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Please note: Manuals for all the system 8800 power supplies is automatically generated. This means that chapters may be omitted if not applicable.

1. Introduction and specifications

1.1. General introduction

The System 8800 Precision Magnet Power Supplies are DC constant current output Power Supplies designed for applications requiring very high stability and low noise combined with reliability and ease of operation.

The System 8800 is aimed at precision spectroscopy and ion beam transport applications. It is the result of an intensive development effort at Danfysik based on more than 30 years of experience in delivering precision DC Power Supplies to industrial and research laboratory users around the world.

The System 8800 is available as a range of power, control and interface modules which can be configured to meet specific application requirements with guaranteed performance.

* Current stability options of 10, 20 or 50 ppm classes.

* Power outputs from 5 kW to 25 kW per unit. 4 units can be mounted in one 19" rack, and many racks may be coupled in parallel for higher currents.

* Output current (maximum) from 50 A to 600 A.

* Precision current transducer ULTRASTAB (DCCT = DC Current Transformer) to achive new performance levels for stability and linearity over very wide current ranges.

* Optically isolated digital control to eliminate ground loops and conducted noise. The control and interface electronics modules are isolated from the power modules by an electrostatic and thermal shielding wall.

1.2. Specifications

STABILITY CLASS ..... ± 50 ppm

DC OUTPUT RATINGS

Power range ..... 5 kW
Current range ..... 336 Amp.
Voltage. ..... 15 V

PERFORMANCE

All drift and regulation data are given for max. current output and after warm up time.

Warm up time
Cold start ..... 30 min.
With control power ON ..... 15 min.

Drift:
Short term 30 min. ..... ± 50 ppm
Long term 8 hours ..... 50 ppm

Line regulation:
±10 % slow.T > 1 min. ..... 0.5 ppm
±1 % fast.T > 3 msec. ..... 0.5 ppm

Load regulation:
+10 % resist. change. T > 1 min.0.5 ppm

Load:
Inductance/resistance (τ) .... <400m sec.
(τ > 400m sec. contact DANFYSIK for loop calculation)

PARD (Periodic And Random Deviation), resistive load, f >1 Hz, output voltage:
PARD ..... 100 mV + 0.01% of V_{out}

Temperature coefficient:
Ambient air ..... <1 ppm/°C
Cooling water ..... <1 ppm/°C

Ramp.time 0 – full scale (Load dependent):
Selectable ..... 10 – 1000 sec.

DC output isolation resistance > 1 Mohm. (Without earth leakage detector & cooling water).

Number of output channels 1
Output polarity ..... UNIPOLAR

Current setting resolution .. 16 Bit, 16ppm

Current readback resolution 16 Bit, 16ppm

TEMPERATURE RANGE

OPERATING:
Ambient temperature ..... 10 to 40°C
Cooling water temperature ... 15 to 32°C
Relative air humidity ..... < 80%

STORAGE temperature .... –20 to 50°C

MAIN COOLING SYSTEM

COOLING WATER PRESSURE:	bar.	psi.
Minimum differential pressure ...	3	43
Maximum absolute (Static pressure)	12	174
Test pressure	15	290

COOLING WATER:
Flow (3 bar diff.press) ..... 6 litre/min.
Cooling water fitting ..... 3/4 inch BSP

AC SUPPLY POWER

MAINS VOLTAGE:
400 V +6%/–10%, three phase, 48 – 62 Hz, 4 wire system.

MAINS CURRENT:
Per phase ..... < 20 Amp.

OVERALL DIMENTIONS AND WEIGHT

MPS UNIT: (19 Inches wide)

	mm
Height	360
Depth	630

WEIGHT (approx.):	Kg.
Net weight per MPS unit	90
Net weight cabinet ex. MPS units	____
Shipping weight per MPS unit	____
Shipping weight of cabinet ex. MPS units	____

COMPUTER INTERFACE

RS 422. May be changed to RS485 by internal strap.

RS 232C available with external converter.

MANUAL INPUT/OUTPUT INTERFACES

Current setting by UP/DOWN button with a digital indication in three 2-digit groups.

Six line LCD display with four modes. The mode is shown in text and it is selected by a separate pushbutton.

DC OUTPUT STATUS mode display:
- SET CURRENT in mA
- OUTPUT CURRENT in mA
- OUTPUT VOLTAGE in Volt
- POLARITY
- Scale 0-120% of full range

AC MAIN INPUT STATUS mode display:

PHASE	CURRENT	VOLTAGE
R	AMP	VOLT
S	AMP	VOLT
T	AMP	VOLT

GROUND LEAK CURRENT in mA

INTERLOCK mode display:
DISPLAYING ACTIVE INTL/ STATUS as text. Up to 5 linies are displayed at a time, scrollable with the Up/Down buttons.

AUX mode display:
- DELTA TEMPERATURE
- OPTIONAL ADC CH1
- OPTIONAL ADC CH2

RAMP & END CURRENT SETUP mode display:
- ACTUAL CURRENT in mA
- SET END CURRENT in mA
- RAMP TIME in 0.1% of MPS max. rated current per second

LEDs and lamps for indicating of:
- Control Power onSTAND BY
- Main Power on ..... ON
- Interlock ..... INTERLOCK
- Local/Remote control mode ... REMOTE

Other buttons:
- Start ramping to set curent ..... START
- Reset interlock ..... RESET
- Emergency stop .. EMERGENCY STOP

1.3. Warranty, disclaimer and general warnings

DANFYSIK A/S warrants the equipment delivered from the company to be free from any defects in materials and workmanship for a period of:

12 Months from the date of installation,

or:

max. 18 months from the date of shipment,

whichever is shortest.

From the above there are the following exceptions:

Parts not manufactured by DANFYSIK A/S are covered by the warranty from the original manufacturer of the parts.

Within these warranty periods, DANFYSIK A/S will repair or replace any defective parts free of charge either on the customers site or at our factory at our choice.

DANFYSIK A/S will pay or reimburse the lowest freight rate two way charges on any items returned to DANFYSIK A/S or our designated agent/representative provided prior written authorization for such return has been given by DANFYSIK A/S

This warranty shall not apply to any equipment which our inspection shows to our satisfaction, to have become defective or unworkable due to mishandling, improper maintenance, incorrect use, radiation damage or any other circumstance, not generally acceptable for equipment of a similar type.

DANFYSIK A/S reserves the right on standard products to make changes in design without incurring any obligation to modify previously manufactured units.

The foregoing is the full extent of this warranty and no other warranty is expressed or implied. In no event shall Danfysik be liable for special damage arising from the delivery, late delivery or use of the equipment.

If any fault develops, the following steps should be taken.

Notify DANFYSIK A/S, giving full details of the problems, and include Model-Type and Serial number.

On receipt of these information, DANFYSIK A/S will give you either service information or instructions for shipping.

All shipments of DANFYSIK equipment should be made according to our instructions and shipped in the original or a similar container.

For smaller parts a carton will be sufficient, if the parts are wrapped in plastic or paper and surrounded with at least 10 centimeters of shock-absorbing material.

2. Unpacking and installation

2.1. Receiving the goods

The Shipping container and the Power Supply should be thoroughly inspected for signs of obvious physical damage immediately upon receipt.

All materials in the container should be checked against the enclosed packing list.

DANFYSIK A/S will not be responsible for shortages against the packing list unless notified immediately.

2.2. Instructions for unpacking

The Power Supply is shipped on a wooden pallet enclosed in either reinforced cardboard or wood crate.

To unpack, remove the packing straps and nails if wood crated. The top lid should be removed first.

Warning: *Using lifting equipment not rated to carry the weight of the individual units may be dangeoous and is consequently forbidden. At least, follow the security rules given by your local authorities. It is dangerous to stand below any burden lifted a lifting device, e.g., crane or truck. When moving the units, it is dangerous if persons or other obstructions comes in the way of the transport equipment.*

If the equipment is damaged in any way, a claim should be filed with the shipping agent, and a full report of the damage should be forwarded to DANFYSIK A/S or our local agent/-representative immediately.

Upon receipt of this report, you will be issued instructions for the repair, replacement or return shipment.

Please include the Model no, Type no, Serial no, and Order no for the Power Supply on any communication with DANFYSIK A/S or our representative.

Keep the original packing materials and use them in case the equipment needs to be transported again.

2.2.1. When the system 8800 is not to be used any longer

Like almost all other electrical and electronic equipment, the system 8800 Magnet Power Supply system contains materials, which may be harmful to nature if the system is not scrapped or deposited properly. When the system is to be scrapped, it is the responsibility of the owner (user) that all local, national and international rules and recommendations for such scrapping is followed.

2.3. Installation requirements

During installation of the Power Supply, local rules and regulations for electric power and water supplies should be respected and the following conditions and installations should be available.

* A normal, dust free room with a humidity not above 80 % and a room temperature within 10 to 40 centigrade.

* Three-phase Mains voltage, switched and fused, see the specifications chapter 1.2. Please, see the specifications section 1.2 in this manual for actual figures for this Power Supply.

* Ground connection according to the local authority regulation and the requirements for the equipment.

* Cooling water supply at a temperature within 15 to 32 centigrade.
  Differential pressure: Min. 3 bar.
  Inlet pressure: Max. 12 bar.

* For cooling of our power dupplies and magnets we recommend the use of demineralized water or pure water with an electrical conductivity of less than 10μS/cm. This reduces the electrolytic corrosion to a minimum.

  During operation, the conductivity of the coolant should be checked regularly. A few days operation with water of poor quality can cause more corrosion damage than during several years operation with good quality water.

  Adding pure ethylene glycol to cooling water with no other additives should not affect the electrolytic corrosion. However, it will reduce the thermal conductivity of the coolant. A percentage of 40% glycol reduces the conductivity by approximate 30%. We would recommend not to use more than 25% corresponding to an approximate reduction of thermal conductivity of 17%. It may be nessary to increase the water flow in the power supply.

  Warning:
  No other additives should be used as they may damage the power supply. Danfysik A/S accepts no liability to any damage to the power supply or its environment due to poor water quality, or if any other additive has been used.

2.4. Installation

The installation has 5 phases:

2.4.1. Before the installation: Checking the MPS and the external connections.
2.4.2. Installation of the rack: What is what on the rack, connections to the rack.
2.4.3. Installation of the single MPS unit - General (incl. back panel connections).
2.4.4. Installation of the single MPS unit - Data communication (if required).
2.4.5. Control of the installation.

2.4.1. Before the installation

Before and during installation of the Power Supply, the following points should be checked/carried out.

* Check that the main voltage and frequency matches to the specified and labeled requirements.

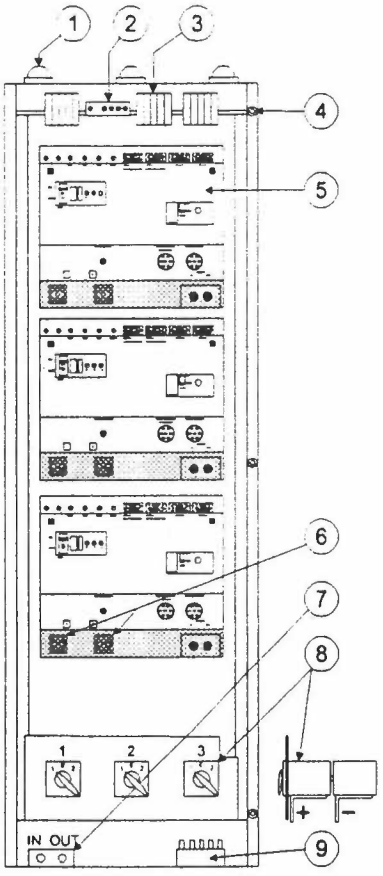
* Check that all screw connections carrying heavy current to the output terminals are tightened.

* Check that all plug terminated cables are pushed into final position.

2.4.2. Installation of the rack

The system 8800 units are installed in a 19" rack. Up to 4 system 8800 units may be installed in one 19" rack. The external connections to the rack are described below.

What is what on the rack:



1. Yellow flashing interlock warning lamp(s), one per MPS unit.
2. TRIGger signal distributor box.
3. AC power input, one per MPS unit. The terminals are marked with the MPU number, and with R, S, T, N, and ground.
4. Door safety switch, one per MPS unit.
   Warning: It may be life threathening to block the function of any door safety switch!
5. MPS unit. One rack can contain 3 units plus polarity switches or 4 units without polarity switches.
6. MPS unit connection terminals. Internally connected to the polarity switch if a polarity switch is mounted.
7. Common cooling water connection block.
8. Polarity switch(es). The terminals and their polarity in position NORMAL are shown on the little drawing to the right of the rack. The switch positions are:
   1: NORMAL polarity.
   0: NEUTRAL = no output current.
   2: REVERSE polarity.
9. Cooling water distribution block.

Fig. 2.4-1 The rear of the rack

Installation procedure:

1. Open the *back* panel door: turn the 3 large screws 1/4 round and open the door.
2. Connect the external ac power cable to the connectors (3) on the top of the rack. Each MPS unit has its own connection block.
3. Connect the magnet current output cable to
   * the polarity switch(es) (8) if polarity switch(es) are installed.
   * the MPS units' output current connectors (6) if no polarity switch(es) are installed.
   Make sure, that the polarity is connected correctly.
4. Connect the water inlet and outlet to the common water connection block (7) at the bottom of the rack.
5. Connect the communication cables to each individual MPS unit, see 2.4.4.
6. If a common trigger distributor (2) is installed connect the external common trigger cable to the left connector on the trigger distributor. If not pre-installed, connect the outputs of the trigger distributer to the TRIG connectors of each (relevant) MPS unit.

2.4.3. Installation of the single MPS Unit – General

The system 8800 units are normally factory installed in the rack. The only installation to be made to the individual unit is the connection of the computer communication cables/ terminator. But in some cases, there may be a need for changing other parts of the installation, too. The possibilities are described below.

What is what on the single system 8800 MPS unit's rear panel:

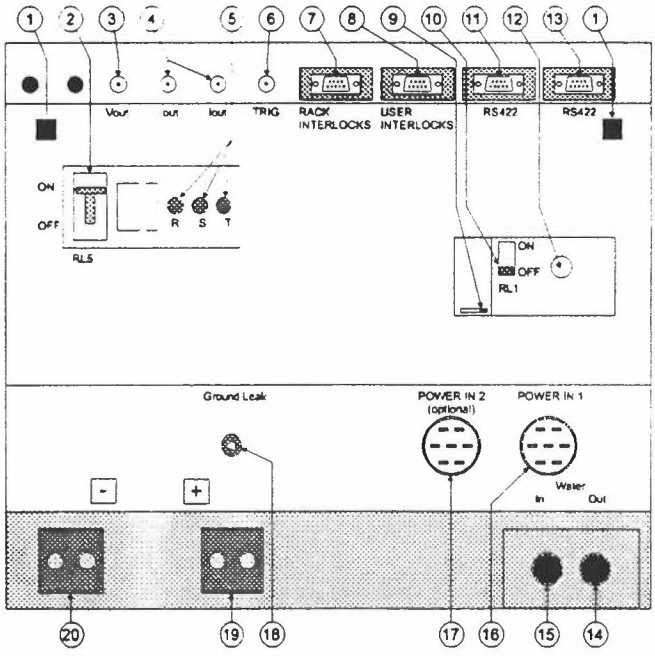


Fig. 2.4-2 The MPS back panel

1. Back panel cover screws (2 pcs.).
2. Control voltage breaker RL5. Powers the magnet power relays (9)–(10), too.
3. Voltmeter: output voltage: 0V=0%. 10V=100% of max voltage.
4. Voltmeter: output current: 0V=0%. 10V=100% of max current.
5. Fuses for ac voltmeter and front panel R, S, and T phase LEDs.
6. Trigger input signal. TTL or 0–24 V levels. 0–>1 = Start.
7. Rack interlocks. Optically insulated TTL or 0–24 V levels. See Interlocks section 4.2.2.
8. User interlocks. See next page and Interlocks section 4.2.2.
9. Holding relay for the magnet power relay (10).
10. Magnet power relay RL1 with undervoltage and overcurrent protection.
11. RS422 connector. Pin–for–pin connected to (13). RS485 or RS232C: see below.
12. AC overcurrent protection setting for (10). Do not change the factory setting!
13. RS422 connector. Pin–for–pin connected to (11). RS485 or RS232C: see below.
14. Cooling water out.
15. Cooling water in.
16. Power input 1.
17 Power input 2. Only mounted if the AC input current is > 32 Amp.
18. Ground leak test terminal.
19. Magnet current output terminal (+).
20. Magnet current input terminal (–).

Installation of the individual MPS

1. Set the address of the MPS, see 2.2.4., below.
2. Install the user interlock plug on the USER INTERLOCK connector, see below.
3. Connect the rack interlock plug to the RACK INTERLOCK connector.
4. Install the data communication system, see 2.4.4, below.
5. If used: connect the optional Hall element and/or external reference cable to their respective connectors on the backside pb-board of the front panel, see Fig. 2.4-3 on the next page.

The USER INTERLOCK connector

The user interlocks are controlled by open/closed contact to 24 V levels.

Important: All unused signal pins 1 to 8 must be connected to pin 9 (common) in the USER INTERLOCK plug, and the plug must be inserted in the connector on the back panel of the MPS, see Fig. 2.4-2. An open connection signals an interlock, which will prohibit the system from starting.

The "user interlocks" are user defineable interlocks which may be connected to the system.

* If the magnet is provided with a water-flowswitch connect its contacts to the USER INTERLOCK connector terminal 1 (signal) and 9 (common).

* If the magnet is provided with a thermal breaker connect its contacts to the USER INTERLOCK connector terminal 2 (signal) and 9 (common).

2.4.4. Installation of the single MPS Unit – Data communication

1. Set the MPS address, see "Setting the MPS's address" below.
2. If necessary, change the communication protocol, see "Setting the communication standard to RS422/RS485" and "Setting the Baud-rate. Bits per byte and parity", below.
3. Install the communication cables, see "Installation of the communication cables", below.

Setting the MPS's address

In order to communicate individually with all the MPS in the system, each MPS must be given an individual address. This is necessary even if all MPSs are identical and should always work identically in parallel, because otherwise the computer cannot receive individual response from each MPS unit. You can address all units simoultaniously without response from the units with the order LALL (Listen ALL)

1. Remove the 4 panes lock screws on the *front* panel and pull out the MPS from the rack.
2. Remove the 2 umbraco screws on top of the front panel. Then loosen the 2 umbraco screws on the side panel and fold the front panel down.
3. Remove the 2 Phillips screws from the metal cover above the pc-board and remove the cover. You have now access to the front panel pc-board:

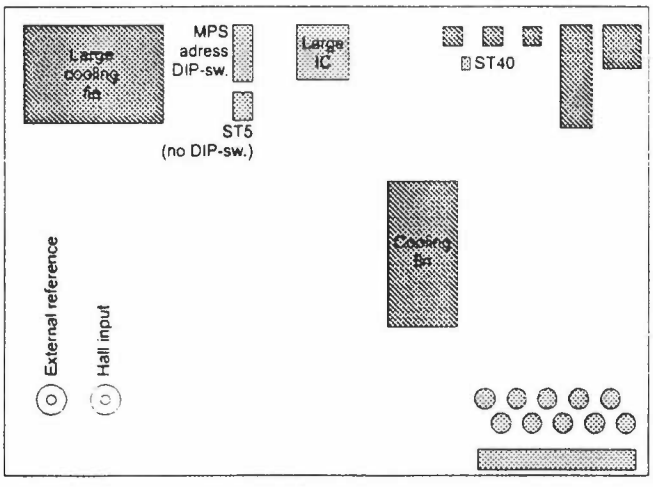


Fig. 2.4-3 The MPS front panel pc-board

4. Localise the MPS DIP-switch (shown on the top of Fig. 2.4-3).
5. Set the binary value of the MPS's address on the DIP-switch:

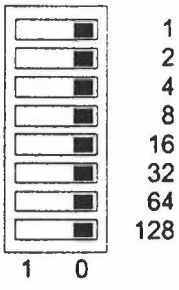


Fig. 2.4-4 The MPS address DIP switch

The address is the sum of the value of the switches, which are set to the 1 position. The address shown is the default address 0.

6. When completed, incl. setting of communication standard and Baud-rate (see next page) if needed, remount the MPS, re. point 3 to 1, above.

Setting the communication standard to RS422/RS485

The selection of the communication system is determined by the solder strap ST40 in the upper right corner of Fig. 2.4.3 above. The default position is RS422 shown on Fig. 2.4-5 below:

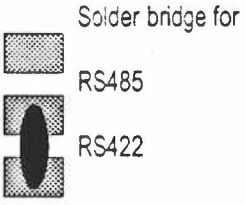


Fig. 2.4-5 The RS422/485 solder bridge

Setting the Baud-rate. Bits per byte, and parity

The transfer protocol is 8 bit, no parity and 2 stop bits.

The selection of the Baud-rate is determined by S15, which is not mounted as default, because no connections gives the default baud-rate: 57.600 Baud.

To change the Baud-rate:
- For 57.600 Baud, no straps must be mounted (default factory setting).
- For 38,400 Baud, mount a strap between point 1 and 8.
- For 19,600 Baud, mount a strap between point 2 and 7.

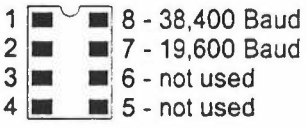


Fig. 2.4-6 The Baud-rate strap field

NOTE! The serial lines has no communication control signals.

Installation of the communication cables

There are 2 connectors for communication cables, (11) and (13): an ingoing connector (from computer) and an outgoing connector (to next MPS unit). They are coupled in parallel, so it does not matter which one you use for what.

If you want to use RS485 communication instead of RS422, see below. The pin connections are shown at the end of this chapter.

1. Connect the cable from the computer to one of the connectors. If you want to use RS232C instead of RS422, insert a RS422/RS232 (DF 81083572) converter between the cable connector and the MPS connector.
2. Connect the cable to the next MPS to the other connector. If you want to use RS232C instead of RS422, insert a RS422/RS232 (DF 81083572) converter between the cable connecter and the MPS connector.

If this MPS is the last unit in the network chain, insert a terminator plug (DF 8108375) on the other connector.

Pin connections

The two connectors are D-SUB Female and Male 9-pin connectors connected in parallel pin for pin.

The direction used in the tables below are:
Rx : Signals received by the MPS from its host.
Tx : Signals transmitted by the MPS to its host.

RS 422	DB 9 S.
Pin No.	Signal
1	Tx high.
2	Tx low.
3	Rx high.
4	Rx low.
5	RETURN.
9	+ 5 Volt

RS 485	DB 9 S.
Pin No.	Signal
1	RETURN
3	Rx/Tx high.
2	Rx/Tx low
9	+ 5V

RS 232C	DB 9 S.
Pin No.	Signal.
2	Tx.
3	Rx.
1	RETURN.

RS232C is available via the DF 81083572 converter connected to the RS422 connector.

The terminator plu are D-SUB Femal 9-pin connector with 4 resistors.

1 kOhm Connected between pin 1 - 9
1 kOhm Connected between pin 2 - 5
1 kOhm Connected between pin 3 - 9
1 kOhm Connected between pin 4 - 5

2.4.5. Control of the installation

1. Apply cooling water to the system and check that the system is water tight.
2. Switch the external power on and start the system.
3. Start the system with *manual* control of the magnet current.
4. When the system works OK with manual control, test the system with remote control (if applicable).

3. Operating instructions

This chapter outlines the procedure and precautions for

3.1 Switching on. Neccessary before any operation in LOCAL or REMOTE mode.
3.2 Operating in LOCAL mode, incl. use of the display.
3.3 Operating in REMOTE mode, incl. description of all commands available.

3.1. Prepare system 8800 for start

The first time it is recommended to start the Power Supply in LOCAL CONTROL mode.

If not otherwise stated, the numbers below refers to Fig. 3.2-1.

1. Apply external power.
2. On the front panel, check if EMERGENCY STOP (1) has been activated. In stopped position the red button is 5 mm from the front panel plate, in normal position it is 10 mm from the front panel plate.
3. Open the *back* panel door: turn the 3 screws 1/4 round and open the door.
4. Check the polarity switch setting: 1 = normal polarity; 2 = reverse polarity. The number at the switch relates to the number of the power supply in the rack (1 = bottom).
5. On the rear panel, check that the control power fuse RL5 (2) on Fig. 2.4-2 is ON (upper position).
6. On the rear panel, activate the circuit breaker RL1 (10) on Fig. 2.4-2: slide the lock (9) on Fig. 2.4-2 to the left and, while keeping it there, move the relay switch upwards to the ON position.
   - If the relay switch falls back to OFF position, points 1-3 above are not fulfilled, or a power line phase is off. Check the LINE R, S, and T lamps on the front panel indicating input power before the first breaker. If any of them is off, see "Error finding", below.
   - If OK, the red RESET lamp (6), and the green REMOTE (8) and STAND BY (5) lamps will be on. The display will show the DC menu. The red lights on top of the cabinet will flash indicating an "interlock". The interlock *was* "no external power before start".
7. Close the back panel door. If open the output current can't be switched on.
8. Reset the interlock: Press INTERLOCK (11) and RESET (6).

3.2. Operating in LOCAL mode – use of the display

3.2.1. The front panel – what is what

A flashing red lamp on top of the cabinet indicates "Interlock!".

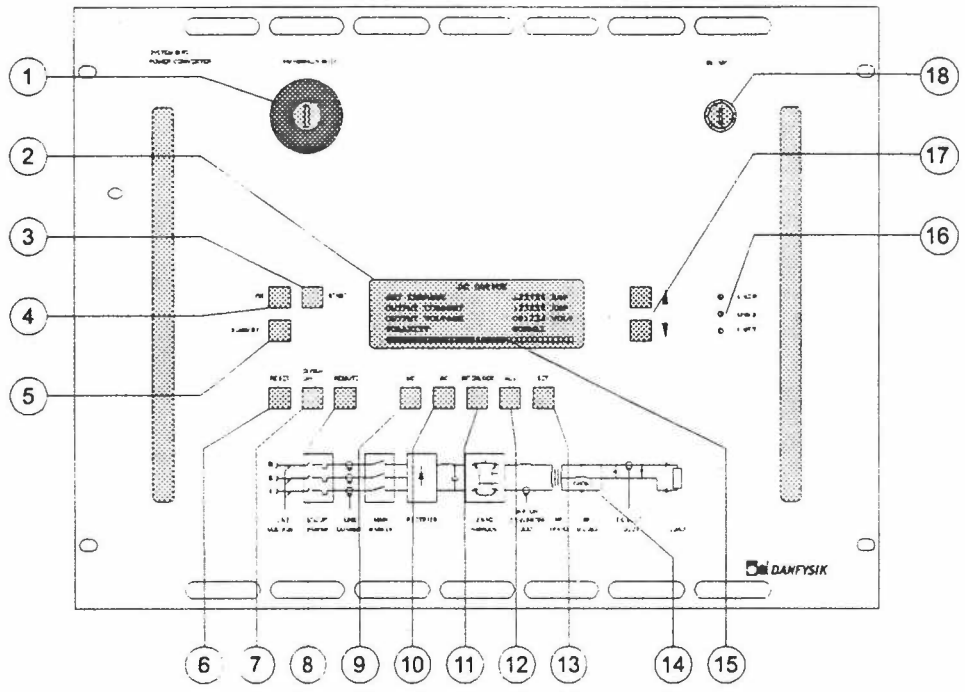


Fig. 3.2-1 The front panel

1. EMERGENCY STOP. See 3.2.3.
2. Display.
3. START: Start ramping to the end current wanted. Light indicates activated function.
4. ON: Output ≥1 Amp. Light indicates activated function.
5. STAND BY. Output: 0 Amp. Light indicates activated function.
6. Press to RESET interlock indication. If this fails, the cause for the interlock still exists.
7. GLOBAL OFF. Switches control power off, too. After use, the "Prepare system 8800 for start" procedure desribed in in chapter 3.1 must be performed.
8. REMOTE mode on/off. Light indicates remote mode.
9. Show DC parameters, see 3.2.4. Default position.
10. Show AC parameters, see 3.2.4.
11. INTERLOCK, see 3.2.4. Light indicates one or more interlock(s). Press to read the interlock status in the display (2). Press (17) for more info.
12. Show AUX parameters, see 3.2.4.
13. SET: Enter Set-up. Switch to the next parameter, see 3.2.4.
14. MPS diagram.
15. Indicator bar on the display (2).
16. Power input lamps, one per phase.
17. Up/Down buttons.
18. For Calibration use,see 3.2.6. or contact your Danfysik service.

3.2.2. Operation in LOCAL mode

Before starting, see 3.1 "Prepare system 8800 for start".

Activate the "Local mode"

1. There are two alternatives to switch to "Local mode":
   - From a remote terminal: use "Remote control com-mands", ADR xxx (or # xx or LALL) and then LOC, see section 3.3.2.
   - On the MPS: press REMOTE (8).

   The REMOTE lamp goes off, indicating "local mode".
2. Press RESET (6) to remove any "interlock" condition. The red lamps on the top of the cabinet and the red RESET lamp go off. If they remain on, there are still interlock conditions. To solve that, see "Error finds - Interlock lamps on". If OK: only the green STAND BY lamp is lit.

Set-up in "Local mode"

```
RAMP AND CURRENT SETUP

ACTUAL CURRENT    001000 MA
SET END CURRENT   123456 MA <<--
RAMP TIME         050 PER T.
```

1. Press SET (13) to enter the set-up menu. "<<--" points at the parameter to be set. For long numbers an underscore bar indicates which 2-digit group is to be set.
2. Set the digits with the UP/DOWN buttons (15). The number cannot exceed the limits of the power supply.
3. Press SET (13). The underscore bar moves to the next two digits.
4. Set the remaining output current digits by repeating step 2 and 3. The arrow now moves to the RAMP TIME line. The number shows the ramp slope in 0.1 % per second. Example: 052 means 5.2% of *rated max.* current per sec.
5. Set the ramp time using the UP/DOWN buttons (15).
6. Press DC (9) to return to the DC menu.

Activate the MPS in "Local mode"

1. Press ON (4). The STAND BY lamp (5) goes off and the ON lamp goes on. The power supply delivers 1 amp. output current.
2. Press the START button (3). The output current increases to the desired level. When the ramped reference has reached its final value, the STAND BY lamp (5) goes off. The linear bar (15) shows the setting in % of max. power.
3. When the display (2) shows RDY in the upper right corner, the current is within 200 ppm from the set value. (UND = "undefined": outside the 200 ppm).
4. A new output current can be entered using the procedure described in "Local mode set-up". When entered, press START (3) to change the output current to the new value.
5. To switch the output current off: press STAND BY (5). The output current ramps down to zero.
6. To switch off the whole system including control power, press GLOBAL OFF (7). After a global off, you have to start with "Prepare system 8800 for start", see page 2.

3.2.3. EMERGENCY STOP (red button)

Press the red EMERGENCY STOP button (1). The circuit breaker PL1 (see Fig. 2.4-2, No. 10) switches *all* power off immediately. *To reset the EMERGENCY STOP button (1), use its key.*

After reseting, the "Prepare system 8800 for start" procedure described in chapter 3.1 must be performed.

3.2.4. The display

To select the display mode press one of the buttons DC, AC, INTERLOCK, AUX or SET. The numbers for the buttons refers to Fig. 3.2-1

DC (default) (9)

```
DC OUTPUT STATUS

SET CURRENT:       123456 MA  RDY
OUTPUT CURRENT:    123456 MA
OUTPUT VOLTAGE:       041 VOLT
POLARITY:          POSITIVE
0      20      40      60      80      100      120
|xxxxxxxxx|xxxxxxxxx|xxxxxxx..|.........|.........|.........|
```

SET CURRENT is the setting in mA. RDY means that the actual OUTPUT CURRENT is ready within 200 ppm from the set current. If this is not the case, RDY is replaced by UND (undefined).

OUTPUT VOLTAGE is the voltage across the output terminals of the unit.

The linear bar shows the actual current in % of the max. current accessible from this unit.

AC (10)

```
AC MAIN INPUT STATUS

PHASE       CURRENT        VOLTAGE
R           000 AMP        218 VOLT
S           000 AMP        220 VOLT
T           000 AMP        221 VOLT
GROUND LEAK CURRENT:    0000 MAMP
```

The AC main input status shows the ac input voltage and current to the power supply incl. control power, which is taken from phase R.

To measure the ground leak current, connect the ground leak terminal ((18) on Fig. 2.4-2) to the plus or minus output terminal ((19) and (20) on Fig. 2.4-2).

INTERLOCK (11)

```
DISPLAYING ACTIVE INTL/STATUS

X
X
X
X
X
```

"Interlock" means, that the system has been stopped by a fault or for safety reasons.
If the red lamp on top of the cabinet flashes, one of the units in the rack has an interlock.

Pressing the INTERLOCK button displays the current interlock status. To remove an interlock:

1. Remove the cause of the interlock. The interlock alarm condition remains.
2. Press RESET to remove the interlock alarm condition in the MPS unit.
3. Press INTERLOCK to check for more/remaining interlocks.

AUX (12)

```
AUX READOUT MENU DISPLAY

DELTA TEMPERATURE:   -00.1 DEG
OPTIONAL ADC CH1:      000 %
OPTIONAL ADC CH2:      000 %
```

Delta temperature displays the reference cell's temperature deviation from its ideal temperature. It should not exceed ±0.2°C.

The inputs to the optional ADC channels are test pins on the front panel pc-board, Fig. 2.4-3. 0% = 0 Volt, 100% = 5 Volt CH1 and 100% = 10 Volt for CH2.

SET (13)

```
RAMP END CURRENT SETUP

ACTUAL CURRENT    001000 MA
SET END CURRENT   123456 MA <<--
RAMP TIME         050 PER T.
```

To set the ramp time and end current, see 3.2.2.

3.2.5. The polarity switch

The polarity switch is an option.

If mounted, the polarity switch(es) is/are placed in the button of the rack, accessible behind the back panel door.

There is one switch for each *magnet*, and the switch has three positions: 1 - 0 - 2.

1. NORMAL polarity
0. NEUTRAL (no output current)
2. REVERSE polarity

To change the polarity:

1. Press STAND BY (5) to switch off the MPS.
2. Open the *back* panel door: turn the 3 screws 1/4 round and open the door.
3. For each MPS unit, switch the polarity to the desired setting. The number at the switch relates to the number of the power supply in the rack (1 = bottom).
4. Close the back panel door and lock it with the 3 screws.

Warning:
If you redesign the system, make sure that all MPS units for one magnet are connected to the same polarity switch. The total current handled by a polarity switch depends on its type and rating. Connecting MPS units to a polarity switch not able to carry the current may be dangerous. Serial connection of MPS units may cause serious stability problems. When coupling MPS units in parallel, make sure that all units are connected (+) to (+) and (−) to (−). Failure to do so may be dangerous.

3.2.6 Setup key calibration of MPS 883

- Main is ON and the MPS is `ON´

-Turn SET UP key.

Display :

SERVICE SWITCH ACTIVATED
DC-AC AUX KEYS ACTS DIFFERENT
USE: DC-KEY TO: DC-SETUP
USE: AC-KEY TO: AC-SETUP
USE: AUX-KEY TO: AUX-SETUP
REMAINING KEYS WORKS AS USUAL

Explanation:

- DC-SETUP : To make a absolute calibration on DC output data.

- AC-SETUP : To make a absolute calibration on AC input data.

- AUX-SETUP : To select Reference source and feed back source for current loop.

-DC-SETUP menu.

- Push the DC pushbutton.

Display :

DC SETUP MENU PICTURE
AFTER ANY SETUP HIT DC-KEY TO
GO TO NEXT STEP
>SET OUTPUT TO 100%: 000000
SET 100% OUTPUT TO: 215000 MA
SET MEASURED VOLTAGE: 025 V

Explanation:

SET OUTPUT TO 100%: Set DAC value for max. output current (absolute calibation of current).

SET 100% OUTPUT TO: Set value of current on output at 100% (absolute calibation of current read back).

SET MEASURED VOLTAGE: :Set value of voltage on output at 100% (absolute calibation of voltage read back).

The select line is indicated by > and _ indicated witch figure you can change.
-Push the SCROLL-UP or SCROLL- DOWN buttom to change value.
-Push the DC buttom to change _ figure in display, push 3 times at DC buttom and > go to next step in the menu.

Calibation of MPS.

Measure the output current to load.

Select menu **SET OUTPUT TO 100%.**

Push SCHROLL-UP or SCROLL-DOWN buttom until MAX output current.

Select menu **SET 100% OUTPUT TO.**

Push SCHROLL-UP or SCROLL-DOWN buttom until the display show MAX output current.

Measure the output voltage.

Select menu **SET MEASURED VOLTAGE.**

Push SCHROLL-UP or SCROLL-DOWN buttom until the display show the output voltage.

- To store date in the CPU, after last step push DC buttom > go to first step in the menu and setup data for this menu are stored in CPU on the control bard.

- Push the AC pushbutton.

Display :

AC SETUP MENU PICTURE
AFTER ANY SETUP HIT DC-KEY TO
GO TO NEXT STEP
>SET MEASURED CURRENT: 100 AMP
SET MEASURED VALTAGE: 230 VOLT
GND-LEAK TRIG LEVEL: 412 MAMP

Explanation:

SET MEASURED CURRENT:
Set value of current on AC input line (absolut calibation of AC current read back).

SET MEASURED VALTAGE:
Set value of voltage on AC input line (absolut calibation of AC voltage read back).

GND-LEAK TRIG LEVEL: Set value for ground-leak current trig level

The select line is indicated by >

-Push the SCROLL-UP or SCROLL- DOWN buttom to change value.

-Push the AC buttom to change step in the menu.

Calibation of MPS.

Measure the AC input current to the MPS.

Select menu **SET MEASURED CURRENT**.

Push SCHROLL-UP or SCROLL-DOWN buttom until the display show AC input current.

Measure the AC input voltage.

Select menu **SET MEASURED VALTAGE**.

Push SCHROLL-UP or SCROLL-DOWN buttom until the display show the AC input voltage.

Select menu **GND-LEAK TRIG LEVEL**.

Push SCHROLL-UP or SCROLL-DOWN buttom until the display show the level for ground-leak warning.

- To store date in the CPU, after last step push AC buttom > go to first step in the menu and setup data for this menu are stored in CPU on the control bard.

- Push the AUX pushbutton.

Display:

REF/F.B. SOURCE SETUP PICTURE
AFTER ANY SETUP HIT AUX-KEY TO
GO TO THE NEXT STEP
>SELECT REF. SOURCE: INTERNAL
SELECT F.B. SOURCE: INTERNAL
USE SCROLL-UP KEY TO TOGGLE

Explanation:

SELECT REF.SOURCE:
Select refenece source for current loop.

INTERNAL: Ref from DAC on the control board is used.

EXTERNAL: Ref from plug on control board.

SELECT F.B. SOURCE:
Select source for feed back unit used in current loop.

INTERNAL: DCCT inside the power supply.

EXTERNAL: Used of ext. unit (hall probe) to measure current in the magnet.

-Push the SCROLL-UP buttom to change INT / EXT.

-Push the AUX buttom to change step in the menu.

- To store date in the CPU, after last step push AC buttom > go to first step in the menu and setup data for this menu are stored in CPU on the control bard.

- Turn the SET UP key back to normal position

3.3. Operating by RS 422, RS 485 or RS 232C I/O

The MPS 8800 uses standard serial interfaces RS 422, RS 485 or RS 232C which are compatible with most computers and terminals.

The interface link is optically isolated from the magnet current circuit and the power net.

Setting up of the system for serial communication is described in chapter 2.4.4.

The following syntax is used for the commands and answers:

<bell>	The control character "bell" (ASCII 7).
<sp>	The character "space" (ASCII 32).
<cr>	The control character "carriage return" (ASCII 13).
<parameter>	The data of the parameter <parameter>.
A	The character "A" (ASCII 65)
B	The character "B" (ASCII 66)
...	

The system accepts upper case letters only. Use of lower case letters will return an error message.

Example:

Syntax: AD<sp><ch><cr>
where <ch> is a number 0-9

means in clear text for ch=9 the transmission of:

"AD 9" (without "") terminated by a cariage return

or in ASCII codes:

65,68,32,57,13.

In a "format":

D is a digit (0-9)
H is a hexadecimal "digit" (0..9,A..F, where A-F is ASCII 65 to 70)
S is a sign (+ or -)
B is a bit (0 or 1).

Example: +09 is the number 9 in the format SDD.

Only the "addressed MPS" can respond to a command. The only exception is when the LALL command is invoked: Here all units will respond to most commands (see the individual command) but no answers are returned.

Errors are reported from the "active MPS", only. This means, that to check for errors, the controlling computer (remote terminal) must address all the relevant MPS adresses regularly. No errors are returned in LALL mode. The error report format is determined by the ERRC or ERRT command. If ERRC or ERRT is *not* activated, the error report is "?<BELL>", only.

The errors listed for each command are the errors which can be returned to the controlling computer for this command. Except in LALL mode, errors are reported even if the command is a "no answer" type.

3.3.1. How to send and receive commands

Before starting, see 3.1 "Prepare system 8800 for start".

The communication is done by transmitting the commands as ASCII characters terminated by CARRIAGE RETURN (press the Enter key or send ASCII 13).

The termination characters from the Power Supply is CARRIAGE RETURN (ASCII 13).

All ERROR messages include the "?<bell>" where <bell> is the ASCII 7 control character.

NOTE! The serial lines has no communication control signals.

3.3.2. Commands - Index

Command	Description	Remarks
AD x (x=0-9)	Read value from A/D conv. No. x	x values: see 3.3.3.
ADCV	Reads the actual output current in mA	Format: DDDDDD
ADR xxx or # xx	Call MPS w/addr. xxx (000-255)	xxx: 000-255. xx: 00-FF. Terminate LALL mode: 2xADR xxx or # xx
ASW	Put WAR and WR in Answer mode	
CMD	Read control mode	REM: Remote mode LOC: Local mode
CMSTATE	Read control mode as text	REMOTE: remote mode (LOCAL: local mode) LOCK: is set to local mode from control panel
ERR*C* / ERR*T*	Return Coded/Text error msg.	See operating instructions 3.3.3
F	Switch magnet power off + reset	
GOFF	Global off: Turns off control power	See GLOBAL OFF button (7) on Fig. 3.2-1
LALL	Listen ALL: Address all MPS units	Multi-MPS system only. Sets MPS answers off.
MAX	Read back "max. rated current"	Format: DDDDDD
N	Switch magnet power on	
NASW	Release answer mode	See ASW
NERR	Suppress MPS error mess.	Error gives ?<bell> only. See also ERRC, ERRT
PO	Read present polarity	+: Normal polarity - : Reverse polarity N: Neutral
RA	Read actual demanded value of the current in mA	Output: 000000-max rating. Format: DDDDDD.
RAR	Read set end current value in mA	Format: DDDDDD
RR	Read slew rate in 0.1% of max setting per sec.	Response: 3 digits
RS	Reset latched interlocks	See operating instructions 3.3.3
S1	Read interlock status	See operating instructions 3.3.3
STOP	Stop ramping	Stops ramping at the actual current.
TS	Trig (start) sequence	Equal to pressing the START button
VER	Returns the programme version	
WAR xxxxxx	Set the magnet current	DDDDDD: Leading zeroes may be ommitted
WR xxx	Set slew rate in 0.1% of max setting per sec.	xxx: always 3-digits
?x	Binary read of 18 bit ADC Always 18 bits (0 or 1).	1: Actual current 2: Status (S1) 3: Combined ?1 and ?2 4: ADC at max. output
Ctrl-V	reset the serial communicalion	

3.3.3. Commands – Details

In the following pages all the commands will be listed in alphabetic order, one command per page.

xx

Address # (write hex)

Syntax: #<sp><address><cr>
where <address> is a number 00 to FF in hexadecimal notation.

Answer: No answer, except errors

Example: Command: # 0C (adressing MPS &h0C = decimal 12)
Syntax: #<sp>0C<cr>

Errors:

SYNTAX ERROR	Wrong syntax.
ILLEGAL REQUEST	Can not activate the addressed MPS unit.
DATA ERROR	The parameter format is incorrect or a non-digit character is found in data field or parameters outside specified. Inspect the settings or correct your parameter, and then rewrite it.

The **ADR** internal command is used to select the actual unit. The previously addressed unit is automatically de-selected.

When the connected units are in **LALL** mode, the first **# xx** command given, following the **LALL** command, will disable this function, only. To address a unit, one more **# xx** command must be send..

Affected commands: LALL

Internal execution time: XXXX μsec.

Related commands: ADR xx (write)

AD x

Analog to Digital converter on channel x

Syntax: AD<sp><ch><cr>
where <ch> is the channel number 0 to 10, see the next page in the format D (0–9) or DD (10).

Answer: <val> is a number in the format specified in the table below.

Example: Command: AD 0
Syntax: AD<sp>0<cr>

Answer: 123
Syntax: 123<cr>

Errors: **ILLEGAL REQUEST** Can not activate the addressed MPS unit.

SYNTAX ERROR Wrong syntax, e.g. missing space between the command and the parameter, or wrong number format.

The primary channels giving errors are the internal supply levels, but any of the channels can be programmed to reflect errors if a certain level is passed, both below and above.

Channel <ch>	Value	Units	<val> format
0	R ac voltage	Volt	"DDD"
1	S ac voltage	Volt	"DDD"
2	T ac voltage	Volt	"DDD"
3	R ac current	Amp.	"DDD"
4	S ac current	Amp.	"DDD"
5	T ac current	Amp.	"DDD"
6	Output voltage	Volt	"DDD"
7	Ground leak current	mA	"DDD"
8	Delta temperature, see 3.2.4 the AUX button	Deg.°C	"SDD.D"
9	AUX CH1	0.1 Volt	"DDD"
10	AUX CH2	0.1 Volt	"DDD"

Where D is a digit 0..9, and S is a sign character (+ or –). The output for channel 9 and 10 measures the voltmeter level outputs for the AUX channel(s) if used.

Affected commands: None.

Internal execution time: XXXX μsec.

Related commands: ADCV

ADCV

Analog to Digital ConVerter (18 bit)

Syntax: ADCV<cr>

Answer: <val><cr>
where <val> is a number 000000 to <max rated output current> in the format DDDDDD.

Example: Command: ACDV
Syntax: ACDV<cr>

Answer: 001234
Syntax: 001234<cr>

Errors: **ILLEGAL REQUEST** Can not activate the addressed MPS unit.

SYNTAX ERROR Wrong syntax, e.g. the space between the command and the parameter is missing.

The function reads the output of the 18 bit A/D converter converted to mA, measuring the actual output current from the MPS unit.

Affected commands: None.

Internal execution time: XXXX μsec.

Related commands: AD x, RA, ?x.

ADR xx

AdDRess (write)

Syntax: ADR<sp><address><cr>
where <address> is a number 000 to 255 in decimal notation and in the format DDD.

Answer: No answer, except errors

Example: Command: ADR 03
Syntax: ADR<sp>03<cr>

Errors:

SYNTAX ERROR Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

DATA ERROR The parameter format is incorrect or a non-digit character is found in data field or parameters outside specified. Inspect the settings or correct your parameter, and then rewrite it.

The **ADR** internal command is used to select the actual unit. The previously addressed unit is automatically de-selected.

When the connected units are in **LALL** mode, the first **ADR xxx** command given, following the **LALL** command, will disable this function, only. To address a unit, one more **ADR xxx** command must be send.

Affected commands: LALL.

Internal execution time: XXXX μsec.

Related commands: # xx (write hex).

ASW

AnSWer

Syntax: ASW<cr>

Example: Command: ASW
Syntax: ASW<cr>

Answer: No answer, except errors

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **ASW** is used to switch the remote line into an auto-answer mode in which **WR, WAR** and **PO x** will generate an answer. PO x exists only if an automatic polarity switch is installed.

The **ASW** mode is suppressed when the controller is in **LALL** mode.

Affected commands: WAR, WR, PO x.

Internal execution time: XXXX μsec.

Related commands: NASW.

CMD

CoMmanD (read control mode)

Syntax: CMD<cr>

Answer: <sp><answer><cr>, where <answer> has 2 possibilities:
REM: the actual unit is in remote control mode.
LOC: the actual unit is in local control mode.

Example: Command: CMD
Syntax: CMD<cr>

Answer: REM
Syntax: <sp>REM<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Local mode has been selected from the units control panel.

The command **CMD** is used to return the control status of the actual unit. It can also be used to detect if anyone had changed the control mode from the control panel, because you will then receive an ILLEGAL REQUEST.

Affected commands: None.

Internal execution time: XXXX μsec.

Related commands: CMDSTATE.

CMDSTATE

CoMmanD line STATE (read control mode)

Syntax: CMDSTATE<cr>

Answer:

REMOTE	the actual unit is in remote control mode.
LOCAL	the actual unit is in local control mode.
LOCK	the actual unit is locked from the remote control line.

Syntax: <answer><cr>

Example:

Command: CMDSTATE
Syntax: CMDSTATE<cr>

Answer: REMOTE
Syntax: REMOTE<cr>

Errors:

SYNTAX ERROR Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **CMDSTATE** is an extended command similar to **CMD** and is also used to return answer about which unit is the addressed unit.

Affected commands: None.

Internal execution time: XXXX μsec.

Related commands: CMD.

ERRC

ERRor in Code (remote line only)

Syntax: ERRC<cr>

Example: Command: ERRC
Syntax: ERRC<cr>

Answer: No answer if there are no errors.
When an error exists or comes on the answer is:
?<BELL><sp><errorcode><cr>
where BELL = ASCII 7

Example: Command: ERRC
Syntax: ERRC<cr>

Answer: ?03
Syntax: ?<bell><sp>03<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **ERRC** is used internally, to put the controller into a mode, in which it will respond any error with the error string followed by two digits, showing which error is encountered.

This mode is normally chosen, when the controller(s) is (are) connected to a host computer, which is able to decode the error message.

CODE NO.	ERROR TEXT
00	E Error buffer empty
01	Syntax
02	Data contents
03	Data length
04	Illegal command
05	Can not execute command
06	Status qou, no change
07	Change in progress
08	No data present
09	Local line, input buffer full

CODE NO.	ERROR TEXT
10	Remote line, input buffer full
11	NOT USED
12	Can not execute command
13	NOT USED
14	Datalog line, input buffer full
15	NOT USED
16	Program module not implemented

Affected commands: None.

Related commands: ERRT, NERR

Internal execution time: XXXX μsec.

ERRT

ERRor in Text (remote line only)

Syntax: ERRT<cr>

Example: Command: ERRT
Syntax: ERRT<cr>

Answer: No answer if there are no errors.
If/when an error exists or comes on the answer is:
?<bell><sp><errortext><cr>

Example: Command: ERRT
Syntax: ERRT<cr>

Answer: ?3
Syntax: ?<bell><sp>DATA CONTENTS<cr>

Errors: **COMMAND ERROR** Spelling error in a command
SYNTAX ERROR Wrong syntax, e.g., wrong number of digits.
ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **ERRT** is used internally, to put the controller into a mode, in which it will respond any error with a message containing an error string followed by the error text.

This mode is normally chosen, when the controller(s) is (are) connected to a host computer, which is *not* able to decode the error message.

CODE NO.	ERROR TEXT
0	E Error buffer empty
1	Syntax
2	Data contents
3	Data length
4	Command error
5	Can not execute command
6	Status qou, no change
7	Change in progress
8	No data present
9	Local line, input buffer full

CODE NO.	ERROR TEXT
10	Remote line, input buffer full
11	NOT USED
12	Can not execute command
13	NOT USED
14	Datalog line, input buffer full
15	NOT USED
16	Program module not implemented

Affected commands: None.

Internal execution time: XXXX μsec.

Related commands: ERRC, NERR.

F
ofF

Syntax: F<cr>

Answer: No answer, except errors.

Example: Command: F
Syntax: F<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **F** is equivalent to pressing the STAND BY button (5) on the front panel, see Fig. 3.2-1. It sets the magnet current to 1 Amp.

All settings of ramp and end current is reset.
Ramp is set to 5%/sec. of max rated current and end current is set to 1 Amp.

Affected commands: N, WAR, WR.

Internal execution time: XXXX μsec.

Related commands: N, GOFF.

GOFF

Global OFF

Syntax: GOFF<cr>

Answer: No answers!

Example: Command: GOFF
Syntax: GOFF<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

The command **GOFF** is used to switch off the addressed MPS completely, incl. control power. It is equivalent to pressing the GLOBAL OFF button on the front panel, see (7) on Fig. 3.2-1.

In **LALL** mode all MPS units are switched off.

Affected commands: None.

Internal execution time: XXXX μsec.

Related commands: F.

LALL

Listen ALL

Syntax: LALL<cr>

Answer: No answers!

Example: Command: LALL
Syntax: LALL<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

The command **LALL** is used to put all the controllers connected into a pseudo–addressed mode. This means that all controllers will respond to all setup (e.g., WAR) and action (e.g. oN) commands. No answers will be available.

The only way to disable the **LALL** mode is by using the **ADR** command either as a setup of a new address or to read last addressed controller. Remark that in **ADR** read, the first access will not give any response, in which way you will have to repeat the command to get an answer.

Affected commands: ADR xxx, # xx, ASW.

Internal execution time: XXXX μsec.

Related commands: ADR xxx, # xx.

MAX

Read MAX current setting

Syntax: MAX<cr>

Answer: The maximum rated current for the MPS unit in mA in the DDDDDD format.
Syntax: <max><cr>

Example: Command: MAX
Syntax: MAX<cr>

Answer: 400000
Syntax: 400000<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **MAX** reads the maximum rated current of the addressed MPS.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: None.

N

oN

Syntax: N<cr>

Answer: No answer, except errors

Example: Command: N
Syntax: N<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **N** is equivalent to pressing the ON button (4) on the front panel, see Fig. 3.2–1. It sets the magnet current to 1 Amp. All setting are left unaffected.

Note: This command can *not* be used in **LALL** mode.

Affected commands: F.

Internal execution time: XXXX sec.

Related commands: None.

NASW

No AnSWer

Syntax: NASW<cr>

Answer: No answer, except errors

Example: Command: NASW
Syntax: NASW<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **NASW** is used to cancel the auto-answer mode, in which some setup commands generate an answer.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: ASW

NERR

No ERRor

Syntax: NERR<cr>

Answer: No answer, except errors

Example: Command: NERR
Syntax: NERR<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **NERR** puts the controller into a mode, in which it responds to any error with the error string ?<bell> only, without any identification of the error.
This mode is chosen, if you only want to be kept informed that an error has occurred.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: ERRC, ERRT

PO

POlarity (read)

Syntax: PO<cr>

Answer: Normal Polarity: + (ASCII 43)
Reverse polarity: - (ASCII 45)
Neutral: N (ASCII 78)
Syntax: <polarity><cr>

Example: Command: PO
Syntax: PO<cr>

Answer: +
Syntax: +<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The **PO** command is an internal command, used to verify actual polarity of the unit. The command returns the polarity sign in ASCII. In neutral position no output current will come out of the system.

If there is no polarity switch build-in, the returned polarity will be positive.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: None.

RA

Read Actual demanded current in mA

Syntax: RA<cr>

Answer: <ra><cr>
where <ra> is a digital value 000000 to <max rated current in mA> in the format DDDDDD.

Example: Command: RA
Syntax: RA<cr>

Answer: 004800
Syntax: 004800<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **RA** reads the actual DAC setting in mA. It is used e.g. during ramping.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: RAR.

RAR

Read end current in mA

Syntax: RAR<cr>

Answer: <rar><cr>
where <rar> is a digital value 000000 to <max rated current> in the format DDDDDD.

Example: Command: RAR
Syntax: RAR<cr>

Answer: 2560000
Syntax: 2560000<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **RAR** reads the set end current value in mA.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: WA, RA

RR

Read Ramping slope in 0.1%/sec. of max rated current

Syntax: RR<cr>

Answer: <ramp><cr>
where <ramp> is a digital value 000 to 100 in the format DDD.

Example: Command: RR
Syntax: RR<cr>

Answer: 480
Syntax: 480<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **RR** is used to read the ramping slope, expressed in 0.1%/sec. of max rated current.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: RA, RR, RAR.

RS

ReSet

Command: RS<cr>

Answer: No answer, except errors

Example: Command: RS
Syntax: RS<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **RS** clears all interlocks, if the reasons for the interlocks are removed. It is equivalent to pressing the RESET button (6) on Fig. 3.2-1. All settings are left unaffected.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: None.

S1

Status 1

Syntax: S1<cr>

Answer: <status>
Syntax: <status><cr>
where <status> consists of 32 signs . or ! , each showing the status of a specific function, including all interlocks. A list is shown on the next page.

Example: Command: S1
Syntax: S1<cr>

Answer: ..!.....!.....!....!.
Syntax: ..!.....!.....!....!.<cr>

Errors: SYNTAX ERROR Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **S1** is used to return answer about the internal status. The returned status line consists of a mixture of interlocks, polarity and on/off status.

The status command can be used in several ways to check polarity (+,- or none), to indicate type of interlocks and on/off status.
In some versions some spare bits can be assigned special functions.
Each sign is specified separately elsewhere in the user manual.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: ?2.

S1 Continued

A typical example could be as follows:

". . ! . . . . . ! . . . . . ! . . . ! ."
0 Character. 31st Character.

The interpretation of the individual characters, when the exclamation mark (!) is shown, is as follows:

Char. No.	Type	Contents
0	Spare	
1	Interlock	User interlock 1
2	Interlock	User interlock 2
3	Interlock	User interlock 3
4	Interlock	User interlock 4
5	Interlock	User interlock 5
6	Interlock	User interlock 6
7	Interlock	Freewheel diode overtemp.
8	Interlock	Low water Flow
9	Interlock	Door open
10	Status	Positive polarity. Note 1
11	Status	Negative polarity. Note 1
12	Spare	
13	Spare	
14	Spare	
15	Spare	
16	Interlock	Diode heatsink overtemp.
17	Interlock	Chassis overtemp.
18	Interlock	IGBT heatsink overtemp.
19	Interlock	H.F. diode overtemp.
20	Interlock	Switch reg. DCCT failure
21	Interlock	Switch regulator supply failure
22	Interlock	IGBT driver failure
23	Spare	
24	Spare	
25	Warning	AC undervoltage
26	Spare	
27	Warning	Excessive current ripple
28	Warning	Ground leak current
29	Interlock	Overcurrent
30	Status	Main power is on
31	Status	Ready

Note 1: Neutral: 10 and 11 is both "!", and this is an interlock.
Not existing: 10 and 11 is ".".

STOP

STOP the ramping

Syntax: STOP<cr>

Answer: None exept errors

Example: Command: STOP
Syntax: STOP<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **STOP** is used to STOP the ramping function. The magnet current remains at the value it had reached when the STOP order was received. To restart the ramping use TS. To go to zero current, use F.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: TS, F.

TS

Trig Start sequence

Syntax: TS<cr>

Answer: No answer exept errors

Example: Command: TS
Syntax: TS<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **TS** is used to start the ramping function. It is equivalent to pressing the START button on the MPS panel, see (3) on Fig. 3.2–1.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: STOP

VER

Software VERsion

Syntax: VER<cr>

Answer: *<sp><type><sp><version>sp>*<cr>
where <type> is the text "DANFYSIK A/S SYSTEM 8800" and <version> is 2 letters, see the example below.

Example: Command: VER
Syntax: VER<cr>

Answer: * DANFYSIK A/S SYSTEM 8800 SB *
Syntax: *<sp>DANFYSIK<sp>A/S<sp>SYSTEM<sp>8800>sp>SB<sp>*<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **VER** is used to read the software version of the MPS control board.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: None

WAR xxxxxx

Write end current in mA

Command: WA<sp><endcurr><cr>

<endcurr>: digits 1000 to <max rated current> in mA. Format DDDDDD. The value must be >1000 mA.

Remark: Leading zeroes can be omitted.

Answer: <endcurr> In ASW mode: digits 000000 to 999999. Format DDDDDD.
Else: No answer.

Example: Command: WAR 004800
Syntax: WAR<sp>004800<cr>
Answer: 004800
Syntax: 004800<sp><cr>

Errors:

SYNTAX ERROR, Missing space between the command and parameters or wrong syntax.

DATA ERROR, Incorrect parameter format, or a non-digit character found in data field or parameters outside specified. In case of this error you should inspect the settings or correct your parameter, and then rewrite it.

ILLEGAL REQUEST Indicates that you are in a wrong command mode.Change REMote or LOCal.

CHANGE IN PROGRESS Indicates that the controller are doing an internal sequence as polar change. While this is running, it is not allowed to make a new setup.

The command **WAR** is used to write the end current in mA, value between 0 and the max rated current for the MPS unit.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: WR, STOP, (ASW)..

WR xxx

Write Ramp

Syntax: WR<sp><ramp><cr>
where <ramp> is the ramp sloop in 0.1% per second. Format DDD.

Answer: <ramp> In ASW mode: digits 001 to 100. Format DDD.
Else: No answer.

Example: Command: WR 100
Syntax: WR<sp>100<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **WR** is used to determine the sloop (rate) for the ramping function.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: STOP (ASW)

?x

Binary read ADC data, etc.

Syntax: ?<par><cr>

Answer: The answer depends of the value of <par> which can be 1, 2, 3 or 4.
Syntax: <result><cr>
where <result> can be:

?1	24 bit for AD converter value.
?2	32 bit for S1.
?3	Combination of ?1 and ?2.
?4	24 bit.
1	Actual current as AD converter out (=ADCV)
2	Status: as S1, but with "." as 0 and "!" as 1.
3	As 1 and 2 combined: first 18 bit for actual current and then 18 bit for status. The format for <result> is <actual current><S1>
4	The AD converter value of the MPS rated maximum current.

Example: Syntax: ?1<cr>
Command: ?1

Answer: 001010001010100101011010
Syntax: 001010001010100101011010<cr>

Command: ?3
Syntax: ?3<cr>

Answer: 000110000001010001001000000100000000000000100001010110000
Syntax: 000110000001010001001000000100000000000000100001010110000
<cr>

Errors: **SYNTAX ERROR** Wrong syntax.

ILLEGAL REQUEST Can not activate the addressed MPS unit.

The command **?x** is used for fast reading of the essential data making the terminal computer able to calculate display the output current and status in its own format without loosing anything on roundings.

Affected commands: None.

Internal execution time: XXXX sec.

Related commands: ADCV, S1, RA

4. Maintenance

4.1. Introduction

Servicing DANFYSIK Magnet Power Supply should be attempted only by trained and qualified personal.

Dangerous voltages capable of causing loss of life are present inside this power supply. Use extreme caution when accessing, handling, testing and adjusting.

4.2. Preventive maintenance

In normal operating environment, perform the following tasks at one year intervals.:

- Clean all fan protection grilles.
- Vacuum the openings in the cabinet and all heat sinks mounted on printed circuit boards to ensure a normal flow of cooling air.
- Check that all screw connections to the primary and from the secondary of the transformer are tightened.
  Check that connections from the secondary of the transformer to the output terminals are tightened.
  (I.e. cable and busbars carrying heavy current).
- Check that the water-flowswitch works correct.

In dusty or dirty environments the above-mentioned points should be performed more often.

- Inspect visually the power supply for components that have been overheated or other suspicious sign.

In high radiation environment, performance of following tasks are recommended at one year intervals.:

- Replace all ICs mounted in sockets on the printed circuit boards.
- Printed circuit boards with ICs mounted without sockets should be replaced.

4.3. Adjustment and calibration

This power supply do not need any regular adjustment or calibration.

5. Trouble shooting

The syntax for trouble shooting hints is:

SYMPTOM:
- Check #1:
  > Details (new check or failure if no other failure is found by the checks)

- Check #2:
  > Details (new check or failure if no other failure is found by the checks)

In case of a failure ...

1. Check if any of the LINE R, S or T lamps are off. If so, see section 5.1 general failures.

2 If possible, read the interlock list, either on the display (see section 3.2.1, point 11, and 3.2.4) or by using the S1 command (see section 3.3). If there are interlocks, see the interlock(s) in section 5.2.

3. Check the general failures list in section 5.1

4. Observe which LEDs are illuminated on the Control panel or the Switch module, see Fig. 5.1-1, and section 6.1.2 below Fig. 6.1.2-1.

5. If you can't remedy the failure yourself, call your Danfysik service.

5.1. General failures

General failures are failures, where the system is *not* able to show an interlock.

THE R, S OR T LAMP IS OFF
- Check the external breakers and fuses.
- Check RL1 on the back panel, see below.

RL1 FALLS BACK TO OFF POSITION WHEN ACTIVATED
- Check if EMERGENCY STOP has been activated.
- Check if RL5 is in ON position.

NO RESPONSE ON CONTROL PANEL:
- Check the internal fuses:
  - > Get access to the fuses:
    1. Remove the 4 panel lock screws on the front panel and pull out the MPS.
    2. Remove the 2 umbraco screws on top of the front panel, loosen the 2 screws on the side panel, and fold the front panel down.

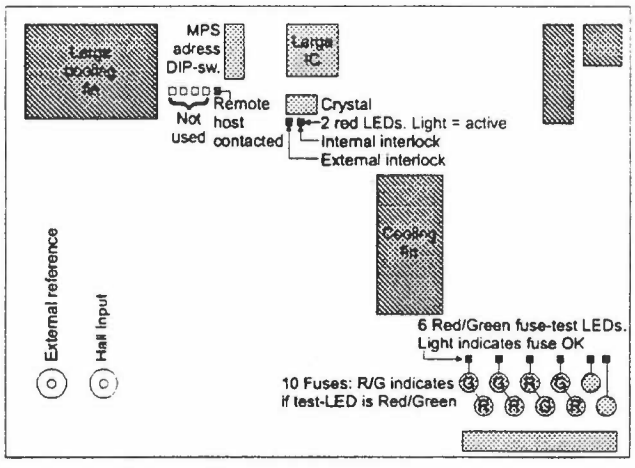


Fig. 5.1-1 The control board with LED positions.

    3. In case any of the 6 fuse-test LEDs is not red+green, switch off all power with GLOBAL OFF and replace its related fuse:
       - A *missing* red R or green G light marks that the related R or G marked fuse is blown, light that it is OK.
       - For unmarked fuses, red+green light means OK.
    4. Remount the front panel. If the fuse blows repeatedly: Contact your Danfysik service.
- Check the cable connections to the control board and the control panel.
  - > Failure on the Control board or the control panel.

WILL NOT GIVE OUTPUT POWER:
- Check for interlocks.
- Check that the polarity switch is not in position Neutral (0).
- Check the connections to the magnet power output terminals and the polarity switch.
  - > Failure on the Control board.

NONE OR BAD REGULATION:

- Check the AC mains voltage, see section 3.2.4, the AC button.
  > The AC voltage on all phases should be within the limits specified in section 1.2 - AC POWER SUPPLY.
- Check the temperature readout, see section 3.2.4, the AUX button :
  > Delta temperature is more than +/- 0.5°C offset (it should approach +/- 0.2°C): Failure on the regulation board.

- Check the ambient temperature, see section 1.2 - TEMPERATURE RANGE.:
  > Temperature too high:
  Ambient temperature must come down.

- Check the cooling water temperature:
  > Temperature low:
  Risk of dew in the electronics. Raise the cooling water temperature .

- Check the OUTPUT VOLTAGE, see 3.2.4 - the DC button. For max permissible output voltage, see 1.2 - DC OUTPUT RATINGS.

5.2. Interlocks

The interlock system is described in more details in section 6.3.

When the interlocks are handled, press RESET (6).
Then press INTERLOCK to see if there are more problems.

DOOR OPEN
- Check the rear panel door of the cabinet.
  > If it was closed, check the 3 panel door contacts one by one.

NEUTRAL POLARITY
- Check the polarity switch(es).

OVER CURRENT
- Check the connections to the DCCT (current measurement transducer) head.
  > Failure on the control module (see 6.1.1) or the SMPC module (see 6.1.2).

LOW WATER FLOW
- Check the water cooling system.

DIODE HEATZINK OVERTEMP
- Check the cooling water temperature, see section 1.2 – TEMPERATURE RANGE.:
  > Too high temperature :
  The cooling water temperature must come down.
- Check the internal water cooling.

IGBT HEATZINK OVERTEMP
- Check the cooling water temperature, see section 1.2 – TEMPERATURE RANGE.:
  > Too high temperature :
  The cooling water temperature must come down.
- Check the internal water cooling.

H.F. DIODE OVERTEMP
- Check the cooling water temperature, see section 1.2 – TEMPERATURE RANGE.:
  > Too high temperature :
  The cooling water temperature must come down.
- Check the internal water cooling.

SWITCH REGULATOR SUPPLY FAILURE
- Check the connection between the SMPC Regulation board and the LEM DCCT board.

IGBT DRIVER FAILURE
- Check the connection between the SMPC Regulation board and the IGBT Driver boards.
- Check the connection between the IGBT Driver boards and the IGBT modules.
  > Failure in the IGBT module

CHASSIS OVERTEMP

- Check the ambient temperature, see section 1.2 - TEMPERATURE RANGE.:
  > Too high temperature :
  The ambient temperature must come down.
- Check the cooling water temperature, see section 1.2 - TEMPERATURE RANGE.:
  > Too high temperature :
  The cooling water temperature must come down.

USER 1-6:

- Check the connections and ext. interlocks.

5.3 Repair and calibration.

This section give some instruction to startup the MPS without damage the supply, for repairing or change a module.
In the power supply there are some hardware calibrations on the control board and SCMC module.

Repair and calibration instruction for MPS 883

1) Set Up:

A) Connect water and test for leaks.

B)Connect mains via a variable transformer, user interlock shorting plug and door interlock/ interlock light flash plug.

C) Connect 220 Vac to the down stream side of RL5 (control power circuit breaker) and neutral. Note : RL5 MUST be OFF.

D) Adjust circuit breaker:_____Amp

E) Check with a ohm-meter between cap.bank and gnd and between transformer and gnd.

2) Control power test:

A) Turn the 220Vac testing control power on.

B) Look at the LED's for the supply on control board all should be "yellow". See that LED (CPU OK) flash red

C) Adjust flow-switch:__ l/m

D) Check that all interlocks can be removed and set (LED's on the frontpanel and on the control board).
- Check all interlocks in AC module.
  - Remove and insert user interlock plug (2 interlocks).
  - Remove and insert door interlock plug (2 interlock).
  - Remove and insert plug for phase failure and diode over temp. (2 interlocks).
- Check all interlocks in SMC module.
  - Remove and insert P2 interlock plug (4 interlocks).
  - Remove and insert P3 interlock plug (1 interlock).
- Check if P7 (dcct) is removed will give interlock.

E) Check that the main circut breaker can be angaged. It sshould be possible to trip it with the emergency switch or the global off buttom.

F) Check main power on-, standby- and reset-function

3) SMC-module Power Up:

A) Turn POT2 on SMC reg board all the way clockwise (min current) and Jump J1 should be shorted between 1 and 2 (local pot. control).

B) Connect oscilloscope probe to gnd and TP30 on smc reg. board.
Connect a wire "short" with a 2k2 resistor in series trough the centre of the transformer and connect the oscilloscope across the resistor.

C) Turn the variable transformer up until the DC voltage across the main capacitor bank is app. 50V. No current should out of the supply.

D) Turning POT 2 counter clockwise slowly the supply should start give current.

E) While turning the ac input voltage up app 100v at the time observe that the output current don't change (max 20%). At every voltage test the regulation range and look at the oscilloscope.

F) Check the 3 phase LED's on front panel (remove phases to check correlation between phase and LED).

4) Calibration of supply:

A) Disconnect the variable transformer and the 220Vac control voltage.
Connect a external current measurement system (DCCT) with a min. 5½ digit voltmeter.

B) Turn supply back on and turn the set-up key. (Control power on for more than one hour).

C) Go to Dc menu. Set supply the rated max output current (reading the external dcct/voltmeter). Set supply's max (Amp's) current into the menu.
Iout:_____
Measure the output voltage and "enter"this.
Vout:_____

D) Goto AC menu. Still with max output, measure phase current and neutral to line voltage enter it into the system.

E) Adjust the Analog 0-10V voltage for output current (POT 5) and voltage (POT 4) (BNCconnectors on rear).

F) Test polarity switch and readout (ON should be disabled in neutral)

6. Technical Description

NOTE: Change notes are placed in section 6.5.

The power supply consists of three modules:
- Control module, placed just behind the MPS front panel. See section 6.1.1.
- Switch converter module, placed in the centre of the MPS. See section 6.1.2.
- AC mains input module, placed at the rear of the MPS. See section 6.1.3.

The modules are mounted in a U shaped chassis, 19" wide, 350 mm high and 600 mm deep, mounted in the cabinet on telescopic rails.

Up to three power supplies are mounted in a rack with manual polarity switches (see section 6.2) in the bottom of the rack. AC power is supplied at the top of the rack and cooling water at the bottom of the rack. The magnets are connected to the polarity output switches at the bottom of the rack.

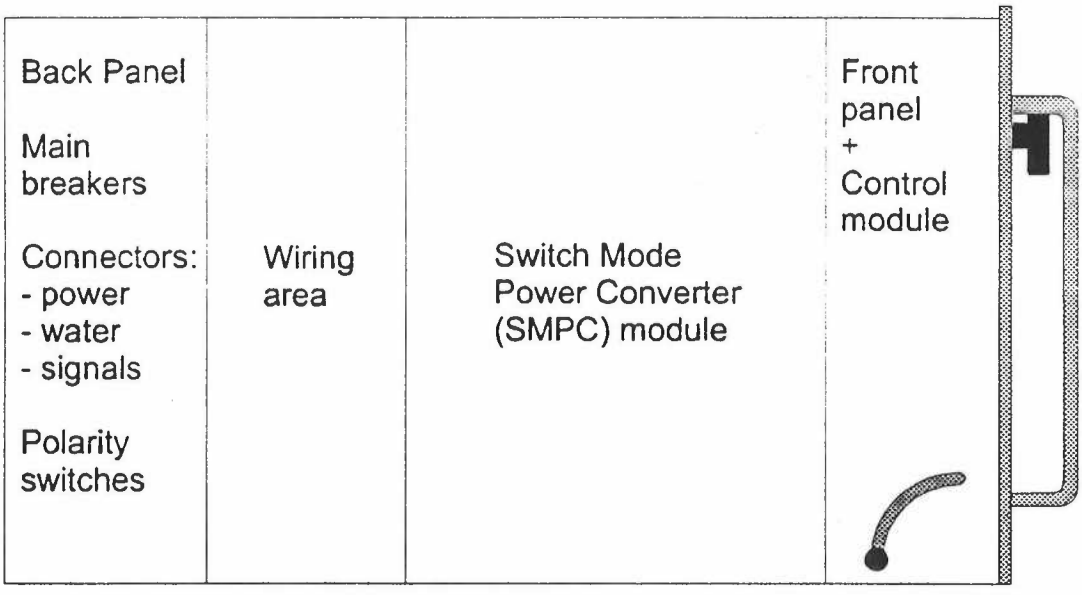


Fig. 6-1 The MPS unit, seen from the left side.

All modules are drawn on one main schematic for easy overview of the complete power supply, see chapter 8.

Chapter 7 contains the parts list with the major components of the main schematic and copies of all relevant data sheets.

6.1. The individual modules

6.1.1. The Control Module

The control module has the following functions:

- Aux. power for the all modules.
- Main CPU control of all commands (Remote and Local).
- Display of status (local).
- Analog current regulation.
- Reference/DAC with temperature control.
- Measuring of output, input and internal signals.
- Interlock control.

To access

The electronics for these functions is located on the control board behind the front plate. To access the control module:

1. Remove the 4 panel lock screws on the front panel and pull out the MPS.
2. Remove the 2 umbraco screws on top of the front panel.
3. Loosen the 2 umbraco screws on the side panels, and fold down the front panel.
4. Disconnect the six D-type connectors (for inspection or fuse replacement, only, just take the cables aside).
5 Remove the 2 screws from the cover, pull the cover free, and lift it out.

This allows for a very quick replacement of all control electronics, thus keeping down the service-time and total downtime.

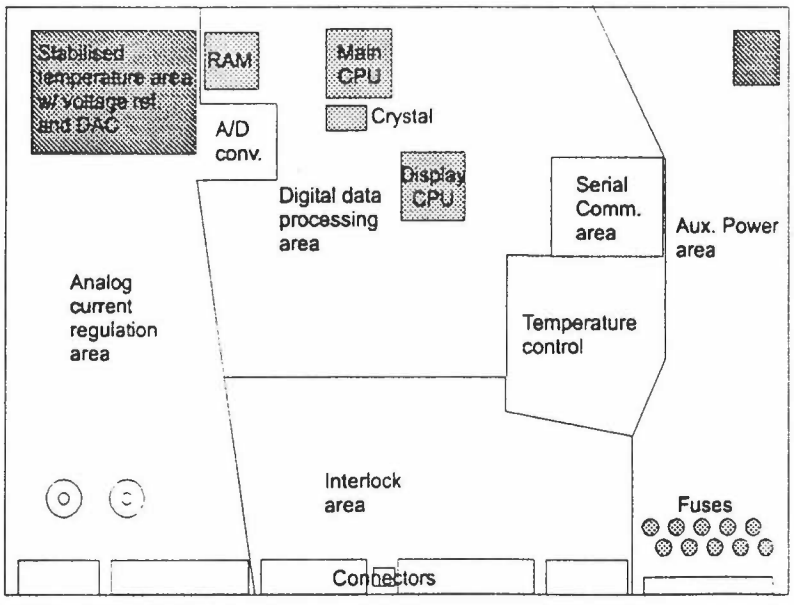


Fig 6.1.1-1 The control board

Aux. power: The transformer for all aux. power is located on the AC module and feed to the control module as AC power. The rectification and regulation for all supplies is placed on the control board. The voltages for interlocks and remote data communication are insulated (2.5 kV) from all other voltages.

Main CPU: An SGS ST9 CPU is used as the main CPU. This CPU has a 16 kB build-in EPROM and four 8 bit I/O ports and it is connected to eight 8 bit ADCs, see "Measurements", below. The main CPU controls all commands for the supply (remote and local) and all interlocks.

The display is controlled by another ST9 CPU. It controls all readouts to the display and it is connected to the local pushbuttons. The two CPUs are talking to each other via a local bus.

The analog current regulation is performed by various high precision amplifiers in order to make a high open loop gain (>10^6) feedback system. See the schematics for the control board, analog regulation section.

The voltage reference, the DAC, the Burden resistor and the error amplifier are all placed in a temperature controlled box where the temperature is kept stable to +/- 0.2°C. The controlling element is a Peltier element which can cool and heat.

When a new current set value is set, the supply will ramp to this new value with the selected ramp speed after a trig. command has been received. In local mode the trig. command is the start push button on the front, in remote control the trigger can be either a software trig. command or an external TTL hardware signal (BNC connector on the rear of the supply, completely isolated from the supply).

Measurements: The main CPU gets its input from eight 8-bit ADCs, which are used to measure the AC inputs (current and voltage), output voltage, etc. A 18-bit (Maxim 132) ADC is used for the high precision measurement of the output current, getting its reference from the temperature controlled main reference.

Interlocks are all opto isolated from the supply via optocouplers with a separate power supply.

6.1.2. The Switch Mode Power Converter (SMPC) module

To access

The switch mode converter is located in the centre module of the supply. Like the control module it can be removed for easy replacement:

1. Remove the 4 panel lock screws on the front panel and pull out the MPS.
2. Fold the front panel down, see the description in section 6.1.1, point 2 to 3.
3. Remove the four umbraco screws on the cover plate covering the SMPC module at the centre of the MPS unit. The module is now accessible, see Fig. 6.1.2-1 below.

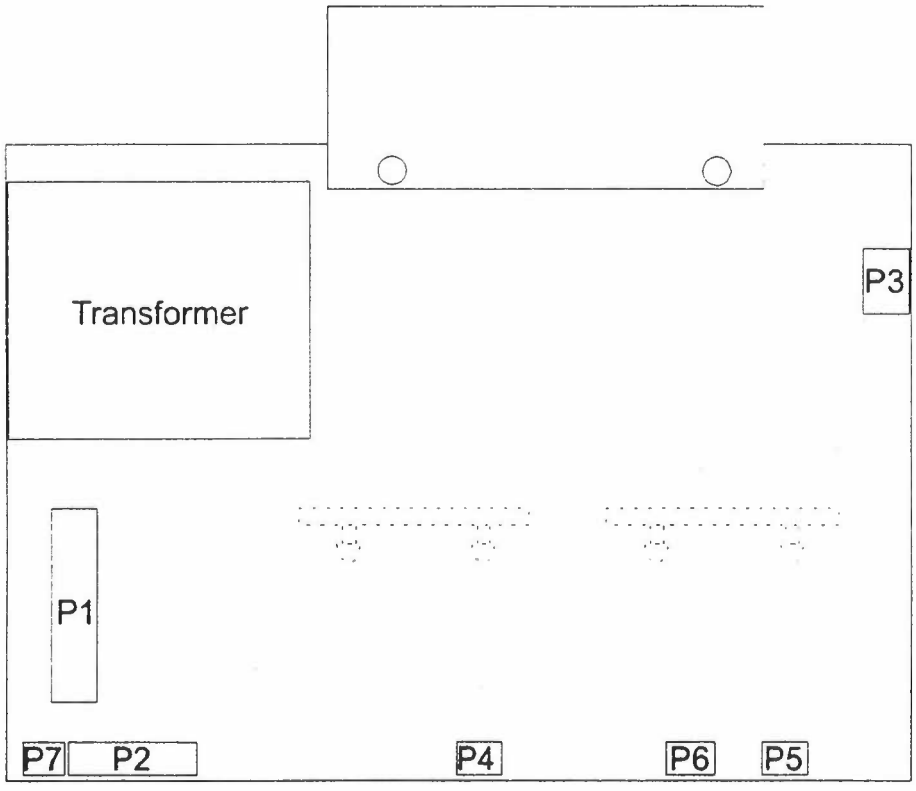


Fig. 6.1.2-1. The SMPC module

Note, that below the pc-board there are placed two small pc-boards (dashed lines). Each of these carries two LEDs. These should always be lit, indicating that the IGBT (Insulated Gate transistors) are OK.

Noise immunity

This is taken care of by using opto isolation for the control signals.

Noise emission

In general, the noise emission depends on the level of noise generated and the possibility to introduce filters in the input/ output connections and to screen the system for radiated noise. Our basic philosophy is to start with a good design considering filtering and screening, and then reduce the noise emission to the desired level.

To get full control over the noise current paths and the airborne transmission of noise, the power converter module is designed with two zones, the one enclosed in the other one as shown on the simplified block schematic. Each zone is an EMC tight box. This implies that two equipotential surfaces are used for the decoupling of the input/output cables. The

damping factors obtained will thus be multiplied.

The main noise sources are the IGBTs and the rectifying diodes in the secondary circuit. A very high efficiency is normally obtained by using fast risetimes. However, this also gives the highest noise level. Instead, resonant transition / quasi resonance switching is used to give a lower noise output accepting a slightly lower efficiency. This system is very compact compared with a resonance conversion circuit and permits the use the "box in box" system.

Circuit description (see the simplified block schematic on DWG No. 83145D

In a "box in box" system it is an advantage to feed in 3 x 400 V, 50 Hz and get the filtered low voltage high current as output.

The 3 x 400 V, 50 Hz supply passes a common mode filter when entering through the external surface. It is then rectified, and the resulting DC voltage is filtered by a choke input filter having the dual function of filtering 300 Hz ripple as well as high frequency noise. The DC output from this filter passes a common mode filter when entering the internal box. Two IGBT dual modules are used for the full bridge rectifier. They are interconnected and connected to the capacitor using copper foil for low self induction and therefore low noise. The transformer is made with a certain stray inductance which will aid the switching and give a low winding to winding capacitance resulting in reduced common mode noise currents.

The switching is performed as follow:

Consider that the Q1a and Q2b are "on" and a current is flowing. Then Q1b is switched off and the current will now go through Q2b and the diode of Q1b until Q2b is switched off. Due to the current flowing in the stray inductance of the transformer the voltage on Q2b will go high and then Q1a can be switched on in zero voltage mode. In this way three improvements are achieved versus the classical hard switching system:

1. A trapezoidal current in the transistors, transformer and secondary rectifier diodes avoids hard snap off diodes, as shown in the figure.
2. The primary transformer winding is always clamped (by the transistor modules) avoiding primary side oscillations.
3. The transistors' turn-on losses are eliminated giving improved efficiency.

The transformer secondary has 4 sections, each with a double rectifier. The primaries of each section are series connected for a near ideal current sharing among the parallel connected rectifiers. The secondary windings are shielded to further reduce the noise transmission between the primary and secondary section. The diodes are placed in a separate box. The filter choke is split in four sections so that the parallel connection will be made on the filter capacitor section. {Er det rigtigt ???}

Small rectifiers in parallel with the main rectifier are used as a main rectifier check, checking the secondary ac voltages. E.g., if one rectifier shorts or opens, the voltage will change compared with the other secondaries and consequently interlocks the power supply. The main rectifiers are also used as freewheeling diodes. All rectifier diodes will be in parallel when the magnet is freewheeling giving a very high margin for failure. For the 585A supply type: the 8 diodes are rated for 100 A each, giving a total of 800 A.

The covers of the two "boxes" can be loosened for inspection and taken out. For service,

disconnect the module from the control cable, the input/ output cables, and the cooling water connection, and lift it out. The module can then be serviced and tested on the bench.

6.1.3. AC mains input module

As for the other modules, the AC mains input module is located in a box which is easy to remove for service or replacement.

To access

1. Open the back door of the cabinet by turning the 3 screws on the back door 90° counterclockwise.
2. Remove the AC mains input module cover: Turn the two black plastic screws on top of the panel 90° in any direction and remove the cover. The module's pc-board is placed just behind the connectors at the top of Fig. 6.1.3-1 with its component side down. Fig. 6.4.3-1 shows the positions of the connectors on the pc-board.

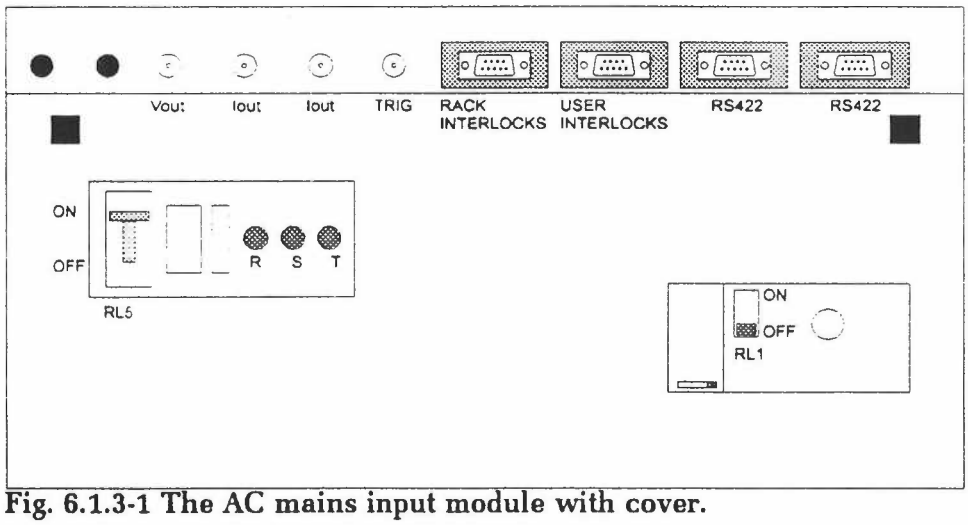


Fig. 6.1.3-1 The AC mains input module with cover.

All the mains power components are located in this module:

Starting from the mains:

a) 3 transformers used for voltage measurement and feeding the "mains present" LEDs on front panel. These transformers are located on the AC interface board and are fused with 0.1 A fuses with a breaking capacity of 30 kA.
b) The main circuit breaker with shunt trip{???} for remote release. Interrupting capacity 30 kA.
c) The main contactor with a soft start contactor. The soft start contactor connects three 3 ohm resistors in series with the mains for approx. 15 msec. to limit the inrush current to max 1.5 x I_{nom}).
d) The thermal breaker for phase overload protection, e.g. in case of a shorted or opened rectifier diode.

The fused aux.-power transformer has a manual circuit breaker for service disconnection.

All control signals for all power components go via the AC interface board, where all signals are routed to their appropriate destinations.

6.1.4 Function description Printed Circuit Board's.

Control Board (83146) has following functions:

- Aux. power for the all modules.
- Main CPU control of all commands (Remote and Local).
- Display of status (local).
- Analog current regulation.
- Reference/DAC with temperature control.
- Measuring of output, input and internal signals.
- Interlock control.

SMC Regulation Board (83197) has following function:

- PWM (Puls With Modulator) controler.
- Current regulator (Primary switch current).
- Make isolation between control and power components.
- Make isolation between control and interlocks.

AC Interface board (83164) has following functions:

- Measurement of line input voltage.
- Measurement of line input current.
- Measurement of ground leak current.
- Connection betweeen in and out side Power Supply.

LEM DCCT Board (83204) has following function:

- Measurement of primary transformer current.

Filter f. SMPC Board (83200) has following function:

- Carring capacitors for output filter.
- EMI earthing.
- Connection for output voltage measurement.

6.2. Polarity Switches

The DC output can be reversed by using the manual polarity reversal switch.

The polarity switches are located in the bottom of the rack (three polarity switches for each of the three supplies). The switched back panel door prevents accidental polarity switching with the power on. The power supply is interlocked if the door is opened with power on.

WARNING: Use only one polarity switch per magnet! See section 3.2.5.

The status of the reversing switch is available on the front panel and on the remote line.

6.3. The Interlock system

An "interlock" is a condition which has stopped the power supply, and which prevents it from being started again before the cause of the interlock has been removed.

All interlocks are shown on the front panel display and can be read from the remote control terminal. If there are more interlocks than can be shown on the front panel display at once, the up and down pushbuttons can be used to scroll up and down through the list.

There are five groups of interlocks:
- Status interlocks. Manually set conditions preventing the MPS from starting.
- AC input module interlock.
- Switch mode converter interlocks.
- Control module interlocks.
- User interlocks. User defineable interlocks, e.g. connected to a magnet thermal breaker or a magnet cooling water flow switch.

Status interlocks:
- Door open
- (Neutral polarity) Shown in the DC menu as NEU

AC input module interlock:
- Over-current (thermal relay on main contactor)

Switch mode converter interlocks:
- Low water flow
- Diode heatzink overtemp.
- IGBT heatzink overtemp.
- H.F. diode overtemp.
- Switch regulator supply failure
- IGBT driver failure
- Chassis overtemp.

Control module interlock:

- Switch reg. DCCT failure

User interlocks:

- 6 user defineable interlocks, opto isolated and available on a D-sub connector on the rear of the supply.

6.4. Connectors

6.4.1 Control board

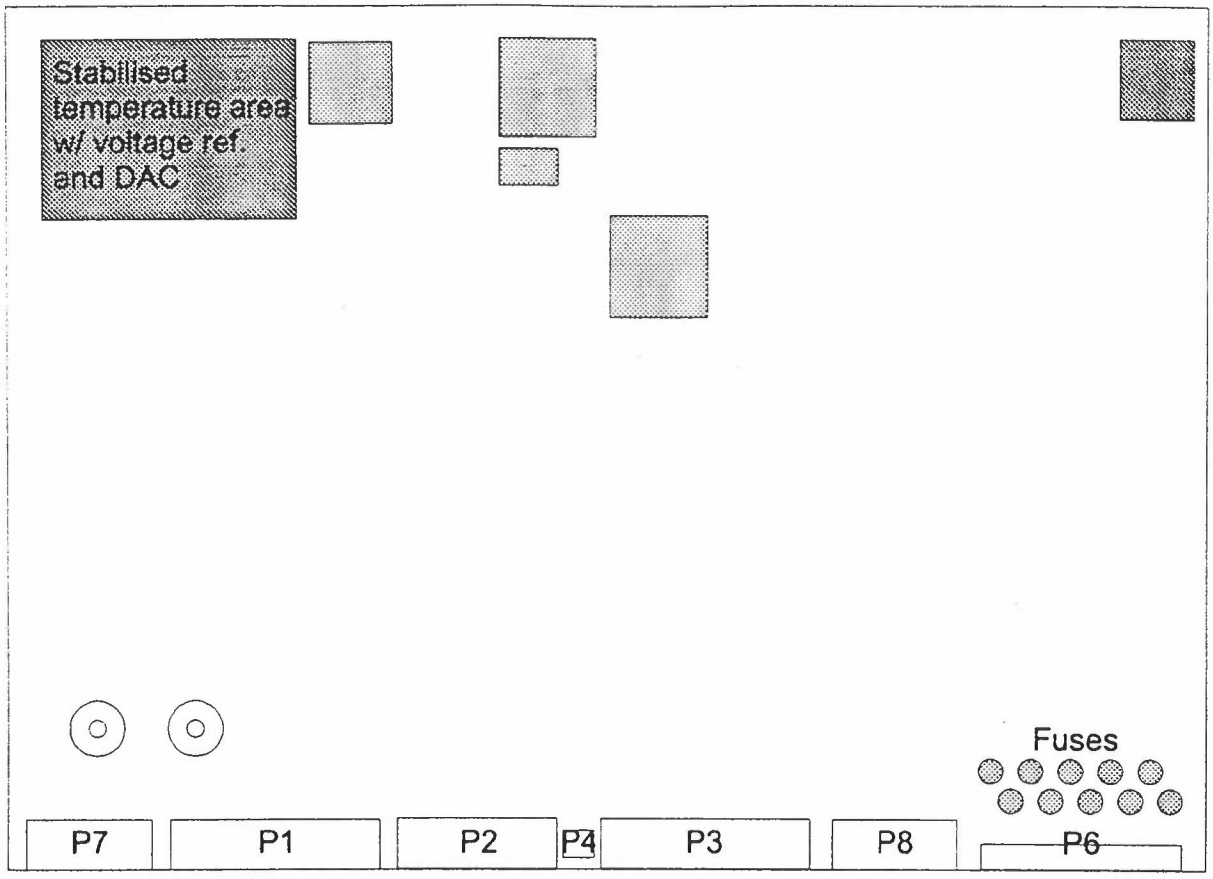


Fig. 6.4.1-1 The control board connectors

The Control board has the following connectors:

-P1 Regulation board interface
-P2 AC Input board interface
-P3 AC Input board interface
-P4 Imergency switch interface
-P5 Service key interface
-P6 Aux – power supply
-P7 DCCT interface
-P8 RS422/RS485 remote line interface

Connector P1: (To/From Regulation board)

Pin no:	Name	I/O	Description & Specification
1	ICTL/P11	O	Voltage high side for high precession current regulation.
2	ICTL/P12	O	Voltage low side for high precession current regulation.
3	VOUT/AN0	I	Voltage representing the voltage at the output terminals.
4	NC		Not used.
5	NC		Not used.
6	/AC1L	O	20VAC Power supply.
7	NC		Not used.
8	NC		Not used.
9	/INT38	I	
10	/INT22	I	IGBT driver failure interlock, when pin 10 & 21 not connected.
11	/INT20	I	Switch reg. DCCT failure interlock, when pin 11 & 21 not connected.
12	/INT18	I	IGBT heatzink overtemp. interlock, when pin 12 & 21 not connected.
13	/INT16	I	Diode heatzink overtemp. Interlock, when pin 13 & 21 not connected.
14	/A+15V	O	+15V Power supply.
15	/GNDA15V	O	Return 15V Power supply.
16	/A-15V	O	-15V Power supply.-
17	NC		Not used.
18	/AC1N	O	20VAC Power supply.
19	NC		Not used.
20	NC		Not used.
21	/GND		Isolated ground for interlocks signals.
22	/INT23	I	Spare interlock, when pin 22 & 21 not connected.
23	/INT21	I	Switch regulator supply failure interlock, when pin 23 & 21 not connected.
24	/INT19	I	H.F. diode overtemp. interlock, when pin 24 & 21 not connected.
25	/INT17	I	Chassis overtemp. interlock, when pin 25 & 21 not connected.

Connector P2: (To/From AC Input board)

Pin no:	Name	I/O	Description & Specification
1	GND LEAK/AN1	I	Voltage represent current that is leaking to ground
2	NC		Not used.
3	/A-15V	O	-15V Power supply.
4	NC		Not used.
5	ACRTN/GNDA15V	O	Return for voltage representing voltage for input voltage/ current.
6	VAC2/AC4	I	Voltage represent input voltage fase S.
7	IAC3/AC2	I	Voltage represent input current fase T.
8	IAC1/AC0	I	Voltage represent input current fase R.
9	DCRTN/GNDA15V	O	Return 15V Power supply.
10	/GNDA15V	O	Return 15V Power supply.
11	/A+15V	O	+15V Power supply.
12	/GNDA15V	O	Return 15V Power supply.
13	VAC3/AC5	I	Voltage represent input voltage fase T
14	VAC1/AC3	I	Voltage represent input voltage fase R
15	IAC2/AC1	I	Voltage represent input current fase S

Connector P3: (To/From AC Input board)

Pin no:	Name	I/O	Description & Specification
1	/+24v	O	+24V Power supply external interlocks.
2	FREE1/INT12	I	Free 1 interlock, when pin 2 & 1 not connected.
3	POL+/ INT10	I	Positive polarity, when pin 3 & 1 connected.
4	THERM/INT8	I	Low water flow interlock, when pin 4 & 1 not connected.
5	USER6/INT6	I	User 6 interlock, when pin 5 & 1 not connected.
6	USER4/INT4	I	User 4 interlock, when pin 6 & 1 not connected.
7	USER2/INT2	I	User 2 interlock, when pin 7 & 1 not connected.
8	ISON/INT33	I	Power is on signal +24V when main contactor is ON.
9	GLOFF/	O	Turn OFF the max. current breaker.
10	TRIG-/INT34	I	Low side trigger for start ramping when the power supply is ON.
11	C15VSUPPLY/C-15V	O	-15V C Power supply.
12	C15VSUPPLY/GNDC15V	O	Return C Power supply.
13	VOUT/P313	O	Voltage 0-10V representing output voltage 0-100%
14	S.INTL/INT37	O	Sum interlock low when a n interlock is present.
15	POL-/INT11	I	Negative polarity, when pin 15 & 1 connected.
16	DOOR/INT9	I	Door interlock, when pin 16 & 1 not connected.
17	PHASE/INT7	I	Freewheel diode overtemp. Interlock, when pin 17 & 1 not connected.
18	USER5/INT5	I	User 5 interlock, when pin 18 & 1 not connected.
19	USER3/INT3	I	User 3 interlock, when pin 19 & 1 not connected.
20	USER1/INT1	I	User 1 interlock, when pin 21 & 1 not connected.
21	MAINON/INT32	O	Indicate that main is ON.
22	TRIG+/INT35	I	High side trigger for start ramping when the power supply is ON.
23	/GND24V	O	Return 24V Power supply.
24	C15VSUPPLY/C+15V	O	+15V C Power supply.

25	IOUT/P325	O	Voltage 0–10V representing output current 0–100%

Connector P4: (Emergency switch interface)

Pin no:	Name	I/O	Description & Specification
1	/INT36	O	Connection to the emergency switch.
2		I	Connection to the emergency switch.

Connector P5: (Service key interface)

Pin no:	Name	I/O	Description & Specification
1	/C12		Connection to the set–up key switch.
2	/GND		

Connector P6: (Aux – power supply)

Pin no:	Name	I/O	Description & Specification
1	24VAC/ACIL	I	24VAC.
2	24VAC/ACIN	I	24VAC.
3	NC		Not used.
4	NC		Not used.
5	A–PSU18VAC/AC2LH	I	18VAC high side A Power supply
6	A–PSU18VAC/AC2N	I	Return 18VAC A Power supply.
7	A–PSU18VAC/AC2LL	I	18VAC low side A Power supply.
8	7VAC/AC3H	I	7VAC high side Power supply Peltier element.
9	7VAC/AC3N	I	Return Power supply Peltier element.
10	7VAC/AC3L	I	7VAC low side Power supply Peltier element.
11	NC		Not used.
12	B–PSU18VAC/AC4LH	I	18VAC high side B Power supply.
13	B–PSU18VAC/AC4N	I	Return B Power supply.
14	B–PSU18VAC/AC4LL	I	18VAC low side B Power supply.
15	NC		Not used.
16	C–PSU18VAC/AC5LH	I	18VAC high side C Power supply.
17	C–PSU18VAC/AC5N	I	Return C Power supply.
18	C–PSU18VAC/AC5LL	I	18VAC high side C Power supply.

Connector P7: (DCCT interface)

Pin no:	Name	I/O	Description & Specification
1	NC		Not used.
2	NC		Not used.
3	/P73	I	Signal to DCCT over-current interlock
4	GNDB/P74	I/O	Output current low side DCCT. 0.4A source current when DCCT head is 100% loaded. Return 15V Power supply.
5	/B-15V	O	-15V Power supply for DCCT head.
6	/P76	I	Output current high side DCCT. 0.4A source current when DCCT head is 100% loaded.
7	NC		Not used.
8	/P78	I	Over current interlock.
9	/B+15V	O	+15V Power supply for DCCT head.

Connector P8: (RS422/RS485 remote line interface)

Pin no:	Name	I/O	Description & Specification
1	TXH/RS2	O	Transmit line high side of the remote RS 422 port.
2	TXL/RS3	O	Transmit line low side of the remote RS 422 port.
3	RXH/RS0	I	Receive line high side of the remote RS 422 port.
4	RXL/RS1	I	Receive line low side of the remote RS 422 port.
5	TXCOM/ISOGND	I/O	Isolated ground for the serial interface.
6	NC		Not used.
7	NC		Not used.
8	NC		Not used.
9	TXVCC/ISOVCC	O	Isolated +5V for the serial interface.

6.4.2 SMPC Regulation board

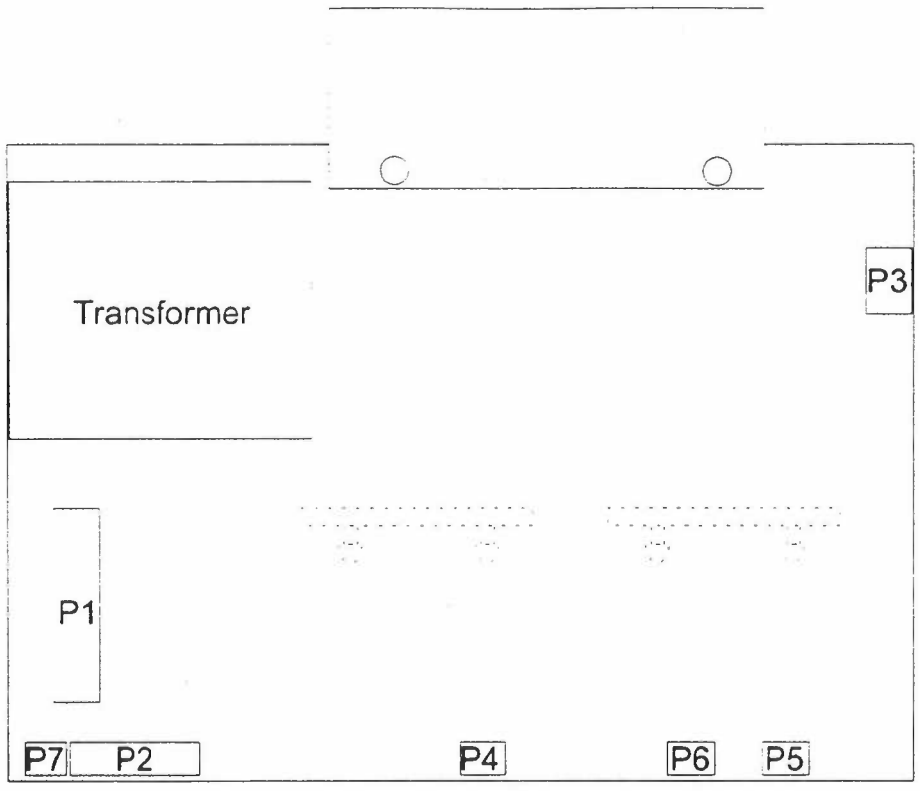


Fig. 6.4.2.1 The SMPC Regulation board

The SMPC Regulation board has the following connectors:

-P1 Control board interface
-P2 Thermal switch intelock interface
-P3 LEM-DCCT board interface
-P4 SMPC output voltage interface
-P5 Driver modul 1 interface
-P6 Driver modul 2 interface
-P7 24VDC Blower

Connector P1: (To/From Control board)

Pin no:	Name	I/O	Description & Specification
1	ICTL/P1-1	I	Voltage high side for high precession current regulator.
2	NC		Not used.
3	VOUT/P1-3	O	Voltage representing the voltage at the output terminals.
4	NC		Not used.
5	NC		Not used.
6	/P1-6	I	20VAC Power supply.
7	NC		Not used.
8	NC		Not used.
9	/P1-9	I	Power is ON.
10	/P1-10	O	IGBT driver failure interlock, low when active.
11	/P1-11	O	Switch reg. DCCT failure interlock, low when active.
12	/P1-12	O	IGBT heatzink overtemp. Interlock, low when active.
13	/P1-13	O	Diode heatzink overtemp. Interlock, low when active.
14	/P1-14	I	+15V Power supply.
15	/P1-15	I	Return 15V Power supply.
16	/P1-16	I	-15V Power supply.
17	NC		Not used.
18	/P1-18	I	20VAC Power supply.
19	NC		Not used.
20	NC		Not used.
21	/P1-21	O	Isolated retutn for interlocks signals.
22	/P1-22	O	Spare interlock, low when active.
23	/P1-23	O	Switch regulator supply interlock, low when active.
24	/P1-24	O	H.F. Diode overtemp. interlock, low when active.
25	/P1-25	O	Chassis overtemp. Interlock, low when active.

Connector P2: (Thermal switch interlock)

Pin no:	Name	I/O	Description & Specification
1	/1	I	High side thermal switch on diode heatzink.
2	/24GND	O	Low side thermal switch on diode heatzink.
3	/3	I	High side thermal switch on chassis.
4	/24VGND	O	Low side thermal switch on chassis.
5	/5	I	High side thermal switch on IGBT heatzink.
6	/24VGND	O	Low side thermal switch on IGBT heatzink.
7	/7	I	High side thermal switch on H.F. diode heatzink.
8	/24VGND	O	Low side thermal switch on H.F. diode heatzink.

Connector P3: (To/From LEM-DCCT board)

Pin no:	Name	I/O	Description & Specification
1	/+/-15V ok &DCCT ok	I	Signal indicate power supply and LEM DCCT board is connected.
2	/A-15	O	+15V Power supply.
3	/Current	I	Current signa lrepresent primeary switch current.
4	/A+15	O	-15V Power supply.

Connector P4: (To/From SMPC filter board)

Pin no:	Name	I/O	Description & Specification
1	+Vout/vout+	I	High side of voltage representing voltage at output terminals.
2	-Vout/vout-	I	Low side of voltage representing voltage at output terminals.

Connector P5: (To/From Driver module 1 board)

Pin no:	Name	I/O	Description & Specification
1	/A+15	O	+15V Power supply.
2	/AGND	O	Return 15V Power supply.
3	/DR-fail A	I	Driver failure on driver A.
4	/Gate A	O	Gate signal driver A
5	/Gate B	O	Gate signal driver B
6	/DR-fail B	I	Driver failure on driver B.
7	/B+5	O	+5V Power supply.
8	/BGND	O	Return 5V Power supply.

Connector P6: (To/From Driver module 2 board)

Pin no:	Name	I/O	Description & Specification
1	/A+15	O	+15V Power supply.
2	/AGND	O	Return 15V Power supply
3	/DR-fail A	I	Driver failure on driver A.
4	/Gate A	O	Gate signal driver A
5	/Gate B	O	Gate signal driver B
6	/DR-fail B	I	Driver failure on driver B.
7	/B+5	O	+5V Power supply.
8	/BGND	O	Return 5V Power supply

Connector P7: (To blower)

Pin no:	Name	I/O	Description & Specification
1	/+24VDC	O	+24V Power supply.
2	/-24VDC	O	Return 24V Power supply.

6.4.3 AC Interface board

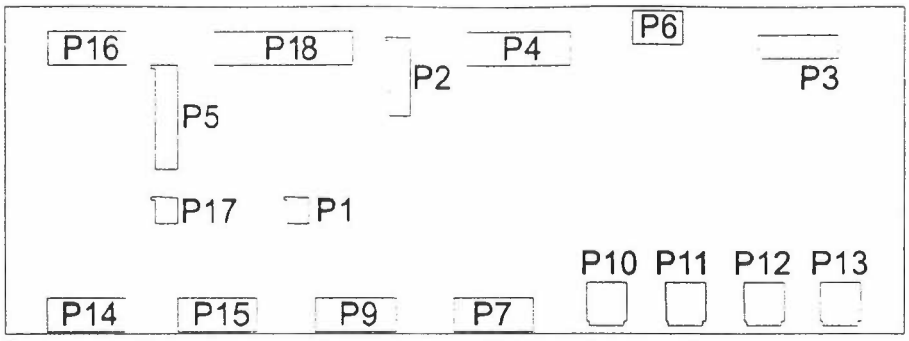


Fig. 6.4.3.1 The AC interface board.

The AC Interface board has the following connectors:

- -P1 Ground leak measument
- -P2 Current trafos interface
- -P3 Input plug interface
- -P4 Control board interface
- -P5 Main contactor interface
- -P6 Interlocks switches interface
- -P7 External interloks interface
- -P8 Control board interface
- -P9 User interlocks interface
- -P10 Ramp start interface
- -P11 Iout (0-10V) interface
- -P12 Iout (0-10V) interface
- -P13 Vout (0-10V) interface
- -P14 RS422/RS485 Remote line
- -P15 RS422/RS485 Remote line
- -P16 RS422/RS485 Remote line interface
- -P17 Interlock light interface.

Connector P1: (Ground leak measument)

Pin no:	Name	I/O	Description & Specification
1	/GND		Not used.
2	/Measument		Measurement of current leak to ground.

Connector P2: (To/From Current trafos)

Pin no:	Name	I/O	Description & Specification
1	/TRTN		Return current-transformer fase T.
2	/TFASE		High side current-transformer fase T.
3	/SRTN		Return current-transformer fase S.
4	/SFASE		High side current-transformer fase S.
5	/RRTN		Return current-transformer fase R.
6	/RFASE		High side current-transformer fase R.

Connector P3: (To/From Input plug)

Pin no:	Name	I/O	Description & Specification
1	/TRTN		Command return voltage-transformers.
2	/TFASE		High side valtage-transformer fase T.
3	/SFASE		High side valtage-transformer fase S.
4	/RFASE		High side valtage-transformer fase R.

Connector P4: (To/From Control board)

Pin no:	Name	I/O	Description & Specification
1	GND LEAK/G Leak	O	Voltage represent current that is leaking to ground.
2	NC		Not used.
3	/A-15V	I	-15V Power supply.
4	NC		Not used.
5	ACRTN/GNDA15V	O	Command return for voltage/current represnt input voltage/current and 15V Power supply.
6	VAC2/S V ac	O	High side voltage-transformer fase S.
7	IAC3/T I ac	O	High side current-transformer fase T.
8	IAC1/R I ac	O	High side current-transformer fase R.
9	DCRTN/	I/O	Return DC and 15V Power supply.
10	/GNDA15V	O	Return 15V Power supply.
11	/A+15V	I	+15V Power supply.
12	/GNDA15V	I	Return 15V power supply.
13	VAC3/T V ac	O	High side voltage-transformer fase R.
15	IAC2/S I ac	O	High side current-transformer fase S.

Connector P5: (To/From Main contactor)

Pin no:	Name	I/O	Description & Specification
1	/Main ON	O	Low side signal to turn main ON.
2	/+24V	O	High side signal to turn main ON.
3	/Main is ON	I	Low side signal indikate that main is ON.
4	/+24V	O	High side signal indicate that main is ON.
5	/Circuit br.	O	Low side signal to hold max. Current breaker ON.
6	/+24V	O	High side signal to hold max. Current breaker ON
7	NC		Not used.
8	/+24V	O	Not used.

Connector P6: (To Interlocks switches)

Pin no:	Name	I/O	Description & Specification
1	Flow switch/Phase	I	Low side waterflow interlock.
2	/+24V	O	High side waterflow interlock.
3	Free wheel/Thermal	I	Low side thermal switch free wheel diode overtemp. interlock.
4	/+24V	O	High side thermal switch free wheel diode overtemp. interlock.

Connector P7: (To/From External interlocks)

Pin no:	Name	I/O	Description & Specification
1	DOOR/Door	I	Low side door interlock.
2	NORMAL/Normal	I	Low side polatity indication positive.
3	REVERSED/Reversed	I	Low side polarity indication negative.
4	INT.LIGHT/Int:light	O	Low side sum interlock for indicator on top of rack.
5	NC		Not used.
6	/+24V	O	High side door interlock.
7	/+24V	O	High side polatity indication positive.
8	/+24V	O	High side polarity indication negative
9	/+24V	O	High side sum interlock for indicator on top of rack

Connector P8: (To/From Control board)

Pin no:	Name	I/O	Description & Specification
1	/+24V	I	Command +24V Power supply for external interlocks.
2	FREE1/Freel	O	Free1 interlock, low when active.
3	POL+/Normal	O	Positive indication.lLow when active
4	THERM/Thermal	O	Low waterflow interlock, low when active.
5	USER6/User6	O	User 6 interlock, low when active.
6	USER4/User4	O	User 4 interlock, low when active.
7	USER2/User2	O	User 2 interlock, low when active.
8	ISON/Main IS ON	O	Power is ON signal +24V when main contactor is ON.
9	GLOFF/Circuit br.	I	Turn OFF the max. Current breaker.
10	TRIG-/TrigRTN	O	Low side trigger for start ramping when the power supply is ON.
11	C15VSUPPL/C-15V	I	-15V Power supply.
12	C15VSUPPL/C GND	I	Return 15V Power supply.
13	VOUT/V(out)	O	Voltage 0-10V representing output voltage 0-100%.
14	S.INT/Suminterlock	I	Sum interlock low when an interlock is present.
15	POL+/Reversed	O	Negative indication. Low when active.
16	DOOR/Door	O	Door interlock, low when active.
17	PHASE/Phase	O	User 6 interlock, low when active.
18	USER5/User5	O	User 6 interlock, low when active.
19	USER3/User3	O	User 6 interlock, low when active.
20	USER1/User1	O	User 6 interlock, low when active.
21	MAINOM/Main ON	I	Indicat that main is ON.
22	TRIG+/Trig	O	High side trigger for start ramping when power supply is

			ON.
23	/+24VRTN	I	Return 24V Power supply.
24	C15VSUPPL/C+15V	I	+15V Power supply.
25	IOUT/I(out)	O	Voltage 0–10V representing output current 0–100%.

Connector P9: (To/FromUser interlocks)

Pin no:	Name	I/O	Description & Specification
1	/User1	I	Low side user1 interlock.
2	/User2	I	Low side user2 interlock.
3	/User3	I	Low side user3 interlock.
4	/User4	I	Low side user4 interlock.
5	/User5	I	Low side user5 interlock.
6	/User6	I	Low side user6 interlock.
7	NC		Not used.
8	NC		Not used.
9	/+24V	O	Command +24VDC Power supply user interlocks.

Connector P10: (Trig signal for ramp start)

Pin no:	Name	I/O	Description & Specification
1	BNC	I	TTL/+24V positive going signal to start ramping when power is ON.

Connector P11: (I (out) 0–10V)

Pin no:	Name	I/O	Description & Specification
1	BNC	O	Voltage 0–10V representing output current 0–100%.

Connector P12: (I(out) 0–10V)

Pin no:	Name	I/O	Description & Specification
1	BNC	O	Voltage 0–10V representing output current 0–100%.

Connector P13: (V(out)0–10V)

Pin no:	Name	I/O	Description & Specification
1	BNC	O	Voltage 0–10V representing output voltage 0–100%.

Connector P14: (To Remote line RS422/RS485)

Pin no:	Name	I/O	Description & Specification
1	TXH/RS8	O	Transmit line high side of the remote RS 422 port.
2	TXL/RS6	O	Transmit line low side of the remote RS 422 port.
3	RXH/RS4	I	Receive line high side of the remote RS 422 port.
4	RXL/RS2	I	Receive line low side of the remote RS 422 port.
5	TXCOM/RS0	I/O	Isolated ground for the serial interface.
6	NC		Not used.
7	NC		Not used.
8	NC		Not used.
9	NC	O	Isolated +5V for the serial interface.

Connector P15: (To Remote line RS422/RS485)

Pin no:	Name	I/O	Description & Specification
1	TXH/RS8	O	Transmit line high side of the remote RS 422 port.
2	TXL/RS6	O	Transmit line low side of the remote RS 422 port.
3	RXH/RS4	I	Receive line high side of the remote RS 422 port.
4	RXL/RS2	I	Receive line low side of the remote RS 422 port.
5	TXCOM/RS0	I/O	Isolated ground for the serial interface.
6	NC		Not used.
7	NC		Not used.
8	NC		Not used.
9	NC		Not used.

Connector P16: (RS422/RS485 to Control board)

Pin no:	Name	I/O	Description & Specification
1	TXH/RS8	I	Transmit line high side of the remote RS 422 port.
2	TXL/RS6	I	Transmit line low side of the remote RS 422 port.
3	RXH/RS4	O	Receive line high side of the remote RS 422 port.
4	RXL/RS2	O	Receive line low side of the remote RS 422 port.
5	TXCOM/RS0	I/O	Isolated ground for the serial interface.
6	NC		Not used.
7	NC		Not used..
8	NC		Not used.
9	NC		Not used.

Connector P17: (To Interlock light)

Pin no:	Name	I/O	Description & Specification
1	/Free1	O	Not used.
2	/+24V	O	Not used.

8. Drawings

	SCHEMATIC Dwg. No.	ASSEMBLY Dwg.No.
Main Wiring Schematic	83507	
Rack Wiring Schematic	83505	
Control Board	83147	83146
SMPC Regulation Board	83197	83196
Filter for SMPC out	83200	83199
LEM DCCT Board	83204	83203
Heatzink for 3-Phase Choke		83259
AC Input Module Wiring		83221B
AC Interface Board	83163	83162
Rack Mount Of Power	87775	
Printed Circuit Board:	PCB No.	
Control Boarder	83148	
SMPC Regulation Board	83198	
AC Interface Boarder	83164	
Data Sheets:		
Rectifier	SD400R02PV	
Rectifier	MUR20040CT	
Tree phase bridge	60MT140K	
IGBT	2MBI 50L-120	
Contactor	LS07.10E	
Contactor	LS27.22	
Max. Current Breaker	Mbs 28	
Fuse	FERRAZ	

9. Change notes

AC interface board: +5V are not present on comunication line RS485/ 422. +5V is taken from P16 pin 9 to P14 and P15 pin 9. (Sch. 83163.)

Control module: A isolation plate is place in front of the display.

Control board: A NTC resistor (NTC1) is placed in the display circle, to handle black and with (Sch 83147-3)

A lav pass filter (4KHz) is place in BNC read back for Vo and Io 160p//R303 and 160p//R348. (Sch 83147-6 and 83147- 9)

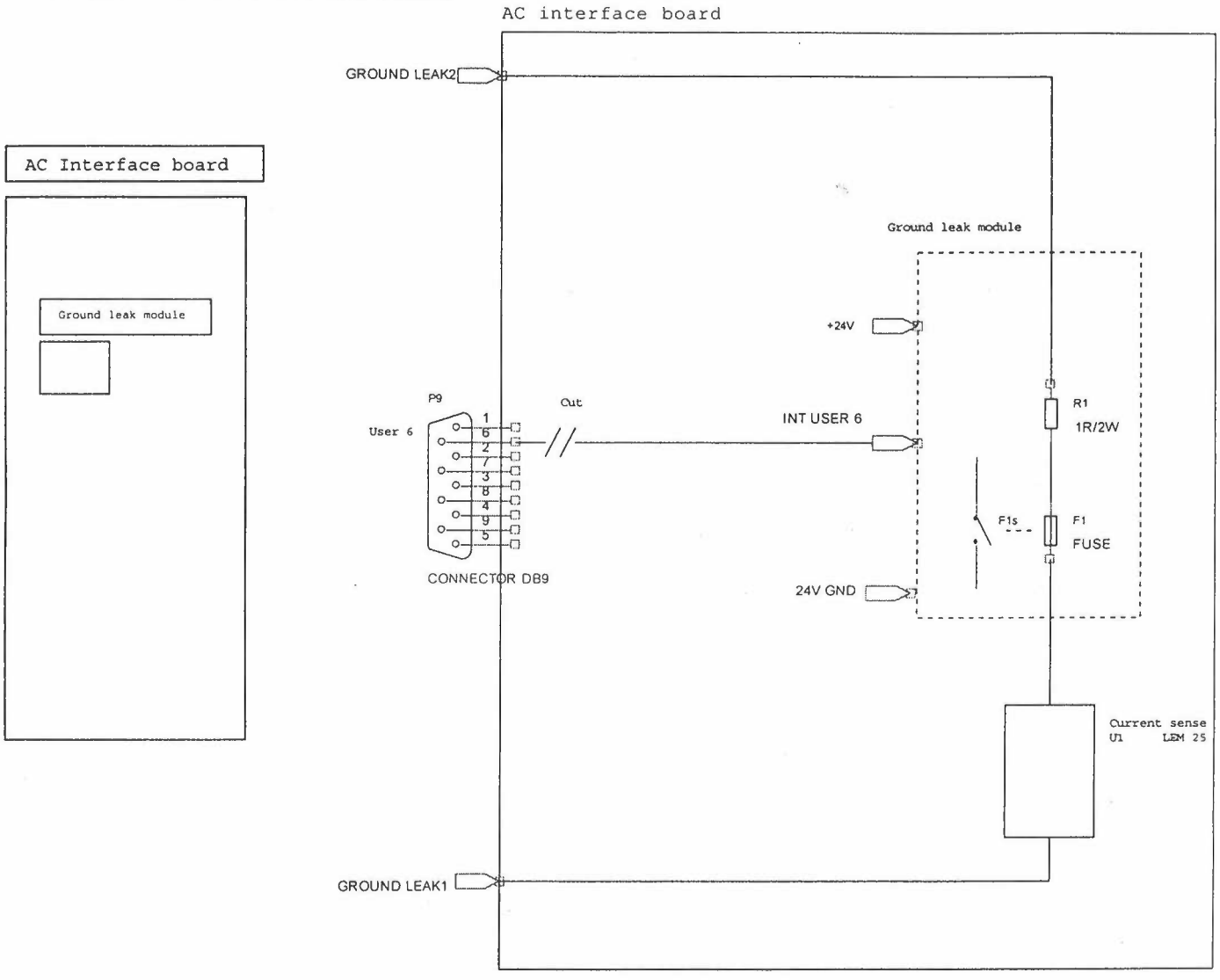
Excessive current ripple C145 and C146 are change from 47p to 100p.

Power unit output filter:

A resistor in the DCCT filter is change from 10R 2W to 10R 5W.

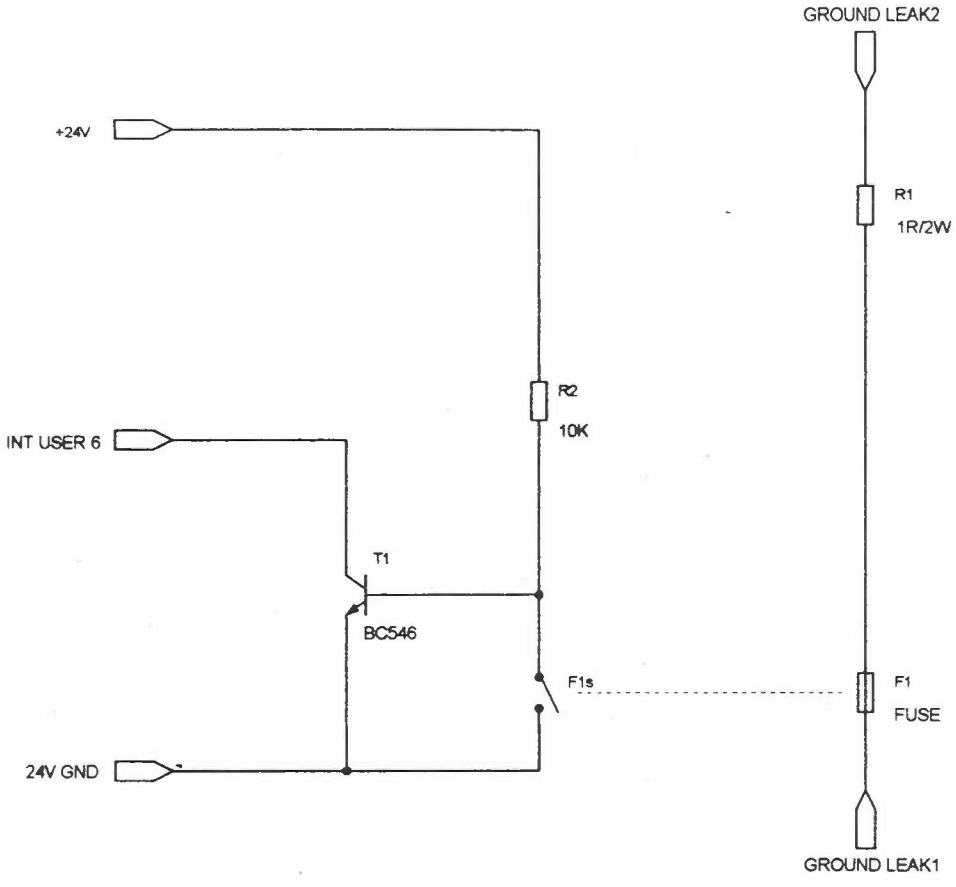
9. Change notes

Modification of GROUND LEAK



Ground leak fuse module is place on R5, the old ground leak resistor. This module uses one of the 6 user interlock to make an alarm if there is an error in ground leak circuit.
User interlock 6 on AC interface module P9 is not more available as external interlock.
If you got an active interlock indicated on user 6 in the power supply a failure in ground leak circuit is detected.

Modify by DANFYSIK dec. 1998.



ASSY 83960

SCH 83961

PCB 83962

GROUND LEAK FUSE MODULE SCHMATIC

SYSTEM 8800

DRAWN BY. 16.11.98 HKM

DESIGN APP. 17.11.98 HKM

PROD APP.

PROJ. ENGR.

DWG.NO.: 83961

DANFYSIK

CUSTM. INFN FRASCATI | ORDER NO. 10915 | REV. | SHEET. 1 OF 1

FILE. L:\PROJECT\10915\SCHEM\83961.DSN | DATE. Tuesday, November 17, 1998 | SIZE. A4

DK-4040 JYLLINGE DENMARK TELEPHONE +45 46 78 81 50 TELEFAX +45 46 73 15 51 E-MAIL DANFYSIK@DANFYSIK.DK

DANFYSIK A/S

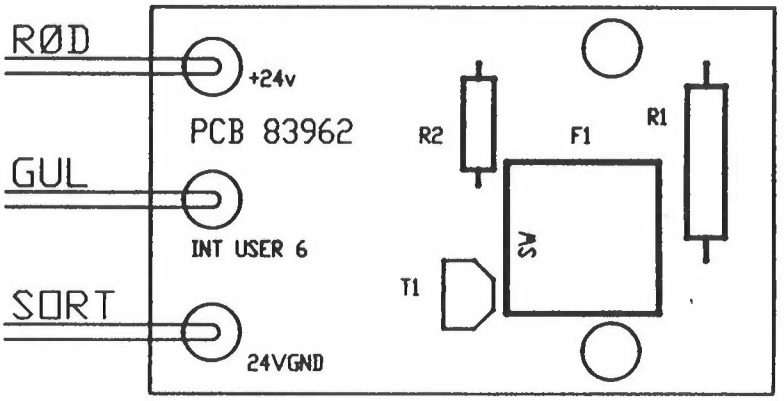
PAGE : 1
ISSUE : 1

PARTSLIST

PART NO.: P-83960
DESC....: GROUND LEAK /FUSE

STOCK.NO	ITEM NO.	PART/DWG NO.	VER	DESCRIPTION	MANUFAC.	NO. REQ
82083961		DWG 83961		GROUND LEAK /FUSE SCH		0,00
83083960		DWG 83960		GROUND LEAK /FUSE ASSY		0,00
84083962	PCB	PCB 83962		GROUND LEAK /FUSE PCB		1,00
21011546	T1	BC 546B	1	TRANSISTOR, NPN 80V 100mA	SIEMENS	1,00
11014100	R2	10K		RESISTOR 1% 1/4W	PHILIPS	1,00
11020010	R1	1R 2W		RESISTOR 5% 2W	PHILIPS	1,00
16083101	F1	FUSE/SW 1A	1	FUSE 1A AND SWITCH	SCHURTE	1,00
16083102	F1	F-HOLDER	1	FUSE HOLDER FOR P/N16083101	SCHURTE	1,00
51041000		PEARL S Ø3,0		STEATIT PEARL Ø3,0X3,0X1,0 (L	FRODE P	2,00
96000010		A 00010	1	PRINT AFPRØVNINGS TID + EVT. R	D.F.	4,00

Notat til varer : P-83960



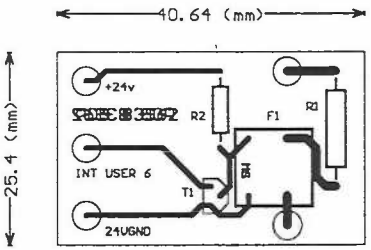
TOLERANCE: ±0.3	SURFACE TREATMENT: .	MATERIAL: .
SCALE: 2:1	MACHINING: .	

GROUND LEAK FUSE MODULE ASSEMBLY DRAWING SYSTEM 8800

DRAWN BY	MK 17.11.98
DESIGN APP.	. 17.11.98 HKM
PROD.APP.	.
PROJ.ENGR.	HKM
DWG.NO.:	83960

DANFYSIK	CUSTOMER: IFN FRASCATI	ORDER NO. 10915-08	REVISION: .	SHEET 1 OF
	FILE: .		DATE: .	SIZE: A4

IRST ANGLE ROJECTION


40.64 (mm)
25.4 (mm)
+24v
R2
F1
R1
INT USER 6
T1
24VGND

9. Change notes

10. Parts Lists

PCB

Main Parts List	F-4546,19-03 & F-4546,19-02
Unit MPS 883	P-83168 (1)
Control Module	P-83170 (1)
Control Board	P-83146 B (2)
SMPC Module	P-83173 (1)
SMPC Reg. Board	P-83196 (5)
Filter for SMPC	P-83199 (1)
LEM DCCT Board	P-83399 (1)
Heatzink for 3-Phase Choke	P-83259 (1)
AC Input Module	P-83172 (2)
AC Interface Board	P-83162 (2)