizing cell voltages if spread has occurred.

For more information, see the *Manual for monitoring unit PCM2*.



WARNING: Generally, batteries of VR-type (vent regulated) should not be subject to equalizing charging. For some battery types equalizing charging could even be harmful to the batteries. Always follow the instructions stated by the battery manufacturer.

4.3.4 Battery circuit test

A battery circuit test is automatically carried out at optional intervals (normally once a day). The test involves checking that the entire battery circuit, i.e. not only the battery block is in working order.

For more information, see the *Manual for monitoring unit PCM2*.

5 OPERATION

5.1 GENERAL

The bulk of the operation is associated to the monitoring unit. This is described in the *Manual for monitoring unit PCM2*. Other operation is detailed in this section.

5.2 RECTIFIER MODULES

5.2.1 General

The front panel of the rectifier module has push-buttons for manoeuvring of the module together with a number of led indication lamps.



5.2.2 Manoeuvre

5.2.2.1 ON

To start the rectifier module, push the ON-button. A green led lamp on the upper left corner of the button tells that the module has started and the orange led lamp by the STBY-button will be put out. DC OK will be put out while ALARM will go red.



If both the ON- and STBY-indications are put out but ALARM is red, the overvoltage protection HVSD may have tripped the module. In this state, it is possible to try a restart by keeping the ON-button pushed for about 5 seconds.

5.2.2.2 STBY (standby)

To stop the rectifier module, push the STBY-button as long as the orange led lamp on the upper left corner of the button is flashing (about 3 seconds). In this way, unintentional shutting off is avoided. When the module is in standby state, the orange STBY-led is put on with steady light while the green ON-led is put out.



If the ON-led is slowly flashing while the STBY-led is off, the output voltage is set to zero as in standby state. The reason might be that the module has remotely been turned off via the function "External blocking" or it may be due to high temperature. Also in this state, it is possible to use the STBY-button to turn off the module "for real".



WARNING: Note that the standby state does not make the equipment dead. For a total dead state, the mains supply and the equipment's DC output must be cut externally.

5.2.3 Indications

5.2.3.1 AC OK

AC OK will be put on with green light if the mains supply is OK.

All indications put out, AC OK included, indicates that there is no mains supply.

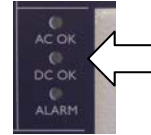


AC OK put out while the ALARM-led is red indicates that there is mains supply but not within limits. The DC output is dead. See also section 4.2.10.

5.2.3.2 DC OK

DC OK will be put on with green light if the DC output is OK.

DC OK will be put out if the output voltage is below 50% of nominal voltage. This means that it is also put out in normal standby state.



5.2.3.3 ALARM

The ALARM-led is put out in normal operation. Red light indicates a fault condition. Also standby state will give red light, because by the systems point of view it is considered as a fault condition.



The cause of the alarm can be studied in detail using the monitoring unit menu system, see *Manual for monitoring unit PCM2*.

5.2.3.4 CURRENT

The output current of the rectifier module, 0-100%, is shown by a led-bar equipped with 10 yellow led-lamps. I.e. there are one led for each 10:th percent of the rated current.



5.2.3.5 Indication table

Indication					Interpretation
ON	STBY	AC OK	DC OK	ALARM	
Green	Put out	Green	Green	Put out	Normal operation
Green	Put out	Green	Green	Red	1. U_{OUT} low, 50-82% of U_{NOM} 2. I_{OUT} limited due to high temperature 3. Fan fault
Green	Put out	Green	Put out	Red	U_{OUT} low, <50% of U_{NOM}
Green	Put out	Put out	Put out	Red	Mains fault
Blinkar	Put out	Green	Put out	Red	1. External blocking 2. HVSD tripped, waiting for restart attempt 3. Turned off due to high temperature
Put out	Put out	Green	Put out	Red	Turned off due to tripped HVSD
Put out	Put out	Put out	Put out	Red	Turned off due to tripped HVSD + mains fault
Put out	Orange	Green	Put out	Red	Normal standby
Put out	Orange	Put out	Put out	Red	Mains fault in standby state
Put out	Put out	Put out	Put out	Put out	No mains supply

5.3 MONITORING UNIT PCM2

The operator panel is the visible part of the monitoring unit PCM2. It is composed of a display, push-buttons and a led-lamp. Operation is described in the *Manual for monitoring unit PCM2*.



When measuring the battery voltage you should avoid measuring directly at the battery terminals due to the risk of arcing in the event of a possible short circuit. Use the short-circuit protected voltmeter terminals on the front panel instead. The voltmeter terminal fits a standard 4 mm measuring pin. To avoid measurement errors, the voltmeter used should have high ohms, 10 Mohm or better.

6 INSTALLATION INSTRUCTIONS

6.1 SAFETY INSTRUCTIONS



WARNING! *This product contains dangerous voltage that when touched can cause electric shock, burns or death. Protective earth must always be connected in a reliable way to avoid the risk of live parts in the equipment in the event of faults. No live parts are permitted during installation. The product must be installed by qualified personnel (see 2 [SAFETY INSTRUCTIONS](#)).*



WARNING! *Check both before and after setting-up that the equipment does not have any mechanical damage. Check that the equipment and individual rectifier modules have the intended rated voltage. Cables for input and output power must be correctly dimensioned to avoid fire hazard.*

6.2 GENERAL

Installation of the parts that belong to the monitoring unit are not dealt with in this manual. For complete installation instructions these instructions should therefore be used in combination with the installation instructions included in the *Manual for monitoring unit PCM2*.

Normally, the rectifier modules are already installed in some kind of system. In these cases, see the possible system manual.

6.3 STORAGE AND PROTECTION

Storage is to be in a dry area and at a temperature that does not exceed the -40 to +70 °C range.

6.4 MOUNTING

The rectifier modules are designed for mounting in a 19" rack frame indoors in a room that is dry, clean and free from conductive dust. Make sure that there is sufficient space for free airflow for all ventilation openings.

Begin with the connections to be done on the back of the rectifier module, see section 6.5. Then push the module in place into the rack frame. Attach the module to the frame via the four mounting holes on the short sides of the front panel.

Note that the module must rest on some kind of shelf or similar to unload the weight. The front panel is not designed to carry all the weight by itself.



WARNING! *The equipment may cause personal injury or damage to property if dropped. Use secure lifting aids where appropriate.*

6.5 ELECTRICAL INSTALLATION

6.5.1 General

The equipment is designed for permanent installation. Protective earth must be connected before any other installation.

All connections are located on the back of the module.



6.5.2 Mains voltage

Check that the outer fuse conforms with the actual mains current, see section 3.

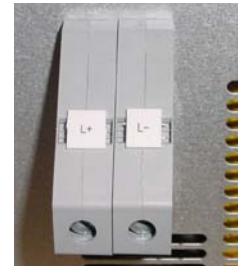
Connect three-phase mains supply to terminals with marking L1, L2 and L3. The phase sequence is insignificant. Connect the ground wire to the adjacent terminal marked with ground symbol.



6.5.3 Battery/Load

Check that the rectifier's rating plate shows the rated voltage that conforms with the battery's nominal voltage.

Connect the DC system to the terminals marked L+ and L-. Select cables that are dimensioned for handling the rectifier's rated current and the closest following fuse.



WARNING! *The rectifier's DC output does not have an internal fuse. Ensure that there is an external fuse to the battery.*

6.5.4 Bus connection

The rectifier module is connected to the monitoring unit via a bus communication cable.

In systems with one single rectifier module, the bus cable can be connected directly to the monitoring unit operator panel via connector X3 and an RJ11 cable of type 6/4.

In systems with two or more rectifier moduler in parallel, the bus cable is connected via X4 (RJ45 cable) to a so called Hub board. For more information, see the system manual.



7 COMMISSIONING

7.1 SAFETY INSTRUCTIONS



WARNING! *This product contains dangerous voltage that when touched can cause electric shock, burns or death. All cover plates and other semi-protection devices must be fitted during operation.*

7.2 GENERAL

First of all, the instructions stated in the applicable system manual should be observed. What is stated here should be considered as a more general instruction.

7.3 PREPARATORY INSPECTION

Check that the equipment is free from damage, correctly fitted and that all the ventilation openings are free from obstacles.

Check that all cable installations, electrical connections and protective earths are correctly implemented.

Check that all contact safety devices and breakers are disconnected.

Check that the rated voltage of the equipment corresponds to the rated voltage of the system.

7.4 ELECTRIFICATION

7.4.1 DC

Start by connecting the battery by connecting a fuse in the battery circuit, for example.

After a few seconds, the operator panel display lights up, and after a few more seconds the text appears on the display. All measurement values are initially reset. The measuring begins after around 10 seconds. Any alarms are activated when a total of around 30 seconds has passed.

7.4.2 AC

Switch on the mains supply. After a delay of about 5-10 seconds the rectifier modules will start, but most likely in standby state (depending on the state when they were last switched off). Start up the modules by pressing the ON-button.

The battery now starts to charge, and if it was in a state of deep discharge, the charging starts with rated current until the float charging level is reached. Certain types of battery require an initial equalizing charge. Always follow the recommendations given by the battery manufacturer.

7.5 CHECK OF CHARGING VOLTAGE

Check the settings of the monitoring units to ensure the voltage level for float charging and equalizing charging conform to the battery manufacturer's specifications, see *Manual for monitoring unit PCM2*.

When the battery is charged to a level where the “High current” alarm is no longer active, you should check that the actual output voltage conforms to the set float charging voltage, see section 8.1.2.

7.6 CHECK OF SETTINGS

Each time the monitoring unit has been without voltage, the built-in clock must be set with the current date and time, see the *Manual for monitoring unit PCM2*.

Check that the measurement values presented agree with the actual position. Check that the parameters for charging voltages, alarms and other parameters conforms to the intended function, see the *Manual for monitoring unit PCM2*.

7.7 CHECK OF OUTPUTS

The alarm outputs A-D and the output for fan control can be operated manually for simple and smooth control of external circuits, see the *Manual for monitoring unit PCM2*.

8 MAINTENANCE

8.1 ANNUAL INSPECTION

8.1.1 General

In addition to these instructions, you must observe the instructions for maintenance in the *Manual for monitoring unit PCM2* and the battery manufacturer's maintenance instructions.

8.1.2 Check of charging voltage

Connect a measuring instrument to the voltmeter terminal (see section 5.3). Check that the rectifier's output voltage corresponds to the set value.

If the float charging voltage is temperature controlled, it is difficult to determine what the expected output voltage should be. The solution is to temporarily shut down the temperature control. You do this using the menu option *Functions, battery temperature* to specify that the temperature sensor is not installed (see the *Manual for monitoring unit PCM2*, section on *Operation, Functions*). Do not forget to reset the parameter for the installed temperature sensor following a completed measurement!

All control is based on measurement. If charge voltage is found to be in a state of non-conformance it is therefore the voltage measurement that should be calibrated, see the instructions for maintenance in the *Manual for monitoring unit PCM2*.

8.1.3 Check of cooling capacity

Check that the ventilation openings for the equipment are not clogged with dust or other contamination. Clean where necessary.

9 FAULT TRACING

9.1 SAFETY INSTRUCTIONS



WARNING! *This product contains dangerous voltage that when touched can cause electric shock, burns or death.*

Service/maintenance work that involves opening of the rectifier module may only be carried out by authorised service personnel (see section 2 [SAFETY INSTRUCTIONS](#)).

9.2 FAULT TRACING FOLLOWING ALARM

Fault tracing in connection with alarm messages in the monitoring unit operator panel is described in the *Manual for monitoring unit PCM2*.

9.3 OTHER FAULT TRACING

The type of faults that can be attributed to the rectifier in general are dealt with here. For faults that relate to the monitoring unit see the *Manual for monitoring unit PCM2*.

The primary fuse trips when the rectifier module is turned on

Cause 1: Incorrect type of mains fuse. Check that the mains fuse observes the specifications in section 3.1.

Cause 2: Internal rectifier module fault. Replace the defective module.

The rectifier has no output, green indicator lamp “AC OK” is put out

Cause 1: Mains voltage missing. Check that there is mains voltage to the mains supply terminals.

Cause 2: If the red lamp ALARM is lit, the rectifier module has tripped due to high or low mains voltage. The module will return to normal operation when the mains voltage is OK.

The rectifier has no output, green indicator lamp “AC OK” and “DC OK” are lit

Cause 1: Fault in external output fuse. Check that the output fuses are properly dimensioned to handle the rectifier's rated current.

The rectifier module's green indicator lamp “AC OK” is lit and “DC OK” is put out

Cause 1: The rectifier module is in standby state, i.e. a normal condition.

Cause 2: The input “EXT. FAULT” of the monitoring unit is used as external blocking and is in open position.

Cause 3: The rectifier module has tripped due to DC overvoltage (HVSD). The module might need to be replaced.

Cause 4: The rectifier module has tripped due to high temperature. Wait until it has cooled off and it will start automatically.

Cause 5: The rectifier module may be defective. Try to replace the rectifier module.

The rectifier module's red indicator lamp “ALARM” is lit

Cause 1: Unless the cause is obvious, e.g. see the alternatives above, you can show the status of the rectifier module in detail via the display on the monitoring unit, see the *Manual for monitoring unit PCM2*.

The rectifier output voltage is too low

Cause 1: The rectifier load is above its capacity (rated current). This is normal in connection with recharging following deep discharge.

Cause 2: Battery circuit test in progress. This is a test that is normally executed automatically once a day.

- Cause 3: High temperature in the battery/battery compartment. Only applicable if the rectifier controls the temperature of the float charging voltage. There is no fault with the rectifier in this case. Look for the fault in the high temperature instead. Alternatively the temperature sensor could be defective. Check whether the display is reporting the correct battery temperature.
- Cause 4: Incorrectly set float charging voltage level. Adjust the setting.
- Cause 5: Incorrectly calibrated voltage measurement. Recalibrate the monitoring unit's measurement of battery voltage.
- Cause 6: The current is internally limited due to high internal temperature or internal power limiting.

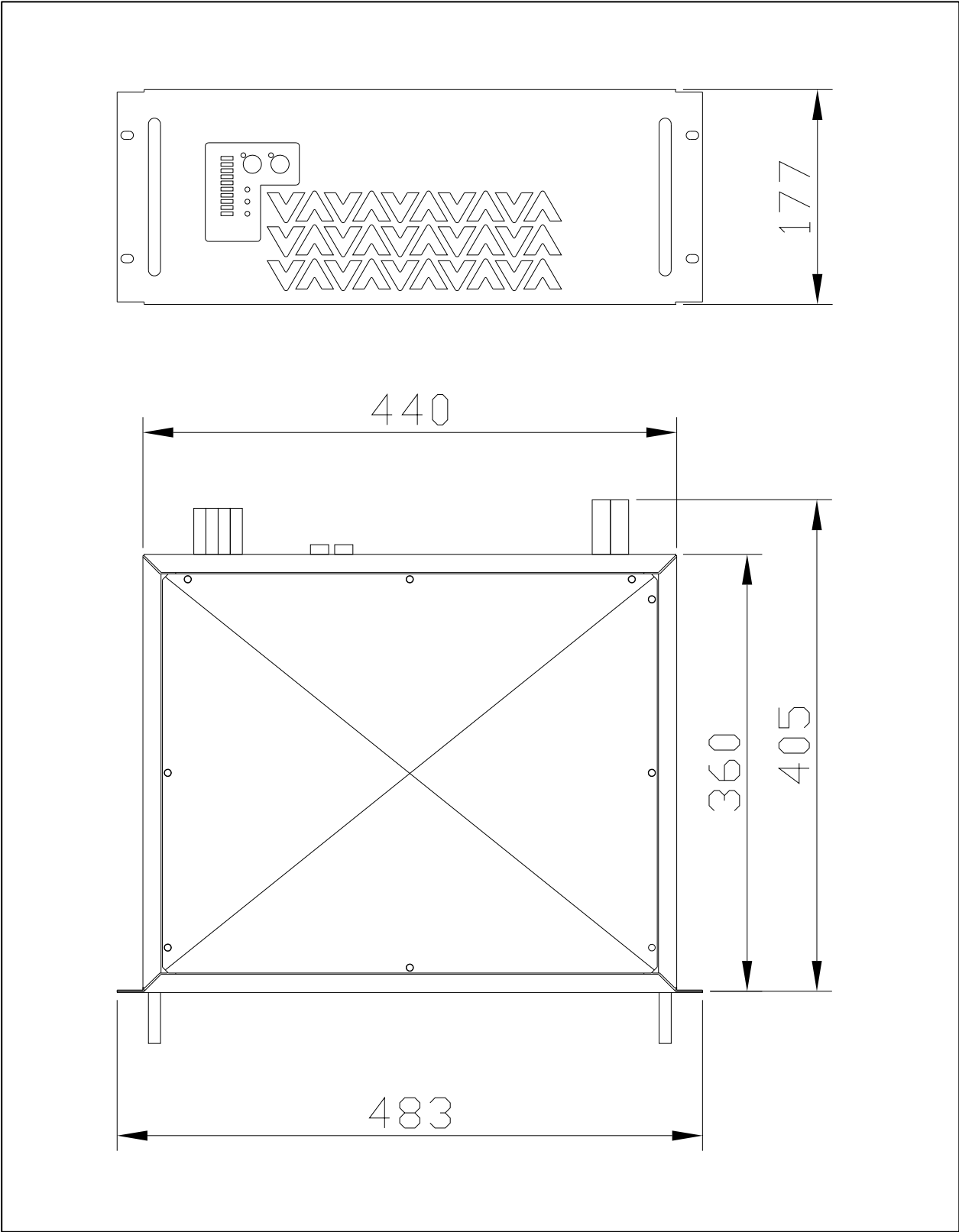
The rectifier output voltage is too high

- Cause 1: Equalizing charging in progress. This has either been initiated manually or automatically following a power failure.
- Cause 2: Low temperature in the battery/battery compartment. Only applicable if the rectifier controls the temperature of the float charging voltage. There is no fault with the rectifier in this case. Look for the fault in the low temperature instead. Alternatively the temperature sensor could be defective. Check whether the display is reporting the correct battery temperature.
- Cause 3: Incorrectly set float charging voltage level. Adjust the setting.
- Cause 4: Incorrectly calibrated voltage measurement. Recalibrate the monitoring unit's measurement of battery voltage.

Rectifier modules in parallel operation does not share the load equally

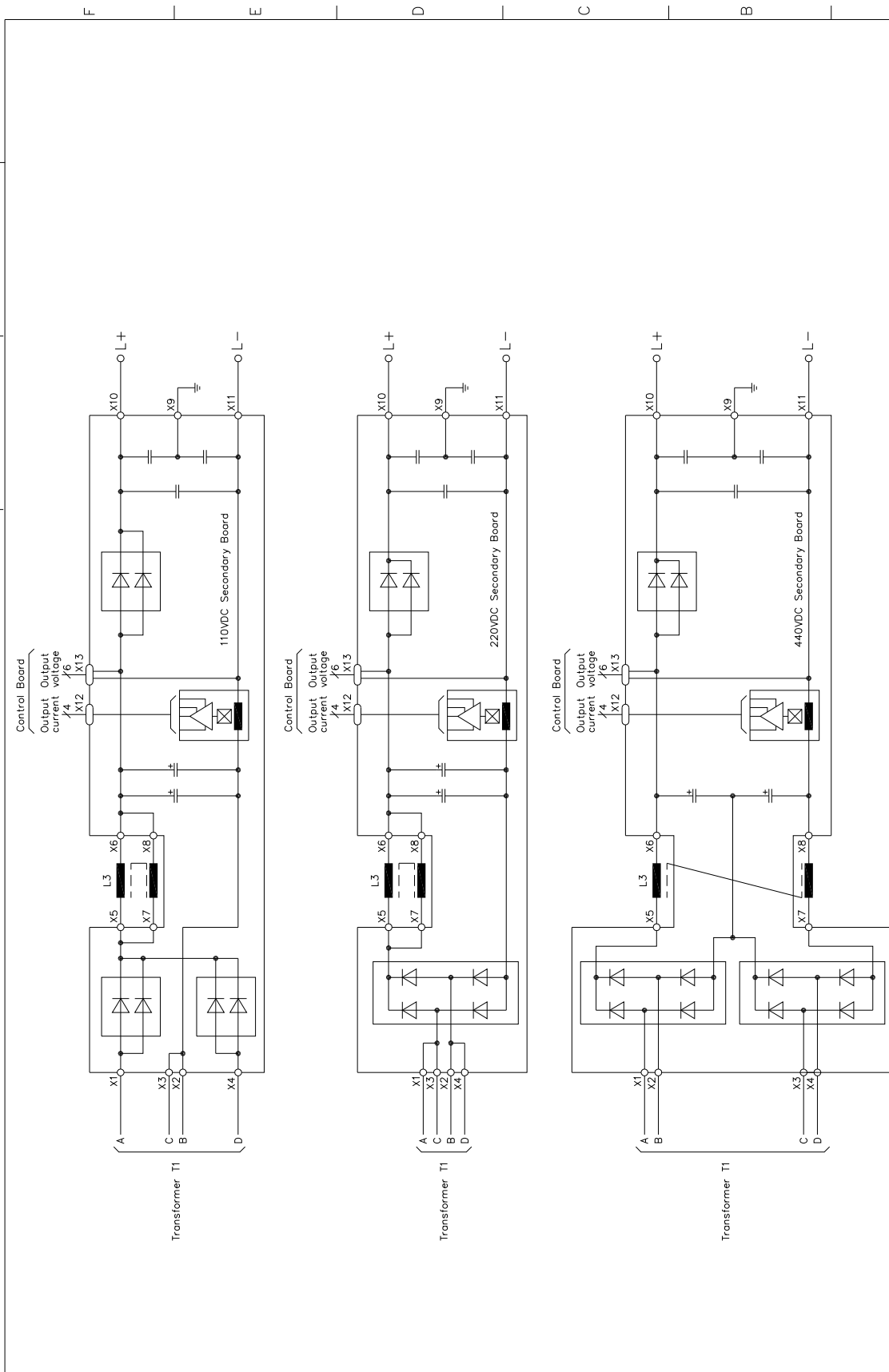
- Cause 1: The current is too high/low to be within the area for active load-sharing. Load-sharing operates within about 10-90% of rated current.
- Cause 2: Certain fault conditions, such as communication fault or first module out of operation, will stop active load-sharing.


Appendix A
DIMENSION DIAGRAM



Dimension diagram, external dimensions, PRM3

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