LAKE SHORE
MODEL # 668

± 65V ± 135A POWER SUPPLY

100 PPM

208V line voltage

TECHNICAL MANUAL
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AF01120B/±65V ±135A 208V 100 ppm
1. **INTRODUCTION**

This supply is a very stable current regulated power supply, class 10⁻⁴. It is designed to deliver ±135A under ±65V into an electromagnet.

The minimum value of the load is 0.29 Ω.

The power supply is water-cooled.

It has protections against lack of water and internal failures. It also includes a protection against condensation.

In order to get a low ripple, the series regulation is made with banks of transistors.

It can be monitored in local and in remote mode.
2. SPECIFICATIONS AND PERFORMANCE

2.1. General specifications

Power requirements: three-phase 208V with Earth ±10% / 50 to 60 Hz
power consumption: less than 39 A/phase; 15.5 kVA.
(or exceptionally 400V ±10%, 20A / phase max).

Minimum load: 0.29 Ω

Main front panel:
- mains indicator
- stand-by switch
- reset push button
- power-on and power-off pushbuttons with light indicator
- 3.5 digits voltmeter
- 3.5 digits ammeter
- local/remote mode selector (locking lever switch)
- 100% ten-turn potentiometer (for local mode only)
- 1% ten-turn potentiometer
- voltage limitation potentiometer
- 100% external input BR2 for remote mode only (± 10V)
- 10% external input (± 10V) (modulation)
- polarity selector (locking lever switch)
- output monitor ± 10V for Vout reading
- output monitor ± 10V for I reading
- a set of 13 leds (status indicators)

General protection:
There are thermal sensors on the heat sinks to avoid failures if there is a lack of cooling. There are several other internal protections (see chapter 3-9 for details).
Some external inputs are available on the D-SUB connector of the rear panel for the interlock.
After a fault, the power supply returns to stand-by position. A led of the front panel lights up to indicate the reason of the breakdown.
To return to normal operation, the reset button must be depressed.

There are 6 fuses inside the power supply see §3-10 for models and locations.

There is also an output voltage limitation. The supply doesn't stop and returns to normal operation when the output current decreases.

In order to reduce the stress on the transistors when operating with a large magnet, the di/dt is internally limited at the rate of 10 Amperes per second maximum.

Connections:
Three-phases R, S, T, and Earth: by external conduit-box at the rear of the cabinet.
Output terminals: On threaded terminals at the rear of the cabinet, protected by a removable cover.
Analogue signals: four BR2 on the front panel
Remote power on/power off and interlock: D-SUB connector on the rear panel.

Water connections:
Input and output are male F ¼ for pipe with an internal diameter of 8 mm.

Construction:
19" steel shielded cabinet, according to EMC requirements.

Dimensions:
19" cabinet 1.35 m high, 700 mm deep, 600 mm wide
Cooling: The rectifier bridge, the banks of transistors and the shunt are water-cooled. The nominal flow rate is 8 litres/min.

2.2. Performance

Type of regulation: current regulation

Output current: ±135 A max.

Output voltage: ±65V max.

Setting value: - two ten-turn potentiometers available on the main front panel, one for the coarse setting (100%), and one for the fine setting (1%).
- One BR2 input for 100% external input ±10V.
- One BR2 input for 10% external input (modulation) ±10V.

Polarity: - a polarity selector for local mode (locking lever switch).
- the sign of the external input gives the polarity in remote mode, with a true zero crossing.

Load: Electromagnet. Minimum resistance of 0.29 Ω is required.

Stability: Line (+10% -10%) ± (2.10^-5 Is + 2.10^-5 In)
Load (+20%) ± (2.10^-5 Is + 2.10^-5 In)
long term ± (10^-4 Is + 10^-4 In) under conditions of constant line voltage, load and temperature

Noise: ± (10^-5 Is + 10^-5 In) peak-peak, between 0.01 Hz and 1 Hz.

Ripple: (5 mV rms. + 10^-4 Vn)

Is is the operating value, In and Vn are nominal values.

Status indicators: 4 green leds when the power supply is OK.
9 red leds for faults (see chapter 3-9 for details)
Fault signal latches and requires either depressing reset button or down powering for reset.

Power light: the power supply delivers a current to the load.

Mains: lights up when the power supply is plugged.

2.3. Environment

2.3.1. Operating Environment

Ambient temperature: +10°C to +30°C

Cooling water: +15°C to +25°C, able to work with tap water (25°C max.). AVOID CONDENSATION!

Humidity: 55% ± 10% (non-condensing)
2.3.2. Shipping and non-Operating environment

Ambient temperature: -10°C to +50°C (remaining water must be removed if the temperature decreases below +5°C)

3. INSTALLATION AND OPERATION

3.1. First installation

Remove the right and the left panels of the cabinet. Be careful when removing the panels, don't damage the EMI gasket.

Since the transformer is mounted on silent blocs to minimize the acoustic noise, two strong bars maintain it for the transport. Remove these bars (there is a hand-written label on each of them).

Then put the lateral panels again.

Attached is a bag including:
- the rear D-SUB plug,
- one BR2 connector for front panel
- two water connections

3.1.1. Front protection

The consumption of the power supply is 39 A per phase with 208 V between phases, and 20A per phase with 400V between phases.

The unit must be installed with a wall breaker.

The requirements are:

<table>
<thead>
<tr>
<th>208V</th>
<th>400V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wire section : 16 mm² on each phase</td>
<td>Wire section : 6 mm² on each phase</td>
</tr>
<tr>
<td>Customer fuses :45A / 500V-- time lag per phase</td>
<td>Customer fuses :20A / 500V-- time lag per phase</td>
</tr>
</tbody>
</table>

Outputs are available on the rear connector for an emergency stop.

3.1.2. Conversion between 208V and 400V.

This power supply is delivered in 208V configuration. You don't need to change the internal wiring if you plug it on a 400V line.

In normal operation, the line voltage must be 208V.

The power supply is designed to work with three-phase mains of either 208V between phases or 400V between phases. The frequency must be comprised between 50 Hz and 60 Hz.

Nevertheless, the internal input protection is set at 44A; this value is optimized for a 208V line voltage, but is too high for a 400V line voltage where the consumption is only 20A.

We consider that this power supply is not designed to run with a 400V line voltage in normal operation. It may operate at 400V for tests only.
If you want to change the configuration, you must change the wiring of the main transformer and of the auxiliary transformer.

To do that, open the large panel in front of the cabinet.

- **main transformer**:

  
  - 3 x 208V line voltage
  - 3 x 400V line voltage

  The three wires are always connected to the terminals "0".

- **auxiliary transformer**:

  Near the terminals of the power transformer, you can see 3 terminals for the auxiliary transformer. The white wire is connected to the "220" terminal or to the "400" terminal and the blue wire is connected to the "5%" terminal or to the "0" terminal according to the line voltage.

![Diagram of auxiliary transformer connections]

Put the front panel back to its place.

### 3.1.3. Cabinet grounding

The electromagnetic compatibility requirements (necessary for the CE mark) are met if the cabinet is grounded to the nearest earth by its copper wire connected under the cabinet.

### 3.1.4. Rear plug

There is a conduit-box at the rear of the cabinet, where the three-phase wires are connected.

The order of the phases is indifferent.
3.1.5. Output connections

Remove the small rear cover to have a good access to the output connections.

```
U  0  Gnd  D-SUB
```

The output wire section must be at least 50 mm². **Threaded terminals M8 : recommended torque = 0.8 m.kg to 1 m.kg max.**

For the safety at low frequencies, if there is a ground wire in cable of the load, you can connect it to the Gnd terminal.

To prevent spurious noise or undesired feedback, don't route output cables with input cables.

The output terminals have floating potentials. The potential between each output and the cabinet ground must not exceed 250 V.

CAUTION: there is no isolation between the BR2 connectors and the power outputs. This is the synopsis of the regulation:

![Diagram](image)

The user must ground the system to be in conformity with the regulations about safety.

3.1.6. Rear D-SUB connector

The electromagnetic compatibility requirements (necessary to get the CE mark) enjoin to use a shielded cable for this connector. A 360° shield connector is recommended.

The minimum configuration for a first installation requires:

- A strap between 5 and 12
- A strap between 1 and 9
- A strap between 6 and 13

See the chapter "rear terminals" for further information.

3.1.7. Water connections

Take the coupling connections delivered with the power supply. It is recommended to put paste (Loctite 577 for example) to improve the water tightness.

**The upper hole is for input, and the lower hole is for water output.**

If inlet and outlet are inverted, the power supply may be less stable.

The minimum recommended flow rate is 8 l/min.

3.1.8. BR2 for analogue signals

The mounting procedure is delivered with the connectors.

The BR2 "100%" is used for remote mode only.
The BR2 "modulation" is active in local and in remote mode, for a fine variation of the current, in a range of ±10% (±13.5A).
The two BR2, I and U, are outputs which deliver a voltage (±10V max.) proportional to the output current and voltage.

For a first installation, you don't need these cables in local mode, and you can use only one cable in remote mode.

Caution: the four BR2 have a common zero, which is on the right pin:

![Signal and 0V connection diagram]

### 3.2. Rear D-SUB pins arrangement

<table>
<thead>
<tr>
<th>Pins</th>
<th>Description</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 and 12</td>
<td>Emergency stop</td>
<td>The power supply stops when the connection opens.</td>
</tr>
<tr>
<td>1 and 9</td>
<td>External fault</td>
<td>When operate with a magnet, connect the magnet flow switch leads to pins such the circuit is closed for normal operation.</td>
</tr>
<tr>
<td>11</td>
<td>+&quot;24V&quot; - 100 mA max</td>
<td>This non-regulated voltage comes up when the power supply is on. It returns to 0V when the power supply is in stand-by mode.</td>
</tr>
<tr>
<td>3</td>
<td>0&quot;24V&quot;</td>
<td></td>
</tr>
<tr>
<td>6 and 13</td>
<td>Remote power - off</td>
<td>Connect a short - circuit for normal operation. The power supply stops if this connection is open for at least 0.5 sec.</td>
</tr>
<tr>
<td>7 and 14</td>
<td>Remote power - on</td>
<td>This connection is normally open. A short - circuit with duration of 0.5s powers - on the power supply.</td>
</tr>
<tr>
<td>8 and 15</td>
<td>Power status</td>
<td>This output is an open contact if the power supply is powered - off, and a short-circuit if the supply is powered on.</td>
</tr>
</tbody>
</table>

### 3.3. Control configurations

The power supply can be monitored either by its potentiometers, or by external analogue voltages.

The power-on and power-off orders are possible whatever are the positions of the local/remote switch.

The different possibilities are listed below. Please, read the other chapters for further explanation.

<table>
<thead>
<tr>
<th>local/remote selector</th>
<th>100% pot</th>
<th>1% pot</th>
<th>BR2 100% input</th>
<th>BR2 modulation</th>
<th>remote on (D-SUB 7 to 14)</th>
<th>remote off (D-SUB 6 to 13)</th>
<th>Polarity switch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local</td>
<td>active</td>
<td>active</td>
<td>disable</td>
<td>active</td>
<td>active</td>
<td>active</td>
<td>active</td>
</tr>
<tr>
<td>Remote</td>
<td>disable</td>
<td>active</td>
<td>active</td>
<td>active</td>
<td>active</td>
<td>active</td>
<td>active</td>
</tr>
</tbody>
</table>

The local / remote and polarity switches have locking levers: please pull the lever when switching.
3.4. Manual mode Control

For a complete manual mode, please, follow the above procedure:

1. Make the water flow into the power supply
2. Switch the selector local/remote to "local"
3. Switch-on the AC mains. The green indicator "mains" lights up.
4. Switch the "stand-by" switch towards the upper position: the 4 green leds light up.
5. Select the polarity with the "polarity" locking lever switch (pull the lever when switching).
6. Press the green "power-on" push-button
7. The green "power" indicator lights up.
8. Turn the two ten-turn potentiometers to adjust the output current.
   The output voltage and the output current are displayed. The speed is internally limited at 10A/sec.
9. You can adjust or sweep the output current within ±10% of Imax with the external "modulation" input by applying a 0 to ±10V voltage.
10. Press the "off" push-button to stop the output current. The "power" indicator lights off.
11. Switch the "stand-by" switch to 0 to completely power down the supply. All the indicators and displays light off after a time that corresponds to the complete discharge of the capacitors.

3.5. Remote mode Control

The "stand-by" switch must be on "stand-by" position for remote mode control.

The available remote functions are:

- remote power-on
- remote power-off
- remote analogue control voltage.

To get a remote power-on: make a temporary short-circuit of 0.5 sec between pins 7 and 14 of the rear D-SUB connector.

To get a remote power-off: open during 0.5 sec the short-circuit between pins 6 and 13 of the rear D-SUB connector.

---

Power relay

<table>
<thead>
<tr>
<th>Power relay</th>
<th>7</th>
<th>14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power-on pushbutton</td>
<td>remote on</td>
<td></td>
</tr>
<tr>
<td>Power-off pushbutton</td>
<td>remote off</td>
<td>6</td>
</tr>
</tbody>
</table>

---

AF01120B / ±65V ±135A 208V 100 ppm
To get a remote analogue control voltage: switch the selector "remote" (pull the lever when switching).
- The output current is controlled by the voltage on the BR2 "input 100%".
- It still may be adjusted by the 1% potentiometer, and by the "MODULATION" BR2 input.

3.6. Power status

This information is available between the pins 8 and 15 of the rear D-SUB connector. An auxiliary contact is in the same position that the main phases relay the terminals of which are available.

3.7. Voltage limitation

The output voltage is limited with the "voltage limitation" potentiometer between 0 and 72 V, with the rate of about 7.2V per turn.

3.8. Interlock

Two inputs are available for external fault detection.

The external input n°1 detects an open circuit. The input n°3 is not available in this power supply. The external input n°2 detects an overvoltage and is used for condensation detection.

An abnormal configuration of one of these inputs makes the led "ext." light up.
3.9. Fault

In stand-by position, the four green leds must light up.
There is one led for each internal auxiliary voltage (+15V, -15V and +5V).
If the power supply is ready to be powered on, the green led "on" lights up. If one of these leds is off, the power supply can't deliver the output current.

When the "fault" indicator lights up, the power supply stops (returns to stand-by position) and the fault is latched.

There are 8 causes of fault. At each cause corresponds a led on the front panel:

SET OF RED LEDS
Failure: when one of the two leds "failure" lights up, the most probable reason is an internal failure in the banks of transistors. After repair, check the fuses F4 and F5 near the capacitors. Never run the unit without F4 or F5.

Bridge over-heating: this led lights up when the power bridges heat sink is too hot. Check the fans.

Banks over-heating: this led lights up when one of the banks of transistors is too hot.
Check the flow rate of water.
Check the value of the load. If it is low, the internal dissipated power in the banks is high and the water flow rate may not be enough.

Overload: this led lights up if the current is higher than ±155A. It generally occurs in remote mode when the external applied voltage is greater than 11V.

Overpower: the internal dissipated power must be limited to prevent the temperature junction from being too high. If the maximum allowed value is overstepped, the power supply stops and gives this indication.

1st stage: this led lights up when the main relay at the input of the power supply detects a current greater than 44 A. This fault occurs in very exceptional cases, insulation fault for example.

Ext.: this led lights up when the external input of the rear DSub is not in the right position or when condensation is detected inside the unit. Check the connection of pins 1 and 9 on the rear DSub. If they are OK, open the unit and check inside for condensation. If the unit is wet because of condensation, you must dry it up before restarting it. Caution: disconnect the unit from mains before opening it.

To reset the power supply, you must cycle the AC power or depress the reset button on the front panel.

FUSES
Some faults can also be caused by a blown fuse (see reference and location thereunder):

F6 or F9 blown: all is OFF, including the "mains connected" light. Power-On can't be carried out.

F10 blown: all is OFF, including the "mains connected" light. Power-On can't be carried out.

F11 blown: the Stand-by mode is allowed, Power-On can be carried out but you can neither hear the fans rotate nor make current circulate by any way.

F4 or F5 blown: the Stand-by mode is allowed.
These fuses blow often after an important failure (bank failure for example).
Never run the unit when F4 or F5 is missing. You may damage the unit.

OTHERS
If only the light "mains connected" comes on, and if the green leds are off, check the short between 5 and 12 on the rear DB15 connector.
If you cannot start the unit, check the short between 6 and 13 on the rear DB15 connector. If there is enough water, if the fuses are OK and if the "fault" can't be cleared, the supply has suffered some serious internal damage. Please refer to BOUHNIK.

### 3.10. Fuses

The power supply must be completely disconnected from the mains before opening the panels to change the fuses.

<table>
<thead>
<tr>
<th>Fuse</th>
<th>Description</th>
<th>Ref.</th>
<th>Location and access</th>
</tr>
</thead>
<tbody>
<tr>
<td>F6-F9</td>
<td>Size 10 x 38 1 A time lag / 500V~</td>
<td>130 01 LEGRAND</td>
<td>Mounted on the right rear DIN rail. Remove the right panel.</td>
</tr>
<tr>
<td>F4-F5</td>
<td>Size 10 x 38 20 A time lag / 400V~</td>
<td>130 20 LEGRAND</td>
<td>Mounted near the capacitors. Remove the large bottom front panel.</td>
</tr>
</tbody>
</table>

The following fuses don't need to be changed as they trip and then return to their normal state.

<table>
<thead>
<tr>
<th>Fuse</th>
<th>Description</th>
<th>Ref.</th>
<th>Location and access</th>
</tr>
</thead>
<tbody>
<tr>
<td>F10</td>
<td>PolySwitch 2.5 A time lag / 60V~</td>
<td>RXE 250 RAYCHEM</td>
<td>Horizontally mounted on the small PCB &quot;040A&quot;, behind the large PCB and near the small transformers. Remove the left panel.</td>
</tr>
<tr>
<td>F11</td>
<td>PolySwitch 2.5 A time lag / 60V~</td>
<td>RXE 250 RAYCHEM</td>
<td>Vertically mounted on the small PCB &quot;040A&quot;, behind the large PCB and near the small transformers. Remove the left panel.</td>
</tr>
</tbody>
</table>

### 3.11. Periodic maintenance and service

The power supply doesn't require adjustments unless a component has been replaced. Only the dust must be removed, if necessary.

It may be necessary to replace the chemical capacitors every ten years.

THE SERVICE MUST BE DONE BY SKILLED PEOPLE ONLY. BEFORE OPENING THE POWER SUPPLY, YOU MUST REMOVE THE REAR PLUG TO DISCONNECT IT FROM THE MAINS.

IF THE POWER SUPPLY RUNS WITHOUT ONE OF ITS PANELS, REMIND THAT THERE ARE DANGEROUS VOLTAGES INSIDE.
4. DRAWING

Attached is the general drawing B65V135A-M-208-220.dsn rev M.a.
FINAL TESTS OF BIPOLAR POWER SUPPLY

Date: February 14, 2003
model: ±65V / ±135A
ref.: AF01120-B

Configuration for test: 400V

Operating environment: line: three-phase, 400V/50Hz between phases

1. Rear SubD connector:
A strap between 5 and 12
A strap between 1 and 9
A strap between 6 and 13

2. Power supply connected to the mains
The "mains" indicator lights up.

3. Auxiliary power supplies
V across the primary terminals of T3 : 407V

<table>
<thead>
<tr>
<th>Before regulation</th>
<th>After regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meas. point</td>
<td>Meas. Point</td>
</tr>
<tr>
<td>&quot;+15V&quot;</td>
<td>TP101</td>
</tr>
<tr>
<td></td>
<td>TP105 (0V)</td>
</tr>
<tr>
<td>&quot;-15V&quot;</td>
<td>TP103</td>
</tr>
<tr>
<td></td>
<td>TP105 (0V)</td>
</tr>
<tr>
<td>&quot;+5V&quot;</td>
<td>TP106</td>
</tr>
<tr>
<td></td>
<td>TP108 (0V)</td>
</tr>
<tr>
<td>&quot;+10V opto&quot;</td>
<td>TP111</td>
</tr>
<tr>
<td></td>
<td>TP112 (0V)</td>
</tr>
<tr>
<td>&quot;48V&quot;</td>
<td>TP109</td>
</tr>
<tr>
<td></td>
<td>TP115 (0V)</td>
</tr>
<tr>
<td></td>
<td>TP109</td>
</tr>
<tr>
<td></td>
<td>TP115 (0V)</td>
</tr>
</tbody>
</table>

4. Internal voltages

<table>
<thead>
<tr>
<th>Uref</th>
<th>Set. value 100%</th>
<th>Set. value 1%</th>
</tr>
</thead>
<tbody>
<tr>
<td>TP401 TP504 (0V)</td>
<td>TP505 (0V)</td>
<td>TP504 (0V)</td>
</tr>
<tr>
<td>+9.9994 V</td>
<td>-10.0015 V to 10.0005 V</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Uref</th>
<th>TP403 TP504 (0V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Uref</td>
<td>-10.0006 V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overpower threshold</th>
<th>TP405 TP105 (0V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2.7994 V</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overpower threshold</th>
<th>TP411 TP105 (0V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2.8000 V</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Voltage adjustment</th>
<th>TP406 TP105 (0V)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-5V at Vout=+65.0V</td>
<td></td>
</tr>
</tbody>
</table>
5. Rectified voltages

$V_{Ph1N} = 234$ Vrms; $V_{Ph2N} = 232$ Vrms; $V_{Ph3N} = 234$ Vrms (nominal voltage is 230V).
$I_{Ph1} = 19.8$ A r.m.s.; $I_{Ph2} = 19.1$ A r.m.s.; $I_{Ph3} = 19.5$ A r.m.s.

<table>
<thead>
<tr>
<th>$\text{At } I_{out} = 0\text{ A}$</th>
<th>$V_{f+} = 95.1$ V</th>
<th>$V_{f-} = -94.9$ V</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{At } I_{out} = +135\text{ A}$</td>
<td>$V_{f+} = 87.9$ V ripple $&lt; 500$ mV pk-pk</td>
<td>$V_{f-} = -88.3$ V ripple $&lt; 520$ mV pk-pk</td>
</tr>
<tr>
<td>$\text{At } I_{out} = -135\text{ A}$</td>
<td>$V_{f+}$ ripple $&lt; 494$ mV at 50 Hz</td>
<td>$V_{f-}$ ripple $&lt; 514$ mV at 50 Hz</td>
</tr>
<tr>
<td>$\text{At } I_{out} = -241$ mV at 300Hz</td>
<td>$\text{At } I_{out} = +135\text{ A}$</td>
<td>$\text{At } I_{out} = -135\text{ A}$</td>
</tr>
</tbody>
</table>

6. Output voltage and current

- **Load**: resistance of 0.49Ω.
  - $\text{At } I_{out} = +135.0\text{ A}$, $V_{out} = 64.4$ V with a ripple of 11 mV pk-pk
  - $\text{At } I_{out} = -135.1\text{ A}$, $V_{out} = -64.4$ V with a ripple of 7 mV pk-pk

- **Load**: magnet; equivalent $R = 0.19\Omega$, equivalent $L \approx 0.3$H.
  - $\text{At } I_{out} = +90.0\text{ A}$, $V_{out} = 16.6$ V with a ripple of 10 mV pk-pk
  - $\text{At } I_{out} = -90.0\text{ A}$, $V_{out} = -16.6$ V with a ripple of 8 mV pk-pk

7. Output monitors

These monitors are located on the front panels.

- **Voltage monitor**: $V = +9.8923$ V at $V_{out} = +64.390$ V
  - $V = -9.8880$ V at $V_{out} = -64.428$V

- **Current monitor**: $V = +10.0007$ V at $I_{out} = +135.01$ A
  - $V = -10.0224$ V at $I_{out} = -135.09$ A

8. Cross-conduction current

At $I_{out} = 0.00\text{ A}$, there is a current flowing through the banks + towards the banks-. Its value is set at about 88 mA by adjusting $R_{303}$.

9. Local mode

- 10-turn potentiometer 100% at max.: $I_{out} = +135.01\text{ A}$ with polarity +
  - $I_{out} = -135.09\text{ A}$ with polarity −

- 10-turn potentiometers 100% and 1% at max.: $I_{out} = +136.34\text{ A}$ with polarity +
  - $I_{out} = -136.43\text{ A}$ with polarity −

10. Remote analogue control voltage: in remote mode only

- $V = +10.00\text{ V on BR2 }"100\%"$ $I_{out} = +134.93\text{ A}$
- $V = -10.00\text{ V on BR2 }"100\%"$ $I_{out} = -134.99\text{ A}$

11. Control by external analogue voltage "modulation" in both local and remote modes

- $V = +10.00\text{ V on BR2 }"\text{ modulation}"$ $I_{out} = \text{ increases of } +13.39\text{ A}$
- $V = -10.01\text{ V on BR2 }"\text{ modulation}"$ $I_{out} = \text{ decreases of } -13.42\text{ A}$

---

2 Final tests
12. Voltage limitation

<table>
<thead>
<tr>
<th>Polarity +:</th>
<th>Number of turns</th>
<th>Output voltage limitation</th>
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13. Long term stability

An external water-cooled shunt (1 V @ 50 A) is connected in series with the load.

The power supply is set in 400V mode (transformers connected between "0%" and "400"). Line voltage: 400V between phases.

The power supply had been running at -135A for about 3.5 hours with a resistive load, then at +135 A for about 2.5 hours.

During the first three hours, the room temperature increased by about four degrees, which explains the special shape of the curve.

The result is as follows:

![Graph showing long-term stability](image1)

![Graph showing long-term stability](image2)

Final tests 3
14. **Tests of faults detection**

Some defects are simulated, and the results are displayed by the set of LED's on the front panel.

<table>
<thead>
<tr>
<th>Normal operation</th>
<th>+15V</th>
<th>-15V</th>
<th>+5V</th>
<th>READY</th>
<th>FAULT</th>
<th>FAILURE</th>
<th>BRIDGE OVV</th>
<th>BANK OVV</th>
<th>OVERLOAD</th>
<th>1F STAGE</th>
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15. **Voltage on the rear 15 pins SubD**

Voltage measurement between 11 (+) and 3 (0V) : 26.1 V.
± 65V ± 135A POWER SUPPLY

100 PPM

208V line voltage

TECHNICAL MANUAL