SAFETY INSTRUCTIONS

This manual must be read **before** installation, use or work on the product.

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

The product must be installed by qualified personnel and according to the installation instructions. Service may only be performed by authorized service personnel. The equipment housing may only be removed by authorized personnel when all power has been cut to the equipment for at least five minutes. The protective covers and contact safety devices inside the equipment may only be removed by authorized service personnel. **The power must always be disconnected** in a safe way before starting any service/maintenance.

**Warning for reverse voltage. Power is supplied from several sources. The mains breaker itself will not give a completely dead condition.**

Manual: 9-1640-B
P/n: 0001089
We reserve the right to make changes to the content of this manual without prior notification.
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Appendices

A LAYOUT AND DIMENSION DIAGRAM
B CIRCUIT DIAGRAM PC05
C CIRCUIT DIAGRAM DM199
D SINGLE LINE DIAGRAM PC05
1 PRESENTATION

PC05 is a complete DC system providing uninterruptible power for e.g. switch gears, control equipment, process control, etc.

The system is built on a modular basis for easy maintenance and high flexibility. It is a complete set of rectifier, battery, battery fuse board, distribution board and monitoring unit. The compact design makes it possible to fit even in limited spaces. The clear display and well-arranged system of menus of the monitoring unit make it easy and pleasant to work with. The rectifiers are of “plug-in” type and can be connected in parallel to increase capacity and availability.

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. Equivalent descriptions of the parts of the equipment that relate to the monitoring unit are detailed in the Manual for monitoring unit type PCM2.

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 D.C. system.

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

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

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

**Authorised service 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 that the content of this description cannot be misunderstood.
- Have undergone a product-specific training programme for authorised service personnel that is approved by KraftPowercon Sweden 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 that the content of 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 protective covers and contact safety devices inside the equipment may only be removed by authorised service personnel.
3 TECHNICAL DATA

3.1 ELECTRICAL DATA

3.1.1 Assortment

PC05 can be equipped with up to three rectifier modules, depending on the model.

<table>
<thead>
<tr>
<th>Model designation</th>
<th>U_NOM (V_{DC})</th>
<th>I_RATED (A)</th>
<th>Rectifier module</th>
<th>Model designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC05 24/108</td>
<td>24</td>
<td>108</td>
<td>36</td>
<td>PCS 24/36</td>
</tr>
<tr>
<td>PC05 24/140</td>
<td>24</td>
<td>140</td>
<td>70</td>
<td>PCS 24/70</td>
</tr>
<tr>
<td>PC05 48/54</td>
<td>48</td>
<td>54</td>
<td>18</td>
<td>PCS 48/18</td>
</tr>
<tr>
<td>PC05 48/150</td>
<td>48</td>
<td>150</td>
<td>50</td>
<td>PCS 48/50</td>
</tr>
<tr>
<td>PC05 110/24</td>
<td>110</td>
<td>24</td>
<td>8</td>
<td>PCS 110/8</td>
</tr>
<tr>
<td>PC05 110/48</td>
<td>110</td>
<td>48</td>
<td>16</td>
<td>PCS 110/16</td>
</tr>
<tr>
<td>PC05 110/66</td>
<td>110</td>
<td>66</td>
<td>22</td>
<td>PCS 110/22</td>
</tr>
<tr>
<td>PC05 220/30</td>
<td>220</td>
<td>30</td>
<td>10</td>
<td>PCS 220/10</td>
</tr>
</tbody>
</table>

3.1.2 Common electrical input data

Rated voltage ............................................ $120^\circV/120^\circV/220/230/240$ V_{AC} 1- fas
Frequency ................................................. 50/60 Hz
Power factor.............................................. > 0.99 at 230 V_{AC}, full load
Connection ............................................... Screw terminal block, 0.2 – 6 mm²

*: Power derating below 190 V_{AC}.
**: A single rectifier module is supplied from one phase, but several modules can each be supplied from separate phases.

3.1.3 Common electrical output data

Voltage regulation (static).......................... $<\pm0.5\%$ of nominal output voltage
Voltage regulation (dynamic).................... $<\pm1\%$ within 3 seconds, 0-100/100-10 % load change
Current regulation ..................................... $<\pm1\%$ of rated current
Setting range, current limit ...................... 0 – 100 % of rated current
Ripple voltage ........................................... $<0.1\%_{\text{RMS}}$
Ripple current .......................................... $<0.1\%$ of rated current
Efficiency .................................................. up to 92 %
Connection ............................................... Screw terminal block 0.5 - 10 mm², slide disconnect
### 3.1.4 Electrical data for rectifier module

<table>
<thead>
<tr>
<th>Model designation, rectifier module</th>
<th>Output data</th>
<th>Input data</th>
<th>Power loss *2 (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$U_{NOM}$</td>
<td>$I_{RATED}$</td>
<td>$P_{MAX}$</td>
</tr>
<tr>
<td></td>
<td>(V$_{DC}$)</td>
<td>(A)</td>
<td>(W)</td>
</tr>
<tr>
<td>PCS 24/36</td>
<td>24</td>
<td>36</td>
<td>1000</td>
</tr>
<tr>
<td>PCS 24/70</td>
<td>24</td>
<td>70</td>
<td>2000</td>
</tr>
<tr>
<td>PCS 48/18</td>
<td>48</td>
<td>18</td>
<td>1000</td>
</tr>
<tr>
<td>PCS 48/50</td>
<td>48</td>
<td>50</td>
<td>2700</td>
</tr>
<tr>
<td>PCS 110/8</td>
<td>110</td>
<td>8</td>
<td>1000</td>
</tr>
<tr>
<td>PCS 110/16</td>
<td>110</td>
<td>16</td>
<td>2000</td>
</tr>
<tr>
<td>PCS 110/22</td>
<td>110</td>
<td>22</td>
<td>2700</td>
</tr>
<tr>
<td>PCS 220/10</td>
<td>220</td>
<td>10</td>
<td>2475</td>
</tr>
</tbody>
</table>

*1: max at 195 V$_{AC}$
*2: typical at 230 V$_{AC}$ and full load
*3: Derating below 190 V$_{AC}$

#### 3.1.5 Electrical data for distribution module DM199

<table>
<thead>
<tr>
<th>Type DM199</th>
<th>Fuse ways</th>
<th>Max fuse rating (A)</th>
<th>Fuse type</th>
</tr>
</thead>
<tbody>
<tr>
<td>DM199 9xDII</td>
<td>9</td>
<td>25</td>
<td>Diaized type DII</td>
</tr>
<tr>
<td>DM199 6xDIII</td>
<td>6</td>
<td>63</td>
<td>Diaized type DIII</td>
</tr>
<tr>
<td>DM199 9xMCB</td>
<td>9</td>
<td>Acc. to spec.</td>
<td>Miniature circuit breaker (MCB)</td>
</tr>
</tbody>
</table>

Power consumption ........... 1 W (24 V), 2 W (48 V), 2 W (110 V), 2.5 W (125 V)
Insulation between ways ....... >1 Mohm
Alarm outputs .................. 250 V$_{AC}$, 5 A, AC1
24/48 V$_{DC}$, 0.3 A at L/R=40 ms
125 V$_{DC}$, 0.15 A at L/R=40 ms
250 V$_{DC}$, 0.12 A at L/R=40 ms
Indications .................... Red/Green LED per group
Settings ...................... Switch per way for monitoring activation/de-activation
Connection, way output ...... 0.5 - 10 mm$^2$, slide disconnect screw terminal block
Connection, alarm output ..... 0.2 – 2.5 mm$^2$, knife disconnect screw terminal block
3.1.6 Electrical data for battery fuse board

Design
Pole separated in plastic housing
Fuse type
NH00, knife blade fuse
Number of ways
4
Battery cable
35 mm², double insulation

<table>
<thead>
<tr>
<th>PC05 Model</th>
<th>Max fuse per position</th>
<th>Recommended fuse per position</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-2 (A)</td>
<td>3-4 (A)</td>
</tr>
<tr>
<td>24/108</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>24/140</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>48/54</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>48/108</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>48/150</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>110/24</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>110/48</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>220/30</td>
<td>63</td>
<td>63</td>
</tr>
</tbody>
</table>

3.1.7 Electrical data for capacity test connector

Connection
4 - 16 mm², screw terminal
Maximum load
25 A

3.1.8 Electrical data for battery

3.1.8.1 Internal battery

Battery type
Vent regulated
Maximum battery blocks
9
Maximum capacity
62 Ah by 9 blocks, otherwise limited by physical size

3.1.8.2 External battery

Battery type
Optional
Maximum battery blocks
No limit
Maximum capacity
No limit

3.2 ENVIRONMENTAL DATA

Class of enclosure
IP21 as per EN 60529
Cooling
Temperature controlled fans in rectifier modules, otherwise natural convection
Ambient temperature (spec. data applies)
0 to +40 °C
Storage temperature
-40 to +70 °C
Humidity
<90 % RH, non-condensed
Altitude a.s.l.
<2000 m
Noise level, at 25 % load
<50 dBA at 25 % load
3.3 MECHANICAL DATA

Design: Floor cabinet with 19" rack frame
Placement: Standing on floor indoors in dry and clean area
Weight: 95 kg, fully equipped but without batteries
Dimensions: 2000/600/400 mm (h/w/d), see also layout drawing Appendix A
Colour: RAL 7035 light grey
Cable inlet: From above or beneath

3.4 CONFORMITY WITH STANDARDS

EN 60529: Protection degree IP21
EN 50178: LVD. Electronic equipment, including power electronics in electrical power installations.
EN 50272-2: Safety requirements for secondary batteries and battery installations
EN 61000-6-2: EMC. Immunity of equipment in an industrial environment
EN 61000-6-4: EMC. Emission from equipment in an industrial environment
4 FUNCTIONAL DESCRIPTION

4.1 GENERAL

PC05 is a complete DC system including rectifier, battery, battery fuse board, distribution board and monitoring unit.

Most of the function is associated with the monitoring unit. This is described in the Manual for monitoring unit PCM2. Only functions added on system level are discussed in this section.

4.2 SINGLE LINE DIAGRAM

Figure 1 Single line diagram PC05

1-3: Rectifier modules (T1-3)  9: PCM2 I/O unit (K1)
5: Battery (G1)  10: PCM2 Operator’s terminal (P1)
6: Battery fuse board (W1/W2)  11: Alarm outputs
7-8: Distribution board (F11/F12)  12: Capacity test terminals (Q2)
4.3 RECTIFIER MODULES

The rectifier modules are of the "plug-in" type and can be replaced during operation. There is room for up to three modules in parallel. For some models though, only two of the slots can be used because the total current otherwise would be too high, see section TECHNICAL DATA.

There are three indicator lamps on the front of the module:

- **AC OK** - Green: Mains OK
  - Off: Mains power failure

- **WARNING** - Yellow (permanent): Remote shutdown (standby) or high temperature warning
  - Yellow (flashing): Communication fault
  - Off: Normal operation

- **ALARM** - Off: OK
  - Red: Alarm (shutdown after DC overvoltage, over temperature, fan error or internal fault)

4.4 BATTERY

The battery is built up of a number of battery blocks connected in series. They can be placed either internal, i.e. inside the PC05 enclosure, or external on a separate stand. In case of internal placement, the battery is always of VR-type, i.e. vent regulated blocks. External batteries can be of any type.

The mid voltage is measured in order to monitor the symmetry of the battery.

4.5 BATTERY FUSE BOARD

The battery fuse board is the most upstream level for distribution of the DC power. Since fuses are normally not permitted between the battery and the battery fuse board, the battery fuse board is of pole separated and short-circuit proof design. The fuses are of the knife blade type NH00.

4.6 DISTRIBUTION BOARD

The distribution board is the next downstream level below the battery fuse board for distribution of the DC power. PC05 can be fitted with one or two distribution boards, F11 and F12, with up to nine ways each. They can be equipped with either Diazed fuses of type DII or DIII, or Miniature Circuit Breakers (MCB).

The distribution board has two-pole zero voltage monitoring with indicator lamp for each way and a common alarm output for the complete board. A fuse fault generates a color shift of the indicator lamp from green to red and the common alarm relay will be de-energized thus causing an alarm. Non-used ways can be de-activated so they will not have any effect on the alarm output. The corresponding indicator lamp is turned off to indicate this condition.

4.7 RACK FOR RECTIFIER MODULES AND OPERATOR PANEL

Rack unit U1 holds the operator’s panel and rectifier modules.

The operator panel P1 is the unit used as the user interface. It is mounted modularly to the left of the rectifier modules.
The rectifier modules (T1-T3) are “plug-in” modules. Of the four locations, two or four of them can be equipped, depending on the PC05 model, see section TECHNICAL DATA.

4.8 TEST CONTACTS
There are short-circuit proof test contacts (X30) alongside the operator panel, for checking of the battery voltage. The test contacts are aimed for 4 mm isolated plugs of safety type but also accept 4 mm banana plugs.

4.9 I/O UNIT
The I/O unit contains connection terminals for the external connections required for the monitoring unit. It is located in the connection compartment behind the door.

4.10 FUNCTIONS

4.10.1 General
Only the most important functions are specified here. For more information, see the Manual for monitoring unit PCM2.

4.10.2 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’s instructions.

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

4.10.3 Equalization charging
Equalization charging means charging at an increased voltage level over a limited period. It is used partly for the initial charge, and partly for equalizing cell voltages if spreading 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 equalization charging. For some battery types equalization charging could even be harmful to the batteries. Always follow the battery manufacturer’s instructions.

4.10.4 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

Most of the operation is associated with the monitoring unit. This is described in the Manual for monitoring unit PCM2. Other operation is detailed in this section.

5.2 MAINS POWER

Behind the door in the so called connection compartment, the mains breaker Q1 for the rectifier modules is located.

Note that the breaker is only breaking the mains power to the rectifier modules. The monitoring unit will still be working due to power from the battery.

WARNING: Especially during equalizing charging, explosive concentrations of hydrogen can arise in vicinity of the battery blocks. In case of internal batteries in systems for 110V, the upper block is located relatively close to the mains breaker. Due to explosion hazard, the mains breaker must not be switched during equalizing charging and the next hour afterwards.

WARNING: Note that the mains breaker does not make the equipment completely dead. For total dead state, the battery must also be disconnected.

5.3 RECTIFIER MODULES

There are three indicator LEDs on the front of the rectifier module with the following functions:

- AC OK - Green:
  - Off: Mains OK
  - Mains power failure

- WARNING - Yellow (permanent):
  - Yellow (flashing):
    - Off: Remote shutdown (standby) or high temperature warning
    - Communication fault
    - Normal operation

- ALARM - Off:
  - Red: Alarm (shutdown after DC overvoltage, over temperature, fan error or internal fault)

When the module gives an alarm you have the option of finding out the cause of the alarm in detail via the operator panel menus, see the Manual for monitoring unit PCM2.

The modules are of the “plug-in” type and can in principle be replaced during operation. For more information, see the section INSTALLATION INSTRUCTIONS.
5.4 BATTERY FUSE BOARD

The battery fuse board holds four fuses of knife blade type (NH00). Fuses for plus and minus are located in separate plastic boxes. The fuses are grouped as follows:

- Position 1-2: Distribution module F11
- Position 3-4: Distribution module F12 (option)
- Position 5-6: Rectifier modules
- Position 7-8: Capacity test terminals and measuring and power for the monitoring unit.

By removing all fuses in the battery fuse board and switch off the mains breaker you can make the system completely dead, disregarding the batteries themselves.

WARNING: When working with knife blade type fuses, use safety approved tools only. Remove all loads before working with knife blade type fuses due to arcing hazard! Do not use fuses with higher ratings than permitted, see section Electrical data for battery fuse board and marking signs in the fuse board. Use insulated tools only and follow the regulations stated for working with live parts.

5.5 DISTRIBUTION BOARD

PC05 can be fitted with one or two distribution boards of type DM199 with up to nine ways each. The fuses can be either Diazed type DII/DIII or Miniature Circuit Breakers (MCB).

Each fuse way is equipped with two-pole zero voltage monitoring with LED indication. A common sum alarm is forwarded to the monitoring unit. Unused fuse ways can be de-activated, see section INSTALLATION INSTRUCTIONS.

The LED indications have the following function:
- Green - Fuse way OK
- Red - Fuse fault
- Off - Fuse way monitoring de-activated

5.6 CAPACITY TEST

The meaning of capacity test is to decide the actual capacity of the battery.

The test should be done like this:
1. Connect an external load to terminal X39.
2. Turn off the charging by switching off the mains breaker Q1.
3. Start the discharging by switching on the capacity test breaker Q2. Use an external instrument to measure the discharged capacity (Ah).
4. Once the desired final voltage is reached the test should be ended by first switching off the capacity test breaker Q2 and then restart the charging by switching on the mains breaker Q1.

WARNING: Especially during equalizing charging, explosive concentrations of hydrogen can arise in vicinity of the battery blocks. In case of internal batteries in systems for 110V, the upper block is located relatively close to the mains breaker. Due to
explosion hazard, the mains breaker must not be switched during equalizing charging and the next hour afterwards.

5.7 BATTERIES

Depending on the design of the PC05 system, the batteries are located either internally or externally.

For maintenance and other work on the batteries, see the battery manufacturer’s instructions.

5.8 TEST CONTACTS

When measuring the battery voltage you should avoid measuring directly on the battery poles, due to the risk of arcing in the event of a possible short circuit. Instead, use the short-circuit protected test contacts X38 just below the operator panel.

The test contacts accept 4 mm insulated safety plugs, and also 4 mm banana plugs. To avoid measurement errors, the voltmeter used should have high internal resistance, 10 Mohm or better.
6 INSTALLATION INSTRUCTIONS

6.1 SAFETY INSTRUCTIONS

WARNING! This product contains dangerous voltages 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. During all handling of batteries, the instructions stated by the battery manufacturer must be followed. The product must be installed by qualified personnel (see section 2, SAFETY INSTRUCTION).

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

6.2 GENERAL

Installation of parts belonging to the monitoring unit is 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.

6.3 HANDLING

WARNING! Without batteries installed in the PC05 enclosure, the center of gravity is high. This fact must be kept in mind during all handling of the product. During all handling of batteries, the instructions stated by the battery manufacturer must be followed.

On the roof there are holes prepared for lifting lugs. If they are used temporarily, don’t forget to restore the plastic plugs that cover the holes in order to maintain the environmental protection class.

6.4 STORAGE AND PROTECTION

6.4.1 Enclosure

Storage is to be in a dry area and at a temperature within the -40 to +70 °C range.

6.4.2 Battery

If the batteries are not installed immediately, they should be stored in a clean, cool and dry environment. Generally, a maintenance charging should be done at least every six month. If possible, the storage temperature should not exceed +20 °C. In other case the maintenance charging should be done more often. For additional information, see the battery manufacturer’s recommendations.
6.5 MOUNTING

6.5.1 Enclosure

The equipment is intended for placement on floor in a dry, clean environment that is free from conductive dust. At least 40 mm free space to the wall should be left on the rear for ventilation reasons. In the bottom of the enclosure, there are holes prepared for bolting to the floor.

Cable inlet is possible from below, from top or from behind. In the case “from behind”, the cable inlet can be chosen upwards or downwards by rotating the rear plate 180 degrees. The part of the rear plate that is aimed as cable inlet is provided with fastening tongues suitable for cable ties. The rear plate is mounted by four screws and caged nuts. If the rear plate is to be rotated, the caged nut needs to be moved. The following positions apply:

- Cable inlet upwards: The thirteenth hole from above and the tenth hole from below.
- Cable inlet downwards: The tenth hole from above and the thirteenth hole from below.

WARNING! The center of gravity of the unit is high. Use the enclosed brackets to avoid the risk of tipping. See also Appendix A, LAYOUT AND DIMENSION DIAGRAM.

6.5.2 Batteries

6.5.2.1 Internal batteries

Place the batteries as far to the bottom of the enclosure as possible. If the third shelf must be used, which most often is the case for the ninth block in an 110V battery, it must be placed as far to the right as possible. The reason is to eliminate a hydrogen explosion hazard due to switching of the breakers for mains input and capacity test.

NOTE: Only vent regulated batteries, also called sealed or VR-batteries, is permitted for installation inside the PC05 enclosure.

6.5.2.2 External batteries

Mount the batteries according to the instruction that is enclosed with the battery stand.

6.6 ELECTRICAL INSTALLATION

6.6.1 General

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

Cable inlet is primarily from the floor through the opening in the bottom of the enclosure. Alternatively, the inlet can be done through the detachable roof plate. In that case, be careful to maintain the environmental protection class. Also the rear can be used for cable inlet, see section 6.5.1 Enclosure.

On the lower part of the inside gables, anchor rails are located for attachment of cables. In case of external battery, there is also an anchor rail with enclosed cable clamps as strain relief of the battery cables.

6.6.2 Earthing

The earthing and shielding are to be connected to the earth rail shown on the adjacent figure.

There are a M8 threaded studs welded on the inside of the right gable, for potential equalization.
6.6.3 Mains voltage

6.6.3.1 External fuse rating

The size of the external primary fuse is selected as follows:

1. Find the maximum mains current for the type of rectifier module in question from the table in section Electrical data for rectifier module.
2. Multiply it by the number of rectifier modules.
3. Choose the next highest fuse rating.

NOTE: If you choose to feed the rectifier modules from different phases (see below), point 2 above must naturally be suitably modified.

6.6.3.2 Connection

Each rectifier module has its own terminal blocks for phase and neutral. It is therefore possible to select between feeding the modules from individual phases or to link two or more to the same phase. To simplify this, the terminal blocks are fitted with bipolar connection links that can be moved or removed. At delivery, all mains inputs are connected in parallel.

Note that since the PC05 holds a maximum of three modules, the fourth terminal is not connected to any module.

The feeding network should be of TN-S type in order to avoid the risk of stray current.

6.6.4 Batteries

6.6.4.1 General

In addition to the instructions given here, the battery manufacturer’s instructions must be followed.

The battery fuse board is of short-circuit proof design which makes it possible to exclude fuses in the link between battery and the battery fuse board. This is strongly recommended since the short-circuit current from the battery is limited, which in turn would make it difficult to ensure selectivity to downstream fuses.

Remove all fuse links in the battery fuse board before the installation of the battery.

Avoid generating higher and higher battery voltage by serial connection. Instead you should start with minor parts of serial connected groups of battery blocks. For each individual group, the polarity and voltage is checked. Then connect group after group while checking polarity and voltage as every new group is added. In this way the risk of faulty connection is minimized.

Restore all the protective covers on the batteries.

DANGER! Always follow the battery manufacturer’s safety instructions!
**WARNING!** The un-fused cabling between the battery and the battery distribution board must be short-circuit proof along the whole distance. This means separate double insulated cables for each pole and placed separated from other cables and combustible substances. Double insulation means two independent insulation layers and can be achieved in a few ways, like the following examples:

- Use underground cable, like FKKJ. Isolate (i.e. do not use) the sheath and use all conductors in parallel.
- Use isolated single cable, like RK, and place it into a plastic pipe.
- Use readymade double insulated cable, like RKK or certain types of welding cable.

### 6.6.4.2 Internal battery

Connect the battery using the double insulated cables that are already connected to the battery fuse board. Measure the voltage in the battery fuse board and check that the voltage and polarity is correct.

Connect the enclosed short-circuit protected cable set for mid voltage measurement according to the Manual for monitoring unit PCM2. A spade terminal for mounting on battery bolt M6 and M8 is enclosed. The point of connection should be as close to the electrical midpoint of the battery as possible. In case of an uneven number of cells, the exact midpoint is physical unreachable. Preferably, the battery pole on the minus side of the midpoint is chosen.

The enclosed temperature sensor (option) is normally already installed and put in its place. In other case, place the sensor on a spot of the battery that best represents the mean temperature of the battery, normally the most central point of the battery. Connect the sensor according to the Manual for monitoring unit PCM2.

### 6.6.4.3 External battery

Make a short-circuit proof installation according to the above general instruction. Make a connection from the battery to the battery connection terminals located in plastic boxes on the rear mounting plane of the PC05 enclosure. Cable clamps for strain relief are enclosed. See to that the double insulation is intact all the way into the plastic boxes. When calculating the battery cable area you should, besides ordinary standards and rules, also consider the voltage drop. The voltage drop should not exceed 2 % of rated voltage at maximum current. Measure the voltage in the battery fuse board and check that voltage and polarity is correct.

Connect the enclosed short-circuit protected cable set for mid voltage measurement according to the Manual for monitoring unit PCM2. A spade terminal for mounting on battery bolt M6 and M8 is enclosed. The point of connection should be as close to the electrical midpoint of the battery as possible. In case of an uneven number of cells, the exact midpoint is physical unreachable. Preferably, the battery pole on the minus side of the midpoint is chosen.

The enclosed temperature sensor (option) is connected according to the Manual for monitoring unit PCM2. Place the sensor on a spot of the battery that best represents the mean temperature of the battery, normally the most central point of the battery.

If the cable for battery mid-point measuring and/or temperature sensor needs to be extended there are no extra requirements for cable or joint box beyond ordinary electrical installation standards. The class of insulation is decided based on the battery voltage.
6.6.5 Rectifier modules

The rectifier modules are normally packed separately and are to be put in place during the installation. The rack module slots should be equipped with modules starting from the leftmost position and with spare slots to the right.

The modules can in principle be replaced during operation. However, we recommend disconnection of the mains supply first.

Press bottom left (see figure above) to release the module. This releases a handle that can be pulled out to enable the module to be extracted from its position.

Conversely, a module is installed by gently pushing the module into place and pushing it into the bottom. Then push the handle towards the module and finally secure the handle with the two screws.

WARNING! Check carefully that the rectifier modules have the correct rated voltage.

6.6.6 External load

External loads are connected to the output terminals X31 for distribution board F11, and X32 for distribution board F12 (option).

The terminal number 1-18 is distribution outputs while terminal number 19-21 are sum alarm outputs from the distribution board.

Output from fuse way 1 is on terminal number 1-2, fuse way 2 on terminal number 3-4, etc. Uneven numbers are plus-pole and even numbers are minus-pole.

The alarm output is a change-over relay contact according to the following:

- Terminal 19 - Open during alarm
- Terminal 20 - Closed during alarm
- Terminal 21 - Common

By delivery, the alarm output is forwarded to the alarm input “Fuse fault” of the monitoring unit. If you wish to use the alarm output in another way, don’t forget to strap the alarm input “Fuse fault”, see Manual for monitoring unit PCM2.

6.6.7 I/O Unit

All the connections to the monitoring units are grouped in a unit called the I/O unit. The connectors are pluggable, i.e. they can be removed for better accessibility when installing. For more information about these connections, see Manual for monitoring unit PCM2.
6.6.8 Operator's panel

The operator's panel is already installed at delivery. The following description is mainly intended for service in the future.

To release the operator panel, press the upper part of the panel causing a magnetic lock to disengage (see upper figure). Pull the upper edge so that the magnet releases and then pull the lower edge free from the spring catch (lower figure). There are two wires on the rear of the panel, if these are released, the panel can be removed completely.

To refit the panel, first connect the two wires. Then check that both the magnetic lock and the spring lock are extended. Press the lower edge onto the spring lock and then the upper edge onto the magnetic lock until it clicks into place.

6.7 SETTINGS

6.7.1 General

All settings are in principal done during commissioning. But there is one exception, the distribution board settings. The reason is the accessibility that makes it more difficult to do these settings later.

6.7.2 Settings, distribution board DM199

The settings available for distribution board DM199 are activation/de-activation of alarm from each separate fuse way. The reason for de-activation is to see to that unused fuse ways will not case any alarms. An alternative to de-activation is to equip unused fuse ways with fuses (Diazed) or keep the fuse switched on (MCB).

The switches for these settings are located on the rear of the distribution board unit. In order to access these switches there are two alternatives:

1. From the back of the enclosure by removing the rear plate. In this case it must be done before the enclosure is put on its final place.
2. Remove the four front screws and gently bend out the left side of the board until the switches is accessible.

Activation/de-activation of alarm indication and alarm relay is done via the two DIL-switches on the rear of the board. Each DIL-switch holds 9 individual switches numbered from 1 to 9 corresponding to fuse way 1 to 9. The left DIL-switch (seen from behind) controls the LED indications while the right switch controls the sum alarm relay. Switch in downward position is normal position (activated) while upward position means de-activation, i.e. turned off LED and no effect on the alarm relay.
7 STARTING UP

7.1 SAFETY INSTRUCTIONS

WARNING! This product contains dangerous voltages that when touched can cause electric shock, burns or death. All contact safety devices and plates must be fitted when operating. Use approved tools only when handling knife blade type fuses in the battery fuse board.

7.2 PREPARATORY INSPECTION

7.2.1 General
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 non fuse protected battery cables are double insulated and separated from other cables and combustible substances.

Check that all protective covers are intact, all breakers are switched off and all fuses switched off or removed.

Check that the number of battery blocks is according to specification.

7.2.2 Battery
Check that all battery blocks are properly connected by measuring some block voltages, multiply the mean value of these voltages with the number of blocks and finally compare the result with the measured total battery voltage.

Check that a possible temperature sensor (option) is placed on a spot that best represents the temperature of the battery.

Check that correct battery voltage is present in the battery fuse board. Ensure that the polarity is correct according to the marking (plus in the left box, minus in the right box).

7.3 POWERING UP

7.3.1 DC

7.3.1.1 Monitoring unit
Fit in knife blade fuses in the battery fuse board position 7 and 8. After a few seconds, the operator panel display lights up, and after a few more seconds text appears on the display. All measurement values are initially reset. The measurement starts after about 10 seconds. Alarms are activated after about 30 seconds.

7.3.1.2 Distribution board
See to that all fuses in the distribution board F11 and F12 are unscrewed/turned off. Firstly, fit in knife blade fuses in the battery fuse board position 1 and 2 while the LED indicators in the distribution board F11 should turn on to red light. If distribution board F12 is installed, then continue with the knife blade fuses in the battery fuse board position 3 and 4 while the LED indicators in the distribution board F12 should turn on to red light.
7.3.1.3 Rectifier modules
Connect the rectifier module outputs by fitting in knife blade fuses in the battery fuse board position 5 and 6. Nothing visible should happen at this state.

7.3.2 AC
Turn on mains breaker Q1. The rectifier modules should now start up.

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 batteries require an initial equalizing charging. Always follow the recommendations given by the battery manufacturer.

7.4 CHECKING THE CHARGING VOLTAGE
Check the settings of the monitoring unit to ensure that 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 with the setting of the float charging voltage, see section 8.1.2 Checking the charging voltage.

7.5 CHECKING THE SETTINGS
Each time the monitoring unit has been powered down, the built-in clock must be reset with the current date and time, see the Manual for monitoring unit PCM2.

Check that the measurements on the display agree with the actual situation. Check that the parameters for charging voltages, alarms and other parameters conform to the intended functions, see the Manual for monitoring unit PCM2.

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

7.7 CONNECTION OF LOAD
Screw on, alternatively switch on, the fuses in the distribution boards. The fuse ways should change indication from red to green. When this is finished, no alarms should remain on the display.

Finally switch on the loads that are connected to the distribution outputs.
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 Checking the charging voltage

Connect a voltmeter to the test contacts (see section 5.8 TEST CONTACTS). Check that the rectifier’s output voltage corresponds to the setting of the float charging level.

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 Operation, Functions). Do not forget to reset the parameter for the installed temperature sensor following the 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 Checking the cooling capacity

Check that the rectifier modules’ ventilation vents are not clogged with dust or other contaminants. Clean where necessary.
9  FAULT TRACING

9.1  SAFETY INSTRUCTIONS

WARNING! This product contains dangerous voltages that when touched can cause electric shock, burns or death.
Service/maintenance work that involves working with a removed cover may only be carried out by authorised service personnel (see section SAFETY INSTRUCTIONS).

WARNING! In the event of excessive voltage, the electrolytic capacitors and varistors may explode. If work must be done when the equipment is powered up and the cover removed, splinter protection must therefore be used (protective goggles and screens).

9.2  FAULT TRACING ALARMS

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

9.3  OTHER FAULT TRACING

The types of faults that can be attributed to the system 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 is turned on
Cause 1: Wrong type of external primary fuse. Check that the system is properly fused according to the instructions in section 6.6.3 External fuse rating.
Cause 2: Internal fault in a rectifier module. Install one module at a time in order to identify the module that is responsible for the problem. Replace the defective module.

The rectifier has no output, green indicator lamp “AC OK” is off
Cause 1: No mains power. Check that there is mains voltage to the mains input terminals and that the mains breaker is closed.
Cause 2: A rectifier module is not fully inserted.

The rectifier has no output, green indicator lamp “AC OK” is lit, yellow indicator lamp “WARNING” is lit and red indicator lamp “ALARM” is off
Cause 1: Input “EXT. FAULT” is used as external blocking and is in open state.
Cause 2: The rectifier module has been switched off due to overtemperature. Check that the rectifier modules’ ventilation vents are not clogged with dust or other contaminants. Clean where necessary. Check that the ambient temperature is within permitted limits.

The rectifier has no output, green indicator lamp “AC OK” is lit, yellow indicator lamp “WARNING” and red indicator lamp “ALARM” are off
Cause 1: Output fuses (fuse 5 and 6 in the battery central) has tripped. Check that the output fuses are properly dimensioned to handle the rectifier’s rated current.

The rectifier module’s green indicator lamp “AC OK” and red indicator lamp “ALARM” are lit
Cause 1: The rectifier module has been switched off due to overtemperature. Check that the rectifier modules’ ventilation vents are not clogged with dust or other contaminants. Clean where necessary. Check that the ambient temperature is within permitted limits.
Cause 2: The rectifier module has been switched off due to fan error in the module. Replace the fan or the entire rectifier module.
Cause 3: The rectifier module has been tripped by high output voltage, HVSD (High Voltage Shut Down). Reset by removing power to the module, most simply by extracting the module for a few seconds until all lamps are off, and then re-inserting it again. If the fault reoccurs, the module may be faulty. Replace the rectifier module.

Cause 4: Other internal fault in the rectifier module. Replace the rectifier module.

The rectifier module’s red indicator lamp “ALM” 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: The requested charging voltage is close to or above the level of the parameter $U_{\text{maximum}}$. The voltage will be limited 1% below this level. If higher voltage is desired, the setting of the parameter $U_{\text{maximum}}$ must be increased., see the Manual for monitoring unit PCM2.

Cause 4: 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 5: Incorrectly set float charging voltage level. Adjust the setting.

Cause 6: Incorrectly calibrated voltage measurement. Recalibrate the monitoring unit’s measurement of battery voltage.

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.
Appendix A
LAYOUT AND DIMENSION DIAGRAM
Appendix B

CIRCUIT DIAGRAM PC05

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