GTEC UPS MODEL:

SATURN 10 – 20 kVA

Transformerless UPS

SERVICE MANUAL

www.gtec-power.eu

Contents

1 INTRODUCTION

This document aims to provide a simple guide for the maintenance and/or troubleshooting of the following ranges of UPS: SATURN 3/3 10-12-15-20kVA (three-phase out., 2x[20+20]batt, SATURN 3/1 10-12-15-20kVA (single-phase out., 2x[20+20]batt).

ALL OPERATIONS MUST EXCLUSIVELY BE CARRIED OUT BY QUALIFIED AND TRAINED PERSONNEL.

2 SOFTWARE OPERATIONS

2.1 SAVING THE UPS LOG FILE

This should be performed before any operation is carried out on the UPS.

To save the log file use the GpDownload application provided with the UcomGp software. Please read the instructions for this application for the correct procedure to be followed.

IMPORTANT:

In the event you need to save log files for a UPS that is visibly damaged (i.e. displaying clear damage to the power boards), we recommend you follow the **safety procedure** (in order to avoid the DC capacitor bank pre-loading stage).

With the UPS fully switched off,

for **SINGLE INPUT UPS:**

- locate the input filter boardB0186 (or additional part of B0055 on three-phase UPS made before 2013, or additional part of B0106 for single-phase UPS made before 2013), and remove the hanging connections from connectors J4, J5, J6, (see Fig. 39 on page 56).
- close the SWIN and save the log file.

for **DUAL INPUT UPS:**

- simply close the SWBYP and save the log file.

2.2 CONFIGURING THE UPS

To configure the UPS, use the dedicated UcomGp software. Please read the dedicated manual for this software for instructions about this application and the correct procedure to be followed.

2.3 UcomGp SOFTWARE

UComGP is a package of applications for the advanced analysis of log files and real-time diagnostics for UPS belonging to the Multi Sentry ranges (from 10kVA to 120 kVA).
Communication between PC and UPS, for the applications that require it, takes place via serial communication port RS232.
The package is currently comprised of seven different applications:

- GpDownload – Log Downloader
- GpHistory – Log Analyzer
- GpEvent – Event Analyzer
- GpRealTime – Status Analyzer
- GpDebug – UPS Debugger
- GpCalibrate – UPS Calibrator
- GpConfig – UPS Configuration tool

For further information on the applications listed above please see:

- UCOMGP Manual RM900
- UCOMGP Configuration tool Manual RM901

2.4 UPDATING THE FIRMWARE

In order to update the firmware, the dedicated "**YSATURN 3/3PRGA (MICRO SATURN 3/3 & DSP PROGRAMMING KIT)**" kit must be used to program the microprocessor and/or DSP. Please see the instructions for this application, attached to the kit.

The firmware to be used is the following:

Firmware	µProcessor	DSP
SATURN 3/3	FW022-xxxx	FW023-xxxx
SATURN 3/1	FW028-xxxx	FW029-xxxx

3 SWITCHING THE UPS ON/OFF

See the instruction manual before carrying out any operations on the machine.

3.1 SWITCHING OFF THE UPS WHILST DELIVERING POWER TO THE LOAD

In the event of a single UPS follow these steps:

1) Close the SWMB
2) Set the UPS to stand-by using the display
3) Open the SWOUT, SWBATT, SWIN and SWBY (if present)
4) Set the 1/0 switch to 0 (if present)
5) Wait for the display to shut down
6) Open all battery fuses

In the event of a UPS operating as part of a parallel system follow these steps:

1) Open the SWOUT, SWBATT, SWIN and SWBY (if present)
2) Wait for the display to shut down
3) Set the 1/0 switch to 0 (if present)
4) Disconnect the RJ45 cables from the parallel board (refer to parallel manual 0MNSATURN 3/3PAR…)

3.2 SWITCHING OFF THE UPS WHILST CUTTING OFF THE POWER SUPPLY TO THE LOAD

1) Set the UPS to stand-by using the display
2) Open the SWIN, SWBY (if present) and SWOUT
3) Set the 1/0 switch to 0 (if present)
4) Wait for the display to shut down
5) Open all battery fuses

3.3 RESTARTING THE UPS

1) Set the 1/0 switch to 1 (if present)
2) Close all battery fuses
3) Close the SWIN, SWBY (if present) and SWOUT
4) IMPORTANT: Switch the UPS on by entering and confirming SYSTEM ON using the display
5) If closed, open the SWMB

3.4 STARTING THE UPS FROM THE BATTERY

Important: this type of start-up should only be carried out if mains power is down and ONLY with the SWMB switch open. Start-up with the SWMB closed is only possible on UPS with a separate bypass option and where the bypass line is present.
NOTE: the minimum voltage for battery start-up is 236Vdc (11.8V for monoblock).

1) Set the 1/0 switch to 1 (if present)
2) Close all battery fuses
3) Close the SWIN, SWBY (if present) and SWOUT
4) Press and hold down the "cold start" button
5) Switch the UPS on by entering and confirming SYSTEM ON using the display

3.5 ADDITIONAL SERVICE OPERATIONS

Additional service operations are available using the dedicated UCOMGP software. See the application manual for further details.

4 UPS INTERNAL STRUCTURE

4.1 GENERAL DESCRIPTION

This section describes the internal structure of UPS models: SATURN 3/1 and SATURN 3/3.

The SATURN 3/1 is the same as the (same circuit boards), except for its enclosure, which allows it to hold twice the amount of internal batteries.

On the SATURN 3/3 there are three input boards B0052, three power boards B0053, an inverter output board B0054, a terminal board B0055, an input filter board B0186 (or additional part of board B0055 for three-phase UPS made before 2013), and two Cy filter boards B0098 for the input and output terminals.

On the SATURN 3/1 there are three input boards B0104, three power boards B0053, a bypass board B0105, an inverter output board B0054, a terminal board B0106 and an input filter board B0186 (or additional part of board B0106 for three-phase UPS made before 2013)

The remaining boards are identical for the 4 sizes/models.

The auxiliary power supplies board (B0059) generates the power supplies for the entire UPS and also provides all the auxiliary services to the boards.

The DSP+uP board (B0067), with two processors, is connected to the signal adaptor board (B0051) and supervises the entire operation of the UPS (**IMPORTANT**: the firmware for SATURN 3/3 and SATURN 3/1 is different, for correct programming see the previous section “Updating the Firmware”).

Lastly, there are the battery charger (B0060), display (B0057) and interface (B0056) boards.

IMPORTANT: in the event that some boards are replaced, the codes given on the replacement boards will be different to those on the original boards. Check with UPSERVICE for the correct correspondence between the two versions.

4.2 TABLE OF BATTERY FUSES

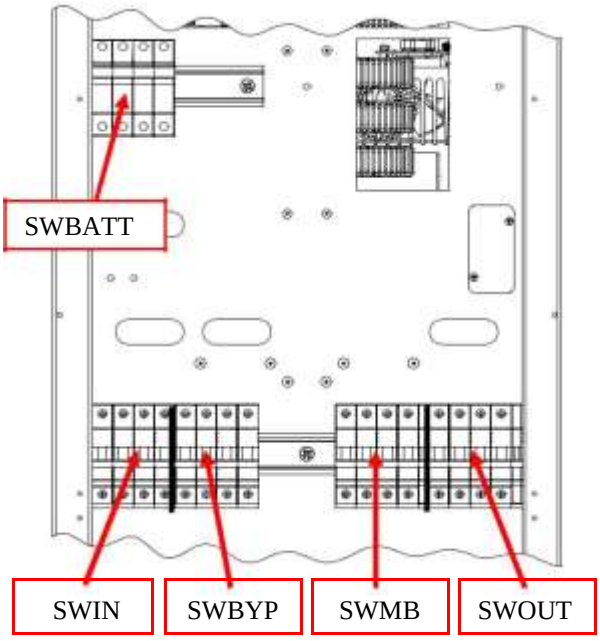
There are 4 fuses accessible behind the UPS door and these vary according to size. Refer to the table below for replacing fuses.

UPS size	Fuse type
10 kVA	32A gG 400V (10x38)
12 kVA	32A gG 400V (10x38)
15 kVA	50A gG 400V (14x51)
20kVA	50A gG 400V (14x51)

IMPORTANT: if the battery fuses are to be replaced due to the previous incorrect connection of a battery box, check the anti-inversion diodes on the terminals board.

4.3 DISCONNECTION SWITCH POSITIONS

SATURN 3/3 10-12kVA



SATURN 3/3 15-20kVA

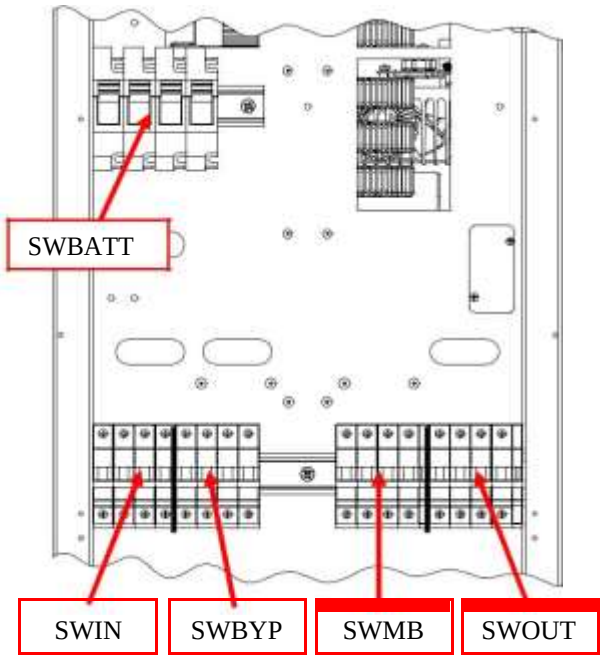
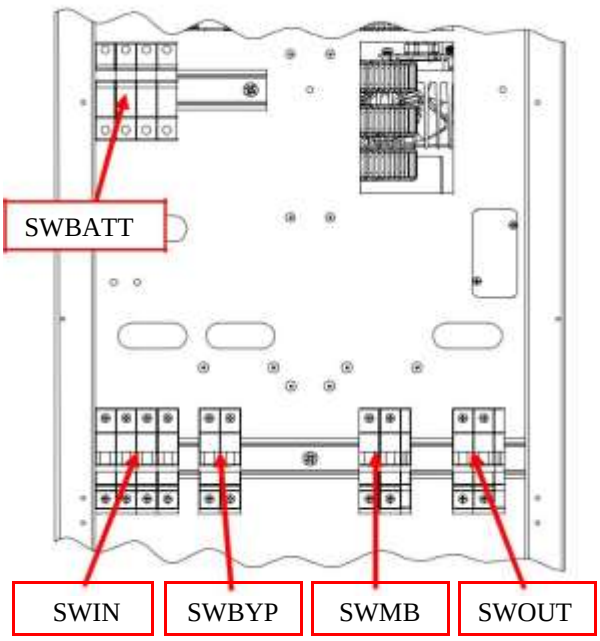


Fig. 3

SATURN 3/1 10-12kVA



SATURN 3/1 15-20kVA

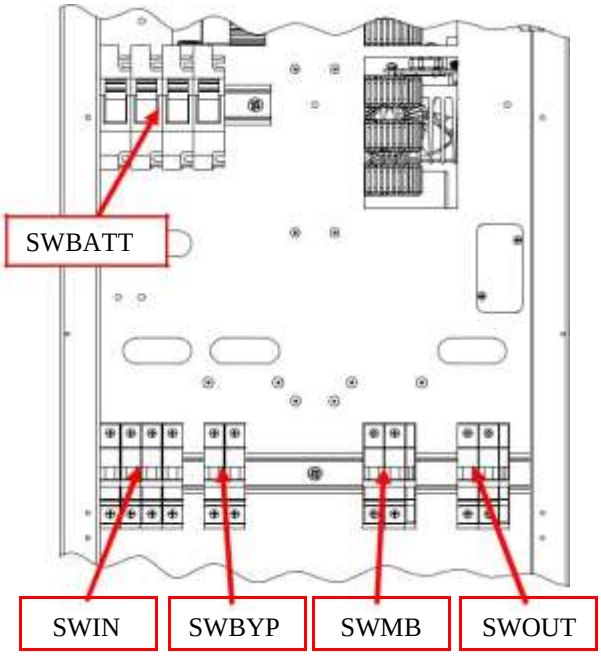


Fig. 4

NOTE: the auxiliary contact on both the SWOUT and SWMB disconnection switches is normally closed (NC) (with the disconnection switch open).

SATURN 3/1 10-12

SATURN
3/1 15-20

Fig. 5

SATURN 3/3 10-12

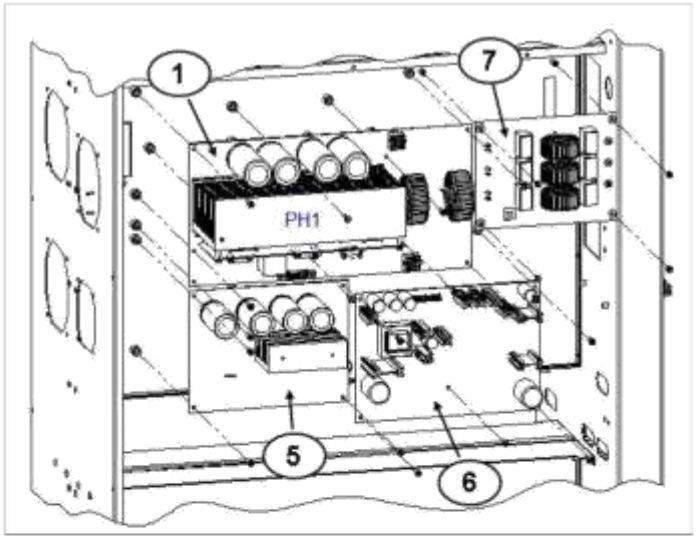
SATURN
3/3 15-20

Fig. 6

4.4 BOARD POSITIONS INSIDE THE MACHINE:

1) phase 1 power assembly
2) phase 2 power assembly
3) phase 3 power assembly
4) inverter output (LC filters)
5) battery charger
6) auxiliary power supplies
7) input filter

SATURN 3/1 - - SATURN 3/3



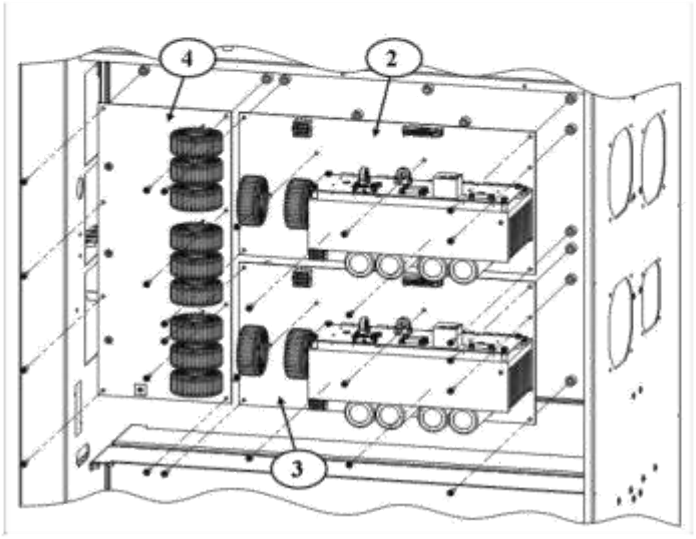


Fig. 7

NOTE: On SATURN 3/3 the phase 1, 2, 3 power assemblies include one B0053 board and one B0052 board secured to the heatsink.

On SATURN 3/1 the phase 1, 2, 3 power assemblies include one B0053 board and one B0104 board secured to the heatsink; the phase 1 also contains board B0105, which is also secured to the heatsink and is connected to board B0104.

8) terminals (battery expansion) - input - separate bypass - output

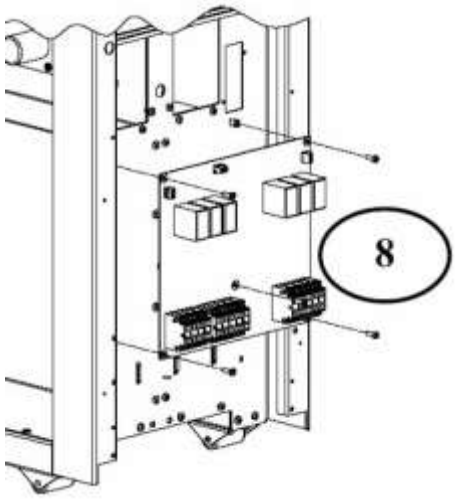
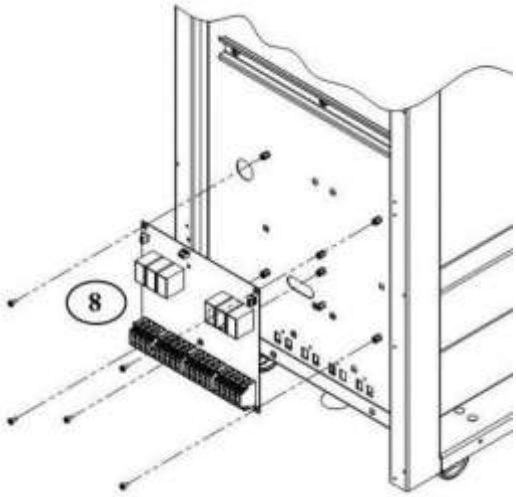
SATURN 3/1	SATURN 3/3
	

Fig. 8

9) control board
10) multi-processor board
11) RS232 - USB - AS400 - power share interface

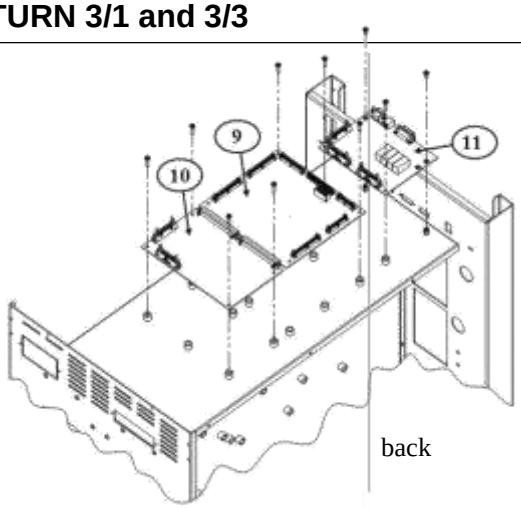
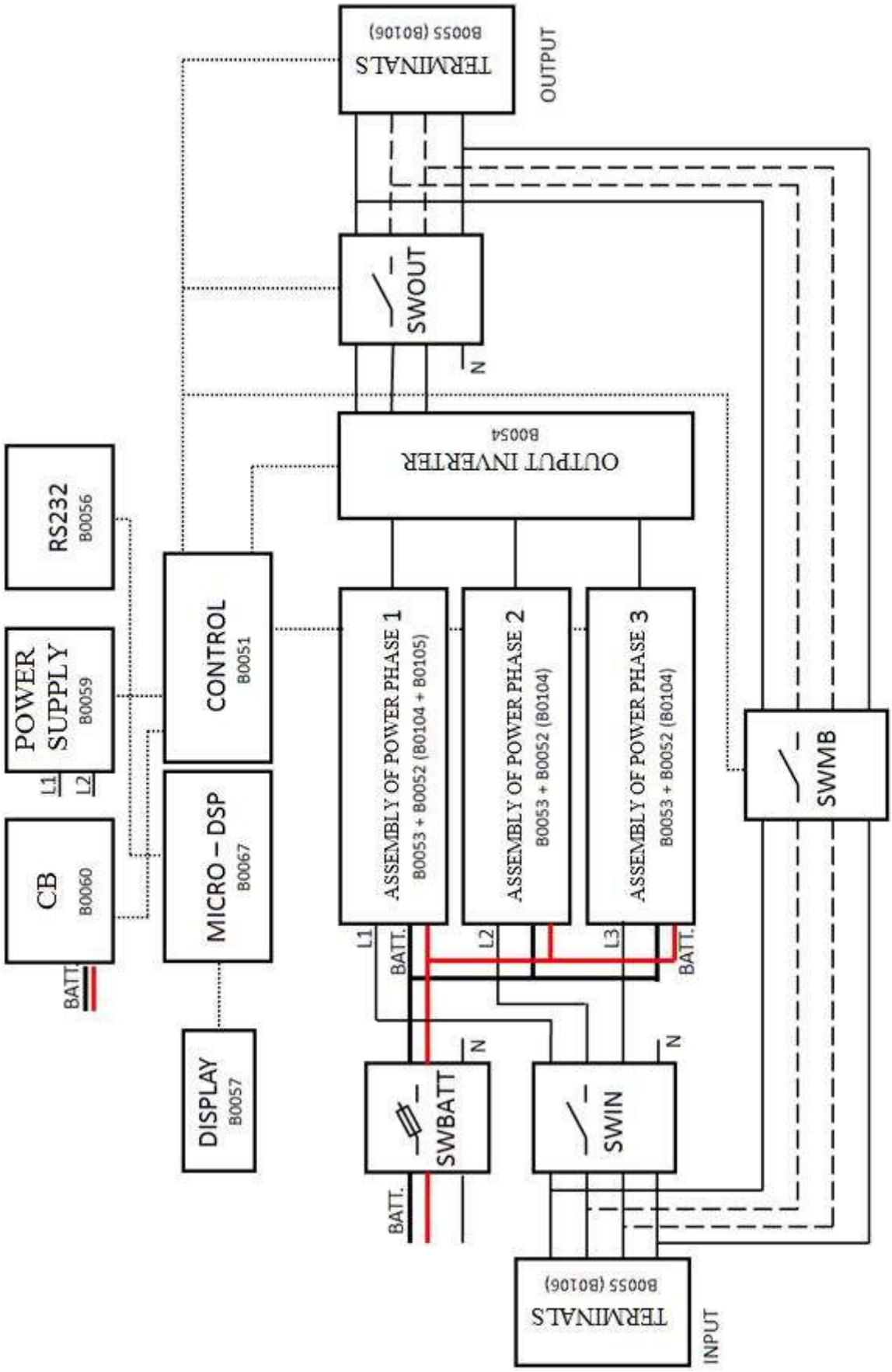
SATURN 3/1 and 3/3


Fig. 9

4.5 UPS BLOCK DIAGRAM



4.6 BLOCK DIAGRAM OF SINGLE PHASE SATURN 3/3

The diagram below shows the basic layout of one phase of the SATURN 3/3 with the main elements mounted on the boards.

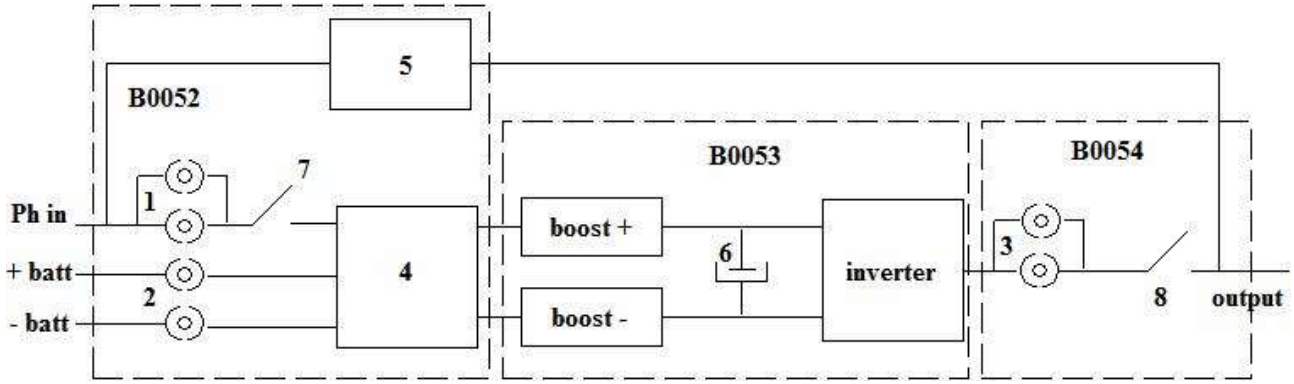


Fig. 10

4.7 BLOCK DIAGRAM OF SINGLE PHASE SATURN 3/1

The diagram below shows the basic layout of one phase of the SATURN 3/1 with the main elements mounted on the boards. The only difference with respect to the SATURN 3/3 model is the input-bypass stage made up of 3 input boards (one for each phase) and one bypass.

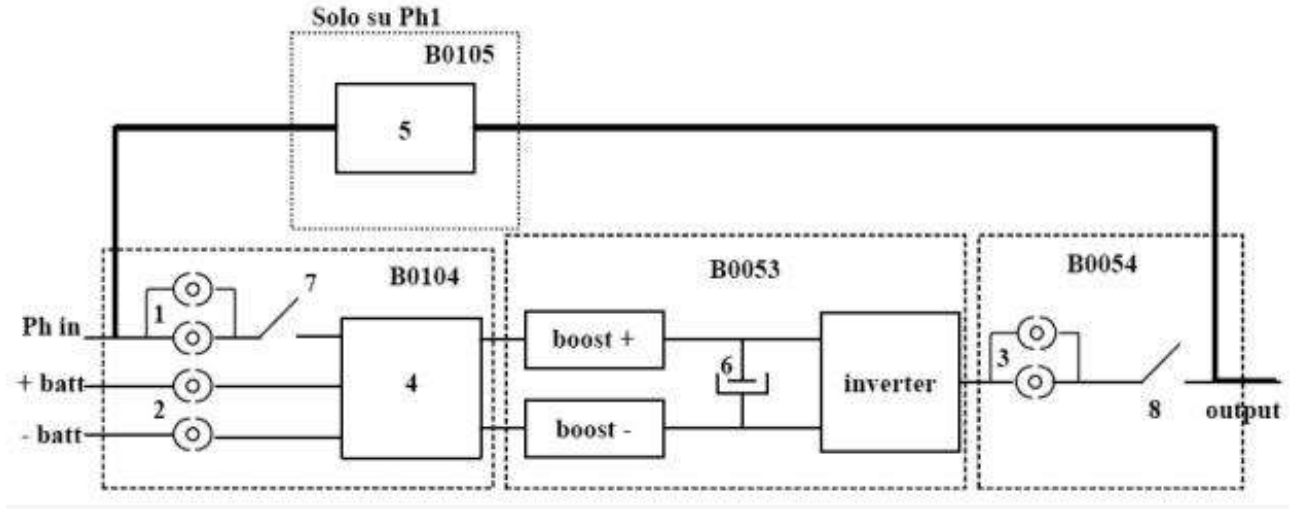
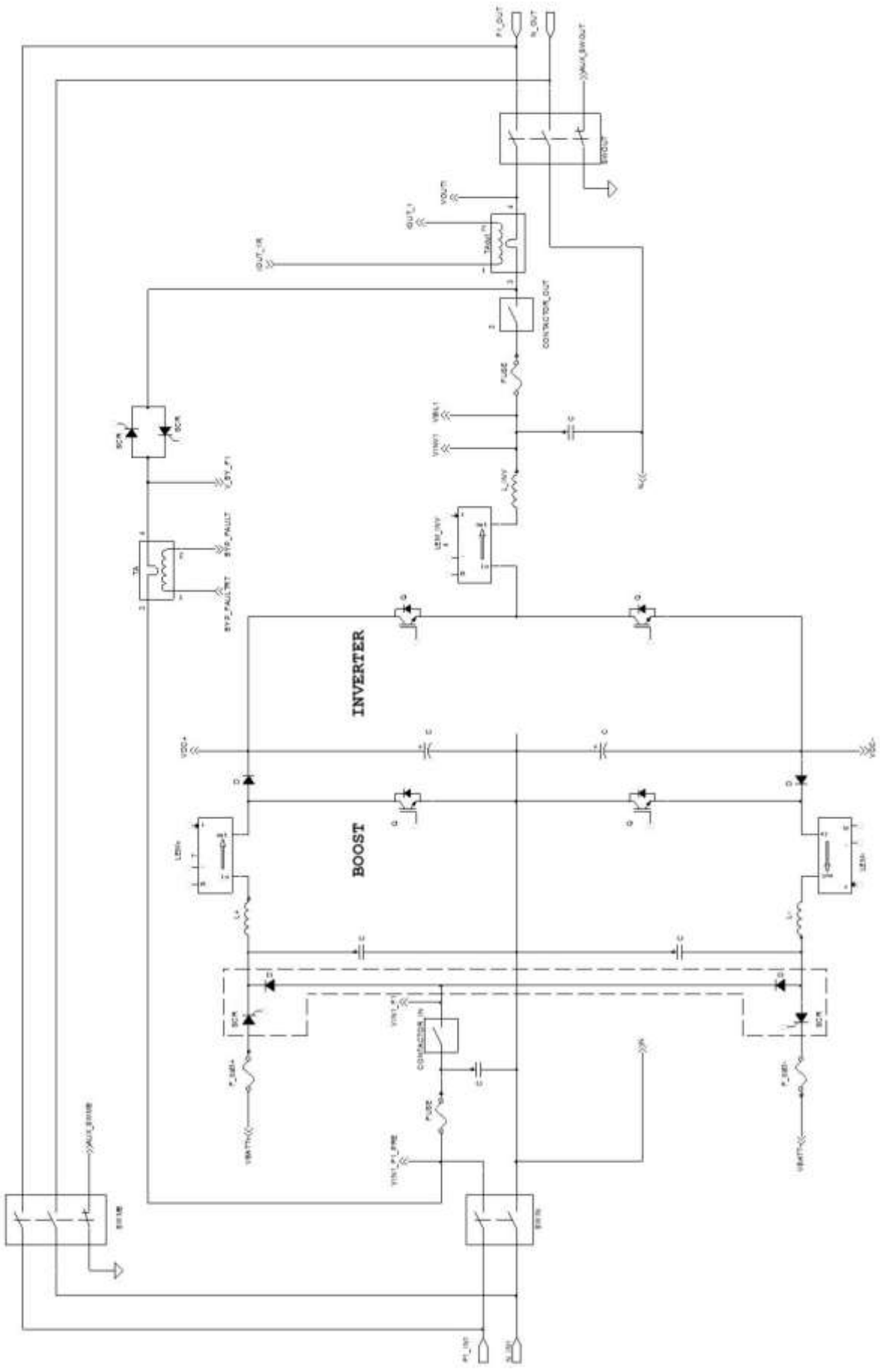


Fig. 11

Key (equivalent for every version):

1) input fuses 10 - 12 kVA 25A FF 500V (6.3x32)
   15 - 20 kVA 2 x 20A FF 500V (6.3x32)
2) battery fuses 10 - 12 kVA 20A FF 500V (6.3x32)
   15 - 20 kVA 20A FF 500V (6.3x32)
3) output fuses 10 - 12 kVA 25A FF 500V (6.3x32)
   15 - 20 kVA 2 x 20A FF 500V (6.3x32)
4) input stage with rectifying diodes and battery SCR in Semitop module
5) Bypass SCR module
6) electrolytic capacitor bank
7) input relay
8) inverter relay

4.8 SINGLE PHASE ELECTRICAL DIAGRAM



5 AUXILIARY POWER SUPPLY FAILURE (L01)

5.1 TESTS

Board B0059 is supplied from 4 different power sources:

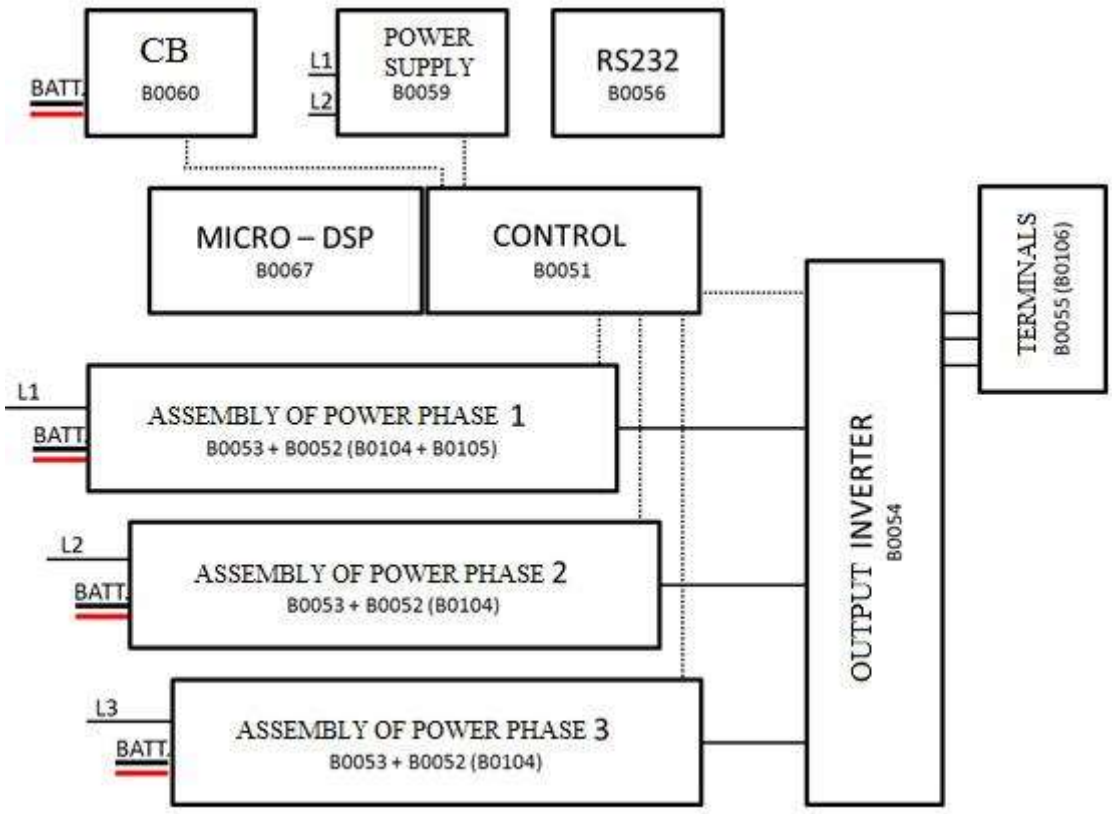
- phase 1 of the input mains power;
- phase 2 of the input mains power or the bypass input mains power if the UPS is dual input (this power source is also used for the redundant power supply of the static bypass);
- direct current from the DC capacitor bank;
- battery voltage for battery start.

Board B0059 generates different voltages for supplying the different parts of the UPS. We can therefore distinguish between:

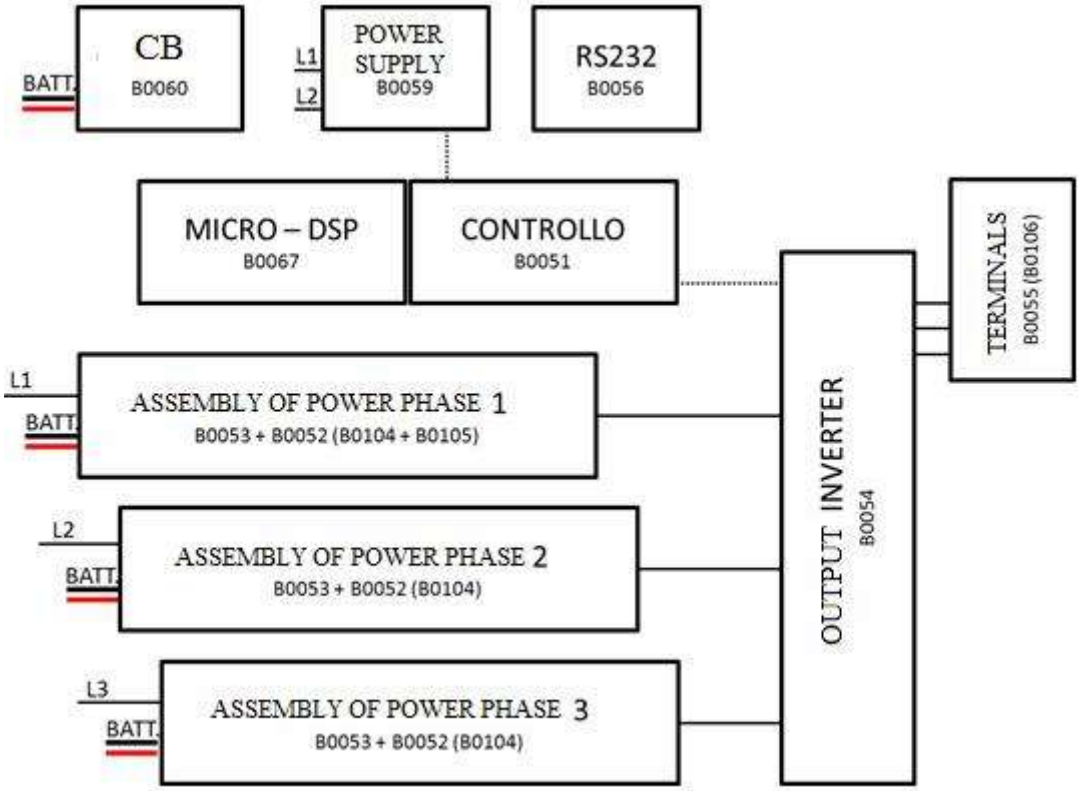
- ±15V voltage (for the booster, battery and inverter LEM)
- ±12V voltage (analogue part of control board B0051 and balancing circuit for direct current at inverter output board B0054)
- regulated 24V voltage (for the fans, from a separate circuit that takes up current from the negative capacitor bank)
- HF voltage (27V 50KHz) for the battery SCR (square wave)
- HF voltage (27V 50KHz) for the bypass SCR (square wave)
- HF voltage (27V 100KHz) for the isolated power supplies for the power stages (IGBT booster and inverter), for the power supply of the electronics on board RS232 (B0056) and for the battery charger board (B0060).

In the diagrams below the dotted line shows the route of each single power supply.

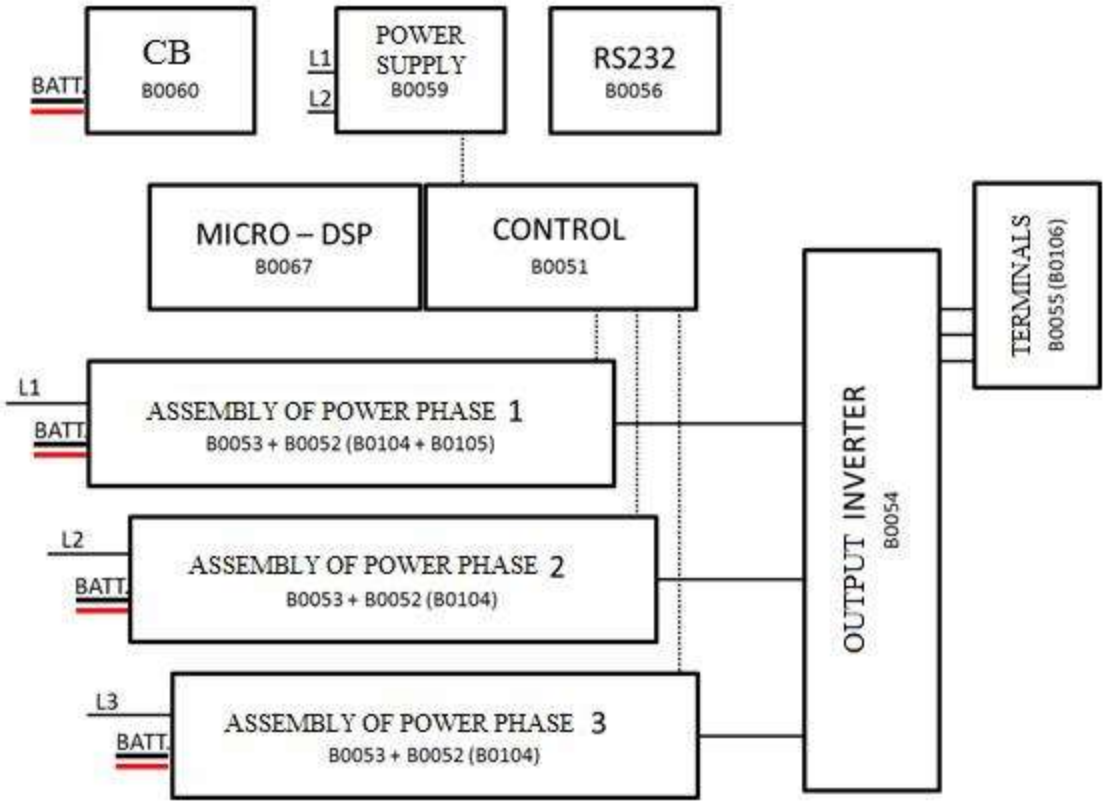
5.2 ±15V – LEM POWER SUPPLY



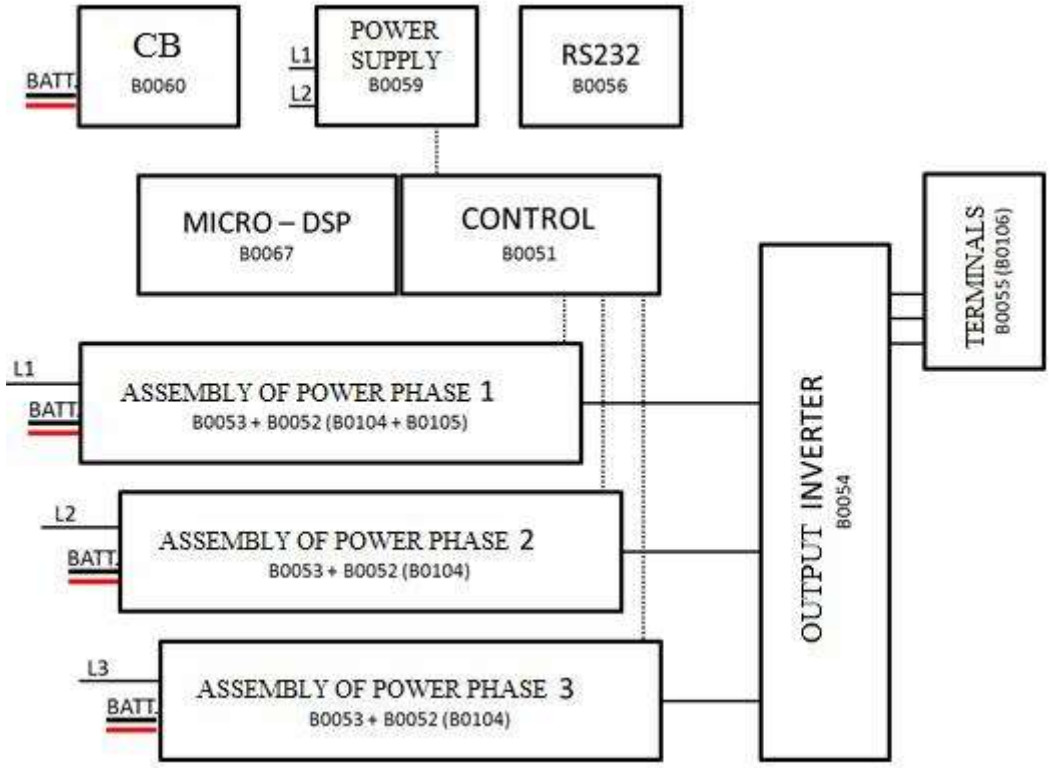
5.3 12V POWER SUPPLY – ANALOGUE PART OF CONTROL BOARD



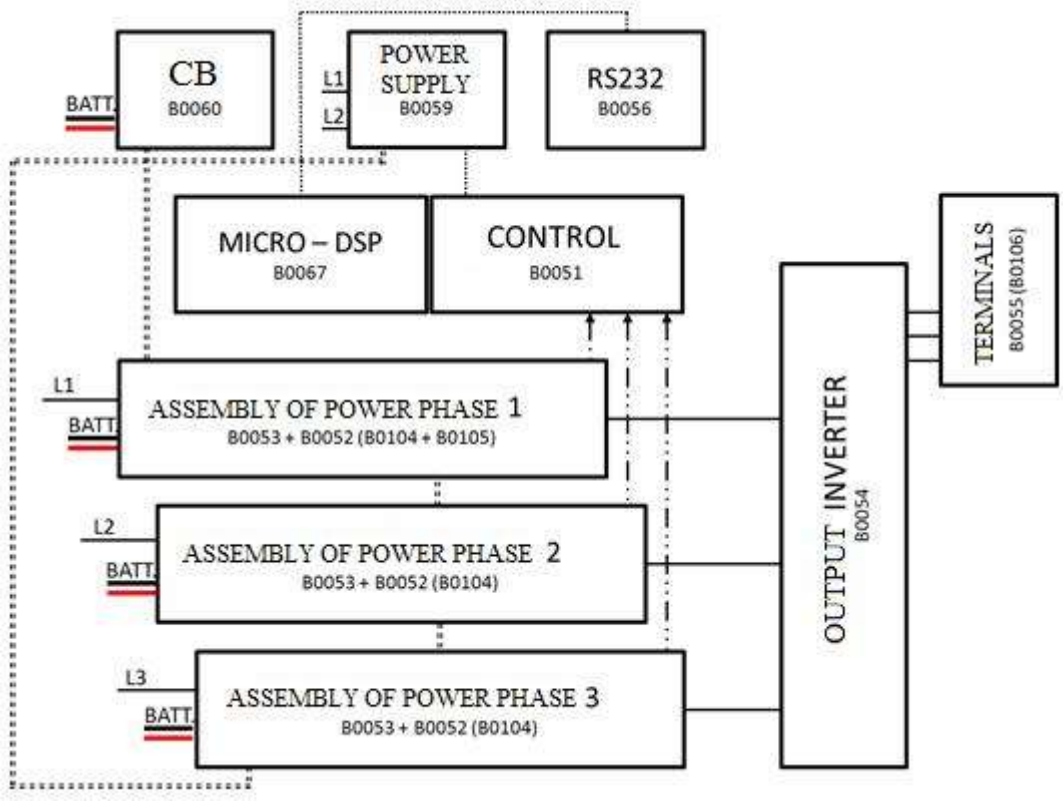
5.4 24V POWER SUPPLY FOR FANS (regulated)



5.5 HF 50KHz POWER SUPPLY FOR BATTERY AND BYPASS SCR



5.6 HF 100KHz POWER SUPPLY FOR POWER STAGES AND RS232



5.7 OVERVIEW OF AUXILIARY POWER SUPPLIES – OBSERVATIONS.

All auxiliary power lines, **except** the HF line for the power stages, first pass through the control board, and are distributed from here to the various parts of the UPS via flat connection cables.

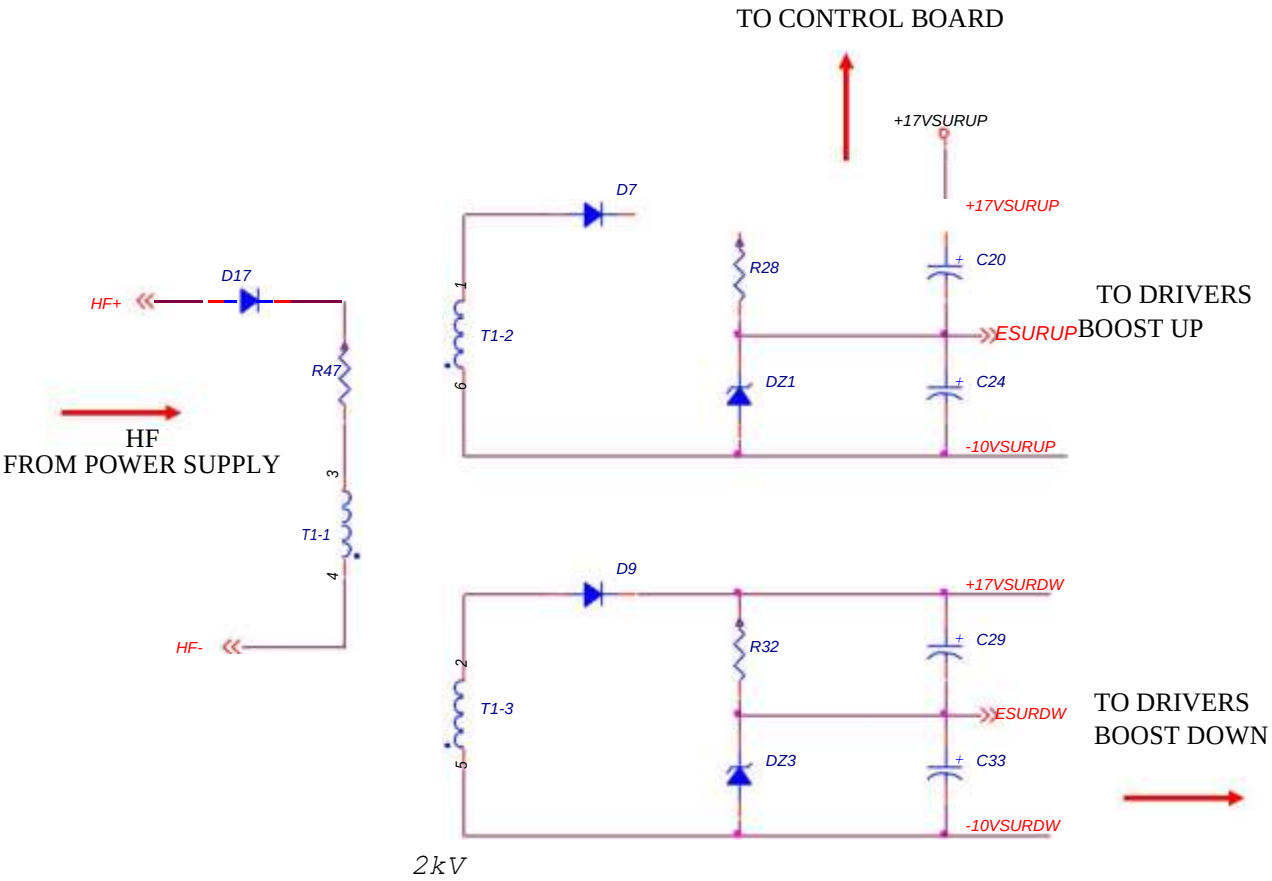
The HF line for the power stages, battery charger and for RS232 deserves particular attention.

This power supply line runs **directly** to the power boards and battery charger over the same plug in connector wiring that carries the 400V direct current without passing through the control board (B0051):

- power boards B0053 supply the primary circuit of the **base drives** (isolation transformers) whose secondary circuit is connected to the booster and inverter drivers.
- a signal is generated from the base drive secondary circuit for the positive boost of each power board B0053, which arrives directly at the control board.
- the battery charger supplies the base drive for the buck up and down IGBTs.

Another line of the same power supply leaves the power supply unit and reaches board RS232 (B0056), passing through the control board and DSP micro board (B0067).

BASE DRIVE ON POWER BOARD

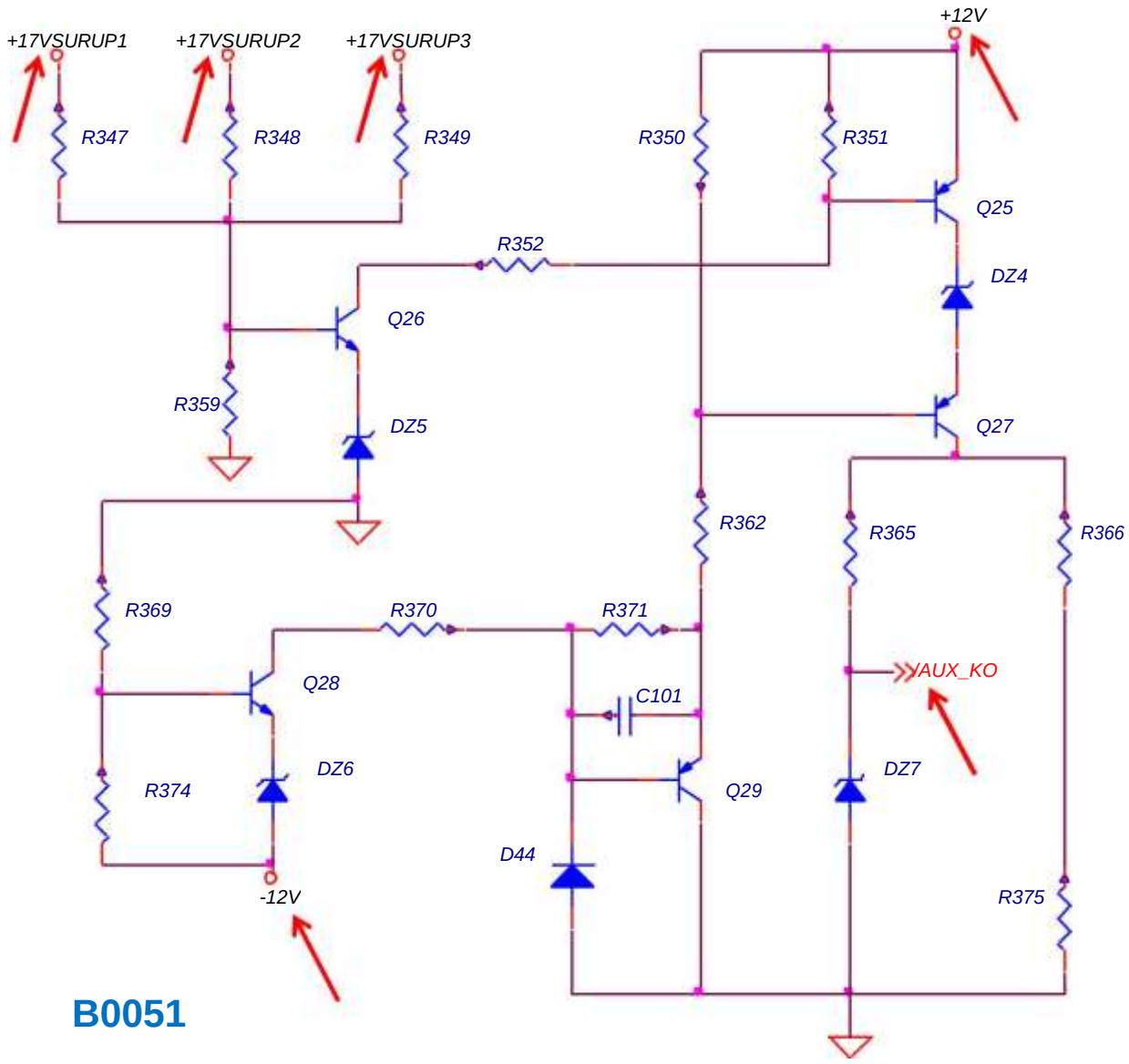


5.8 “AUX KO” (L01) DETECTION LOGIC

A logic test is carried out on the control board to check whether the auxiliary power supplies are present and correct. The test is performed:

- on +12V, -12V voltages (for the analogue part of the control board);
- on the HF voltages derived from the base drive secondary circuit of the positive boost of power boards B0053 for each phase.

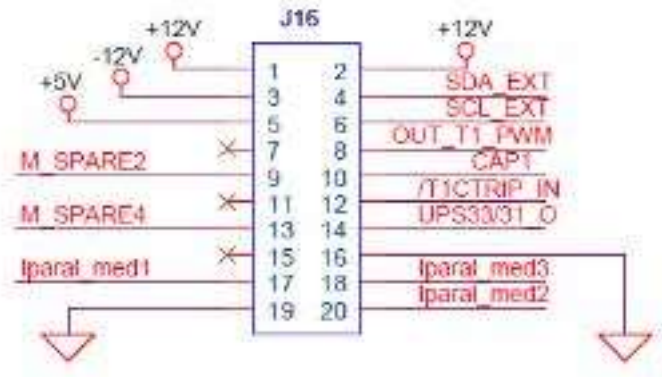
If all the power supplies are correct, the UPS starts up; if the logic AND gives a negative result, the machine stops and displays L01.



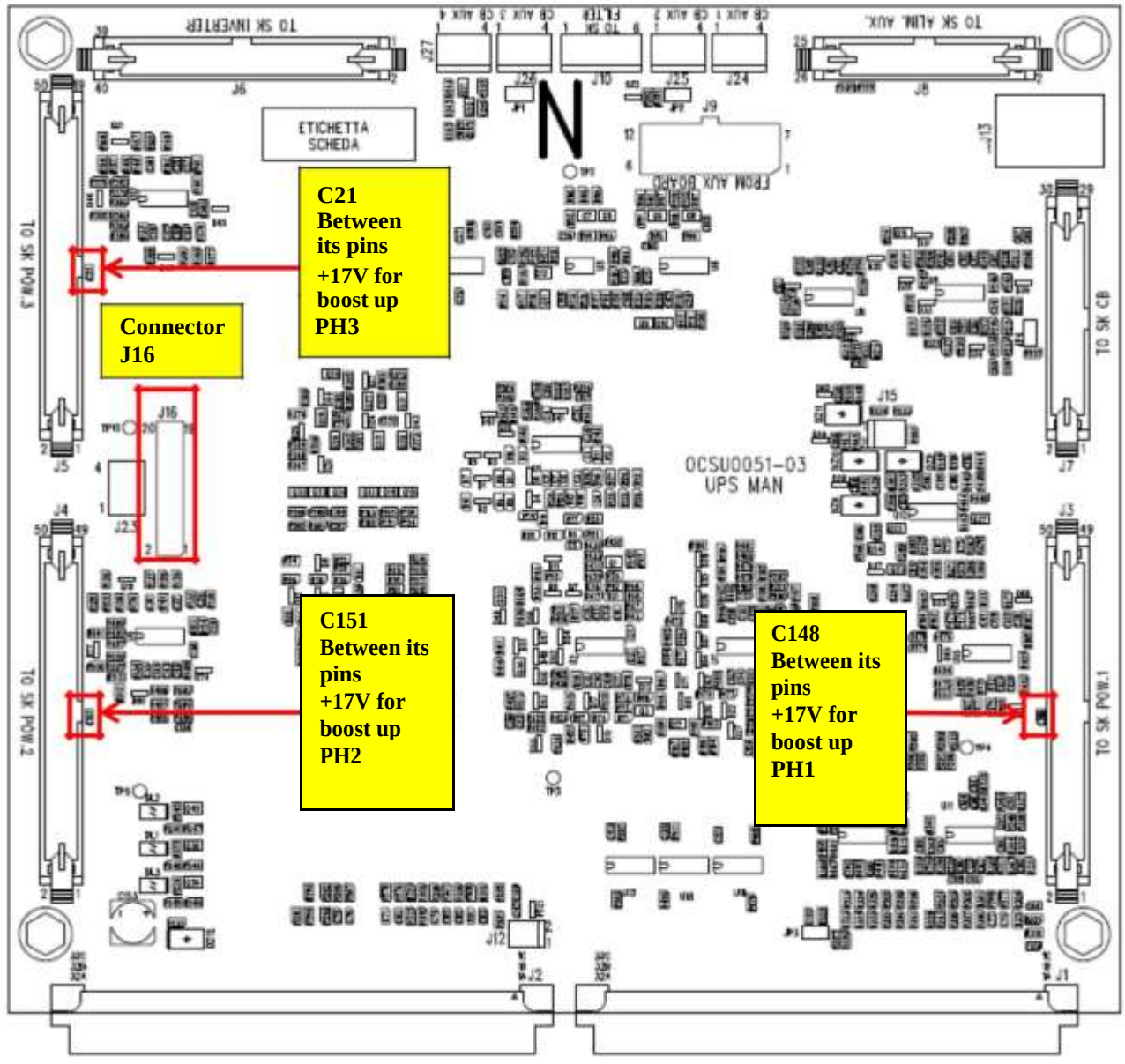
The difficulty in resolving this kind of fault lies in identifying the cause of the problem. In particular it is necessary to understand why the control logic of board B0051 has failed (the failure is not necessarily due to an incorrect voltage supplied by the power supply unit).

5.9 CHECK AUX VOLTAGE (L01)

To understand the problem about the L01 alarm, is necessary to check the voltage/s not present. So, is possible to measure, on control board B0051, these points (with UPS in standby mode):

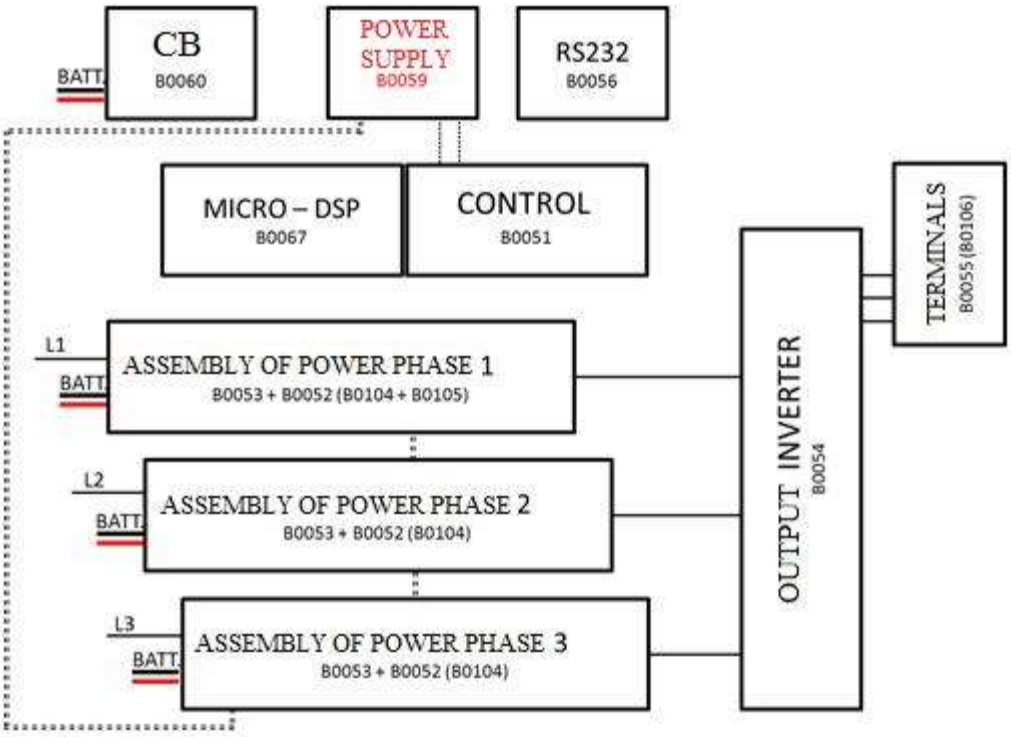


On connector J16 on board B0051 between the pins
1 & 19 → +12V
3 & 19 → -12V



If on the board B0051 is present the coating, is necessary to remove it on pins of the component before taking measurements.

5.10 POWER SUPPLY UNIT FAULT

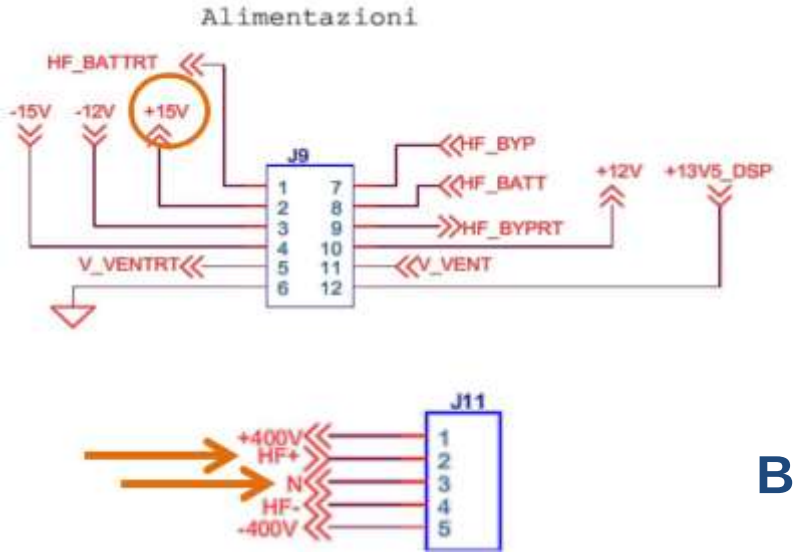


OBSERVATIONS

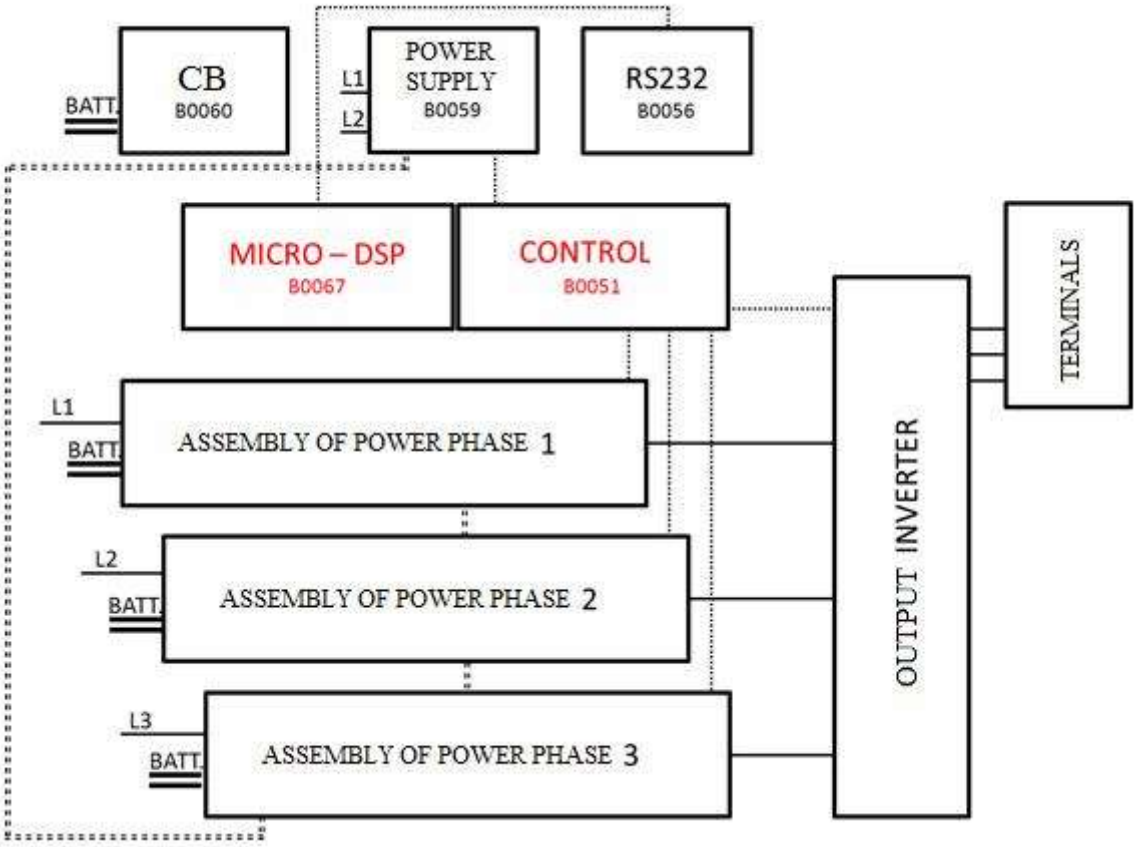
If the auxiliary power supply unit ceases to provide the correct power supply (i.e. the 12V or HF supplies), the logic board stops the UPS and displays error L01.

In the most serious cases the machine may not switch on if the voltage supplied from the power supply unit is insufficient to activate the logic board.

The presence of power supply voltages can be checked directly on board B0059 by disconnecting connector J9 (**with the UPS completely switched off**) and leaving J11 connected closing the SWIN. Check for the presence of power supply voltages and, if possible, the presence of the HF+ supply (measuring between HF+ and N with the multimeter in DC mode, the reading should be approx. 27V).
In the event of missing or incorrect power supplies, replace board B0059.



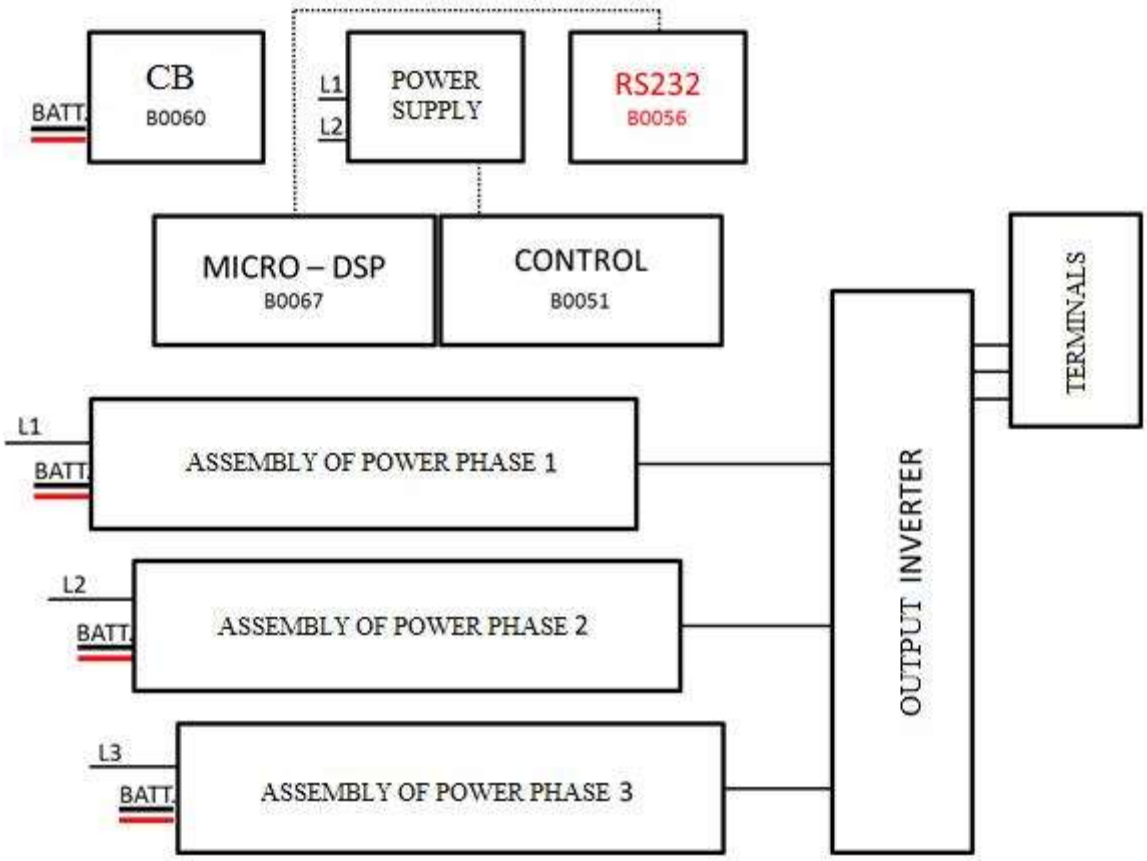
5.11 MICRO DSP / CONTROL BOARD FAILURE



It is possible that a fault at the logic boards, which affects an integrated circuit, may produce error L01 due to an error in the auxiliary power supplies test.

In addition, it is possible that the failure of particular components could lead to the absorption of a strong current at the 100KHz HF power supply circuit and damage the fuse resistors on the power boards (see following section 6.2). It is therefore necessary to continue with the fault analysis using the tests detailed in the following chapter 6.2. It is also possible that the fault impacts the power supply unit board as well, causing the protections to blow (see the section 5.10 on power supply unit failure).

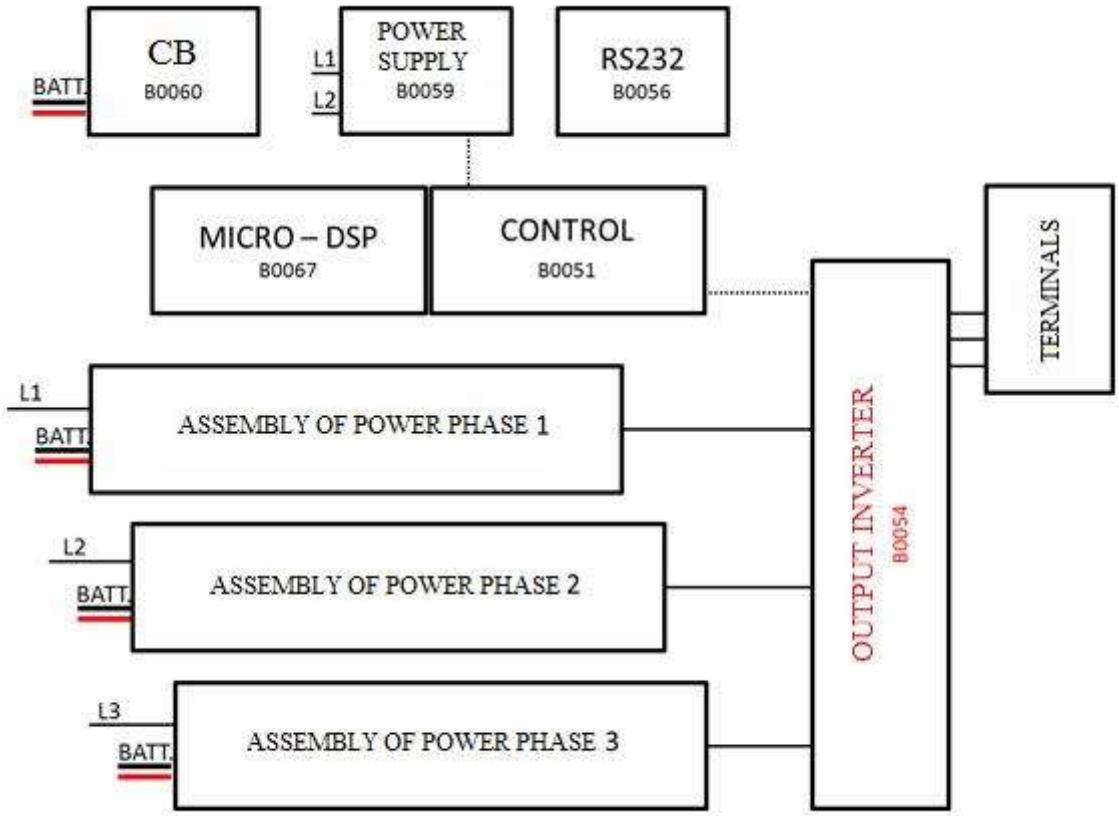
5.12 BOARD RS232 FAILURE



The failure of a component of board RS232 (supplied by a HF line directly through the control board and DSP micro board) could cause error L01. Often, in the event of the failure of this board, the UPS also signals that the EPO is disconnected, or that a remote command is present (in reality this is a false command generated by the fault).

A serious fault may also damage the power supply unit, which should, if necessary, be replaced along with board RS232.

5.13 INVERTER OUTPUT BOARD FAILURE



A short circuited current sensor (LEM) at the inverter output board may absorb too much current and may also damage the control board and flat connection cable.

The LEM are supplied at ±15V and the power supply line is quite robust, so much so that the control board can sometimes overheat near the connector that leads to the inverter output. A similar result may arise due to a failure at the direct current output balancing circuit (supplied at 12V). In this case the two boards and connection cable should be replaced.

Following a failure at the power supply board or strong interference in the input mains power (i.e. the disconnection of the neutral), the 0Ω fuse resistor that connects the UPS logic to GND may blow. In this case, there is no actual problem at the auxiliary power supplies; however, the logic is no longer working correctly and typically displays error L01 (i.e. the result of the first check that the UPS carries out upon start-up). The problem can be resolved by changing the fuse resistor or replacing the inverter output board. This resistor is R40 on board B0054

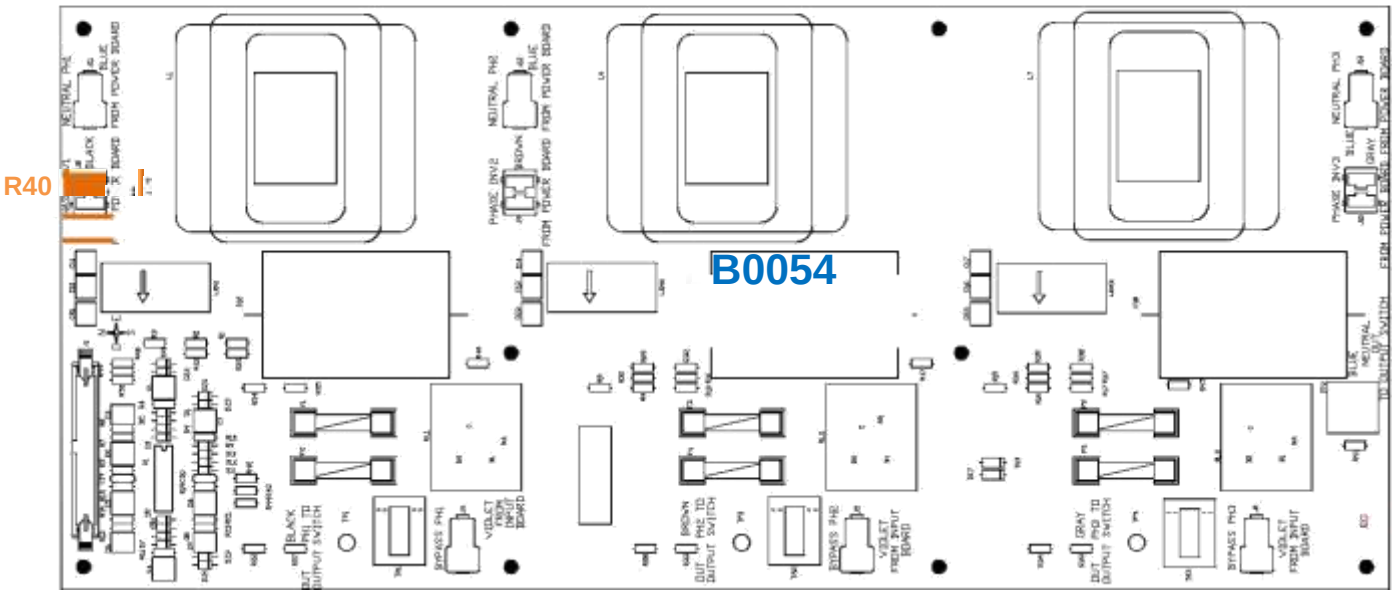
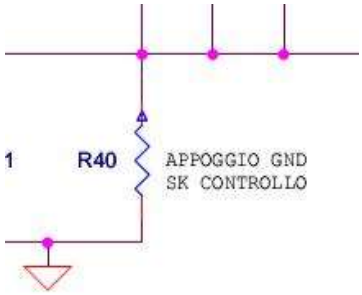


Fig. 12



5.14 FAN FAILURE

The presence of a blocked fan or a fan with a short circuit winding may damage the power supply unit board. It may occur that after replacing the power supply unit board, it fails once again because the problem at the fan persists. It is therefore advisable to note that a dual failure of the power supply unit board may be caused by a blocked fan.

A short circuit at one of the fans may also lead to the overheating of the tracks on the control board, in the same way as described for a failure at the inverter output LEM.

6 COMPONENT TESTS FOLLOWING THE FAILURE OF THE POWER ASSEMBLY

Following visible damage inside the UPS that requires the replacement of a power assembly, it is also necessary to check the status of all the other power boards (even if they appear not to be damaged).

1) Open all disconnecting switches. **IMPORTANT:** it is very important that all battery disconnecting switches are open. Disconnect any internal batteries.
2) **IMPORTANT:** completely disconnect the UPS from any power supply, including any battery boxes, other UPS in parallel or other power sources. Make sure there is no voltage present.
3) Discharge the DC capacitor bank and wait 10-15 minutes for the voltage in the bank to reach a level close to 0V.

6.1 TESTS FOR POWER INPUT BOARD (B0052 or B0104)

Always check:

1. the status of the mains power input fuses (see Fig. 24 on page37 or Fig. 36 on page 53).
2. the status of the positive branch battery fuses and negative branch battery fuses (see Fig. 24 on page 37 or Fig. 36 on page 53).
3. use a multimeter to check that the contacts of relay RL1 are not short circuited between NO and COM).

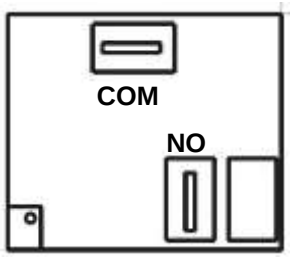


Fig. 13

The fuses should be replaced if they are damaged and the additional tests described in the next section should be carried out.

If the relay contacts are short circuited, board B0052 or B0104 must be replaced.

6.2 TESTS FOR POWER BOARD (B0053) AND INPUT POWER BOARD (B0052 OR B0104).

1) Disconnect the hanging wires from connectors J6, J7 and J8 on boards B0053 for all phases

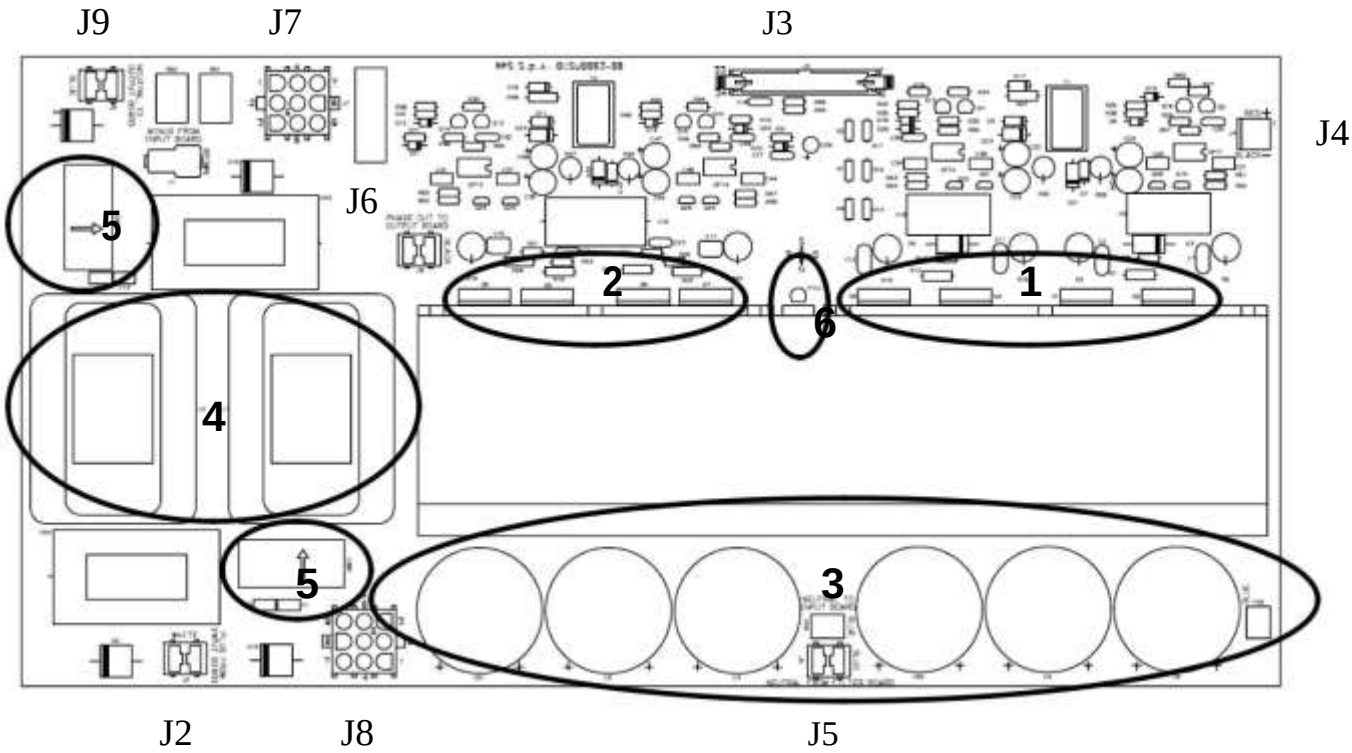


Fig. 14

2) Using a multimeter set to ohmmeter mode, check that there are no short circuits between J7-pin6 and J7-pin3 **&** J7-pin6 and J7-pin9.

3) Using a multimeter set to diode test mode, check that the semitop modules (B0052 or B0104, B0105) are OK. In the event that a diode or SCR is short circuited, replace B0052 or B0104, B0105. Refer to Fig. 15, Fig. 16 and Fig. 17.

Semitop module input (B0052, B0104).

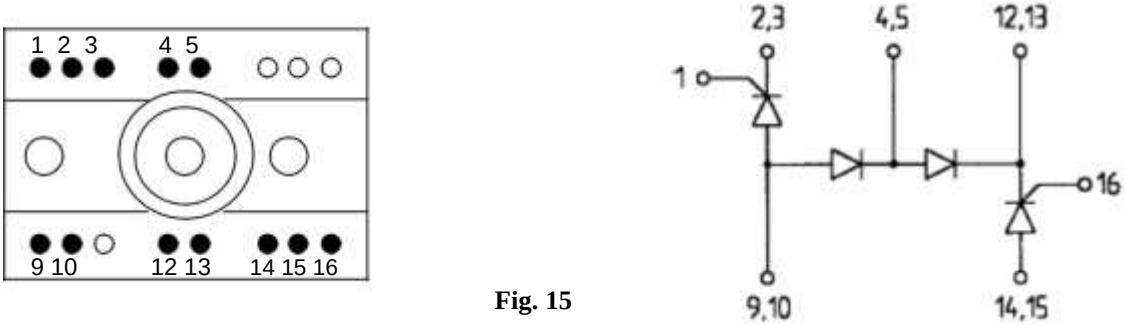
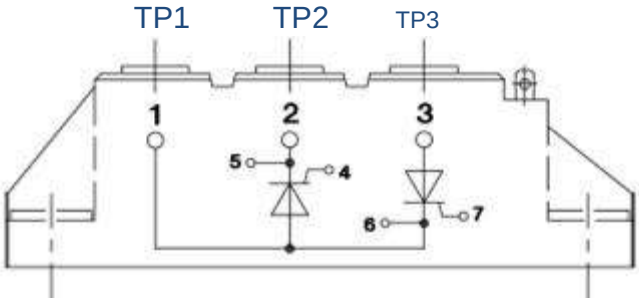


Fig. 15

Semitop module bypass (B0052).

Fig. 16

Modulo Semikron (B0105)



Bypass board (B0105)

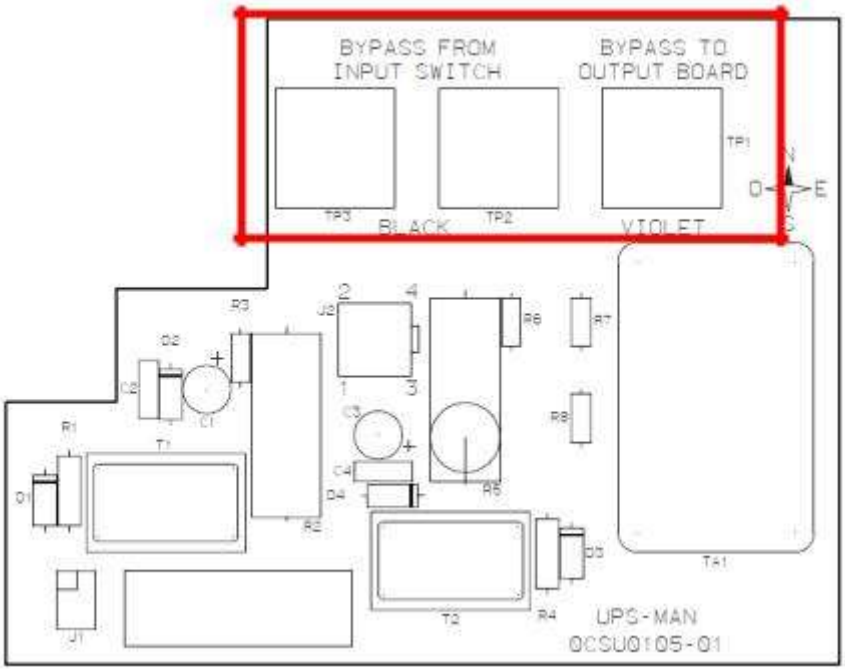


Fig. 17

4) Test the inverter and booster:

- in diode test mode measure between J7-PIN6 and J2 & J7-PIN6 and J1
- in diode test mode measure between J7-PIN3 and J2 & J7-PIN9 and J1
- in diode test mode measure between J6 and J7-PIN3 & J6 and J7-PIN9

Check that each pair of measurements returns a similar value and that no short circuits are present (see Fig**.** 18). If this is not the case, the assembly is faulty and must be replaced.

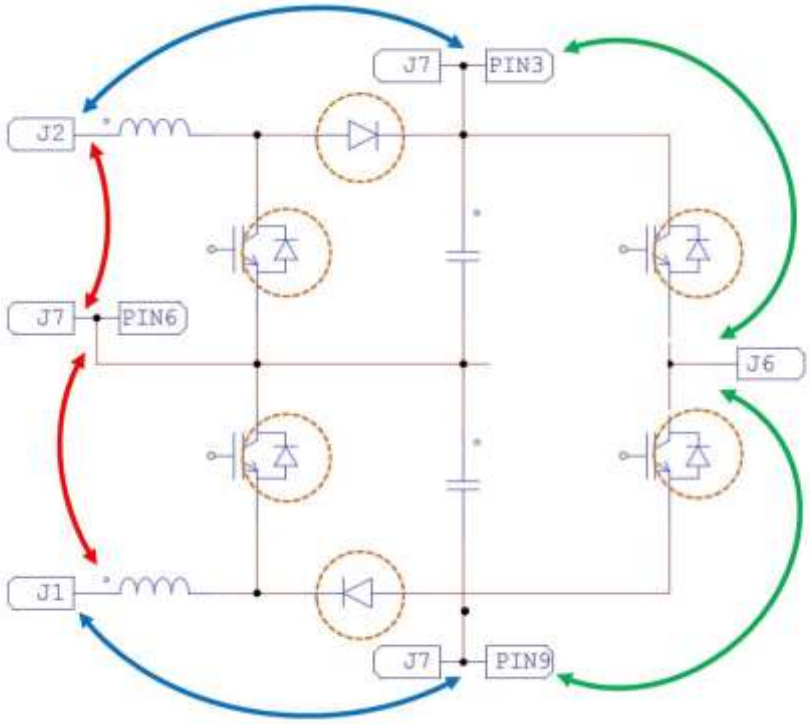


Fig. 18

Connector J7 on board B0053

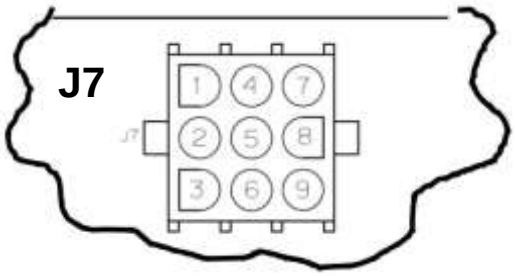


Fig. 19

5) Check the fuse resistors:

It is possible that an IGBT module on a power assembly fails and absorbs too much current from the auxiliary power supply, causing a fuse resistor R47 (1.2Ω) to blow on a power assembly (board B0053).

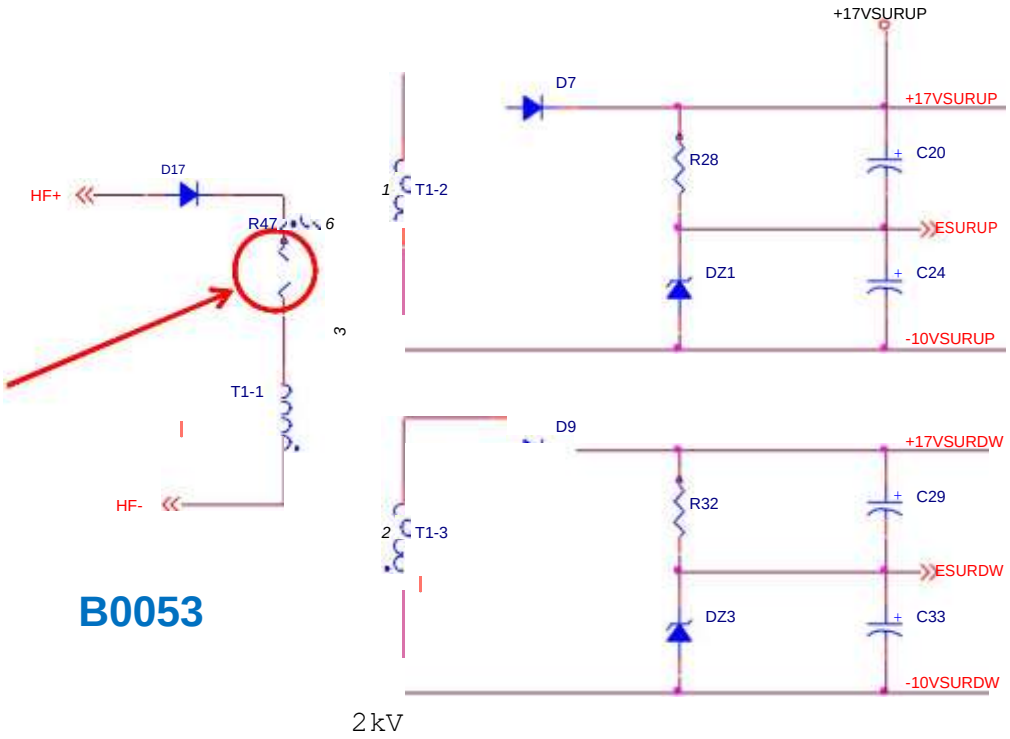


Fig. 20

Resistor R47 is located on the primary circuit of the base drive that distributes power to the IGBTs for the positive and negative booster.

The same board also houses a resistor on the base drive for the power supply to the positive and negative inverter stage R48 (1.2Ω) highlighted in Fig. 21.

10-20KVA POWER ASSEMBLY

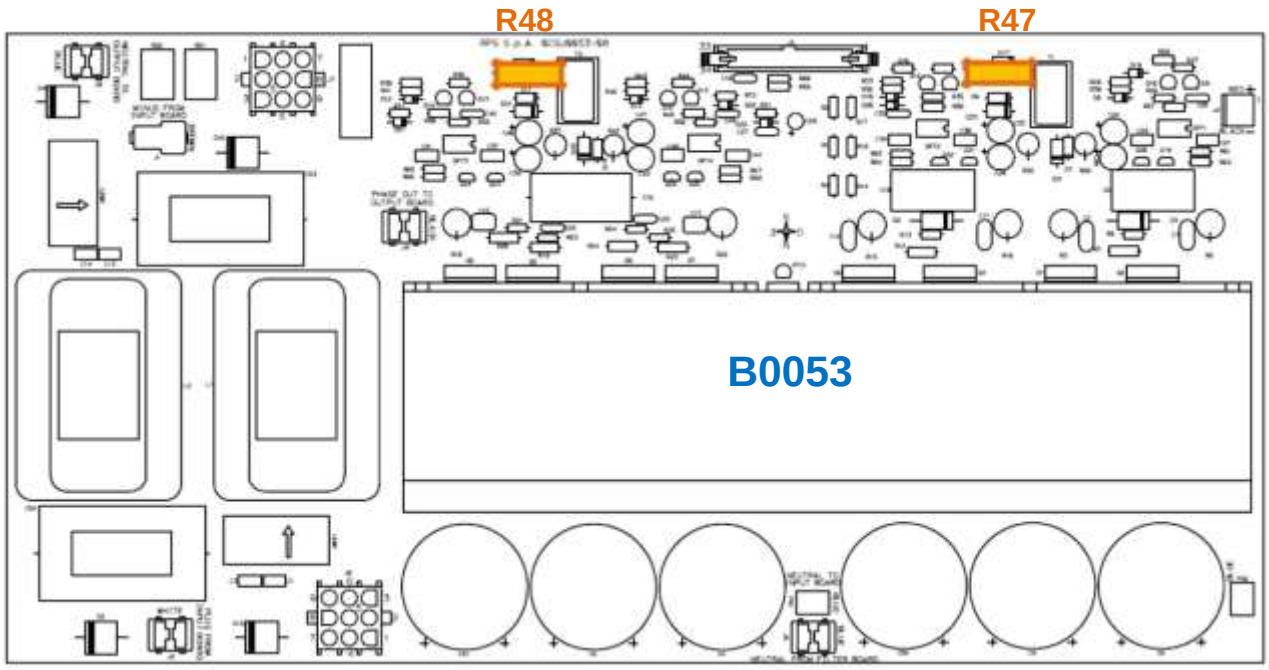


Fig. 21

The fuse resistors described above may blow following the failure of a power module, or due to a short circuit between the pins of the plugin connectors that carry the 400V direct current, or due to a fault at the power supply unit.

Once the resistors on all three phases have been checked, the following conclusions can be reached:

1. only one assembly has a problem at the fuse resistors. Replace the power assembly affected by the fault.

2. all three power assemblies have a fault at the fuse resistors. The fuses blowing may have been caused by a fault at the power supply unit (if this has not already been replaced it is advisable to replace it as a precautionary measure) or by a fault at the logic boards.

6.3 CABLE CONNECTIONS TEST (LINK FAIL)

If necessary, use a multimeter set to ohmmeter mode to check the following on board B0051:

- resistance within the range of **0-10**Ω between test points TP4 and TP5
- resistance within the range of **1-2**kΩ between test points TP3 and TP4
- resistance within the range of **1-2**kΩ between test points TP3 and TP5

If the tests give a positive result it means that the flat cables have been connected correctly. If this is not the case, check the correct insertion of the flat cables into the respective holders on the CS.

BOARD B0051, TEST POINT POSITIONS

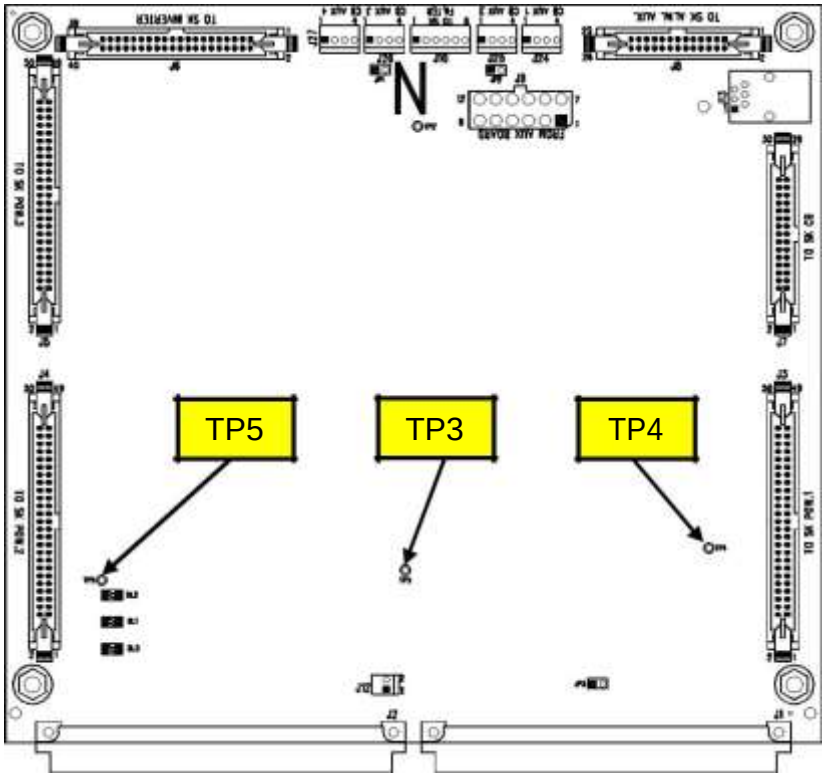


Fig. 22

7 DESCRIPTION OF BOARDS

7.1 CONTROL BOARD (B0051)

Versions:
B0051-01. Signal Control Card SATURN 3/3/SATURN 3/1 10-20 (for all versions and sizes)

The layout of the control board connectors is given below.

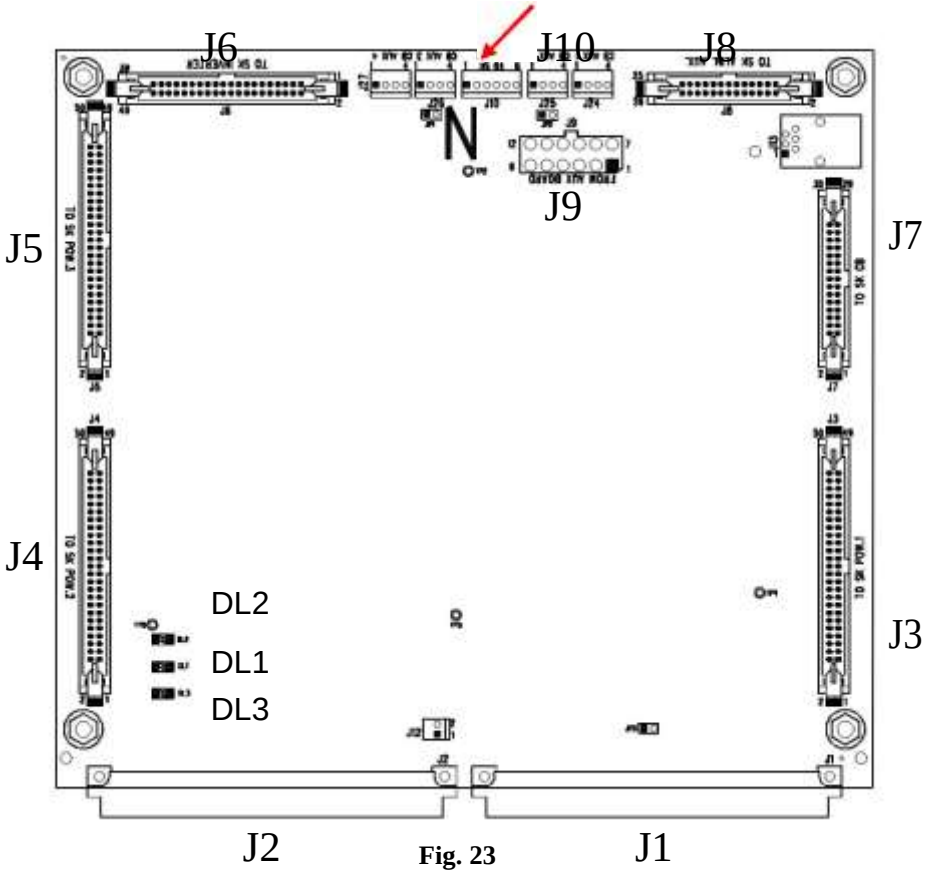


Fig. 23

Connector	Description	Notes
J1	Signals for DSP-uP board	From B0067
J2	Signals for DSP-uP board	From B0067
J3, J4, J5	Flat connections to input boards and power boards	From B0052 (B0104) and B0053
J6	Flat connection to output board	From B0054
J7	Flat connection Battery Charge board	From B0060
J8	Flat connection to aux. power supplies board	From B0059
J9	Connection to aux. power supplies board	From B0059
J10	Connections from terminal board	From B0055 (B0106)

LEDs	Description	Notes
DL1, DL2, DL3	No meaning	

7.2 SATURN 3/3 INPUT POWER BOARD (B0052)

Versions:
B0052-01. Input Power Card SATURN 3/3 10-20

The board is made up of the following main elements:

1) input stage with rectifying diodes and battery SCR in Semitop module
2) input relay
3) mains input fuses
4) battery input fuses
5) bypass SCR in Semitop module
6) bypass current measuring TA

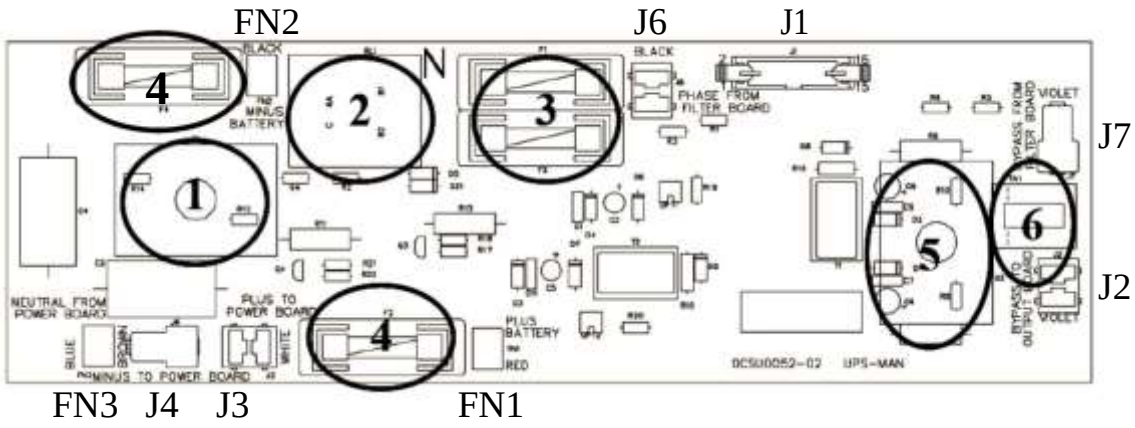
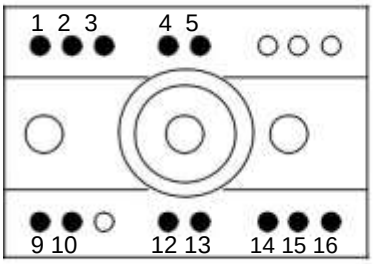
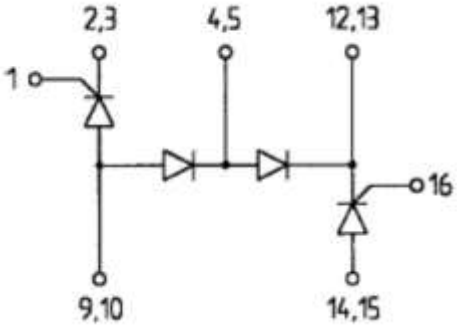


Fig. 24

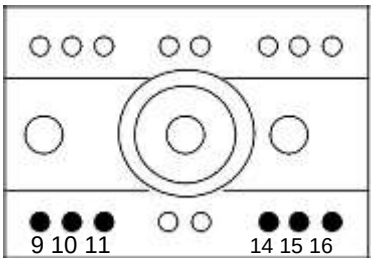
Connector	Description	Notes
J1	Flat connection from control board	From B0051
J2	Connections from output board	From B0054
J3, J4, FN3	Connections from power board	From B0053
J6	Connection from input filters board	From B0186 (or additional part of B0055)
J7	Connection from SWBYP (with dual input) Connection from SWIN (with single input)	
FN1	SWBATT positive connection	
FN2	SWBATT negative connection	

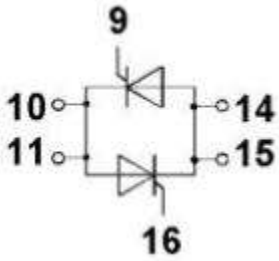
Semitop module input.





Semitop module bypass.





7.3 POWER BOARD (B0053)

Versions:
B0053-02. Power Assembly SATURN 3/3 10-12
B0053-03. Power Assembly SATURN 3/3 15-20
B0053-04. Power Assembly SATURN 3/1 15-20
B0053-05. Power Assembly SATURN 3/1 10-12

The board is made up of the following main elements:

1) dual boost (input stage)
2) half bridge inverter (output stage)
3) electrolytic capacitor bank
4) boost inductances (toroidal)
5) boost current sensors
6) heatsink temperature sensor

NOTE: the active devices on the heatsink can be fitted on IMS type modules or directly onto the heatsink using clips. There are no fuses on this board.

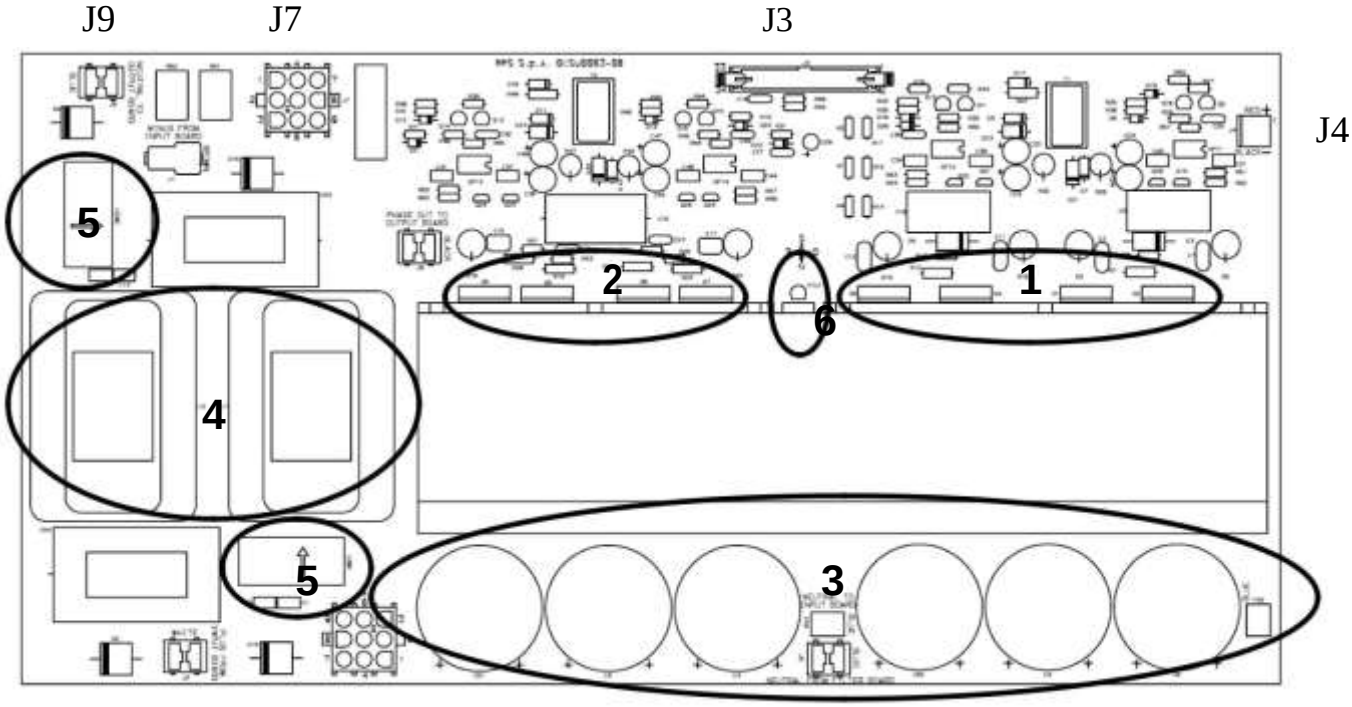
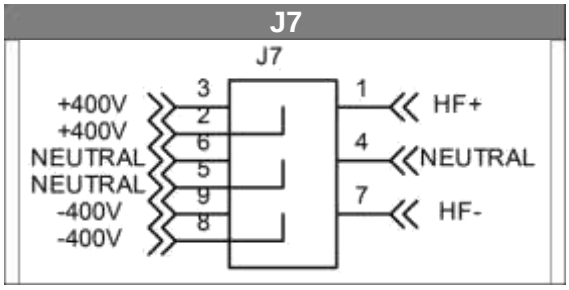
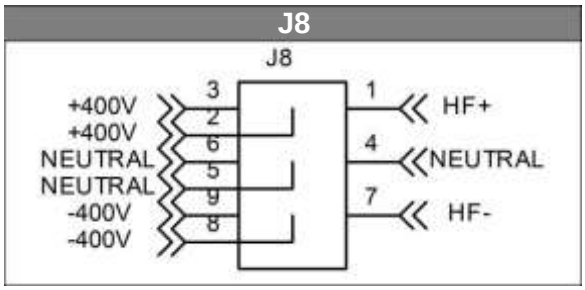


Fig. 25

Connector	Description	Notes
J1, J2, FN1	Connections from input board	From B0052
J3	Flat connection from control board	From B0051
J4	Fan power supply connector	
J5	Connection from input filters board (neutral)	From B0186 (or additional part of B0055, or B0106)
J6, J9	Connections from output board	From B0054
J7, J8	DC BUS, HF connectors	

Connector pin layout:





7.4 INVERTER OUTPUT BOARD (B0054)

Versions:
B0054-02. Replaced by B0054-05. Output Inverter Card SATURN 3/3 and SATURN 3/1 10-12 B0054-03. Replaced by B0054-06. Output Inverter Card SATURN 3/1 15-20
B0054-01. Replaced by B0054-07. Output Inverter Card SATURN 3/3 15-20

The board is made up of the following main elements:

1) inverter inductances (toroidal)
2) output capacitors
3) inverter current sensors
4) inverter relays
5) output fuses
6) output current measuring TA
7) balancing circuit

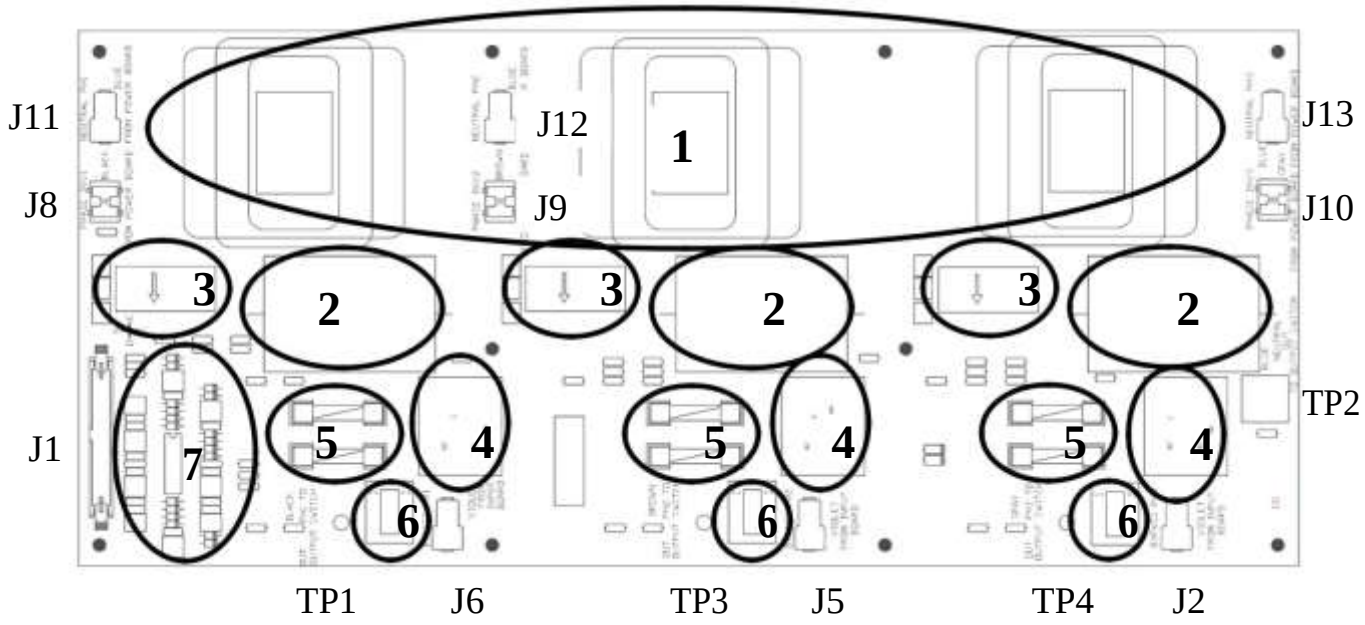


Fig. 26

Connector	Description	Notes
J1	Flat connection from control board	From B0051
J2, J5, J6	Connections from input boards	From B0052 if SATURN 3/3 From B0105 if SATURN 3/1
J8, J9, J10, J11, J12, J13	Connections from power boards	From B0053
TP1, TP2 TP3, TP4	Connections from SWOUT	

7.5 TERMINAL BOARD SATURN 3/3 (B0055)

Versions:

B0055-03. Terminal Card SATURN 3/3 10-20 (for standard UPS) B0055-04. Terminal Card SATURN 3/3 10-20 (for dual input UPS)

B0055-05. Terminal Card SATURN 3/3 10-20 (for standard UPS without battery connection) B0055-06. Terminal Card SATURN 3/3 10-20 (for dual input UPS without battery connection)

The board is made up of the following main elements:

1) input / separate bypass (optional) / output terminals
2) battery terminals
3) battery connection (only for SATURN 3/3 with B0055-05 or B0055-06)
4) input / bypass /output VDR

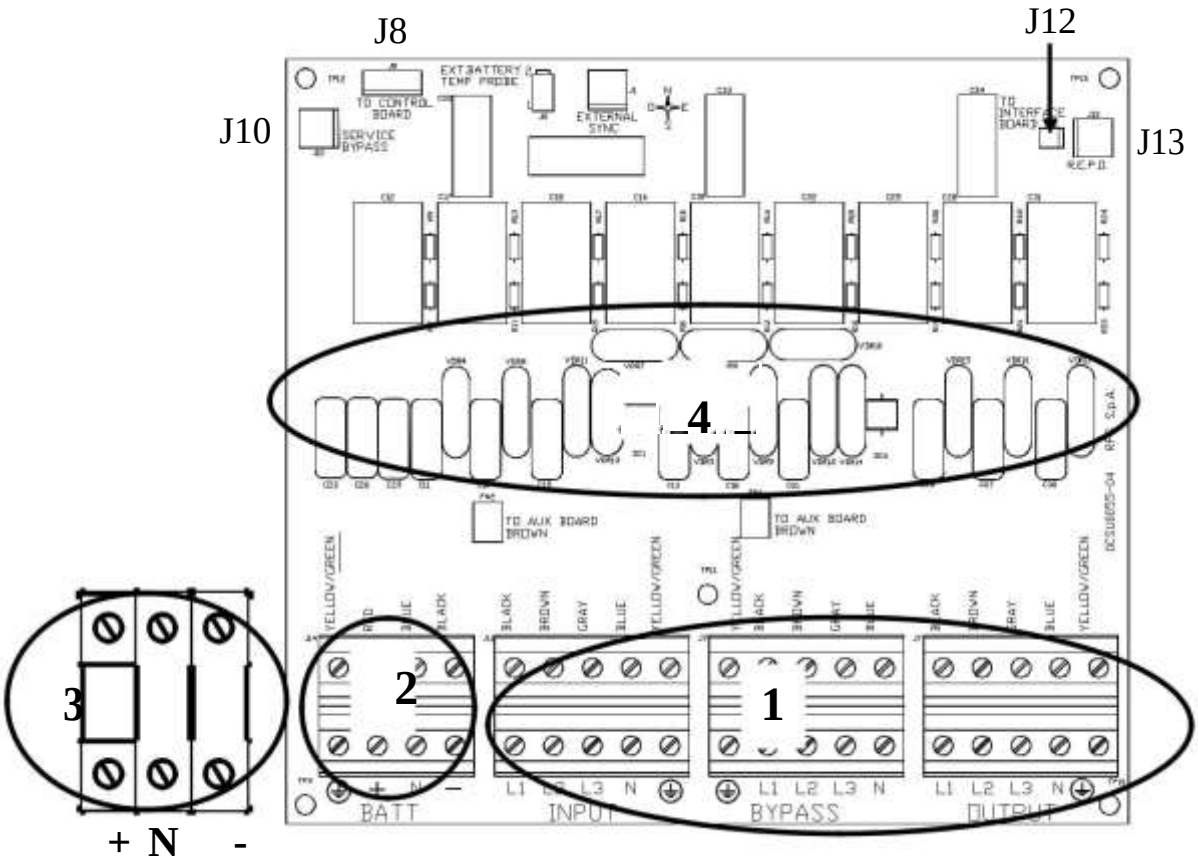


Fig. 27

Connector	Description	Notes
J8	Connection from control board	From B0051
J10	Connector for external aux. SWMB	

NOTE : board B0055-01 was replaced by B0055-03 and board B0055-02 was replaced by B0055-04.

7.6 INTERFACE BOARD (B0056)

Versions:
B0056-02. Interface SATURN 3/1 and SATURN 3/3 10-120

NOTE : on UPS without accessories JP3, JP4, JP6 must be closed and JP1, JP2 must be open.

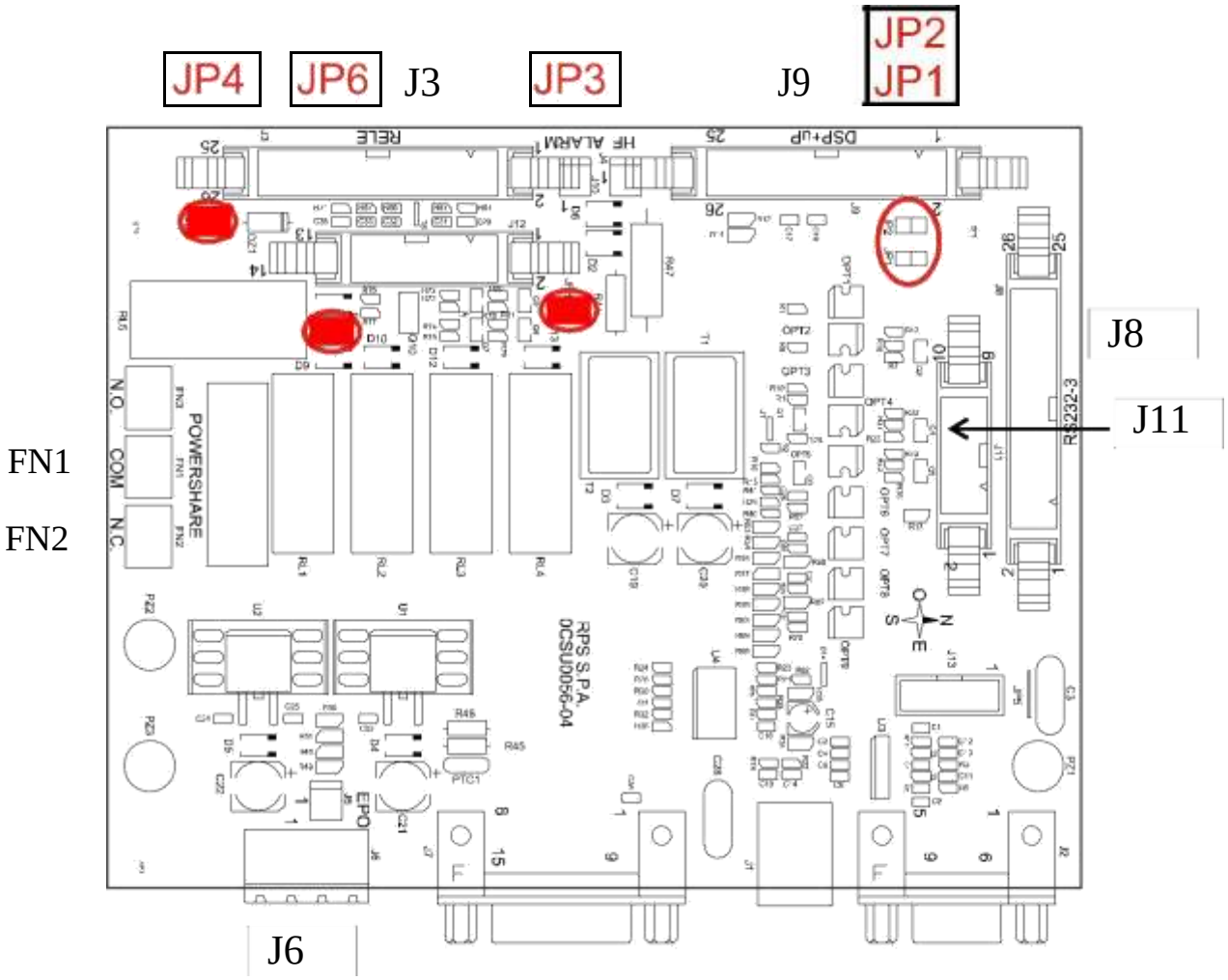


Fig. 28

Connector	Description	Notes
J3	Flat connection from relay board	From aux relay slot
J6	EPO connector	
J8	Flat connection from DSP-uP board	From B0067
J9	Flat connection from DSP-uP board	From B0067 and slot1
J11	Flat connection to slot 2	To slot 2
FN1-FN2	Powershare connectors	

7.7 DISPLAY BOARD (B0057)

Versions:
B0057-02. Display Card SATURN 3/3 - Neutral Version SATURN 3/1 and SATURN 3/3

The display board is made up of the following main elements:

1) DL1, 2, 3, 4, 5 and 6 Led indicator
2) SW1, 2, 3, 4 Are selection buttoms

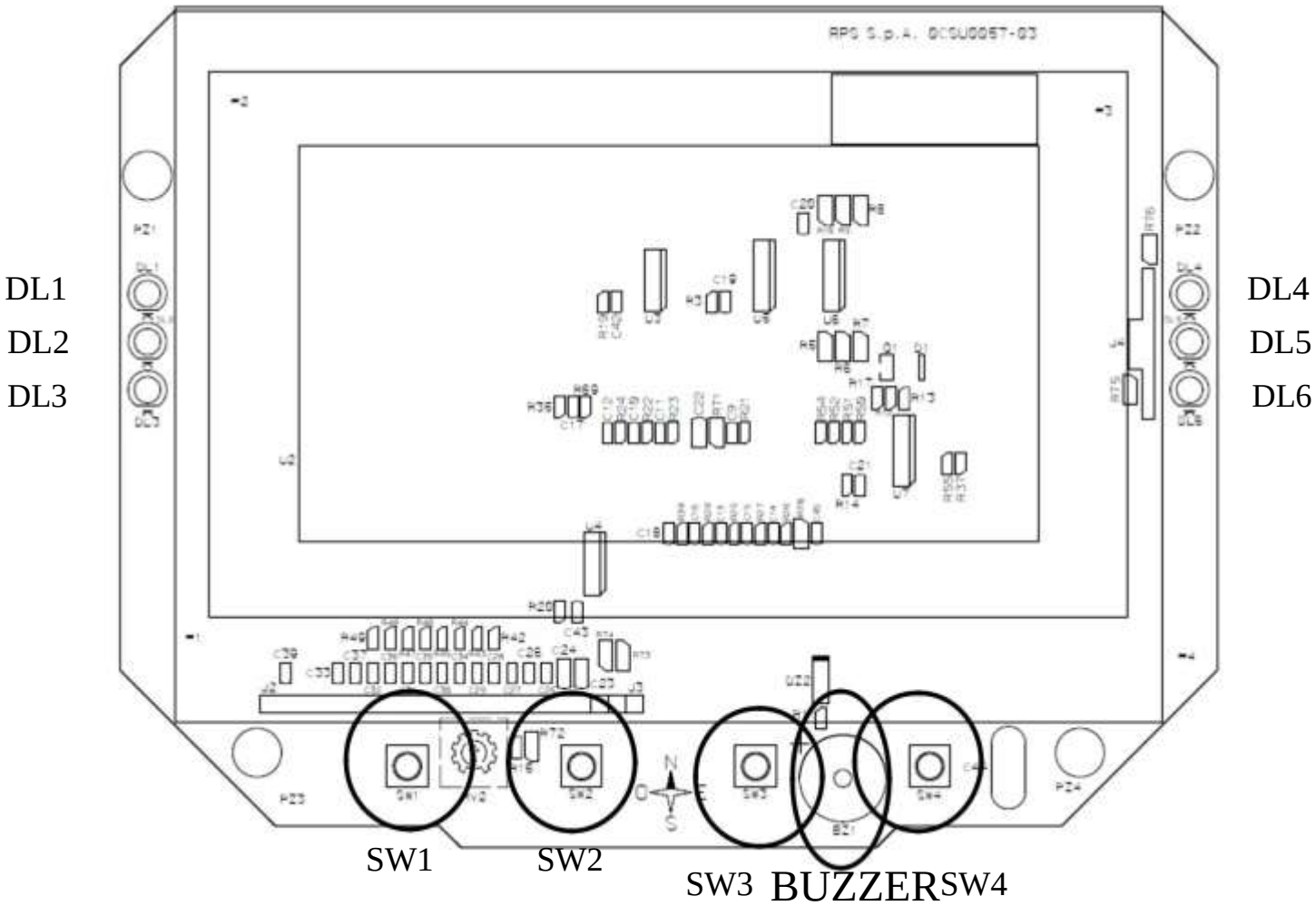


Fig. 29

Led	Description	Notes
DL1	Mains operation LED	
DL2	Battery operation LED	
DL3	Load on bypass LED	
DL4	Standby/alarm LED	
DL5	Replace batteries LED	
DL6	ECO mode LED	

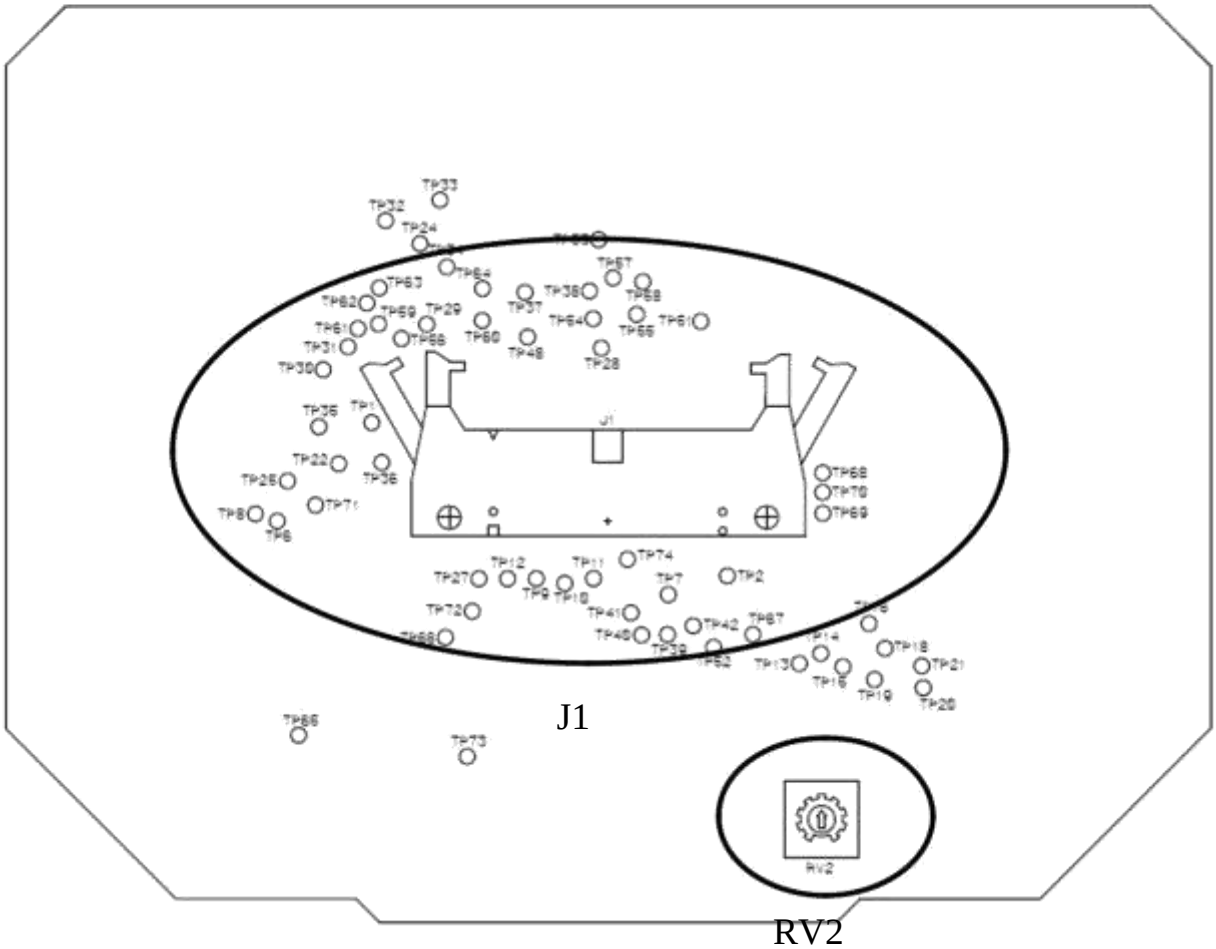


Fig. 30

Connector	Description	Notes
J1	Flat connection to uC+DSP board	Alla B0067
RV2	Trimmer to regulate the contrast on display	

ATTENTION: It is important when starting the UPS in a very cold environment to allow the display time to warm up before adjusting the contrast via RV2.

7.8 AUXILIARY POWER SUPPLIES BOARD (B0059)

Versions:
B0059-01. Aux power supply card SATURN 3/3 10-40 (for all versions and sizes)

The auxiliary power supplies board is made up of the following main elements:

1) fuse (code 0602020066_6.3x32 2A 500V GF)
2) DC Bus pre-charge from mains
3) main power supply unit
4) fan power supply unit
5) redundant bypass power supply unit

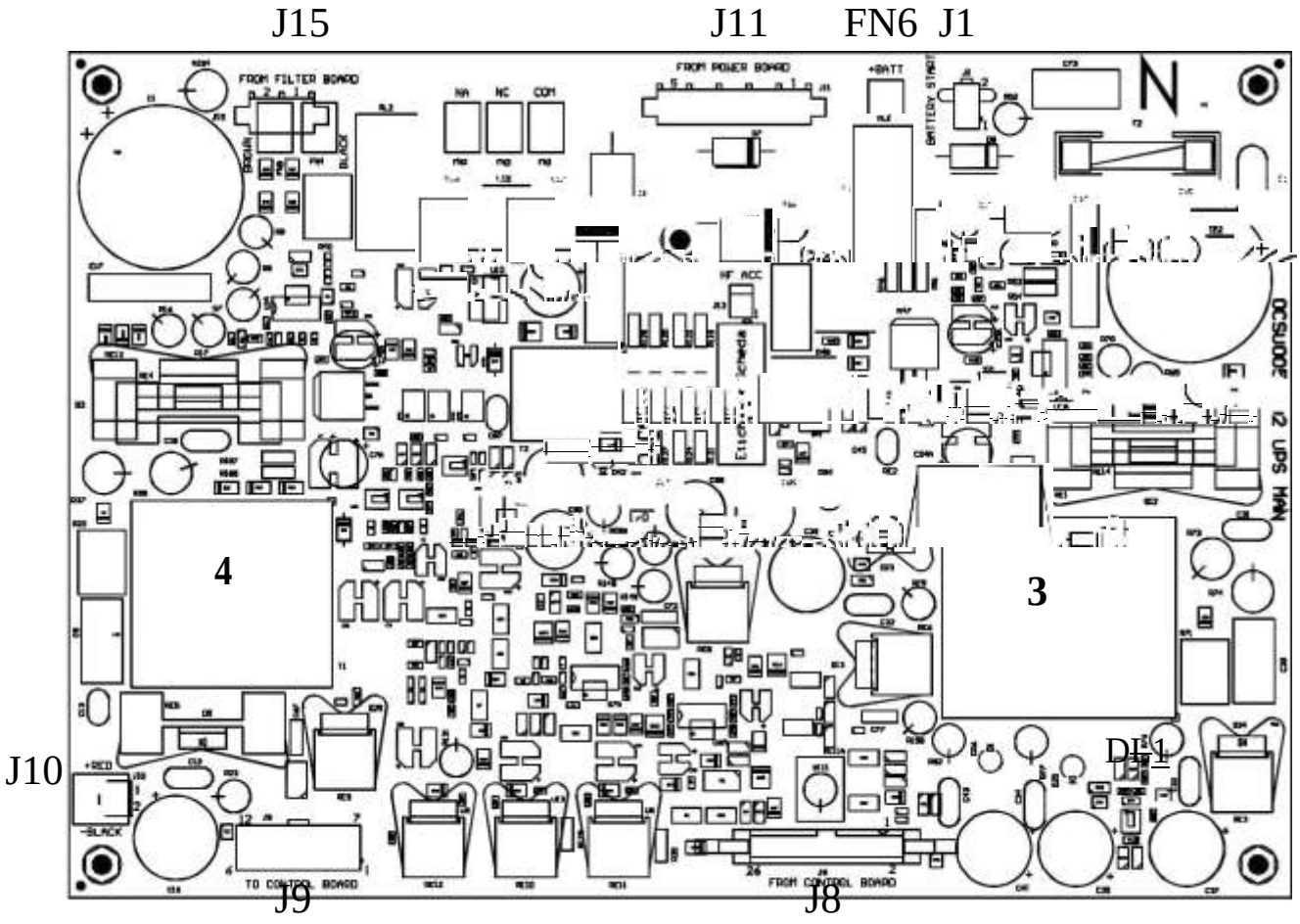


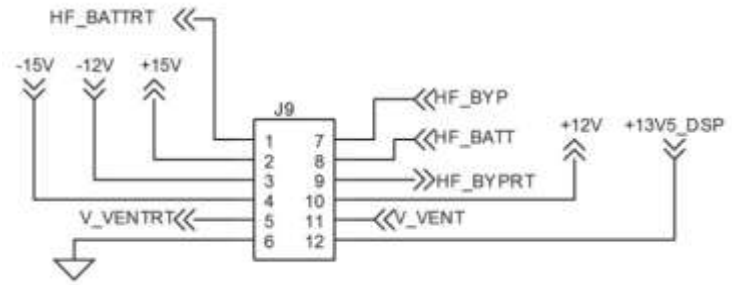
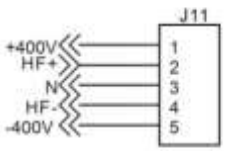
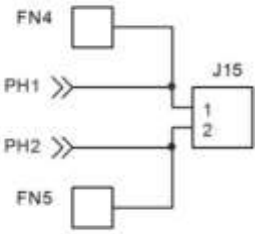
Fig. 31

J1	Vbat connector for battery start-up	
J4	Connector for I/0	Put jumper
J8	Flat connector from control board	From B0051
J9	Connector for power supplies to control board	From B0051

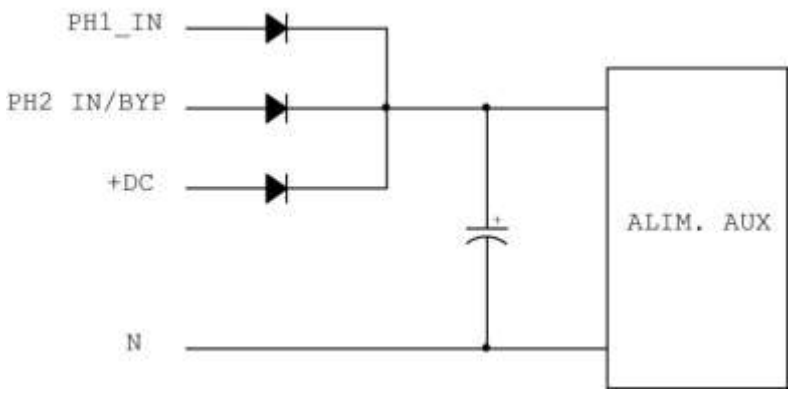
Connector	Description	Notes
J10	Fan power supply connector	
J11	DC BUS, HF connector	From B0053 phase 3
J12	Connector for I/0	
J15	Connector for mains power supply	pin1 → from FN3 B0186 (or additional part of B0055 or B0106) pin2 → from TP2 B0186 (or additional part of B0055 or B0106) (with single input UPS) pin2 → from PH2 SWBYP (with dual input UPS)
FN6	+batt connector for battery start-up	

LEDs	Description	Notes
DL1	Aux ON warning LED	

Connector pin layout:

J9	J11	J15
		

Power supply diagram:



7.9 BATTERY CHARGER BOARD (B0060)

Versions:
B0060-01. Battery Charger Card 6A (for standard UPS)
B0060-02. Battery Charger Card 10A (optional)

The battery charger board is made up of the following main elements:

1) 2 fuses 6.3X32 - 16A 500V rapid
2) DC Bus pre-charge resistors from battery (4 x 22Ω 10W)
3) input capacitors
4) output capacitors
5) dual buck + heaksink temperature sensor
6) current sensors
7) buck inductances
8) blocking diodes

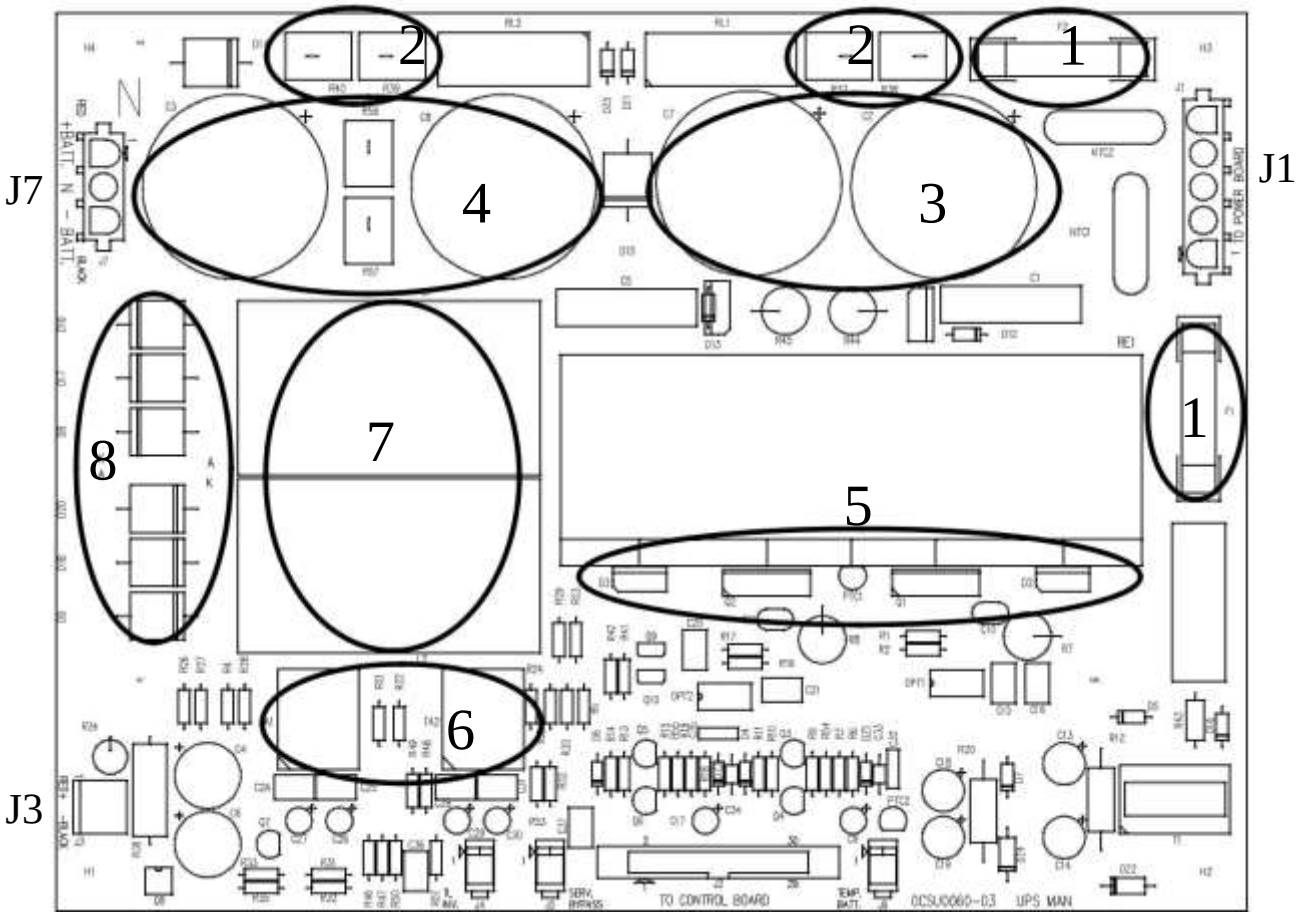
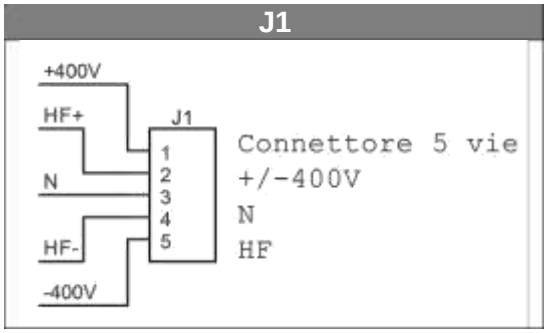
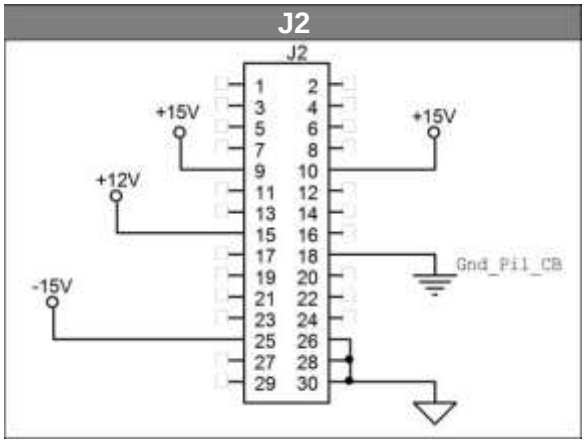


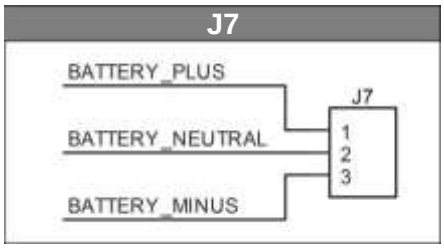
Fig. 32

Connector	Description	Notes
J1	Battery charger input connector	From B0053 phase 1
J2	Flat connection from control board	From B0051
J3	Fan power supply connector	
J7	Battery charger output connector	

Connector pin layout:







7.10 uC + DSP BOARD (B0067)

Version:
B0067-01. DSP+µC Control Card for SATURN 3/3

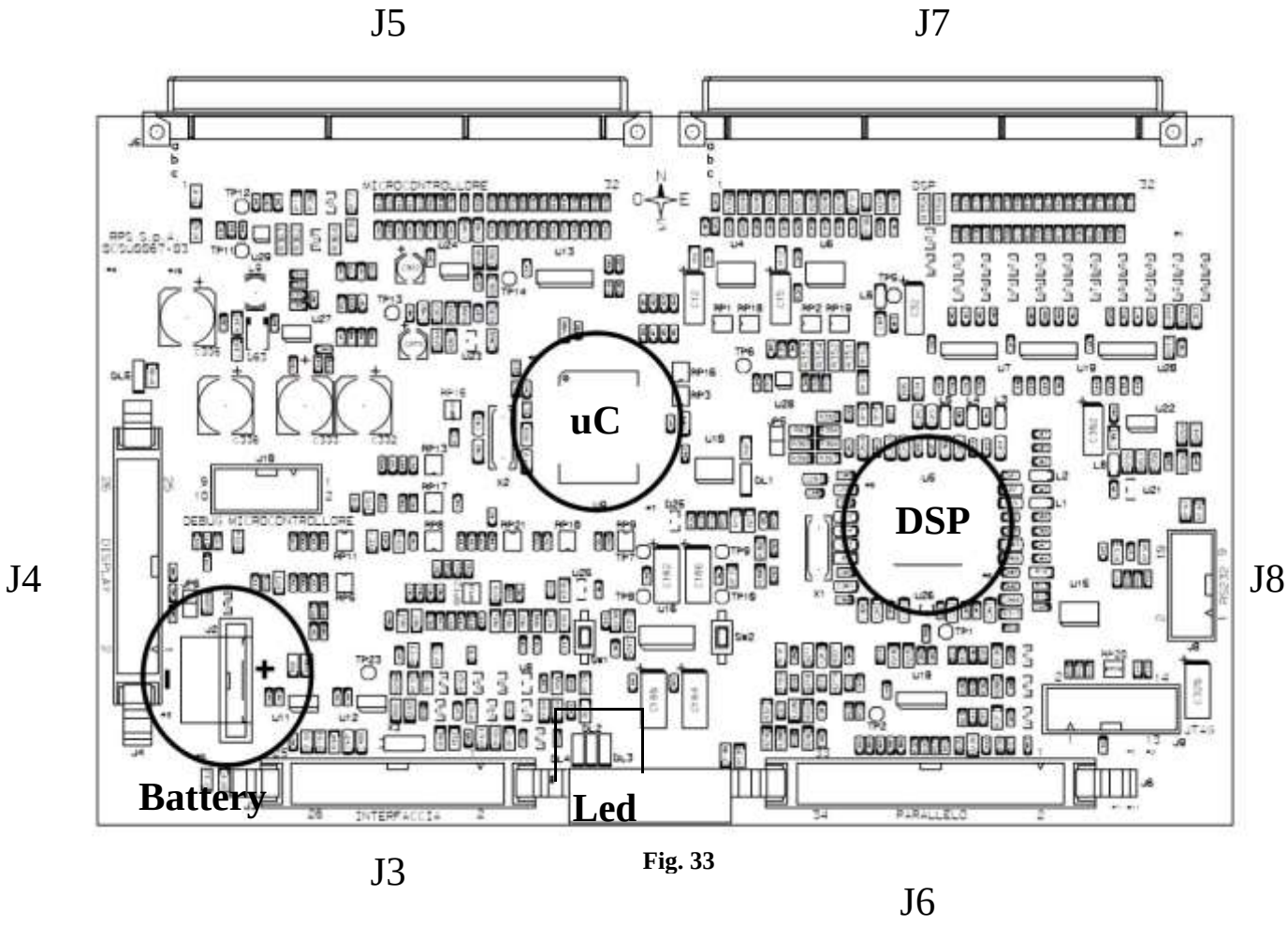


Fig. 33

Connector	Description	Notes
J3	Flat connections to interface boards for SLOT 1	To B0056 and SLOT 1
J4	Flat connections to display boards	From B0057
J5	connector uC to control board	To B0051
J6	connector uC to parallel board	
J7	connector DSP to control board	To B0051
J8	Flat connections to interface boards for SLOT 2	To B0056 and SLOT 2

Test point	Voltage present
Between TP11 and TP12	+5V
Between TP7 and TP8	+1,9V
Between TP9 and TP10	+3,3V
Between TP14 and TP10	+2,3V
Between TP5 and TP6	+3,3V
Between TP13 and TP10	+4,6V

Led turns on	Means
DL1	Present +5V
DL2	Reset uC
DL3	Presen +1,9V t

7.11 PARALLEL BOARD (B0085)

Version:
B0085-01. Parallel Card SATURN 3/3 (for all sizes)

The parallel board is made of these elements:

1) SW1 to select the “Start” or “Continue” mode
2) Yellow led indicates that SW1 is in “Start” position
   Green led indicates that the parallel board is powered
3) SW2 to select the terminating resistor
4) SW3 the input communication line is opened or closed
5) SW4 the output communication line is opened or closed

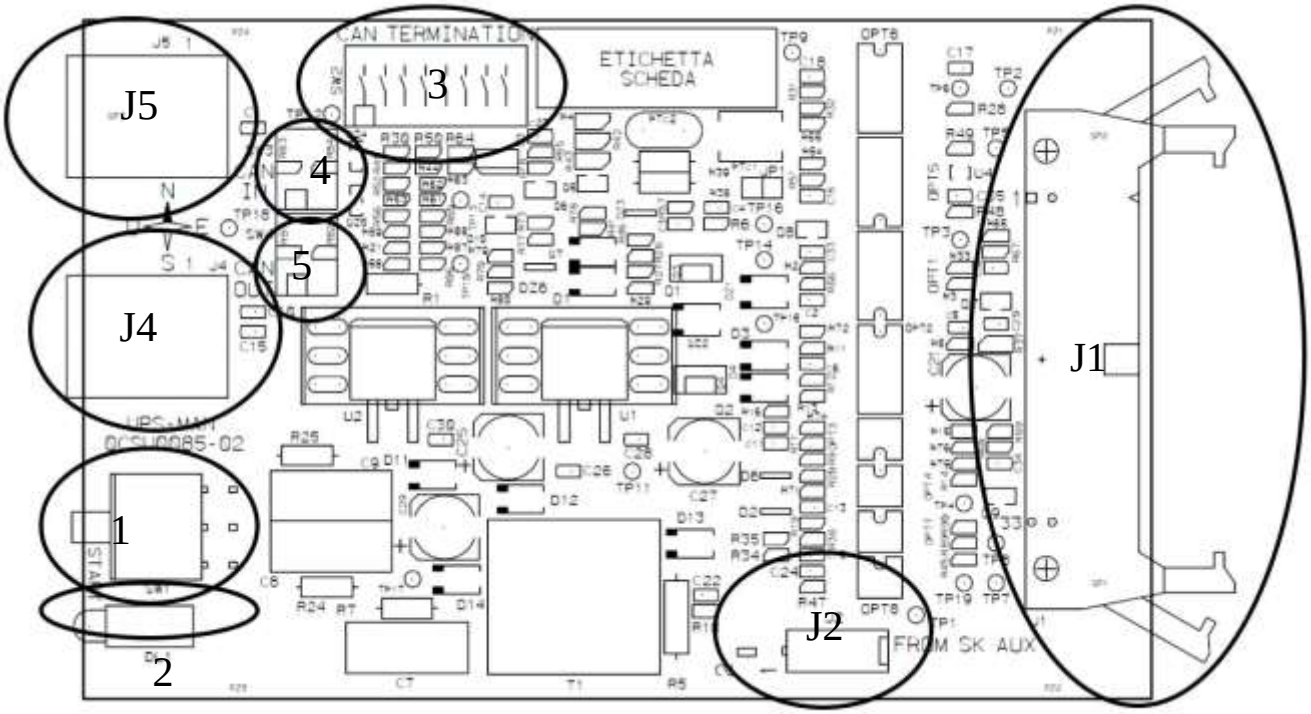


Fig. 34

Connector	Description	Notes
J1	Flat connection to uC+DSP board	To B0067
J2	Connection to auxiliary board	To B0059
J4	Output communication line RJ45- OUT	To B0085
J5	Input communication line RJ45- IN	To B0085

7.12 CY CAPACITOR BOARD (B0098)

Versions:
B0098-01. Filter Cy Card SATURN 3/3 10-20
B0098-02. Filter Cy Batt Card SATURN 3/3 10-20 (&SATURN 3/1)

The board is made up of the following main elements:

1) CY Capacitors
2) Wires to be inserted into in/out terminals on board B0055

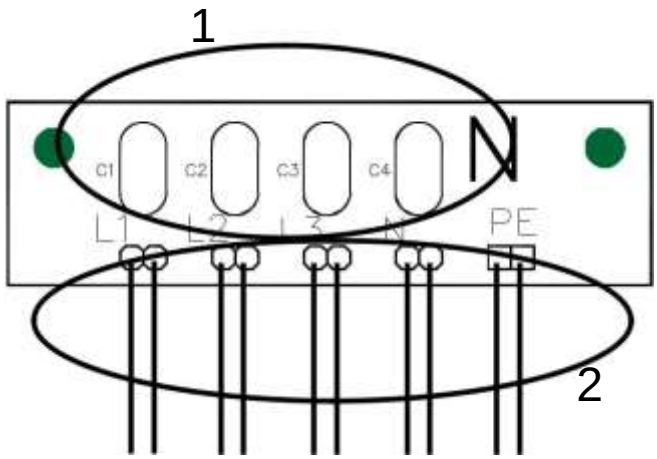


Fig. 35

7.13 SATURN 3/1 INPUT POWER BOARD (B0104)

Versions:
B0104-01. Input Power Card SATURN 3/1 15-20
B0104-02. Input Power Card SATURN 3/1 10-12

The board is made up of the following main elements:

1) input stage with rectifying diodes and battery SCR in Semitop module
2) input relay
3) mains input fuses
4) battery input fuses

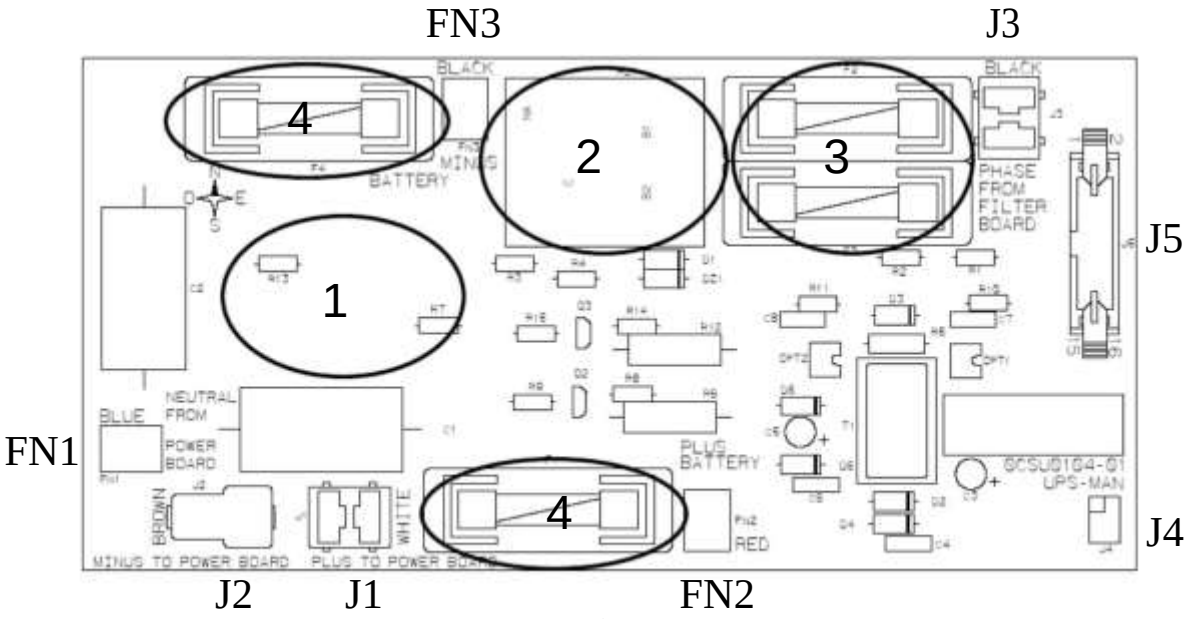
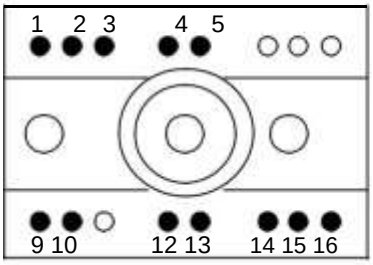
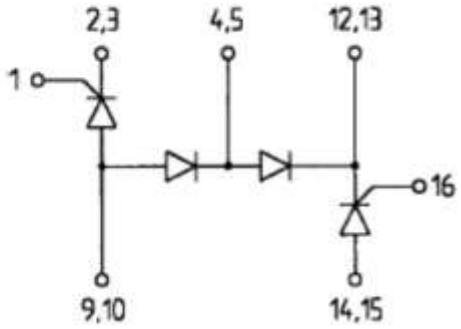


Fig. 36

Connector	Description	Notes
J1,J2, FN1,	Connections from power board	From B0053
J3	Connection from input filters board	From B0186 (or additional part of B0106)
J4	Connector for Bypass card (phase 1 only)	From B0105
J5	Flat connection from control board	From B0051
FN2	SWBATT positive connection	
FN3	SWBATT negative connection	

Semitop module input.





7.14 BYPASS BOARD SATURN 3/1 (B0105)

Versions:
B0105-01. Bypass Card SATURN 3/1 10-20

The board is made up of the following main elements:

1) bypass SCR in Semipack module
2) bypass current measuring TA

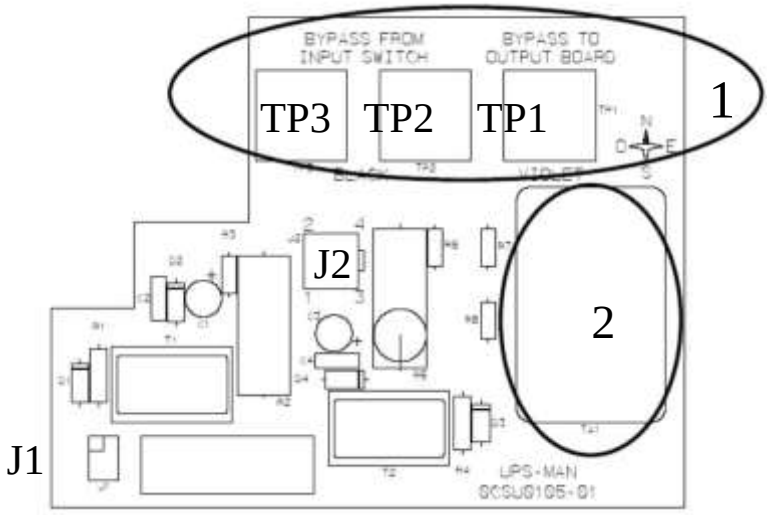


Fig. 37

Connector	Description	Notes
J1	Connector for input power board	From B0104
J2	SCR BYP control signal connector	
TP1	SCR BYP module and connections from output card	From B0054
TP2	SCR BYP module	
TP3	SCR BYP module input connection	from PH1 SWIN (with single input UPS) from PH1 SWBYP (with dual input UPS)

7.15 TERMINAL BOARD SATURN 3/1 (B0106)

Versions:

B0106-01. Terminal Card SATURN 3/1 10-20 (for standard UPS) B0106-02. Terminal Card SATURN 3/1 10-20 (for dual input UPS)

B0106-03. Terminal Card SATURN 3/1 10-20 (for standard UPS without battery connections) B0106-04. Terminal Card SATURN 3/1 10-20 (for dual input UPS without battery connections)

The board is made up of the following main elements:

1) input / separate bypass (optional) / output terminals
2) battery terminals
3) battery connection (only on SATURN 3/1 with B0106-03. or B0106-04.)
4) input / bypass /output VDR

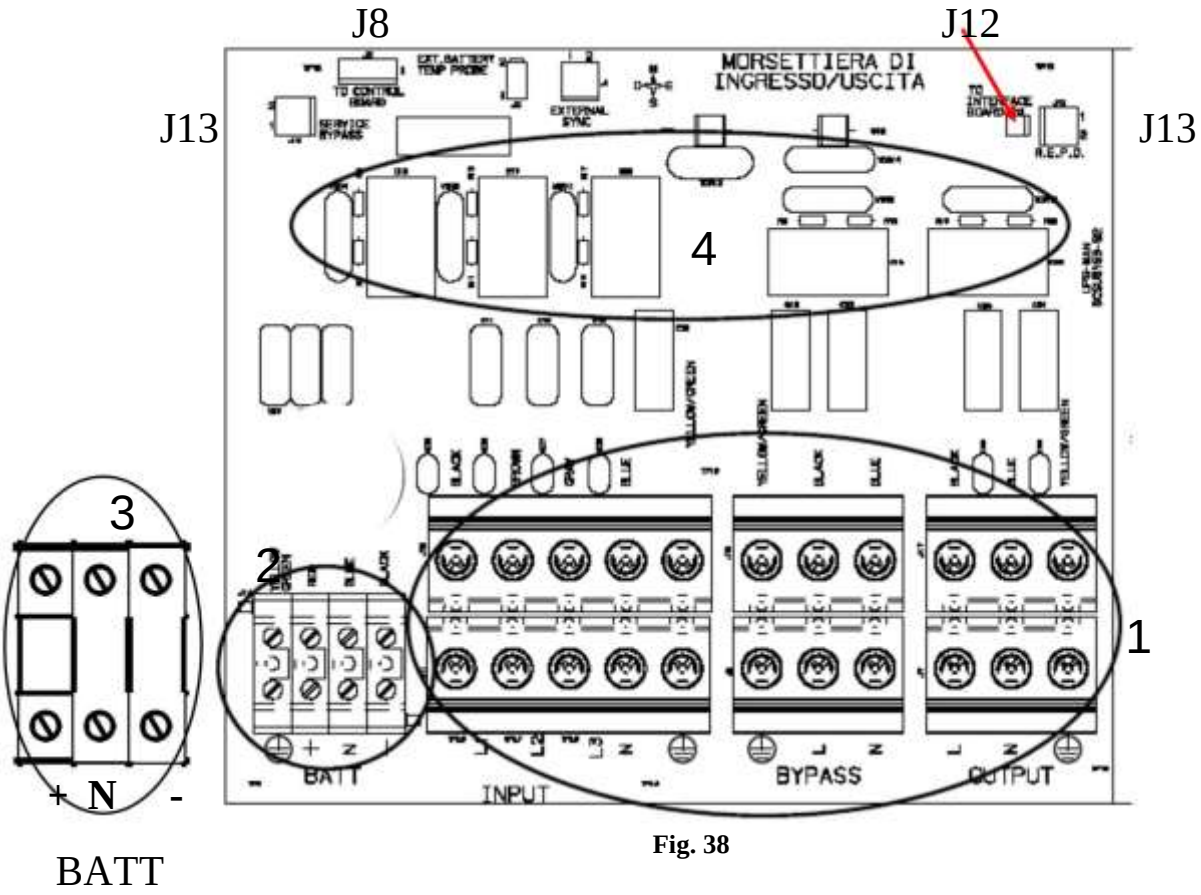


Fig. 38

Connector	Description	Notes
J8	Connection from control board	From B0051
J10	Connector for external aux. SWMB	

7.16 INPUT FILTER BOARD (B0186)

Versions:
B0186-01. Input Filter Card (for all versions and sizes)

The board is made up of the following main elements:

1) filter capacitors
2) filter coils
3) input VDR

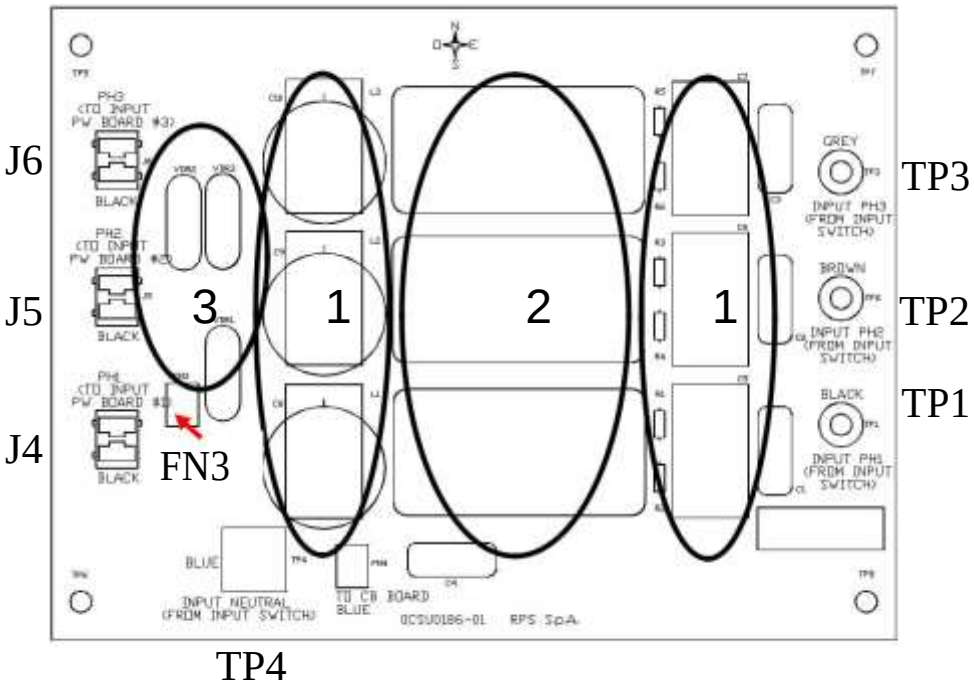


Fig. 39

Connector	Description	Notes
J4, J5, J6	Connections from input power boards	From B0052 if SATURN 3/3 From B0104 if SATURN 3/1
TP1, TP2, TP3	Connections from SWIN	
TP4	Neutral connections from SWIN, SWBYP with dual input.	From B0053
FN3	Connection towards aux. power supplies board	From B0059

8 SERVICE OPERATIONS ON THE UPS

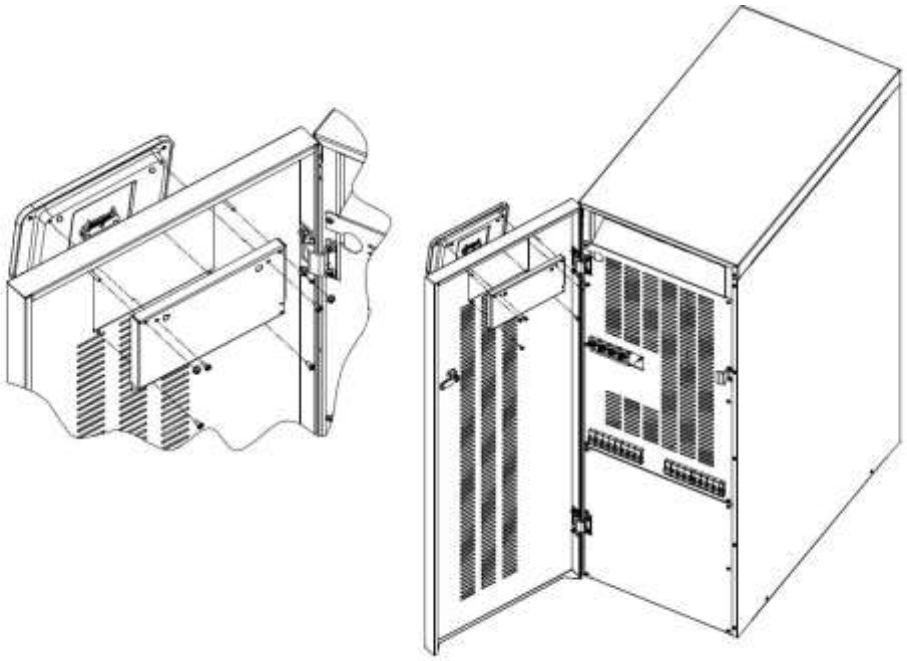
8.1 HOW TO OPEN THE UPS

Open the door and remove it, sliding the pins out of the dedicated hinges (for SATURN 3/3 and SATURN 3/1 UPS see the following page).

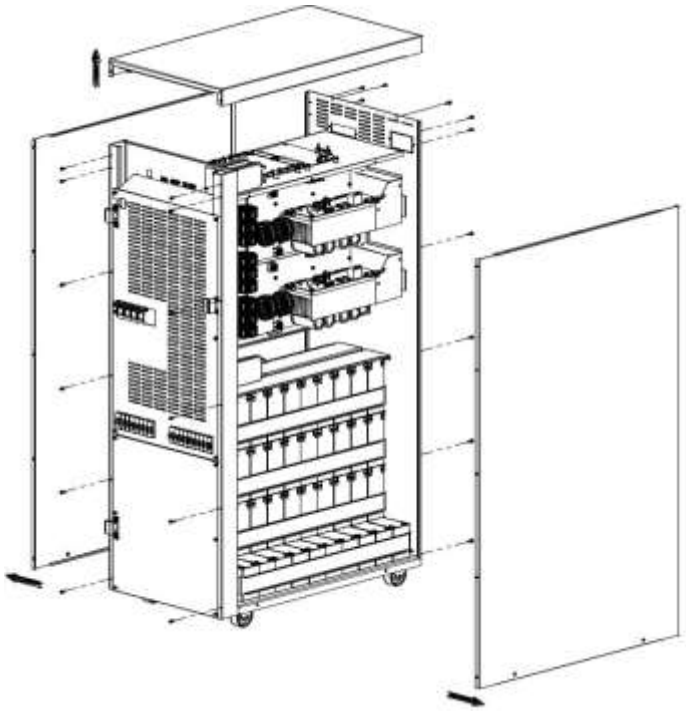
To access the terminal area, first ensure the UPS is completely isolated from the mains and battery sources. remove the front panel by removing all the screws

To access the internal boards, remove the wrap-around covers by removing all the screws shown in the following diagrams.

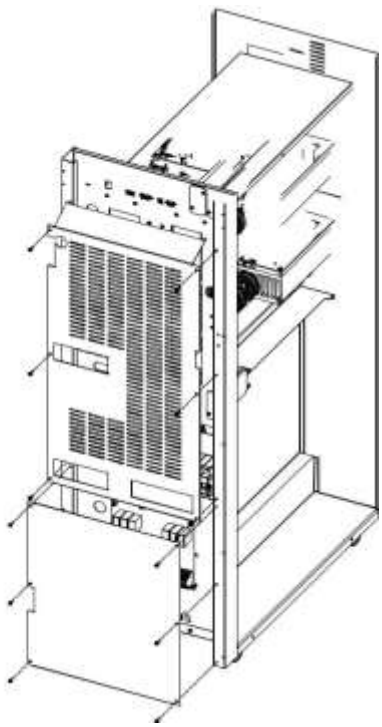
SATURN 3/3 and SATURN 3/1



IMPORTANT: To remove the left and upper wrap-around covers you must first remove the door. If the operation is carried out with the UPS switched off it is advisable to slide out the flat cable and remove the display, otherwise refit the door after removing the covers, taking care not to force the display flat cable.



Screws for side and upper wrap-around covers



Front panel fastening screws

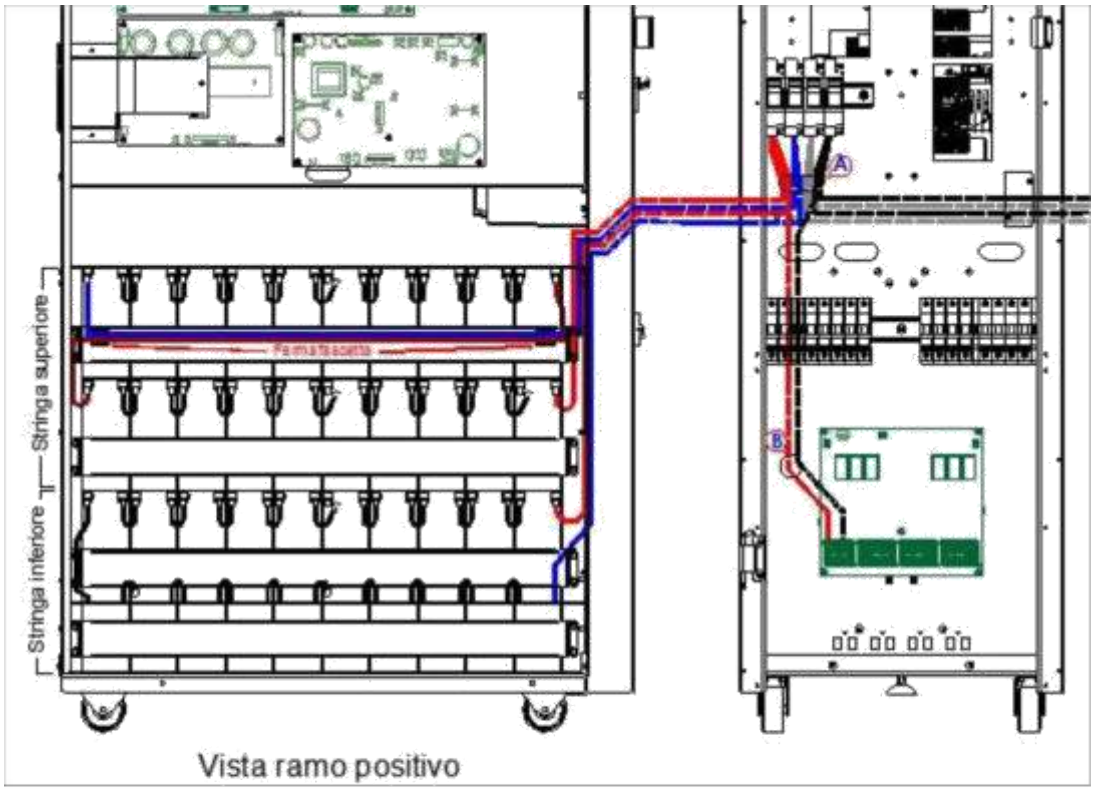
Fig. 41

8.2 REPLACING THE INTERNAL BATTERIES

The batteries are fitted in the lower part of the UPS and are accessible after removing the side wrap-around covers. The layout of the batteries is shown in the diagram below: the wiring connections between the batteries are also shown.

IMPORTANT: take the necessary safety precautions before working on the batteries follow these instructions:

1) open the battery fuse holder, making sure that the UPS is supplied from the mains. If the UPS is in battery operation mode, restore mains power before carrying out any operation
2) close the SWMB and completely switch off the UPS (open SWIN and SWOUT)
3) remove the side wrap-around covers
4) replace the batteries, as per the wiring shown in the diagram
5) refit the wrap-around covers
6) close the SWIN, SWOUT and the battery fuse holders, position the 1/0 button on 1 (if present) and switch on the UPS
7) on the display, check that the UPS recognises the batteries and perform a battery test
8) open the SWMB


Stringa superiore
Stringa inferiore
A
B
Vista ramo positivo

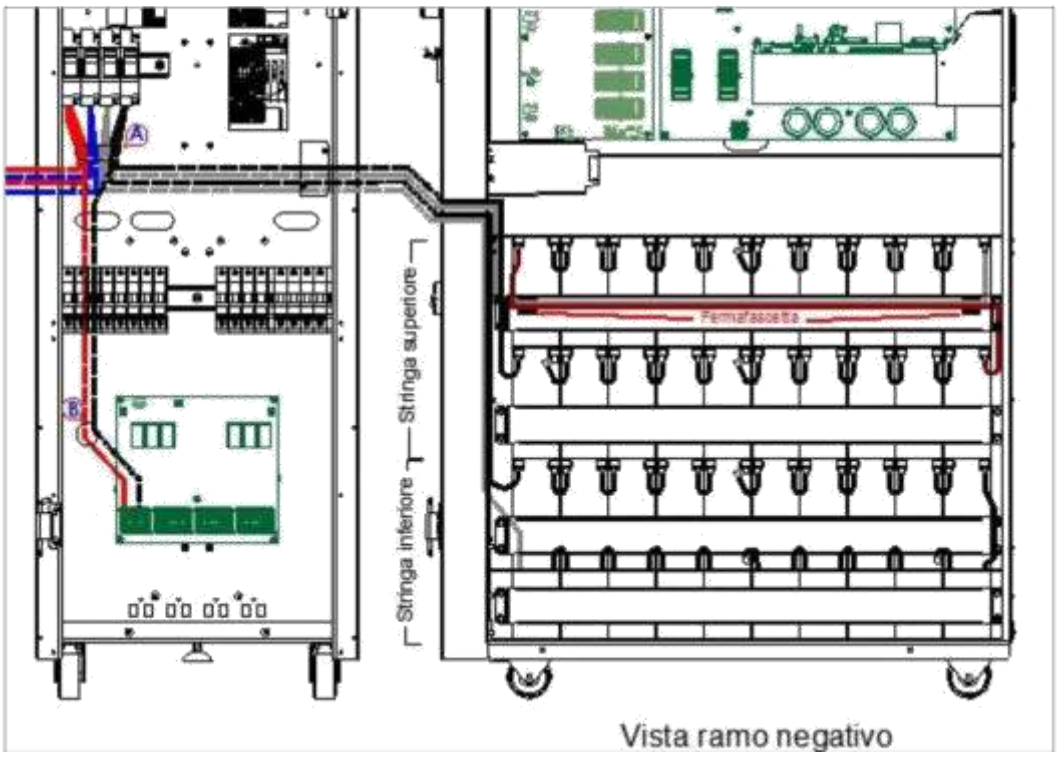

A
B
Stringa superiore
Stringa inferiore
Vista ramo negativo

Fig. 43

8.3 REPLACING THE FANS

This operation can only be performed with the machine switched off and with the input/output and battery disconnection switches open.

1) remove the ducts from the heatsinks:

   a) remove the fastening screws

      power boards: n°1 screw per duct battery
      charger board: n°3 screws per duct

   refer to the diagrams below for screw positions

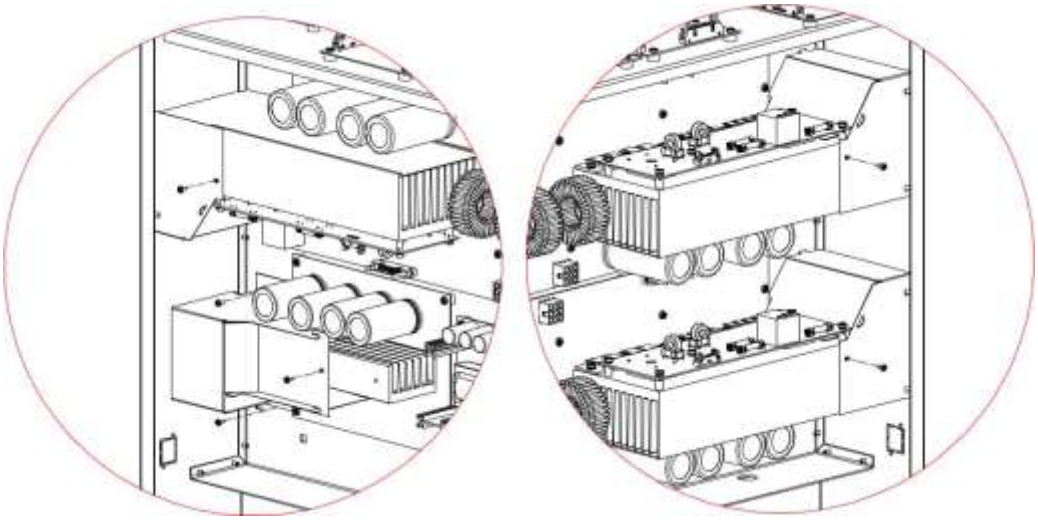


Fig. 44

   b) remove the ducts, taking care not to damage the fastening tabs

2) disconnect the fans from the respective boards, removing the red and black cables from the terminals

3) remove the protection grilles and free the fans, referring to the diagram below for the positions of fastening screws

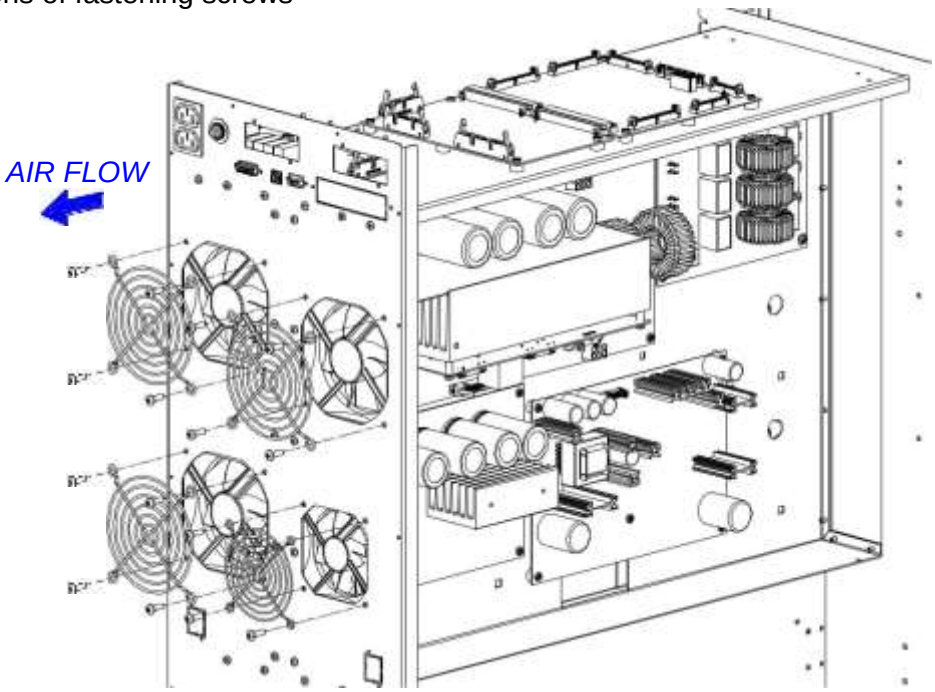


Fig. 45

To fit the new fans follow the instructions for removal in reverse

8.4 REPLACING THE TERMINAL BOARD

It may be necessary to replace the terminal board if it has been damaged by the VDR blowing, or due to the deterioration of a connector. Proceed as follows to replace the terminal board:

1) Open all disconnecting switches. **IMPORTANT:** it is very important that all battery disconnecting switches are open. Disconnect any internal batteries.
2) **IMPORTANT:** completely disconnect the UPS from any power supply, including any battery boxes, other UPS in parallel or other power sources. Make sure there is no voltage present in the board.
3) Using a section of electrical cable, place one end of the wire in contact with the UPS casing (GND) and with the other end touch all the screws on each terminal (INPUT, OUTPUT and BYPASS if present) in order to fully discharge the filter capacitors on the board.
4) Remove all hanging cable connections from board B0055 or B0106
5) Disconnect all cables connected to the terminals, UPS side
6) Remove the fastening screws
7) Replace the board
8) Secure the board to the casing by tightening the fastening screws
9) Reconnect all cables to the terminals, UPS side, and reinsert all the hanging cable connections

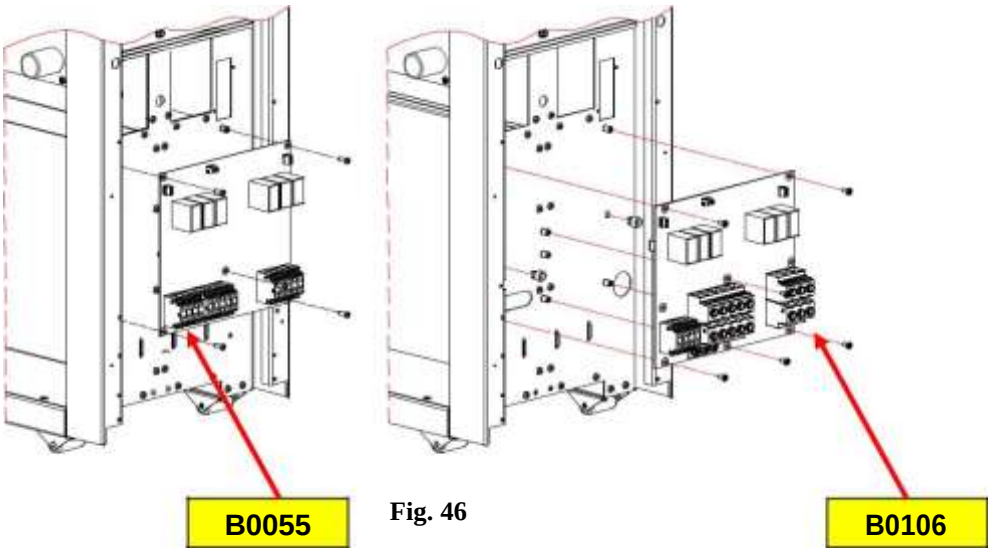


Fig. 46

8.5 REPLACING A POWER ASSEMBLY

Once a faulty power assembly has been identified it should be replaced. Proceed as follows to replace a power assembly:

1) Open all disconnecting switches. **IMPORTANT:** it is very important that all battery disconnecting switches are open. Disconnect any internal batteries.
2) **IMPORTANT:** completely disconnect the UPS from any power supply, including any battery boxes, other UPS in parallel or other power sources. Make sure there is no voltage present.
3) Discharge the DC capacitor bank and wait 10-15 minutes for the voltage in the bank to reach a level close to 0V.
4) Disconnect all flat connectors [B0053-B0052 (B0104+B0105)].
5) Disconnect all hanging cable connections [B0053-B0052 (B0104+B0105)].
6) Disconnect the fan wires connected to B0053.
7) Disconnect the cables connected to the BYP SCR module (SATURN 3/1).
8) Remove the screws securing board B0053; see Fig. 47.
9) Remove the faulty assembly and replace it with a working assembly.
10) Replace the fastening screws and reconnect the cables, following the instructions for removal in reverse.

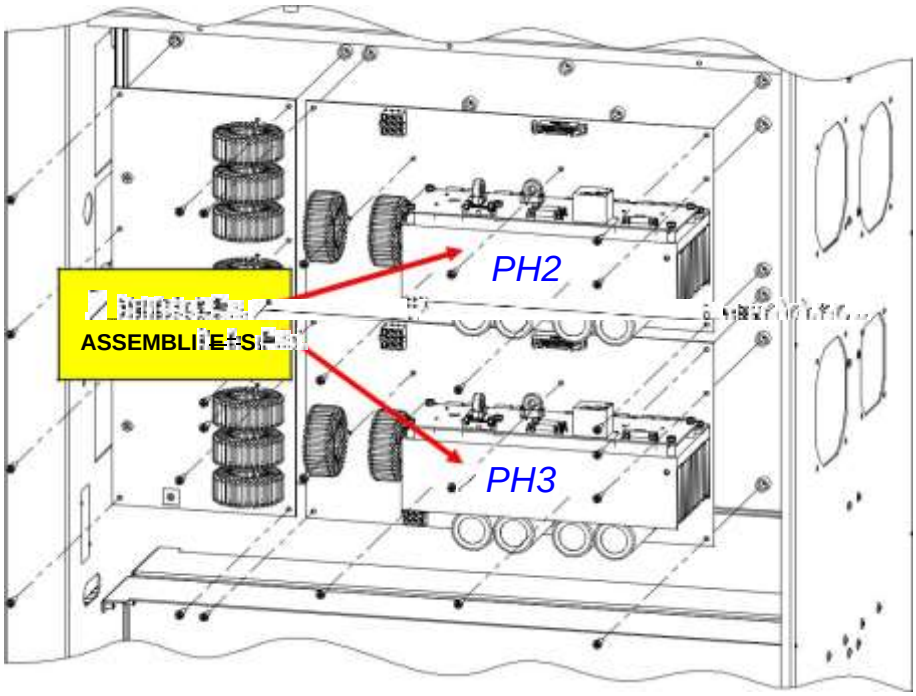


Fig. 47

8.6 REPLACING THE BYPASS SCR (SATURN 3/1).

In the event of BYPASS SCR failure (only present on phase 1), remove the damaged module and replace it with the correct spare part based on the UPS power level.

Before reassembly, cover the aluminium part on the back of the module and the part of the heatsink it will be fitted to with a thin layer of thermally conductive paste. The paste must be spread uniformly on both surfaces.

Please remember that it is essential to completely cover the surface without applying too thick a layer of paste (<100µm in total).

Place the SCR module onto the heatsink (see Fig. 48) and pressing onto it, move it in several directions to make sure that the paste is uniformly distributed between the module and the heatsink.

Refit the SCR module onto the heatsink using the previously removed screws. Remove any excess paste from the edges of the module.

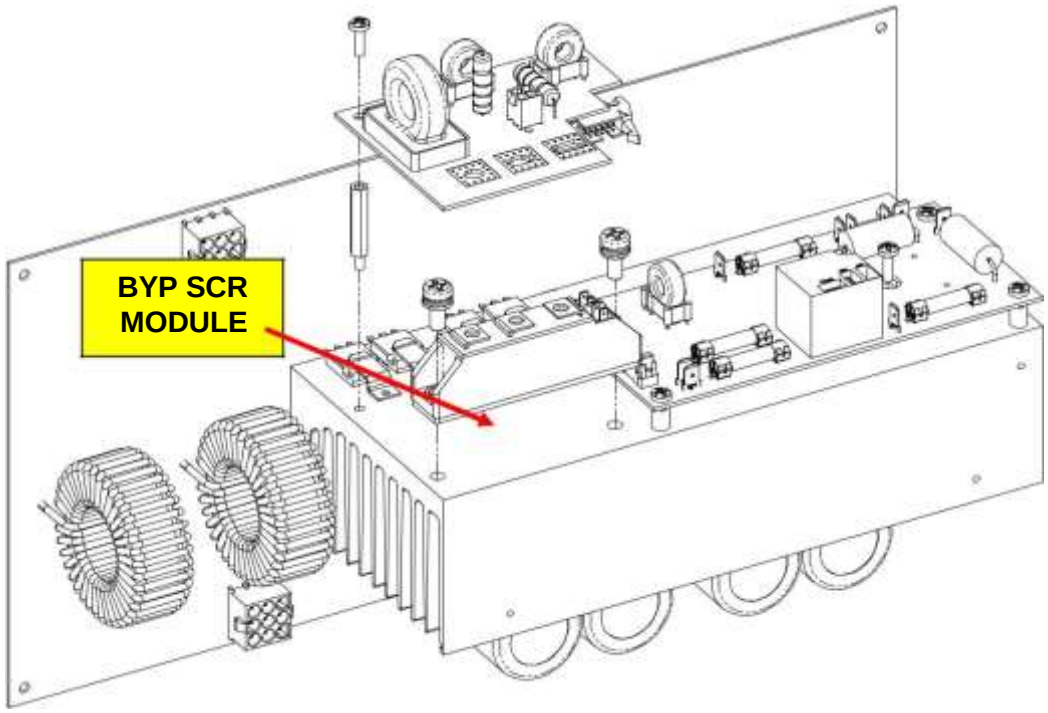
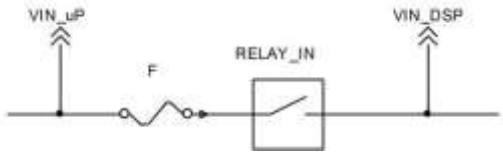


Fig. 48

9 MAP OF MAIN READINGS

The following section provides useful indications for troubleshooting problems with the UPS.

9.1 INPUT VOLTAGES



Input voltages are measured both by the µC and DSP; the measurement points are however different: the µC measures the voltage upstream of the input fuse and input contact, whilst the DSP measures it downstream from them.

The VIN_uP reading on the display is shown as PH-N whilst the VIN_DSP reading on the display is shown as PH-PH (this is only visible with the input relay closed, during start-up the reading is therefore only available at the end of the pre-loading stage).

With the machine switched off, use a multimeter to check that the input fuse on board B0052 or B0104 is intact.

With the machine still off, check that there is no short circuit between the fast-on connectors for RL1 on board B0052 or B0104 (input power board).

Test to check the continuity of the µC signal (this test should be carried out with the UPS switched off, not supplied and with the battery disconnected); with a multimeter set to ohmmeter mode, check the continuity between the following points:

		Phase 1	Phase 2	Phase 3	Notes
	Input fuse	Before	Before	Before	
	B0052 (B0104)	J6 (J3)	J6 (J3)	J6 (J3)	
	B0052 (B0104)	R3 (R2)	R3 (R2)	R3 (R2)	150 kR
->	B0052 (B0104)	R1 (R1)	R1 (R1)	R1 (R1)	150 kR
	B0052 (B0104)	J1-6 (J5-6)	J1-6 (J5-6)	J1-6 (J5-6)	
	Flat Cable	||	||	||	
	B0051	J3-6	J4-6	J5-6	
->	B0051	R291	R294	R295	1.37 kR

(Position the probes between the two points marked with "->" to test the continuity of the flat cables)

Test to check the continuity of the DSP signal (this test should be carried out with the UPS switched off, not supplied and with the battery disconnected); with a multimeter set to ohmmeter mode, check the continuity between the following points:

		Phase 1	Phase 2	Phase 3	Notes
	Input relay	After	After	After	
	B0052 (B0104)	RL1 COM.	RL1 COM.	RL1 COM.	
	B0052 (B0104)	R4 (R3)	R4 (R3)	R4 (R3)	150 kR
->	B0052 (B0104)	R2 (R4)	R2 (R4)	R2 (R4)	150 kR
	B0052 (B0104)	J1-10 (J5-10)	J1-10 (J5-10)	J1-10 (J5-10)	
	Flat Cable	||	||	||	
	B0051	J3-10	J4-10	J5-10	
->	B0051	R313	R314	R315	887 R

(Position the probes between the two points marked with "->" to test the continuity of the flat cables)

9.2 BYPASS VOLTAGES

Bypass voltage readings are measured by the µC only. The reading point is near J7 on board B0052 (SATURN 3/3) or TP2 on board B0105 (SATURN 3/1).
To check for the presence of voltage, with the UPS switched on, measure between neutral and:

- J7 on board B0052 (with SATURN 3/3).
- TP2 on board B0105 (with SATURN 3/1).

This reading is needed to synchronise the inverter and to enable or disable the bypass.

Test to check the continuity of the µC signal (this test should be carried out with the UPS switched off, not supplied and with the battery disconnected); with a multimeter set to ohmmeter mode, check the continuity between the following points:

SATURN 3/3		Phase 1	Phase 2	Phase 3	Notes
	B0052	J7	J7	J7	
	B0052	R5	R5	R5	150 kR
->	B0052	R6	R6	R6	150 kR
	B0052	J1-9	J1-9	J1-9	
	Flat Cable	||	||	||	
	B0051	J3-9	J4-9	J5-9	
->	B0051	R265	R292	R293	150R / 1.37kR / 1.37kR

(Position the probes between the two points marked with “->” to test the continuity of the flat cables)

SATURN 3/1		Phase 1	Phase 2	Phase 3	Notes
	B0105	TP2			
	B0105	R7			150 kR
->	B0105	R8			150 kR
	B0105	J1-2			
	Strip conn.	||			
	B0104	J4-2			
	B0104	J5-9			
	Flat Cable	||			
	B0051	J3-9			
->	B0051	R265			150R

(Position the probes between the two points marked with “->” to test the continuity of the flat cables)

9.3 BATTERY VOLTAGES

The battery voltage readings, measured by the µC and the DSP, are taken at the output of board B0060 (battery charger board);
The reading shown on the display is that taken by the µC; this reading is used for regulating the battery charger, the batteries present test, the battery charge status and the “battery over voltage” alarm.
The reading taken by the DSP is only used for internal regulation.

Test to check the continuity of the µC signal (this test should be carried out with the UPS switched off, not supplied and with the battery disconnected); with a multimeter set to ohmmeter mode, check the continuity between the following points:

		DC +	DC -	Notes
	B0060	J7-1	J7-3	
	B0060	R29	R27	2 MR
->	B0060	R30	R28	2 MR
	B0060	J2-5	J2-6	
	Flat Cable	||	||	
	B0051	J7-5	J7-6	
->	B0051	R278	R289	57.6 kR

(Position the probes between the two points marked with “->” to test the continuity of the flat cables)

Test to check the continuity of the DSP signal (this test should be carried out with the UPS switched off, not supplied and with the battery disconnected); with a multimeter set to ohmmeter mode, check the continuity between the following points:

		DC +	DC -	Notes
	B0060	J7-1	J7-3	
	B0060	R23	R26	2 MR
->	B0060	R5	R4	2 MR
	B0060	J2-7	J2-8	
	Flat Cable	||	||	
	B0051	J7-7	J7-8	
->	B0051	R277	R288	40.2 kR

(Position the probes between the two points marked with “->” to test the continuity of the flat cables)

9.4 INVERTER VOLTAGES

The inverter voltage readings are taken by the DSP. The reading point is exactly next to the inverter filter capacitors on board B0054 (inverter output board).
This reading is used to check the inverter and check the status of the inverter relays and fuses (combined with the output voltage reading).

To check for the presence of voltage, with the UPS switched on, place the probes between neutral and the head of the inverter output fuse.

Test to check signal continuity (this test should be carried out with the UPS switched off, not supplied and with the battery disconnected); with a multimeter set to ohmmeter mode, check the continuity between the following points:

		Phase 1	Phase 2	Phase 3	Notes
	B0054	F1-F2	F3-F4	F5-F6	fuses
	B0054	R25	R31	R37	150 kR
->	B0054	R24	R30	R36	150 kR
	B0054	J1-33	J1-35	J1-37	
	Flat Cable	||	||	||	
	B0051	J6-33	J6-35	J6-37	
->	B0051	R333	R334	R335	887 R

(Position the probes between the two points marked with “->” to test the continuity of the flat cables)

9.5 OUTPUT VOLTAGES

The output voltage readings are taken by the DSP only. The reading point is next to TP1,TP2 and TP3 on board B0054 (inverter output board). This reading is used to calculate the output power (combined with the Iout reading) and to check the status of the inverter relays and fuses (combined with the inverter voltage reading).

To check for the presence of voltage, with the UPS switched on, place one probe on neutral and test terminals TP1, TP2, TP3 (respectively for phase 1, phase 2, phase 3).

Test to check signal continuity (this test should be carried out with the UPS switched off, not supplied and with the battery disconnected); with a multimeter set to ohmmeter mode, check the continuity between the following points:

		Phase 1	Phase 2	Phase 3	Notes
	B0054	TP1	TP2	TP3	
	B0054	R27	R33	R39	150 kR
->	B0054	R22	R28	R34	150 kR
	B0054	J1-10	J1-12	J1-14	
	Flat Cable	||	||	||	
	B0051	J6-10	J6-12	J6-14	
->	B0051	R301	R302	R303	301 KR

(Position the probes between the two points marked with “->” to test the continuity of the flat cables)

9.6 OUTPUT CURRENTS

The output current readings are taken by the DSP only. The reading is taken by the TA at the output of each single phase on board B0054 (inverter output board). The TA reads the output current, i.e. that distributed by the inverter with the UPS on line or that distributed by the bypass with UPS in bypass mode. The TA is situated on the cables that connect B0054 to the SWOUT.
This reading is used to calculate the output power (combined with the Vout reading).

10 STATUS / ALARM CODES

For information on the meanings of status/alarm codes refer to the document:

code RM021 Rev..-XX “STATUS/ALARM CODES”

11 TROUBLESHOOTING TABLES

The UPS is able to check and display its status and any faults and/or failures that may occur during operation on the display panel. In the event of a problem, the UPS reports the event by displaying the type of alarm and alarm code on the display panel.

11.1 TROUBLESHOOTING 'FAULT' TYPE PROBLEMS

The tables below provide useful information for troubleshooting problems connected with 'fault' type alarm codes. The table does not cover all possible UPS failure causes, the information contained here should be considered as a suggestion of the possible causes of problems and how they might be resolved.

Alarm code	Description	Possible cause	Boards affected	Corrective actions
F01	Internal communication error	Programming board inserted into communication slots	B0096	Remove the programming board from the slot
		Communications interface board faulty.	B0056	Replace board B0056
		Board B0067 faulty	B0067	Replace board B0067
F02	Incorrect cyclic direction of phases	Input phases connection error		Check input phases connection
F03	Input fuse blown or phase 1 relay not closed	input diodes or relay blown	B0052 B0104 B0051 B0059	Check for blown diodes, fuses and relays. If necessary replace the power assembly
F04	Input fuse blown or phase 2 relay not closed			
F05	Input fuse blown or phase 3 relay not closed			
F06	Phase 1 input relay does not open	Input relay blocked	B0052 B0104	Check relays. If necessary replace board B0052 or B0104
F07	Phase 2 input relay does not open			
F08	Phase 3 input relay does not open			
F09	Positive branch capacitor preload failed	Short circuit in inverter and/or PFC stages	B0052 B0053 B0104	Replace the affected boards
		Preload diodes faulty	B0059	
F10	Negative branch capacitor preload failed	Control logic faulty	B0067 B0051	
		Input relay out of tolerance values		Check that Vin < 250V

F11	Boost stage fault	PFC stage short circuit	B0052 B0053 B0104	Replace the affected boards
		Control logic faulty	B0067 B0051	
F12	Incorrect cyclic direction of bypass phases	Connection error in bypass power supply		Check bypass power supply connection
F14	Sinusoid Phase 1 inverter distorted	Inverter stage short circuit	B0052 B0053 B0054 B0104	Replace the affected boards
F15	Sinusoid Phase 2 inverter distorted	Control logic faulty	B0067 B0051	Replace the affected boards Check for SC between phases
F16	Sinusoid Phase 3 inverter distorted	Phase-Phase short circuit		
F17	Inverter stage faulty	Inverter stage blown	B0053 B0054	Replace the affected boards
		Control logic faulty	B0067 B0051	
F19 F20	Positive battery overvoltage Negative battery overvoltage	Batteries disconnected		UPS operation with the batteries disconnected may lead to an overvoltage at the battery charger output. Shut down and restart the UPS and reconnect the batteries. If the UPS is set up for operation without batteries (freq. conv) the CB is automatically disabled
F23	Overload at output	Excessive load		Reduce the load
		Wrong UPS size following control board replacement		Set the correct size
		Output power reading faulty	B0054 B0067 B0051	Replace the affected boards
		Error in output voltage setting		Set the correct output voltage

F26 F27 F28	Phase 1 output relay blocked (does not open) Phase 2 output relay blocked (does not open) Phase 3 output relay blocked (does not open)	Failure in relay control circuit	B0054 B0067 B0051	Replace the affected boards
F29	Phase 1 output fuse blown or output relay blocked (does not close)	Failure in relay control circuit	B0054 B0067 B0051	Replace the affected boards
F30 F31	Phase 2 output fuse blown or output relay blocked (does not close) Phase 3 output fuse blown or output relay blocked (does not close)	Output fuse blown		Replace blown output fuse
F32	Battery charger stage faulty	Output voltage from CB is missing in one of the two battery branches	B0060	Check the flat cable connections and if necessary replace the affected boards
		CB control and feedback signals faulty	B0060 B0067 B0051	
F34	heatsink overheated	Cooling fans faulty	B0059	• Check for SC at fans → replace fans • Check R194 on board B0059, check voltage at connector J10, check fan power supply link →replace board B0059
		Temperature readings faulty	B0051 B0067 B0052 B0053 B0104	Check the interconnections between the affected boards, if necessary replace the boards
		Temperature sensor faulty	B0053	

F37	Battery charger overheated	CB cooling fan faulty	B0060	•Check that the fitted fan is correct (12V) →replace fan •Check for SC at the fan → replace fan •Check voltage at connector J3 → replace board B0060
		Incorrect duct installation	B0060	Check that the duct secured to board B0060 is correctly installed
		Temperature readings faulty	B0060 B0067 B0051	Check the interconnections between the affected boards, if necessary replace the boards
		Temperature sensor faulty	B0060	replace board B0060
F42 F43 F44	BOOST 1 battery fuses blown BOOST 2 battery fuses blown BOOST 3 battery fuses blown	Battery SCR blown	B0052 B0104	Check battery SCR (semitop)

11.2 TROUBLESHOOTING 'LOCK' TYPE PROBLEMS

The tables below provide useful information for troubleshooting problems connected with 'lock' type alarm codes. This table does not cover all possible UPS failure causes, the information contained here should be considered as a suggestion of the possible causes of problems and how they might be resolved.

Code	Description	Possible cause	Boards affected	Corrective action
L01	Incorrect auxiliary power supply	Aux power supplies missing B0059	B0059 B0051	Check that LED DL1 is lit on B0059 → if it is not lit check connections and/or replace board. Detailed description of L01 ch. 5 (see page 18)
L02	One or more internal cables disconnected	Flat cables not connected or partially connected	All boards with flat cables	Check the connections of the UPS flat cables
L03 L04 L05	Phase 1 input fuse blown Phase 2 input fuse blown Phase 3 input fuse blown	input diode blown	B0052 B0104	Check if diode is blown → replace the fuse. Check Boost and if necessary replace board B0052 or B0104
L06	Overvoltage at positive BOOST stage	Any unidirectional loads connected at output		Check for the presence of unidirectional loads at the output
		Output short circuit		Check for the presence of short circuits at the output
L07	Overvoltage at negative BOOST stage	Inverter stage short circuit		Check inverter stage
L08	Undervoltage at positive BOOST stage	The UPS does not have battery operation	B0052 B0104	Check the battery boost fuses and battery SCR
		Control logic faulty	B0067 B0051	Check the connections between the boards and if necessary replace them
		No mains power with the batteries disconnected		Check the battery box connection and/or battery box fuses
L09	Undervoltage at negative BOOST stage	Boost stage blown	B0053	replace board B0053
		Inverter stage blown		
L10	Static bypass switch faulty	Bypass SCR blown	B0052 B0105	Check bypass SCR and if necessary replace it

L11 L12 L13	Bypass output blocked L1 Bypass output blocked L2 Bypass output blocked L3			
L14 L15 L16	Overvoltage at phase 1 inverter Overvoltage at phase 2 inverter Overvoltage at phase 3 inverter	Inverter output capacitor faulty	B0054	Check the inverter output capacitor and if necessary replace board B0054
		Inverter operating logic faulty	B0067 B0051	Replace the affected boards
L17 L18 L19	Undervoltage at Phase 1 inverter Undervoltage at Phase 2 inverter Undervoltage at Phase 3 inverter	Phase-Phase short circuit		Check for SC between the output phases
		Control logic faulty	B0067 B0051	Check the connections between the boards and/or replace the specified boards
L20 L21 L22	DC voltage at inverter output or Phase 1 inverter sinusoid distorted DC voltage at inverter output or Phase 2 inverter sinusoid distorted DC voltage at inverter output or Phase 3 inverter sinusoid distorted	Inverter blown	B0053	Check for blown IGBT on inverter side → if necessary replace board B0053
		Control logic faulty	B0067 B0051	Check the connections between the boards and/or replace the specified boards
		Phase-Phase short circuit		Check for the presence of SC at the output
L23 L24 L25	Overload at Phase 1 output Overload at Phase 2 output Overload at Phase 3 output	Excessive load		Reduce the load
		Wrong UPS size following control board replacement		Set the correct size
		Output power reading faulty	B0094 B0067 B0051	Replace the affected boards
		Error in output voltage setting		Set the correct output voltage

L26 L27 L28	Short circuit at Phase 1 output Short circuit at Phase 2 output Short circuit at Phase 3 output	Short circuit at neutral phase output		Check for the presence of SC between the phases and neutral at the output
L34	Phase 1 heatsink overheated	Cooling fans faulty	B0059	• Check for SC at fans → replace fans • Check R194 on board B0059, check voltage at connector J10, check fan power supply link → replace board B0059
L35	Phase 2 heatsink overheated	Temperature readings faulty	B0067 B0051 B0052 B0053 B0104	Check the interconnections between the affected boards, if necessary replace the boards.
L36	Phase 3 heatsink overheated	Temperature sensor faulty	B0053	
L37	Battery charger overheated	CB cooling fan faulty	B0060	• Check that the fitted fan is correct (12V) → replace fan • Check for SC at the fan → replace fan • Check voltage at connector J3 → replace board B0060
		Incorrect duct installation	B0060	Check that the duct secured to board B0060 is correctly installed
		Temperature readings faulty	B0060 B0067 B0051	Check the interconnections between the affected boards, if necessary replace the boards
		Temperature sensor faulty	B0060	Replace board B060

L38 L39 L40	Phase 1 heatsink temperature sensor faulty Phase 2 heatsink temperature sensor faulty Phase 3 heatsink temperature sensor faulty	Temperature readings faulty	B0067 B0051	Check the interconnections between the affected boards, if necessary replace the boards
		Temperature sensor faulty	B0053	Replace board B0053
L41	Battery charger temperature sensor faulty	Temperature readings faulty	B0060 B0067 B0051	Check the interconnections between the affected boards, if necessary replace the boards
		Temperature sensor faulty	B0060	Replace board B060
L42 L43 L44	BOOST 1 battery fuses blown BOOST 2 battery fuses blown BOOST 3 battery fuses blown	Battery SCR blown	B0052 B0104	Check battery SCR (semitop)

12 APPENDIX

12.2 LIST OF BOARDS

board	description	quantity for ups
B0051	Signal Control Card	1
B0052	Input Power Card	3
B0053	Power Assembly	3
B0054	Output Inverter Card	1
B0055	Terminal Card	1
B0056	Interface Card	1
B0057	Display Card	1
B0059	Aux Power Supply Card	1
B0060	Battery Charger Card	1
B0067	DSP+µC Control Card	1
B0085	Parallel Card	1
B0098	Filter Cy Card	2
B0104	Input Power Card	3
B0105	Bypass Card	1
B0106	Terminal Card	1
B0186	Input Filter Card	1