SM 1540-D
SM 7020-D
SM 3004-D

DESCRIPTIONS

1) OUTPUT

The SM7020 and SM3004 feature an AUTORANGING faciliy where the power supply automatically switches over between two current ranges. This switching, which is unnoticeable the user, results in a versatile power supply with **twice the output voltage range**.
This means for the SM7020: the maximum output power (700W) is available at both 35V and 70V. For the SM3004: 600W at both 150V and 300V.

Note: the voltage and current settings will never be altered by the AUTORANGING, only the maximum attainable current will change. E.g. on the SM3004, with an initial setting of 1.5A. When the voltage is decreased from 200V to 150V the max. current output remains 1.5A as originally set.

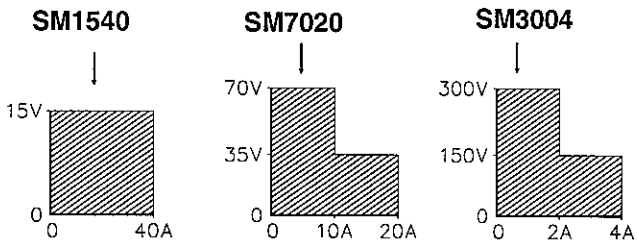


fig. 2 - 1
The output ranges.
every point in hatched area can be used

° DISPLAY CV/CC SETTING FUNCTION
The setting of the voltage and current control can be observed on the front panel meters by pressing the Display CV/CC Setting button. This allows the current limit to be set when operating in the CV mode without shorting the output terminals, and the voltage limit to be set when operating in the CC mode without opening the load leads.

° PULSATING LOAD
To avoid overheating of the output capacitors, the AC component of the load current should be limited. See fig. 1 - 2. The max. values are:

SM1540	SM7020	SM3004
10 A rms	5 A rms	1 A rms

One method of decreasing the AC current through the output capacitor is by using a large external electrolytic capacitor in parallel with the load.

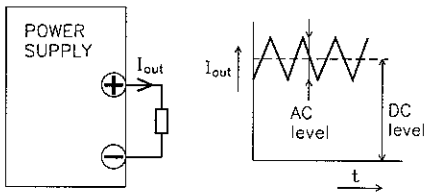


fig. 2 - 2
pulsating load current

° OVERLOAD PROTECTION
The power supply is fully protected against all overload conditions, including short circuit.

2) EFFICIENCY

The efficiency is very high and constant over a wide output current range, see fig. 2 - 3. High efficiency also means low power loss and low heat production.

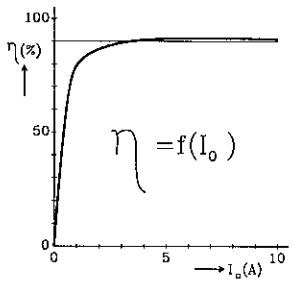


fig. 2 - 3
Efficiency vs output current, SM7020
DC input , Vout = 70 V

3) REGULATION

The load regulation should be measured directly on the output terminals. A few cm of cable can have a voltage drop of several mV (at high current !).

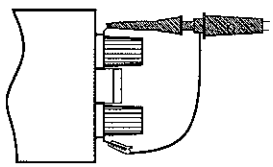


fig. 2 - 4
measuring ripple voltage
WRONG !

4) RIPPLE & NOISE

The output ripple is very low with almost no spikes.
The ripple voltage has to be measured directly on the output terminals using a probe with very short connections (to avoid pick up of magnetic fields). See fig. 2 - 4 and fig. 2 - 5.

° LOW TEMPERATURE
At –20 °C the CV ripple increases to the following values:

	SM1540	SM7020	SM3004
CV ripple (rms/pp)	6 / 20 mV	10 / 35 mV	no change

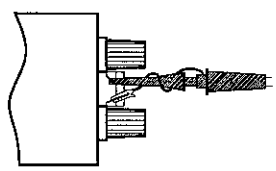


fig. 2 - 5
measuring ripple voltage
RIGHT !

5) RECOVERY TIME

Fig. 2 - 6 shows the recovery time for the SM7020 at 25 °C , a 50 – 100 % load step and at maximum output voltage. At –20 °C the recovery time increases by 100 µs.

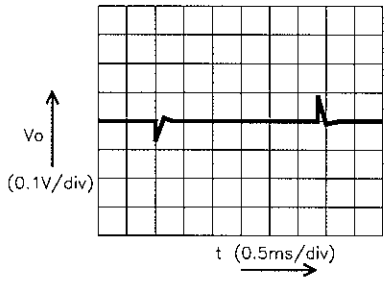


fig. 2 - 6
recovery time SM7020
50 - 100 % load step, V_o = 70 V

6) OVP

The over voltage protector shuts off the power supply immediately after the output voltage reaches the trip level. The led on the frontpanel will indicate whether the OVP has tripped. The OVP status output will give a logic 1 (+5 V). To **reset** the OVP it is necessary to switch off the power supply. The trip voltage can easily be set on the frontpanel using the DISPLAY OVP SETTING function. In order to avoid false tripping, it is recommended to set the trip level well above the working output voltage. The minimum recommended offsets are 2, 5, 20 V for resp. the SM1540, SM7020 and SM3004.

7) PROGRAMMING INPUTS

The output voltage and current can be programmed by an external voltage. The analog programming is very accurate and linear, (nonlinearity < 0.15 %). The levels are all standardised on 5V. The connections and levels are compatible with the **IEEE 488** programmer PSC44M.
The inputs have a protection circuit formed by a series resistor and a parallel zener, see fig. 2 - 8. The capacitor limits the speed to a safe value. Note that the analog inputs (and outputs) are ***not floating***, but the common is connected to the negative output terminal. Wrong connection of Ø can blow the fuse.

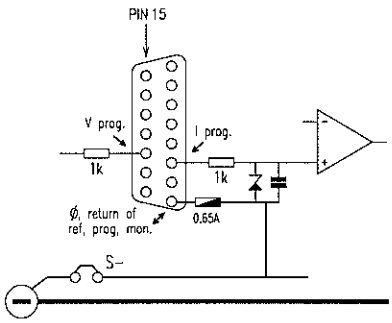


fig. 2 - 8
programming inputs
(internal circuit)

The programming mode (programm and manual) can be selected by means of the prog switches which are situated below the programming connector, see fig. 2 - 7.

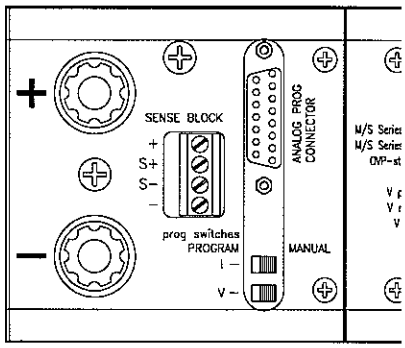


fig. 2 - 7
location of output terminals and analog prog. connector on rear panel (SM3004 has no sense block)

8) MONITORING OUTPUTS

The monitor outputs give a voltage 0 - 5 V proportional to the output current or voltage. The output current can easily be measured without an external shunt using the CC monitor, see fig. 2 - 9. The monitor outputs are buffered by op-amp's and protected by series resistors and parallel zeners see fig. 2 - 10.

output	pin	R_o	I_o max
Vref	9	15 Ohm	10 mA
Vmon	10	20 Ohm	10 mA
Imon	2	20 Ohm	10 mA
+12 V	7	500 Ohm	25 mA
Ø	1	1.2 Ohm	

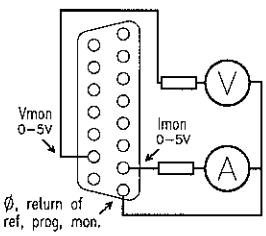


fig. 2 - 9
external meters
using monitor outputs

9) REMOTE SHUTDOWN

A voltage of +5V on the Remote Shutdown input on the programming connector will switch off the power circuit of the unit. In standby mode the power supply consumes very little power.
It is also possible to use a relay contact or a switch to shut down the unit: connect a switch between Vref and Rem. shutd. (pin 9 and 5).
Note: The Remote Shutdown will also cause the **OVP-led** to burn and the OVP-status will be high.

10) STATUS OUTPUTS

The status outputs have an open output voltage of 5 V and a short circuit current of 10 mA. This makes it possible to drive directly: an opto-coupler, a TTL gate or a CMOS gate (put leakage resistor to Ø).

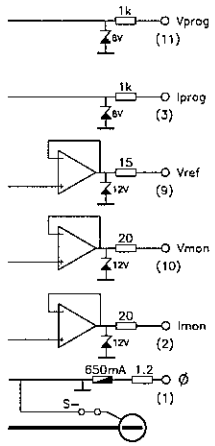


fig. 2 - 10
buffered monitor outputs
(internal circuit)

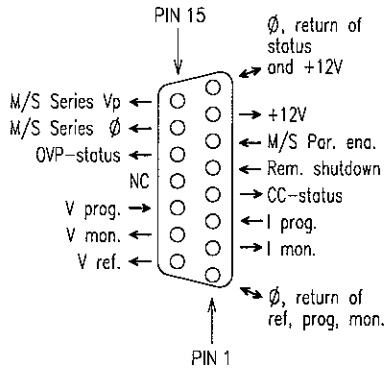


fig. 2 - 11
connections ANALOG PROG. CONN.

pin	description
1	Ø, return of reference, prog. inputs and monitor outputs.
2	current monitor output (0 - 5V)
3	current programming input (0 - 5V)
4	CC status output, logic 1 = CC mode (5 V / 10 mA)
5	Remote Shutdown, 5V=off (not always available)
6	M/S parallel, slave enable (only for autoranging)
7	+12 V output (Ri = 500 Ohm)
8	Ø, return of status outputs, +12 V and remote shutdown
9	reference voltage 5.1 V
10	voltage monitor output (0 - 5V)
11	voltage programming input (0 - 5V)
12	not connected
13	OVP status output, logic 1 = OVP mode (5 V / 10 mA)
14	M/S series, output for slave (Ø)
15	M/S series, output for slave (prog.)

11) IEEE 488 PROGRAMMING

The connector on the power supply is pin compatible with the (external) interface PSC44M. Voltage and current can easily be programmed and read back, and the CC and OVP status can be read by the computer.

12) PROGRAMMING RESPONSE TIME

The response time is measured with a step waveform at the CV prog. input. Programming from a low to a high output voltage is nearly load independent, but programming down to a low voltage takes more time at lighter loads. This is caused by the output capacitors, which can only be discharged by the load because the power supply cannot sink current.

13) PROGRAMMING BANDWIDTH

For small signals the bandwidth is 50 Hz, but for large signals there is a limitation in the maximum amplitude of the output waveform. The output capacitors limit the max. slew rate. Fig. 2 - 12 shows the maximum peak to peak output voltage swing as a function of frequency, with the load as a parameter. The higher the load resistance the lower the max. amplitude. The measurements were carried out with a sine wave. The DC level of the output is 50 % of the max. output voltage. On the SM7020 and SM3004 measurements were also carried out at 25 % of the max. output voltage.

14) INPUT VOLTAGE

The power supplies have a wide input voltage range. The 2 ranges (110V / 220V) are selectable with a switch on the rearpanel, see fig. 2 - 15. In the 220V position the units can also be used as a DC/DC converter.

- nonstandard line input voltage

The units will still operate at a line input voltage lower than standard, but with a reduction in output power. Fig. 2 - 14 shows the max. output current as a function of output voltage with AC or DC line input voltage as a parameter.
Example: When the required output voltage is 12.5 V at a line input voltage of 150 V AC. Fig. 2 - 13 shows the maximum current for the SM1540 to be 32.8 A.

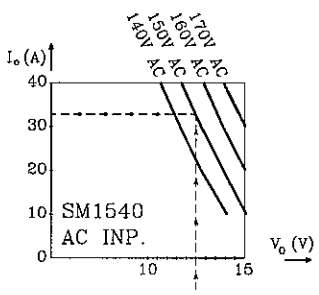


fig. 2 - 13
example how to use the graph

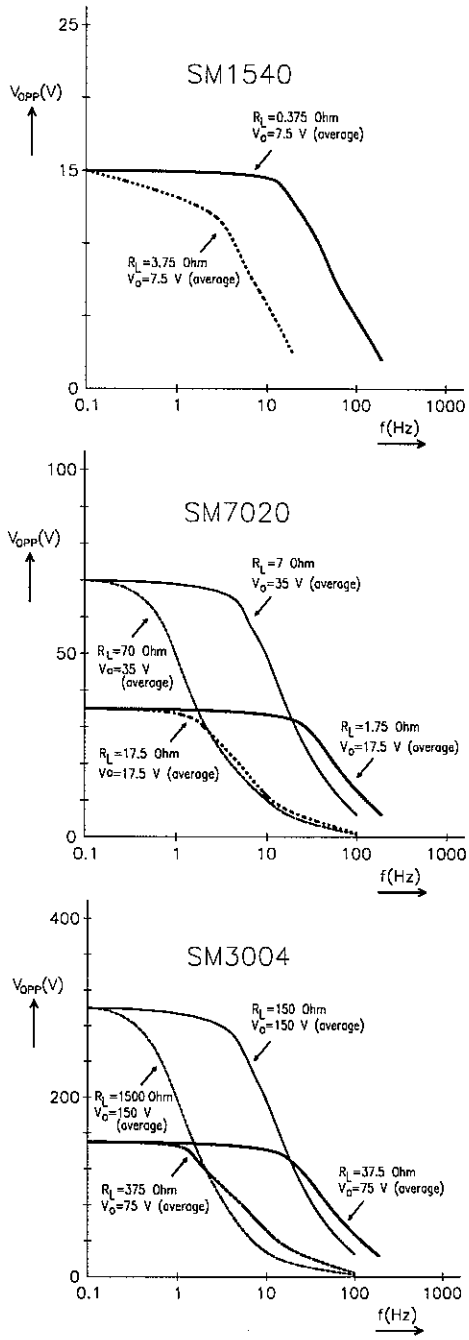


fig. 2 - 12
max. peak to peak output voltage swing vs frequency

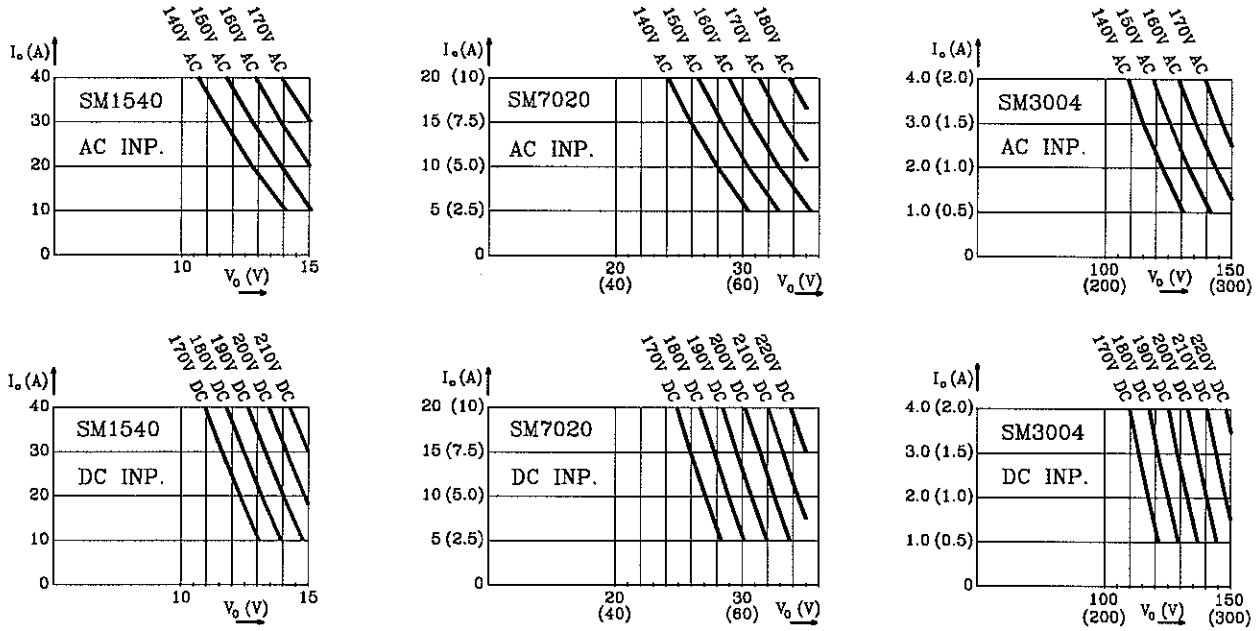


fig. 2 - 14
max. output current vs output voltage
with AC or DC line input voltage as a parameter

15) INPUT CURRENT

The input circuit has a large series choke to improve the waveform. The result is: a lower rms input current, less mains distortion and no large peak currents.
The units also have an inrush current limiter and a soft start circuit, for smooth switch on.

- FUSES
  At 220 V: 8A Slow blow, at 110 V 16 A Slow blow.

16) INPUT POWER (standby)

The unit consumes very little power when in standby. This makes it possible to leave the input power on and use the programming input(s) for shutdown, see fig. 2 - 16.

17) TURN ON DELAY

The output voltage is available 0.5 sec after mains switch on.

18) HOLD - UP TIME

The hold - up time depends on the load, output voltage and line input voltage. A lighter load, a lower output voltage or a higher line input voltage all result in a longer hold - up time. See fig. 2 - 18. For example: the SM1540 at 220 VAC input and 12 V / 40 A output will have a hold-up time of 50 ms.

19) NOISE SUPPRESSION (input / output)

The input / output noise suppression is measured with a pulse generator (a) in series with the line input or (b) between input and case (earth), see fig. 2 - 17. The generator produces a high energy pulse of about 300 V. To avoid a false reading make sure the oscilloscope on the output does not have an electrical connection with the input. The suppression for the SM3004 is lower, but the relative disturbance on the output is comparable to the SM1540.

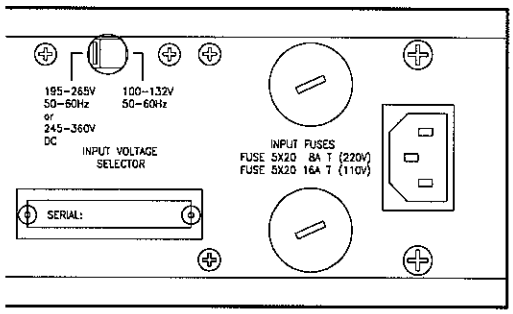


fig. 2 - 15
input voltage selector at rearpanel

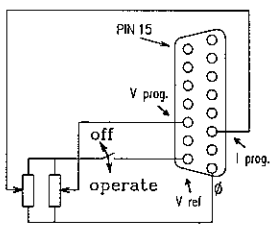


fig. 2 - 16
external potmeters + remote shutdown

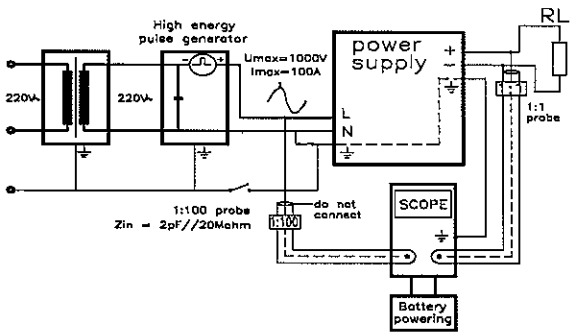


fig. 2 - 17
measuring input / output noise suppression

20) INSULATION

For safety the insulation of the separating components (transformers) between input and output is tested at 3750 Vrms during 1 minute. This is tested before assembling.
The 3750 Vrms cannot be tested afterwards on the assembled unit because the insulation between the components on the input side to the case (like the bridge rectifier) is specified at 2500 Vrms. Since the insulation output - case is low (only 600 VDC) the insulation of the primary components to case will break down when 3750 Vrms is applied between input and output (2500 Vrms + 600 VDC < 3750 Vrms).

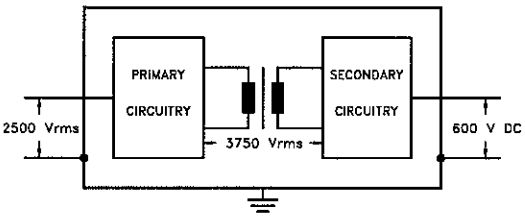


fig. 2 - 19
insulation test voltages

21) RFI SUPPRESSION

Both the input and output have RFI filters, resulting in very low conducted RFI to the line and load. Due to the output filter the output voltage is very clean, having almost no spikes.

22) OPERATING TEMP

At full power the operating temperature range is –20 to +50 °C. From 50 to 75 °C the output current has to be derated linearly to 20 % at 75 °C. See fig. 2 - 20. These temperatures hold for normal use, i.e. the air must be able to pass freely vertically along and through the unit.

23) THERMAL PROTECTION

A thermal switch shuts down the output in case of insufficient cooling. In this condition the OVP led on the frontpanel will burn, and the OVP status output will be high.

24) COOLING

The cooling is by natural convection **no noisy blowers** are present. The unit should have sufficient free space to let the air flow vertically through the unit. A distance of 5 cm around the unit is recommended.

25) REMOTE SENSING

The voltage at the load can be kept constant by remote sensing. This feature is not recommended for normal use but only if the load voltage is not allowed to vary by a few millivolts.
In order to compensate for the voltage drop in the load leads the unit will have to supply a higher voltage i.e. the voltage drop in each lead + the voltage on the load, see fig. 2 - 21. The OVP reads the voltage directly at the output and the setting must be increased by the total voltage drop on the load leads. The voltmeter which is connected to the sense leads, reads the voltage on the load and not the voltage on the output terminals.
The sense leads are protected for **accidental interruption**, in which case the output voltage will go to a max. of 115% of the set value.
Warning: Do not interrupt the minus lead while the S– lead is still connected to the load, during operation. It causes the OVP circuit to trigger. It is also possible that the capacitor C808 on P385 or P386 will be damaged.

Note: A voltage >3V between S– and – causes the OVP circuit to trigger, even a short pulse. To reset the power supply switch off the unit for some seconds.

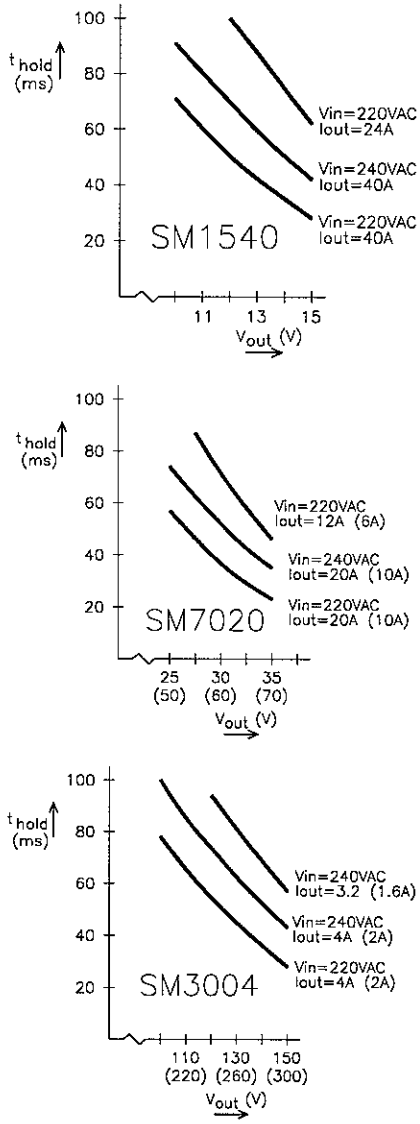


fig. 2 - 18
holdup time vs V_{out}
with line input and I_{out} as parameters

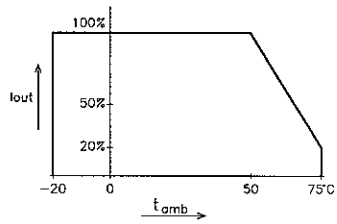


fig. 2 - 20
operating temperature range

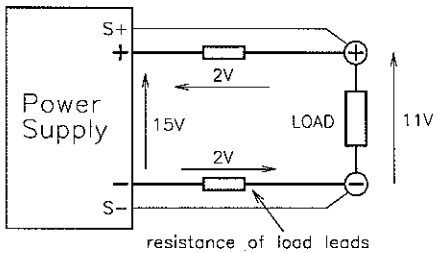


fig. 2 - 21
remote sensing, voltage drop in load leads subtracts from max. output

With pulsating loads, the inductance in a long lead can give problems. In this case an electrolytic capacitor in parallel with the load will reduce this problem. Care must be taken so that the capacitor in combination with the lead inductance will not form a series resonant circuit.
Note that the SM3004 has no remote sensing.

26) SERIES OPERATION

Series operation is allowed up to 600V total voltage. The power supplies can be connected in series without special precautions. For easier control, Master / Slave operation is recommended.
By using the *Master / Slave - Series* feature a **dual tracking** power supply can be made with one master and one slave unit. See fig. 2 - 22 (detailed description fig. 3 - 5).

27) PARALLEL OPERATION

Paralleling of the units has no limitations. The power supplies can be connected in parallel without special precautions. For easier control, Master / Slave operation is recommended.
Note: Master / Slave parallel operation is not recommended for more than 4 units, consult factory for a solution with more than 4 units.

28) MASTER / SLAVE OPERATION

The Master / Slave feature makes it possible to use the power supplies as building blocks to form one large unit, see fig. 2 - 23. Mixed parallel and series operation is also possible (fig. 2 - 24), to a maximum of 600V. The resulting combination of units behaves like **one power supply** and can be programmed on the master.
In the Master / Slave mode the autoranging feature still works. Fig. 2 - 25 shows a computer controlled M/S parallel combination.
The slaves will follow the master. The result is true **current or voltage sharing** in the parallel or series mode respectively.
The connections can be made very easily on the analog programming connector.
In the parallel mode the master controls all the slaves. In the series mode the master controls one slave, which in turn controls the second slave and so on.

29) POTENTIOMETERS

- Standard: - CV and CC potentiometers with knobs at front panel, OVP potentiometer with screwdriver adjustment at the front panel.
- Option P001: - Screwdriver adjustment for CV, CC and OVP at the front panel, fig. 2 - 26.
- Option P002: - Screwdriver adjustment for CV, CC and OVP at the rear panel (no potentiometers at front panel), fig. 2 - 27.

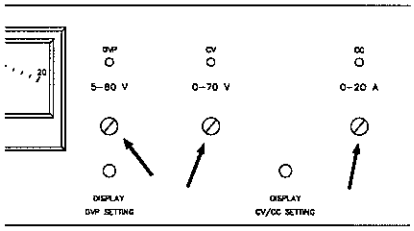


fig. 2 - 26
screwdriver adjustment at front panel

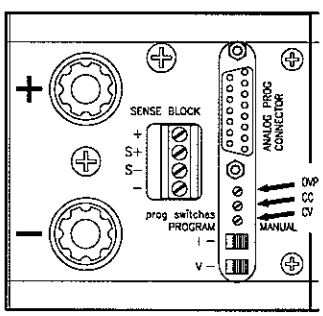


fig. 2 - 27
screwdriver adjustment at rear panel

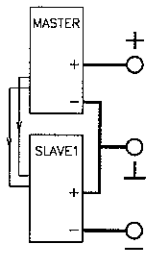


fig. 2 - 22
Dual tracking power supply

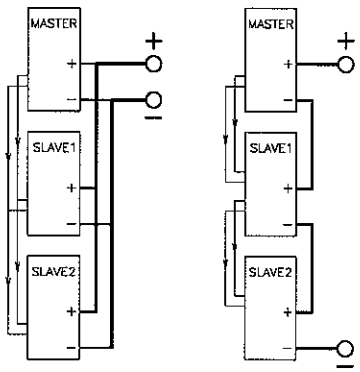


fig. 2 - 23
Master / Slave Operation
left Parallel, right Series mode

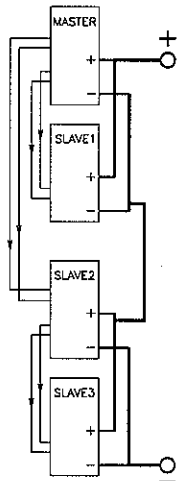


fig. 2 - 24
mixed Series Parallel Master / Slave

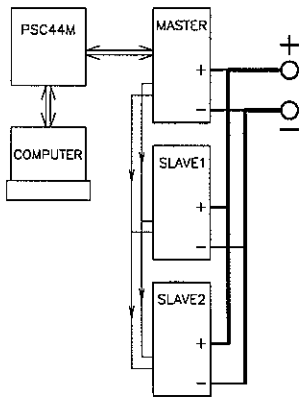
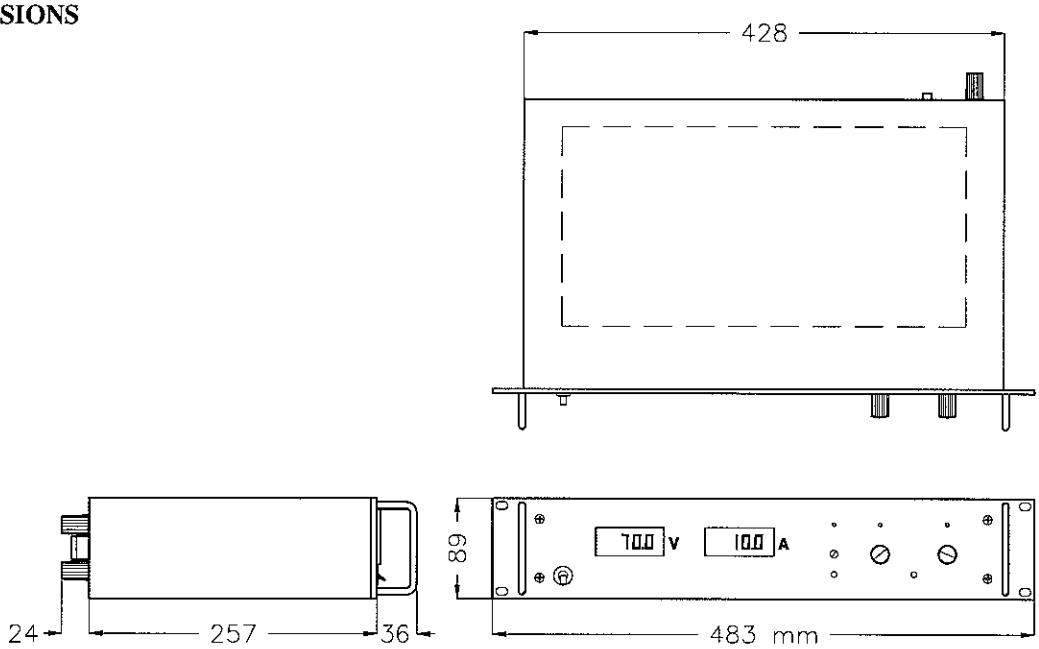


fig. 2 - 25
the master slave combination can also be programmed

30) **DIMENSIONS**



CIRCUIT DESCRIPTION

The 220 V AC line voltage is rectified by a bridge rectifier and smoothed by a large electrolytic capacitor. The 50 Hz choke in the input circuit improves the waveform of the input, so that no low frequency distortion is produced on the line voltage.

Carefully designed RFI filters protect the line and the load from the high frequency interference produced inside the power supply.

When the unit is switched on, the electrolytic capacitor is charged via the resistor of the SOFT START circuit, so no large inrush current will flow. As soon as the voltage is sufficiently high the power supply starts working and the series resistor is bypassed by a triac.

The operating switching frequency of 100 kHz has many advantages like small size, light weight, low ripple and fast regulation.

The rectified 220 V (300 V DC) is chopped by the transistors and transformed to a lower voltage. This 100 kHz power converter is of the feed forward type. The regulation is achieved by pulse width modulation.

Careful design, over-rating of vital components, several built-in protections and cool operation (because of the very high efficiency) make the SM series very reliable power supplies which can be used continuously at maximum rating.

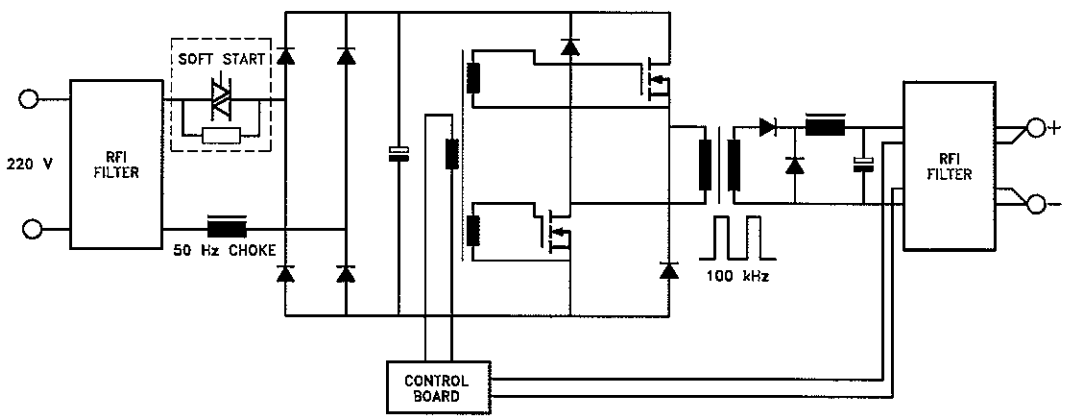


fig. 2 - 28
simplified functional diagram of SM1540, SM7020, SM3004

OPERATING MANUAL

1) OPERATING UNIT FOR THE FIRST TIME

- Set the **input voltage selector** switch found on the rear panel to the required input voltage (110/220V). A wrong setting can seriously damage the unit. Do **not** switch the selector switch when the unit is in use.
- Check input fuses. For 110 V operation fuses have to be replaced. See text at rear panel.
- Check there is no condensation on the unit. If there is, allow some time to dry.
- Set the prog. switches on the rear panel on MANUAL.
- Check that there is a jumper between + and S+ and between – and S– on the SENSE BLOCK (on rear panel)
- Set OVP potentiometer (on front panel) to maximum (fully clockwise).
- Switch on unit.
- Turn both the CV and CC potentiometer a few turns clock wise. A voltage should now be present on the output.
- By pressing the DISPLAY CV/CC SETTING button the meters will show the setting of the CV and CC potentiometer.
- By pressing the DISPLAY OVP SETTING button the volt meter will show the setting of the OVP potentiometer.

2) ANALOG PROGRAMMING

- Put the appropriate switch(es) in the position PROGRAM.
- Connect the programming voltage source(s) (0 - 5 V) to the ANALOG PROG. CONNECTOR on the rear panel. See fig. 3 - 1.
- If only the voltage is programmed, the maximum current can still be set with the CC potentiometer and vice versa. If this is not desirable the CC or CV can be set with an external potentiometer, to have a fixed setting.
- CAUTION: The analog inputs are not isolated from the output. The Ø of the prog. input (pin 1) is internally connected to the S–, the S– is connected to the negative output. To protect the internal wiring a 250 mA fuse is connected in series (F600 on P385, P386 or P387), see fig. 2 - 10.
  Isolated analog programming is possible with an isolation amplifier.
- To avoid hum or noise, the programming cable may have to be shielded and / or twisted in some cases.

3) IEEE 488 PROGRAMMING

- With the (external) IEEE 488 interface PSC44M simply connect the PROG. CONNECTOR of the power supply with the mating connector of the PSC44M (pin compatible).
- Set both prog. switches to the position program.
- Both CV and CC can be programmed and read back. The CC and OVP status can also be read by the computer.

4) MONITORING OUTPUTS

- The 5 V level is compatible with most interfaces.
- The monitoring outputs can drive a meter directly. See fig. 3 - 2.

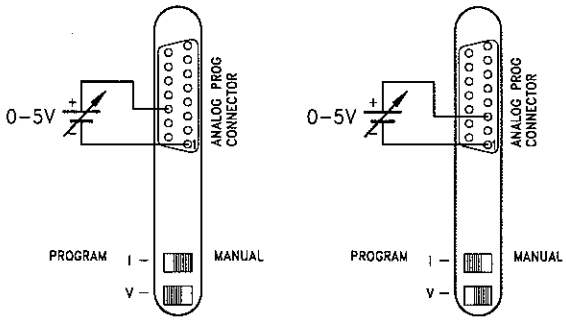


fig. 3 - 1
programming by voltage
left voltage programming, right current program-

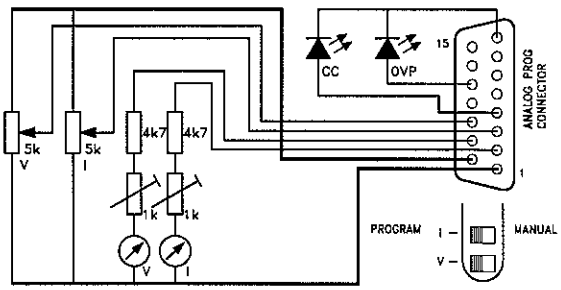


fig. 3 - 2
remote control

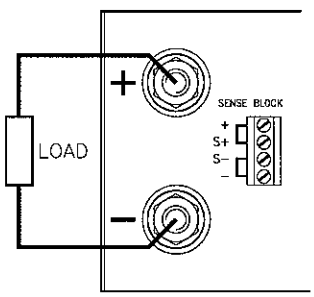


fig. 3 - 3
local sensing

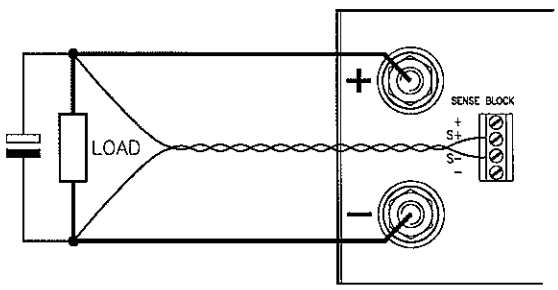


fig. 3 - 4
remote sensing

5) STATUS OUTPUTS

- The status outputs have a separate Ø connection (pin 8) to avoid unwanted offsets in the programming. This pin is protected by a 250 mA fuse (F601 on P385, P386 or P387).

6) REMOTE SENSING

- Not available on SM3004.
- Remove jumpers on SENSE BLOCK (on rear panel) and connect sense leads (thin measuring wires) to S+ and S–. See fig 3 - 3 and fig. 3 - 4.
- With remote sensing the voltage on the load can be kept constant. The voltage drop in the load leads will be compensated. This feature is not recommended for normal use, because it can easily give problems.
- Max. 2 V per load lead can be compensated. Note that the voltage drop in the leads decreases the max. output voltage rating.
- In order to prevent interference it is advisable to twist the sense leads. To minimise the inductance in the load leads keep the leads close to each other. The inductance of the loads leads could give a problem with pulsating loads. In this case a large electrolytic capacitor in parallel with the load will help. Check that the capacitor in combination with the load leads does not form a resonant circuit resulting in a large AC current flowing in the leads.
- Since the **voltmeter** is internally connected to the sensing terminals, it will automatically indicate the voltage at the load.

7) MASTER / SLAVE SERIES OPERATION

- First, connect output terminals and test system in **normal series** operation. Ensure that all power connections are reliable.
- The voltage drop in the connecting leads between the units should be kept < 10 mV.
- Second, switch off units. Plug in Prog. Connectors with the connections according to fig. 3 - 5. The prog. switches of the slaves should be in the position PROGRAM.
- Do not forget the jumper on the slaves between pin 3 and pin 9 of the prog. connector. This jumper sets the current limit of the slaves at maximum.
- The max. number of slaves is only limited by the max. total voltage of 600 V.
- The AUTORANGING feature still works.
- **WARNING**, the master must always be on the positive side of the combination. Wrong connection can damage the power supplies.

8) MASTER / SLAVE PARALLEL OPERATION

- **Note: Master / Slave parallel is not recommended for more than 4 units, consult factory for using more than 4 power supplies in parallel.**
- For all models.
- First connect output terminals and test system in **normal parallel** operation. Ensure that all power connections are reliable.
- Use the connecting scheme as in fig. 3-6.
- Second, switch off units.
  Plug in Prog. Connectors with the connections according to fig. 3 - 6.
  Disconnect the jumpers between the S– and – of the slaves

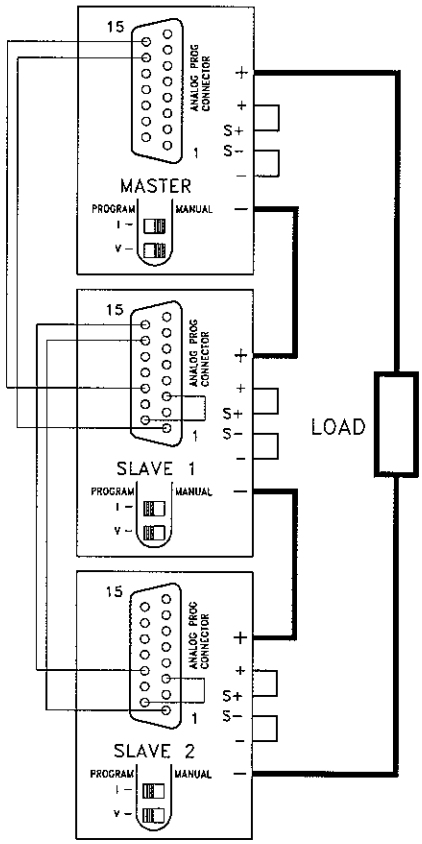


fig. 3 - 5
Master Slave series connection

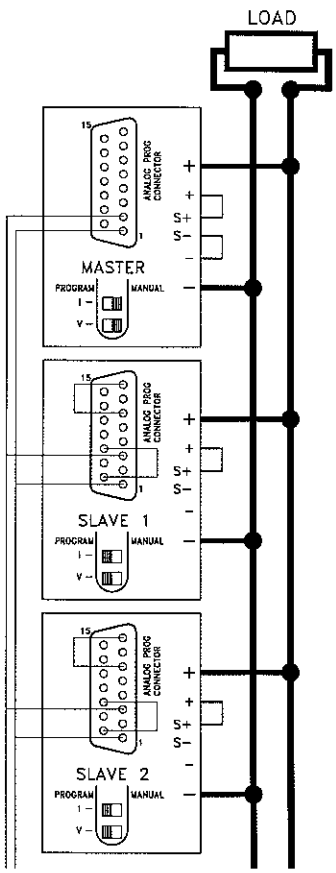


fig. 3 - 6
Master Slave parallel connection

only.
The prog. switches of the slaves should be in the position PROGRAM.

- The purpose of the jumper between pin 9 and 11 is to set the voltage limit of the slaves at maximum.
- An extra jumper on the slaves (between pin 6 and 8) is needed for the AUTORANGING feature.
- Keep the load close to the master. Keep wiring between master and slaves short. The voltage drop between a unit and the buss bar should be kept < 10mV.
- Accidental interruption of a negative load lead of a unit during operation will cause fuse F600 to blow, see section 'trouble shooting'.

9) MASTER / SLAVE MIXED SERIES PARALLEL OPERATION

- See fig. 3 - 7.

10) BATTERY CHARGER

- The CV / CC regulated power supplies are ideal battery chargers. Once the output is set at the correct voltage the battery will charge constantly without overcharging. This can be useful for emergency power systems.
- **Protective measures**
  Use a CIRCUIT-BREAKER in series in order to protect the power supply from **accidental reverse connection**, see fig. 3 - 8 The circuit-breaker should have a DC voltage rating 2x the battery voltage. Use the very fast type (Z), a type meant for protecting semiconductors.

Suggested Circuit Breakers for protection power supply			
Model	Type number Circuit Breaker	Brand	Remarks
SM1540	S281 UC-Z 40	ABB	
SM7020	S281 UC-Z 20	ABB	**extra parallel diode on output = OPTION P021**
SM3004	S282 UC-Z 4	ABB	2 poles in series, **extra parallel diode on output = OPTION P022**

The unit has a reverse diode in parallel with the output, this diode and the wiring cannot withstand the thousands of amperes supplied by a wrongly connected battery.

- **Remote sensing** cannot be recommended, because it easily causes defects inside the power supply.
  If you really need remote sensing, please use the circuit in fig. 3 - 9. The internal circuit can be protected by relatively small anti-parallel diodes. To protect the anti-parallel diodes, please connect the fuses in series as indicated in fig. 3 - 9. A practical choice for the fuses is 250mA, the diodes can be any normal 3 or 5A type.
- Note: The **SM7020 and SM3004** need an extra parallel diode on the output. The diode should have a surge current rating of resp. 2000 and 3000 amps during 1 msec (I_{FSM} = 2000 / 3000 A). For the SM7020 2x BYT52PI200 and for the SM3004

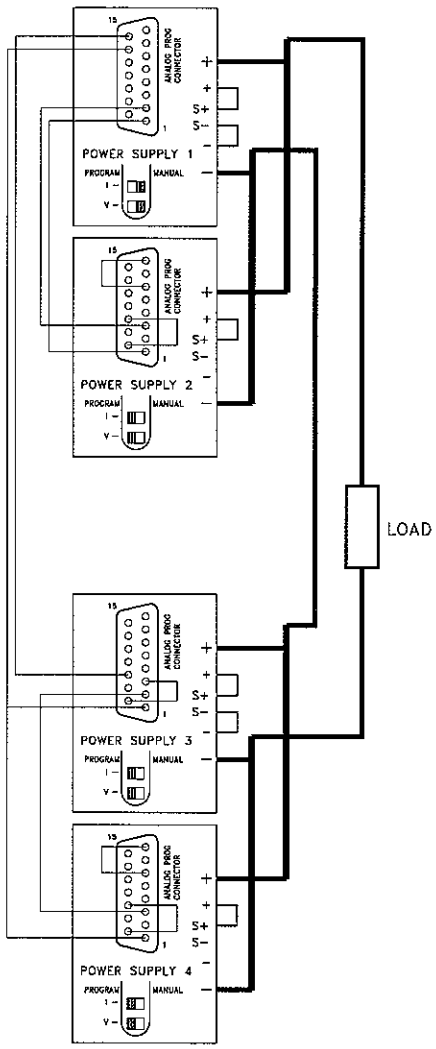


fig. 3 - 7
Master Slave mixed series parallel connection

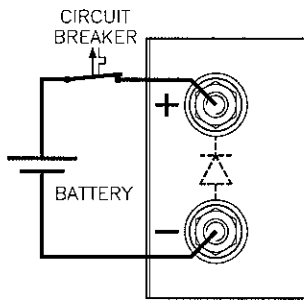


fig. 3 - 8
Charging battery with circuit-breaker in series

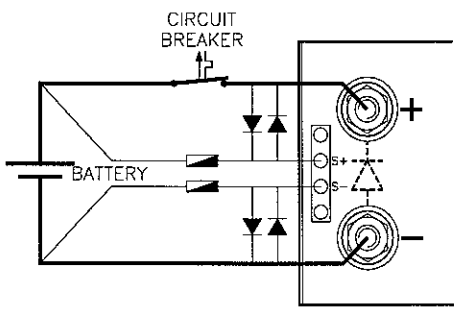


fig. 3 - 9
Charging battery with circuit-breaker in series

2x BYT261PIV400 from ST will work. The SM7020 with option P021 and the SM3004 with option P022 have an extra diode built-in.

TROUBLE SHOOTING

General:

In case you need assistance for repairing the unit, please first fill in the Problem Report (also in this manual) and fax it to us.

1) **NO OUTPUT (normal operation)**

- Check input voltage selector at rear panel. Wrong selection can cause serious damage to the unit. Do not operate the selector switch when the unit is switched on.
- Check input fuses. For 110 V operation fuses have to be replaced. See text at rear panel.
- Check position of prog. switches at rear panel, they should be on MANUAL.
- Check connections on SENSE BLOCK (at rear panel), there should be a jumper between + and S+ and between – and S–.
- Set OVP potentiometer (at front panel) at maximum (fully clock wise).
- Switch on unit.
- Turn both the CV and CC potentiometer a few turns clock wise, a voltage should be present on the output now.

2) **PROGRAMMING DOES NOT WORK**

- Check position of prog. switches at rear panel.
- **The Unit works OK in manual control,** but no reaction in programming mode with random output voltage / current. Probably the fuse in series with Ø (pin 1) of Prog. Connector is blown. See fig. 3 - 10. To check the fuse (F600) measure the resistance between Ø and the minus output, an open circuit means a blown fuse. F600 = 250 mA.
  The fuse can be blown by accidental connection of the load to the Ø of the prog. connector.

3) **STATUS OUTPUTS FAIL**

- Check fuse F601 in series with Ø (pin 8), see fig. 3 - 10. To check the fuse (F601) measure the resistance between Ø and the minus output, an open circuit means a blown fuse. F601 = 250 mA.

4) **MASTER / SLAVE PARALLEL FAILURE**

- Accidental interruption of a minus lead of a unit during operation will cause fuse F600 to blow. See fig. 3 - 10. To check the fuse (F600) measure the resistance between Ø (pin 1) and the minus output, an open circuit means a blown fuse. F600 = 250 mA
- AUTORANGING behaves abnormally. Check jumper between 6 and 8 on the prog. connector of the **slaves.**
- Check jumper between pin 9 and 11 on the prog. connector of the slaves

5) **OUTPUT VOLTAGE IS HIGHER THAN SET VALUE**

- Check connections on SENSE BLOCK (on rear panel), There should be a jumper between + and S+ and between – and S.

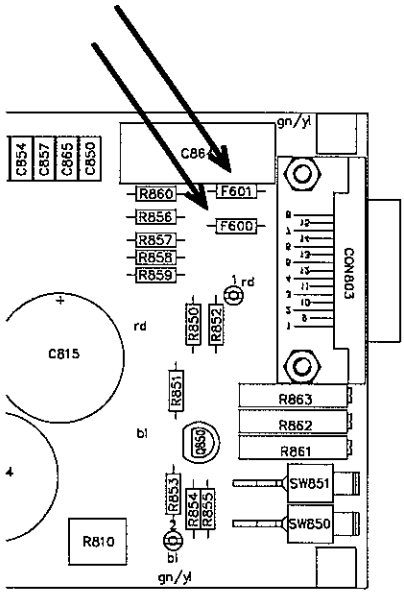
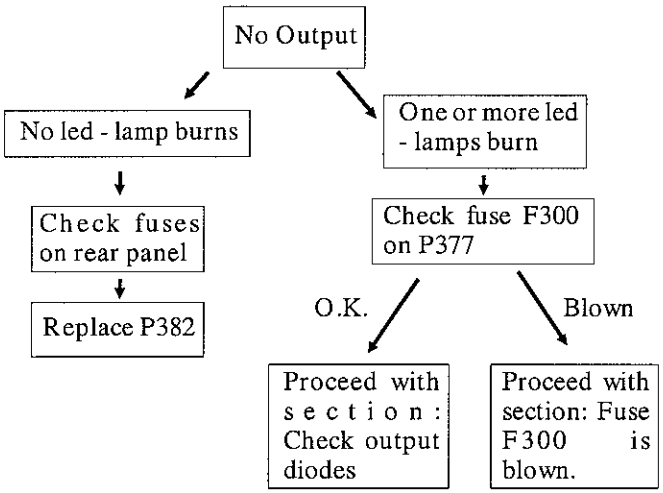


fig. 3 - 10
location of programming fuses on output board P385, P386 or P387

6) **OVP LED burns.**



- Check OVP setting.
- Overheating also causes the OVP led to burn.
- You are using Remote Sensing.
  A voltage > 3V between – and S – causes the OVP circuit to trigger, even a short pulse.

7) **FAILURE EXPECTED**

- Check output diodes.
  Defective diodes give a short.
  SM1540 Check diodes D400 - D403
  SM7020 Check diodes D400 and D402 on P380.
  SM3004 Check diodes D400 - D404, D410 - D414, D420 - D424, D440 - D434 on P381.
  Replace defective parts.
- Fuse F300 is blown.
  Do not replace F300 until the unit is repaired.
  Probably defect on P378.
  First check output diodes, see above.
- Repairing P378.
  Check diodes D301 - D308, check transistors Q300 - Q303. When defective they usually give a short. Replace defective components.
- If necessary, send P378 for repair.

CALIBRATION

1) **GENERAL**

- The power supplies are factory calibrated and normally need no further calibration.

2) **METER CALIBRATION**

- First calibrate the offset or zero indication.
  Connect an accurate voltmeter to the output.
  Make sure the output voltage is exactly zero, do not connect a load.
  See also fig. 3 - 11.
  Calibrate the offset of the A-meter with R708 on P388.
  Calibrate the offset of the V-meter with R706 on P388.
- Second, calibrate the full scale indication.
  Connect an accurate voltmeter on the output and set the output voltage to the max. specified voltage.
  Calibrate the V-meter full scale indication with R706 on P388.

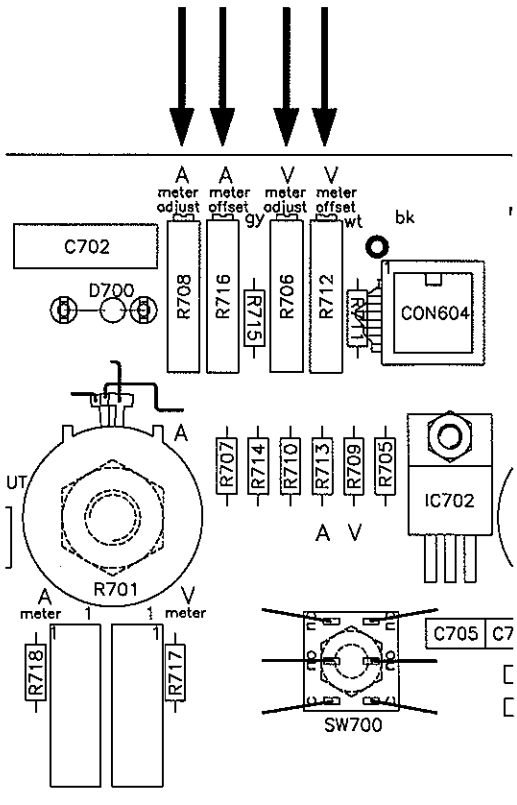


fig. 3 - 11
meter calibration, P388

Switch the unit off and connect an accurate Amp. meter accross the output terminals. Switch the unit on and set the current to the max. specified current.
Calibrate the A-meter full scale indication with R708 on P388.

3) SPECIAL CALIBRATIONS

- The following calibrations must be done by qualified personnel only. Wrong calibration causes malfunction. These calibrations are only needed after special repairs. Warning ! Damage caused by wrong calibration is not warranted.
- CALIBRATING MAX. CURRENT RANGE or CALIBRATING CC MONITOR FULL SCALE.
  The max. output current can be calibrated with R686. R686 is located on P385, P386 or P387. See fig. 3 - 12.
  Program CC input with exactly 5.00 V. Set output voltage to a low value, ensuring the power supply is in CC mode. Measure the output current with an accurate shunt. Calibrate the current with R686 exactly on the rated max. current.
  Warning! Wrong calibration can damage the unit.
- CALIBRATING THE CC MONITOR OFFSET.
  With R652 on P384 the offset of the CC monitor voltage can be calibrated. See fig. 3 - 13. The unit has to be unloaded, the output voltage set on a low value. Measure the offset voltage of the CC monitor on the prog. connector. Calibrate the offset on a negative value between –10 mV and zero mV.
  Warning! wrong calibration can damage the unit.

SPARE PARTS

- When ordering spare parts please state: Model, Serial number, Component number and Component description. example:
  - Model SM7020
  - Serial no..... 1034
  - Component no..... D402
  - Component descr. BYV52-PI-200

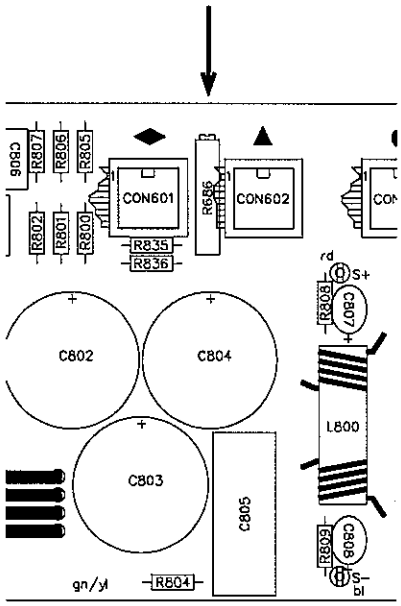


fig. 3 - 12
calibrating max current
P385, P386 or P387

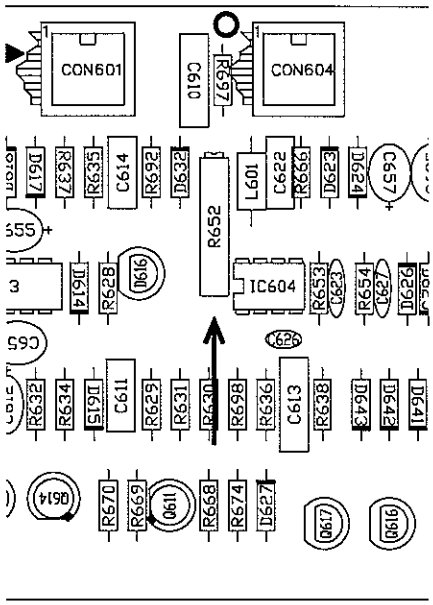


fig. 3 - 13
calibrating CC monitor, P384

DELTA ELEKTRONIKA BV

FAX + 31 111 416919
TEL + 31 111 413656
P.O. BOX 27
4300 AA ZIERIKZEE
NETHERLANDS

From:

.....

.....

.....

.....

PROBLEM REPORT

Type number .....
Serial number ..... Date .....

CONDITIONS BEFORE OR DURING FAULT	
Output voltage, Output current	
Ambient temperature, Input voltage	
Programming used, Remote sense used	
Master / Slave used (parallel or series mode)	
Setting of Prog. Switches and setpoint of OVP	

FAULT DESCRIPTION	
Output voltage present	
Max. Output power available	
Problem continuous or intermittend	
Which LED-lamps are burning, which are not	
+ 12 V on programming connector present	

Remarks:

.....

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.....

RECOMMENDED SPARE PARTS

FOR USE IN A SERVICE DEPARTMENT

Note: The listed spare parts are mainly modules.

In case of a problem:
Please first fill in the problem report (also in this manual) and fax it to us.
We will then assist you with the repair of the unit.
Defective modules can be send to us for repair.

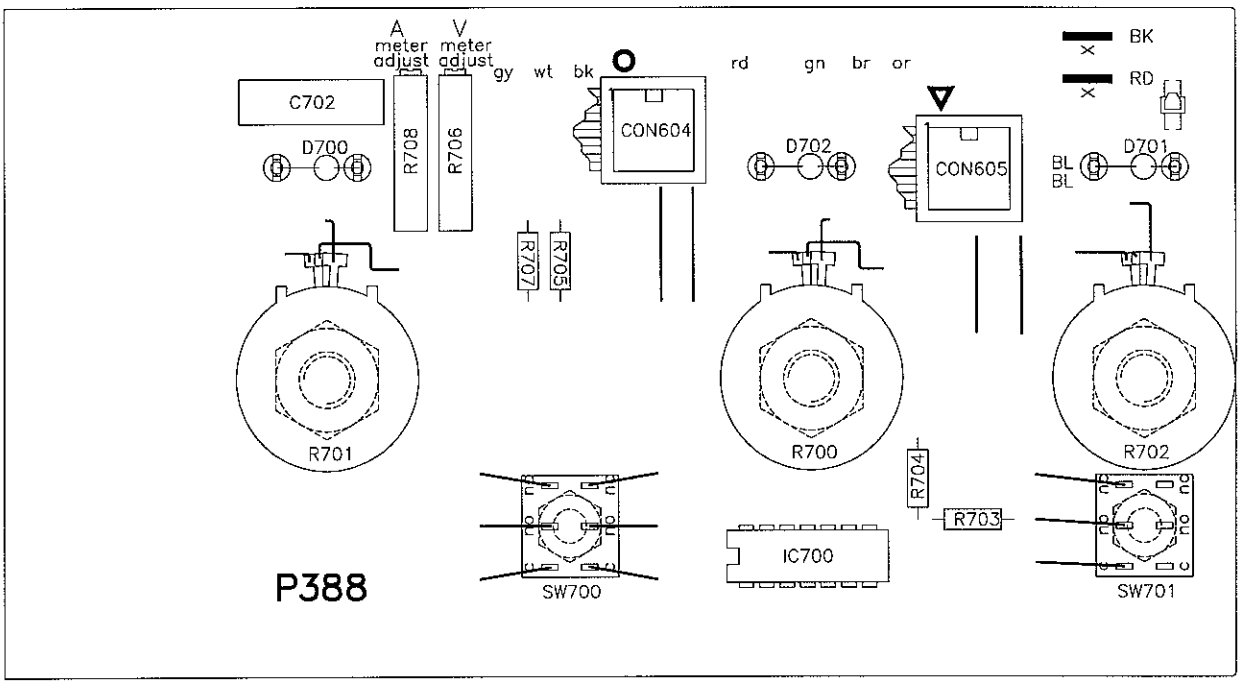
Quantity	Order code	Description
5	FUSE PTC .65	fuse for programming input
4	FUSE 5X20 8T (220V) FUSE 5X20 16T (110V)	input fuses
5	JUMP 0830 DIP	8 pole flat cable, with dip connectors
1	SKB 25-06	input bridge rectifier
2	16ER 15	15 ohm resistors for inrush current limiter
3	10SL 5K	potmeter, 5 kOhm, 10 turns
1	P378 + FUSE 6X32 6.3FF	switch unit + special fuse
1	P384	analog control board
1	P383	digital control board
1	P382	auxiliary power supply

Only for SM1540		
Quantity	Order code	Description
4	60HQ100	output rectifiers

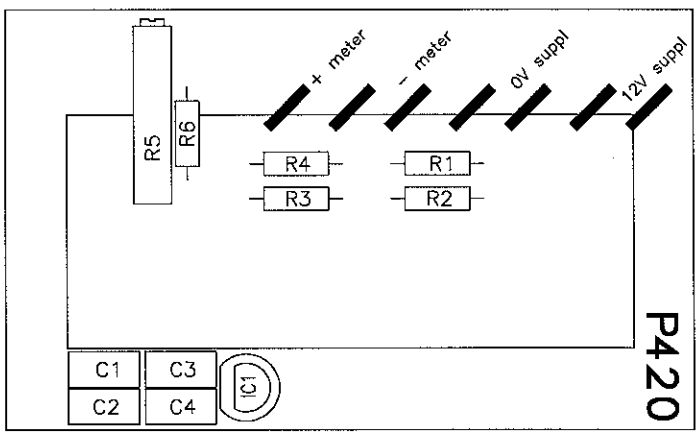
Only for SM7020		
Quantity	Order code	Description
1	P380	output rectifier board, SM7020

Only for SM3004		
Quantity	Order code	Description
1	P381	output rectifier board, SM3004

For Analog meters and LCD-digital meters only.



Old version P388 only, see page 5-8 for P388A.



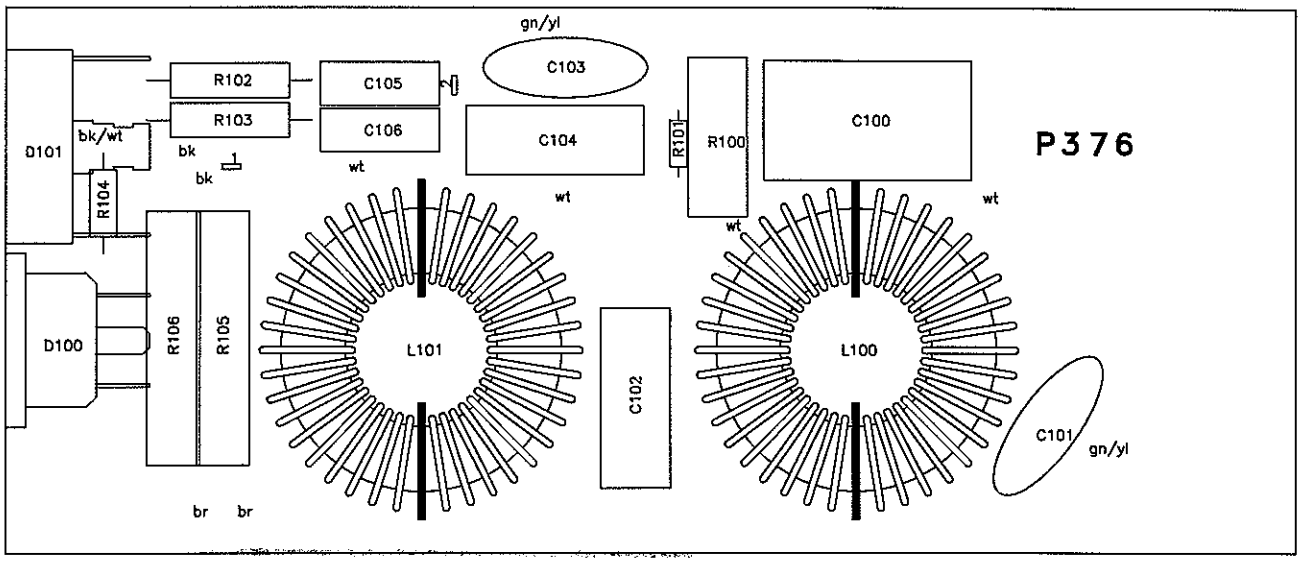
P420 is only used for LCD-digital meters

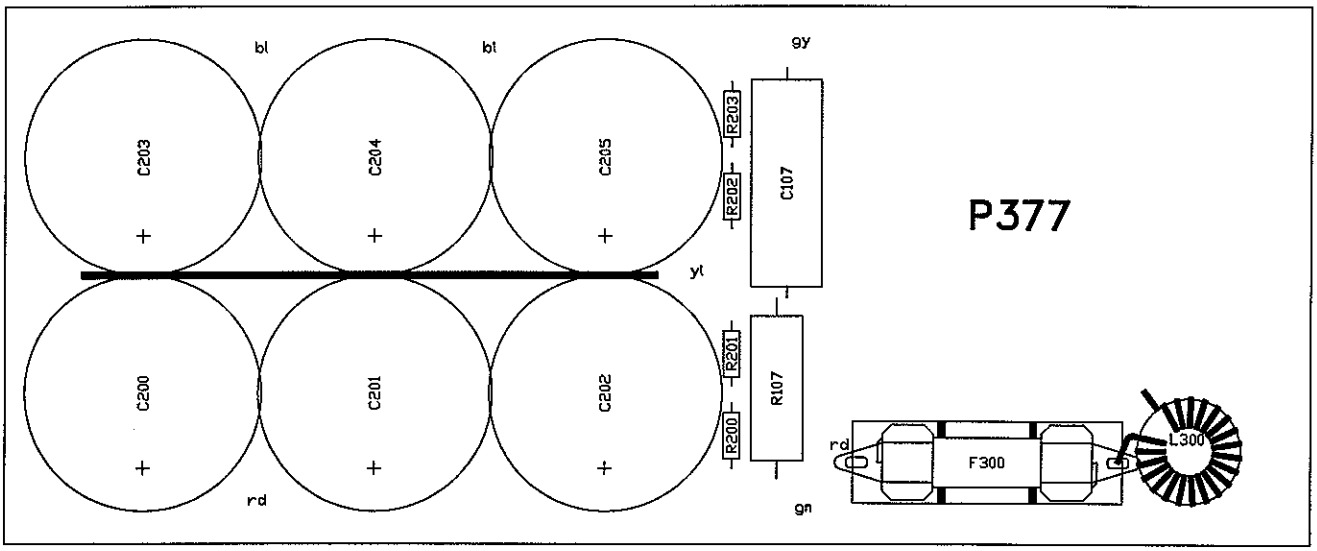
P388

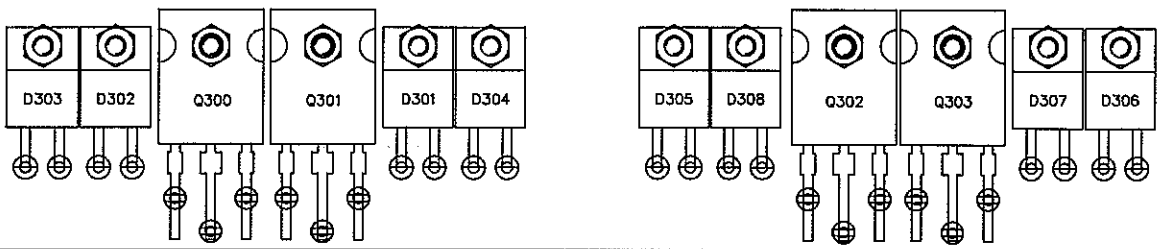
C702	=	10NF 1000V MET POLYES
D700	=	LED 3MM GREEN PHILIPS
D701	=	LED 3MM RED PHILIPS
D702	=	LED 3MM GREEN PHILIPS
IC700	=	TL084IN TEXAS
R700	=	5K POTM 10 TURNS
R701	=	5K POTM 10 TURNS
R702	=	5K POTM 10 TURNS
R703	=	1K MF/0.6W/250V
R704	=	4.75K MF/0.6W/250V
R705	=	4.75K MF/0.6W/250V
R706	=	1K TRIMPOTM 20 TURNS
R707	=	4.75K MF/0.6W/250V
R708	=	1K TRIMPOTM 20 TURNS
SW700	=	SWITCH DPDT 1A PUSH
SW701	=	SWITCH DPDT 1A PUSH

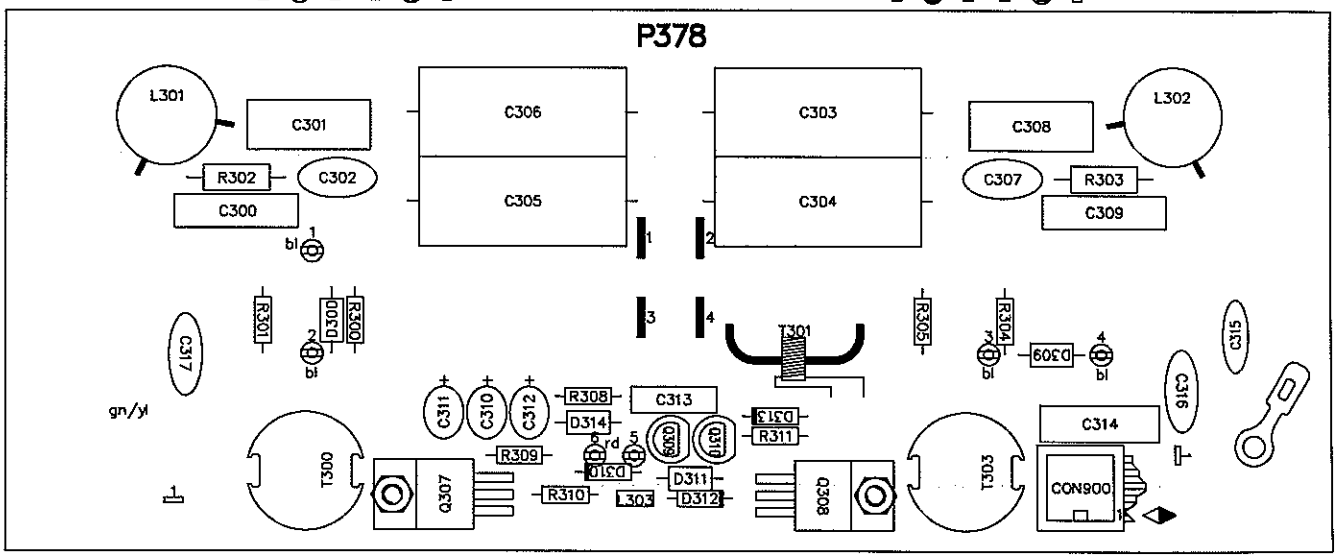
P420

C1	=	0.22UF 100V MULT LAYR
C2	=	0.22UF 100V MULT LAYR
C3	=	0.22UF 100V MULT LAYR
C4	=	0.22UF 100V MULT LAYR
IC1	=	L78L05 MOTOROLA
M1	=	LCD DISPLAY 3.5 DIGIT
R1	=	CR MF/0.6W/250V
R2	=	267 MF/0.6W/250V
R3	=	1K MF/0.6W/250V
R4	=	1K MF/0.6W/250V
R5	=	10K TRIMPOTM 20 TURNS
R6	=	1M MF/0.25W/1600V


P376
gn/yl
C103
C104
C105
C106
R102
R103
C100
R100
R101
D101
bk/wt
R104
bk
wt
D100
R106
R105
L101
L100
C102
C101
gn/yl
br
br


P377
bl
bl
gy
C203
C204
C205
R203
R202
C107
yl
C200
C201
C202
R201
R200
R107
rd
gn
F300
L300


D303
D302
Q300
Q301
D301
D304
D305
D308
Q302
Q303
D307
D306


P378
L301
C301
R302
C302
C300
C306
C305
C303
C304
C308
C307
L302
R303
C309
R301
R300
D300
C317
gn/yl
T301
R305
R304
D309
C315
C316
C311
C310
C312
R308
C313
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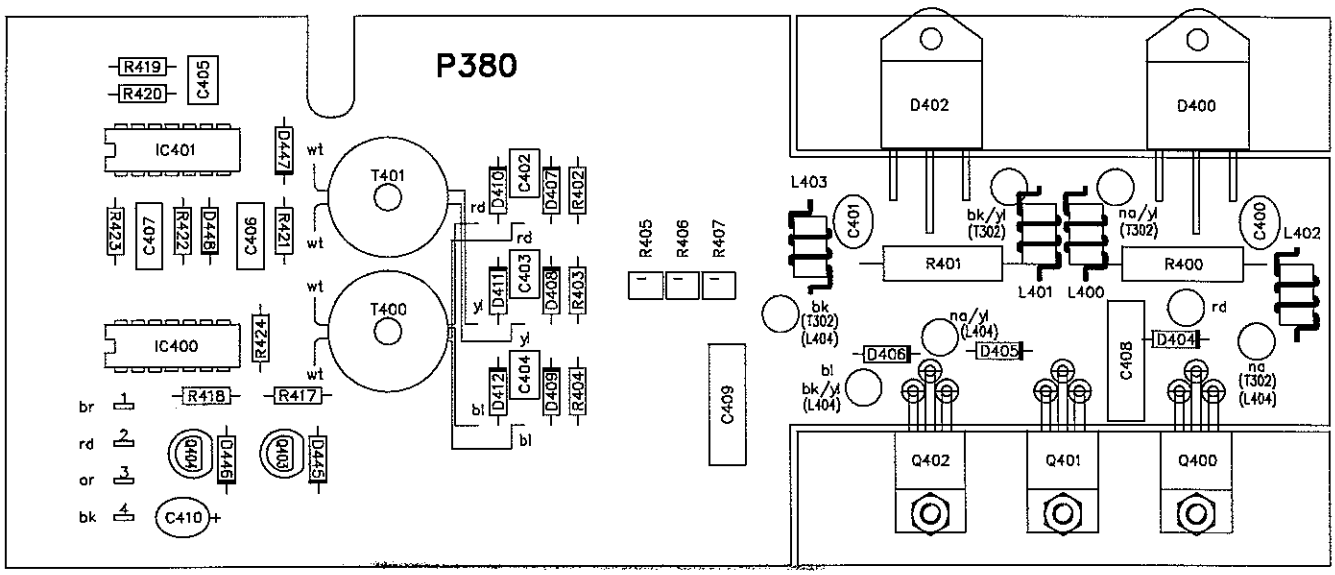
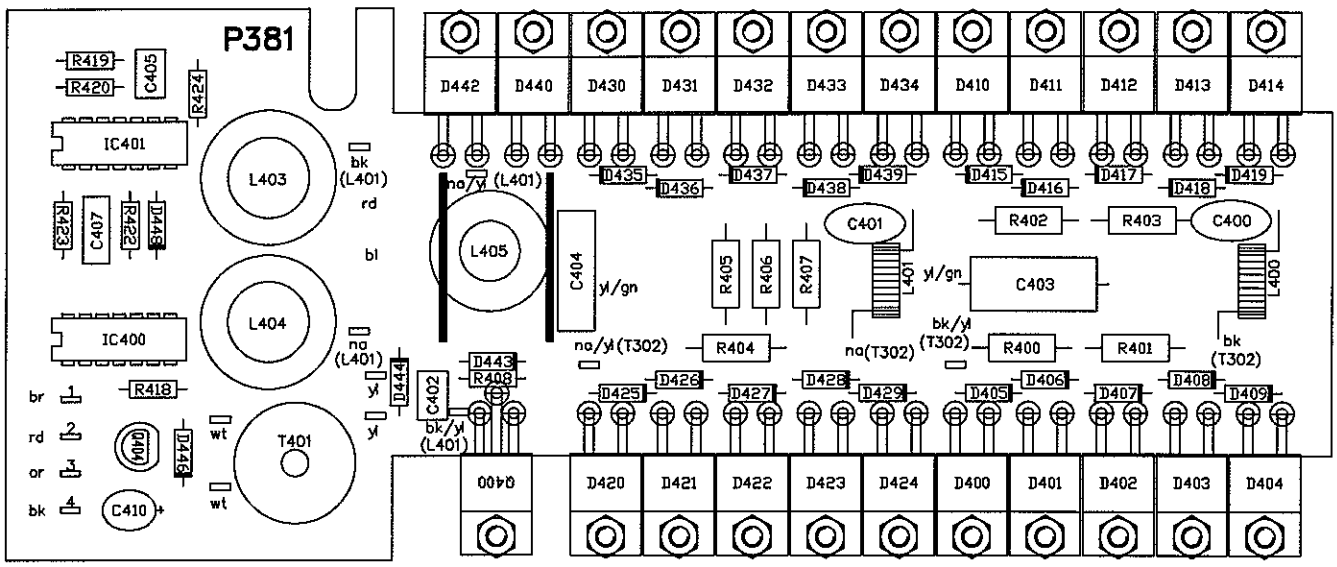
D312
T300
Q307
Q308
T303
C314
CON900


P380
R419
R420
C405
IC401
D447
T401
wt
D410
C402
D407
R402
R423
C407
R422
D448
C406
R421
C403
D408
R403
T400
yl
D411
IC400
R424
D412
C404
D409
R404
br
R418
R417
rd
or
bk
D444
D446
D445
C410
R405
R406
R407
C409
D402
D400
L403
C401
bk/yl (T302)
na/yl (T302)
C400
L402
R401
R400
L401
L400
bk (T302) (L404)
na/yl (L404)
D406
D405
C408
D404
rd
bl
bk/yl (L404)
na (T302) (L404)
Q402
Q401
Q400


P381
R419
R420
C405
R424
IC401
L403
bk (L401)
rd
bl
R423
C407
R422
D448
L405
C404
yl/gn
na/yl (L401)
IC400
L404
na (L401)
yl
br
R418
rd
or
bk
D444
R408
C402
bk/yl (L401)
D400
T401
wt
C410
D443
R405
R406
R407
na/yl (T302)
R404
C401
L401
C403
na (T302)
bk/yl (T302)
R402
R403
C400
L400
R400
R401
bk (T302)
D442
D440
D430
D431
D432
D433
D434
D410
D411
D412
D413
D414
D435
D436
D437
D438
D439
D415
D416
D417
D418
D419
D425
D426
D427
D428
D429
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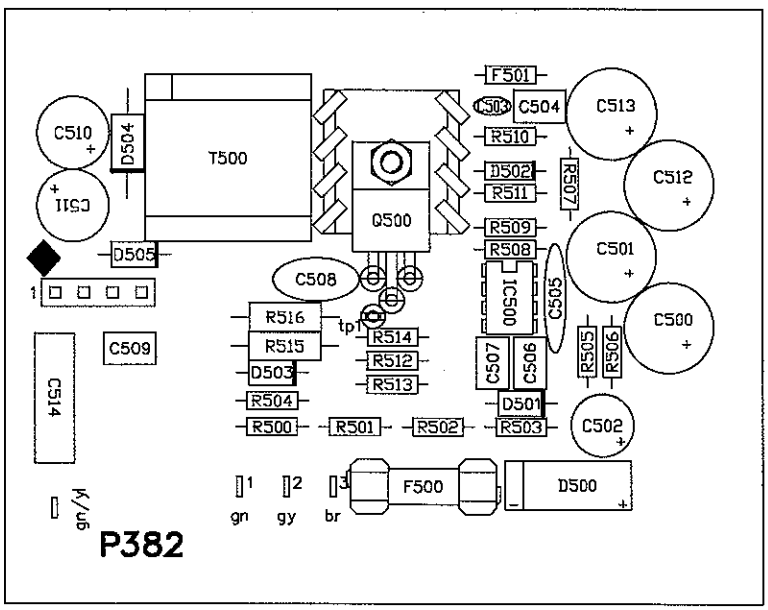
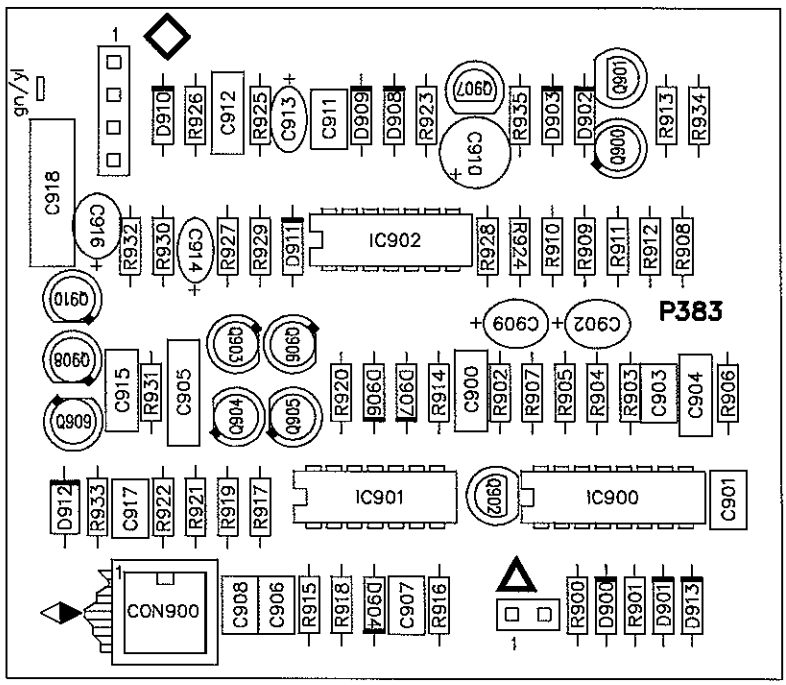
D424
D400
D401
D402
D403
D404

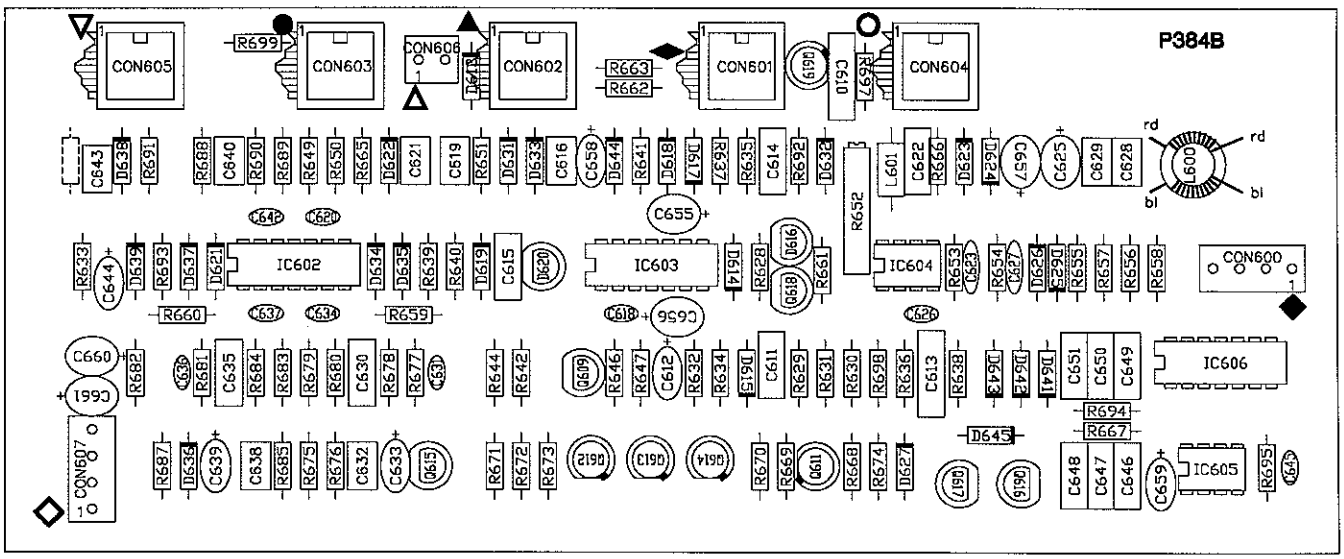

P382
C510
D504
T500
C511
Q500
D505
C508
R516
R515
D503
R504
R500
R501
R502
R503
R514
R512
R513
C509
C514
yl/gn
F501
C503
C504
C513
R510
D502
R511
R507
C512
R509
R508
C501
IC500
C505
C507
C506
R505
R506
C500
D501
C502
F500
D500
1
2
3
gn
gy
br

MAIN SECTION

C100	=	1UF 250V RMS X2
C101	=	4700PF 400V RMS SAFETY
C102	=	0.22UF 250V RMS X2
C103	=	3900PF 400V RMS SAFETY
C104	=	0.22UF 250V RMS X2
C105	=	22NF 630V POLYPROP
C106	=	22NF 630V POLYPROP
C107	=	1.5UF 250V MET POLYES
C108	=	470PF 400V RMS SAFETY
C109	=	0.33UF 250V RMS X2
C200	=	680UF 200V SPRAGUE
C201	=	680UF 200V SPRAGUE
C202	=	680UF 200V SPRAGUE
C203	=	680UF 200V SPRAGUE
C204	=	680UF 200V SPRAGUE
C205	=	680UF 200V SPRAGUE
C300	=	2.7NF 1000V POLYPROP
C301	=	10NF 630V POLYPROP
C302	=	100PF 1000V CERAMIC
C303	=	1UF 400V MET POLYES
C304	=	1UF 400V MET POLYES
C305	=	1UF 400V MET POLYES
C306	=	1UF 400V MET POLYES
C307	=	100PF 1000V CERAMIC
C308	=	10NF 630V POLYPROP
C309	=	2.7NF 1000V POLYPROP
C310	=	15UF 16V SOLID ALU
C311	=	15UF 16V SOLID ALU
C312	=	15UF 16V SOLID ALU
C313	=	0.22UF 63V MET POLYES
C314	=	10NF 1000V MET POLYES
C315	=	2500PF 250V CERAMIC
C316	=	470PF 400V RMS SAFETY
C317	=	33PF 400V RMS SAFETY
C500	=	22UF 250V MARCON
C501	=	22UF 250V MARCON
C502	=	22UF 160V ERO
C503	=	100PF 400V CERAMIC
C504	=	2200PF 100V POLYPROP
C505	=	10NF 500V CERAMIC
C506	=	2200PF 100V POLYPROP
C507	=	2200PF 100V POLYPROP
C508	=	100PF 1000V CERAMIC
C509	=	1000PF 100V POLYPROP
C510	=	220UF 35V ERO
C511	=	220UF 35V ERO
C512	=	22UF 250V MARCON
C513	=	22UF 250V MARCON
C514	=	10NF 1000V MET POLYES
C610	=	0.22UF 63V MET POLYES
C611	=	10NF 250V MET POLYES
C612	=	2.2UF 25V SOLID ALU
C613	=	0.22UF 63V MET POLYES
C614	=	47NF 250V MET POLYES
C615	=	47NF 250V MET POLYES
C616	=	2200PF 100V POLYPROP
C618	=	100PF 400V CERAMIC
C619	=	1000PF 100V POLYPROP
C620	=	100PF 400V CERAMIC
C621	=	470PF 100V POLYPROP
C622	=	22NF 250V MET POLYES
C623	=	47PF 400V CERAMIC
C625	=	15UF 16V SOLID ALU
C626	=	470PF 500V CERAMIC
C627	=	47PF 400V CERAMIC
C628	=	2200PF 100V POLYPROP
C629	=	2200PF 100V POLYPROP
C630	=	22NF 250V MET POLYES
C631	=	100PF 400V CERAMIC
C632	=	470PF 100V POLYPROP
C633	=	2.2UF 25V SOLID ALU
C634	=	100PF 400V CERAMIC
C635	=	10NF 250V MET POLYES
C636	=	100PF 400V CERAMIC
C637	=	100PF 400V CERAMIC
C638	=	2200PF 100V POLYPROP
C639	=	2.2UF 25V SOLID ALU
C640	=	470PF 100V POLYPROP
C642	=	100PF 400V CERAMIC
C643	=	470PF 100V POLYPROP
C644	=	2.2UF 25V SOLID ALU
C645	=	15PF 500V CERAMIC
C646	=	10NF 250V MET POLYES
C647	=	10NF 250V MET POLYES
C648	=	10NF 250V MET POLYES
C649	=	10NF 250V MET POLYES
C650	=	10NF 250V MET POLYES
C651	=	10NF 250V MET POLYES
C655	=	15UF 16V SOLID ALU
C656	=	15UF 16V SOLID ALU
C657	=	15UF 16V SOLID ALU
C658	=	2.2UF 25V SOLID ALU
C659	=	2.2UF 25V SOLID ALU
C660	=	15UF 16V SOLID ALU
C661	=	15UF 16V SOLID ALU
C702	=	10NF 1000V MET POLYES
C703	=	2.2UF 25V SOLID ALU
C704	=	2.2UF 25V SOLID ALU
C705	=	2.2UF 25V SOLID ALU
C706	=	2.2UF 25V SOLID ALU
C850	=	0.22UF 100V MULT LAYR
C852	=	0.22UF 100V MULT LAYR
C853	=	0.22UF 100V MULT LAYR
C854	=	0.22UF 100V MULT LAYR
C855	=	0.22UF 100V MULT LAYR
C857	=	0.22UF 100V MULT LAYR
C858	=	0.22UF 100V MULT LAYR
C859	=	0.22UF 100V MULT LAYR

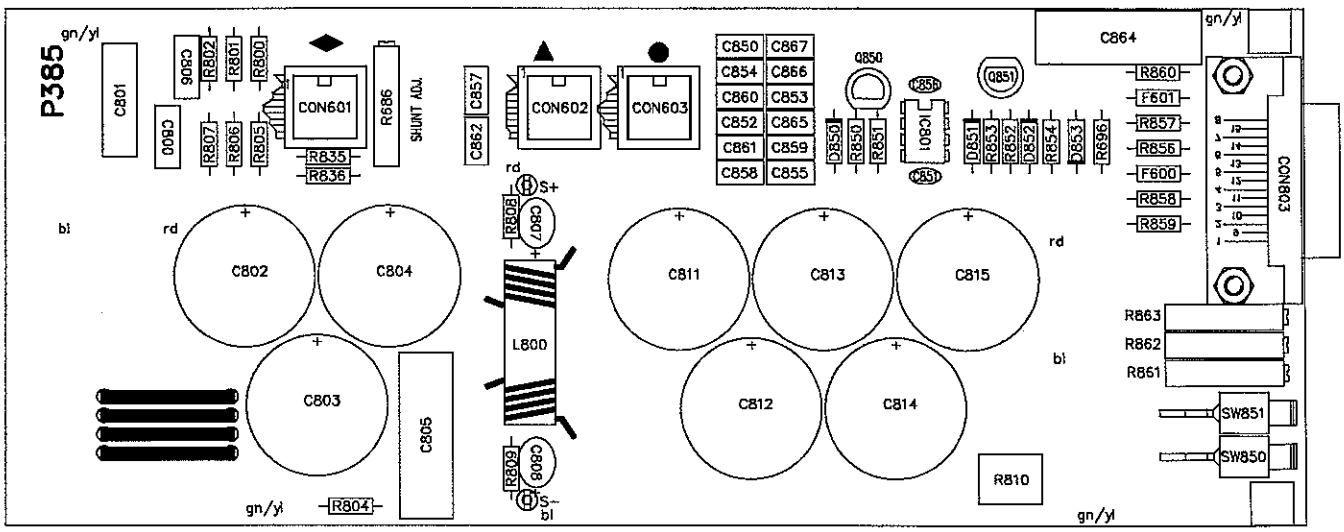


C860	=	0.22UF 100V	MULT LAYR
C861	=	0.22UF 100V	MULT LAYR
C862	=	0.22UF 100V	MULT LAYR
C864	=	0.22UF 250V RMS	X2
C865	=	0.22UF 100V	MULT LAYR
C866	=	0.22UF 100V	MULT LAYR
C867	=	0.22UF 100V	MULT LAYR
C900	=	47NF 250V	MET POLYES
C901	=	1000PF 100V	POLYPROP
C902	=	15UF 16V	SOLID ALU
C903	=	1000PF 100V	POLYPROP
C904	=	10NF 250V	MET POLYES
C905	=	0.22UF 63V	MET POLYES
C906	=	150PF 100V	POLYPROP
C907	=	220PF 100V	POLYPROP
C908	=	2200PF 100V	POLYPROP
C909	=	15UF 16V	SOLID ALU
C910	=	47UF 40V	ERO
C911	=	1000PF 100V	POLYPROP
C912	=	22NF 250V	MET POLYES
C913	=	0.1UF 100V	MULT LAYR
C914	=	2.2UF 25V	SOLID ALU
C915	=	47NF 250V	MET POLYES
C916	=	15UF 16V	SOLID ALU
C917	=	4700PF 63V	POLYPROP
C918	=	10NF 1000V	MET POLYES
D100	=	BTA 25-700B	ST
D101	=	GBPC35-08	GEN.INSTR.
D300	=	TZB15CB	SEMICON
D301	=	BYT08PI400	ST
D302	=	BYT08PI400	ST
D303	=	BYT08PI400	ST
D304	=	BYT08PI400	ST
D305	=	BYT08PI400	ST
D306	=	BYT08PI400	ST
D307	=	BYT08PI400	ST
D308	=	BYT08PI400	ST
D309	=	TZB15CB	SEMICON
D310	=	1N4148	PHILIPS
D311	=	1N5818	MOTOROLA
D312	=	BZX85-C20	ITT
D313	=	BZX55-C15	ITT
D314	=	1N5818	MOTOROLA
D500	=	SKB2-08L5A	SEMIKRON
D501	=	BYV26B	PHILIPS
D502	=	1N4148	PHILIPS
D503	=	BYV26B	PHILIPS
D504	=	BYV28-200	PHILIPS
D505	=	BYV26B	PHILIPS
D613	=	BZX85-C5V6	ITT
D614	=	1N4148	PHILIPS
D615	=	1N4148	PHILIPS
D616	=	Z0104BA	TAG
D617	=	1N4148	PHILIPS
D618	=	BZX55-C12	ITT
D619	=	BZX55-C8V2	ITT
D620	=	TL431ILP	TEXAS
D621	=	1N4148	PHILIPS
D622	=	BZX55-C12	ITT
D623	=	1N4148	PHILIPS
D624	=	1N4148	PHILIPS
D625	=	1N4148	PHILIPS
D626	=	1N4148	PHILIPS
D627	=	BZX85-C5V6	ITT
D631	=	1N4148	PHILIPS
D632	=	1N4148	PHILIPS
D633	=	1N4148	PHILIPS
D634	=	1N4148	PHILIPS
D635	=	1N4148	PHILIPS
D636	=	BZX55-C8V2	ITT
D637	=	1N4148	PHILIPS
D638	=	BZX55-C12	ITT
D639	=	BZX55-C8V2	ITT
D641	=	BZX85-C12	ITT
D642	=	BZX85-C12	ITT
D643	=	BZX85-C12	ITT
D644	=	BZX55-C8V2	ITT
D645	=	BZX55-C12	ITT
D700	=	LED 3MM GREEN	AEG
D701	=	LED 3MM RED	PHILIPS
D702	=	LED 3MM GREEN	AEG
D900	=	1N4148	PHILIPS
D901	=	BZX55-C6V2	ITT
D902	=	BZX55-C10	ITT
D903	=	BZX55-C8V2	ITT
D904	=	1N4148	PHILIPS
D906	=	1N4148	PHILIPS
D907	=	1N4148	PHILIPS
D908	=	1N4148	PHILIPS
D909	=	1N4148	PHILIPS
D910	=	1N4148	PHILIPS
D911	=	1N4148	PHILIPS
D912	=	BYV26B	PHILIPS
D913	=	1N825A	ST
F100A	=	FUSE 5X20 8T	220V
F100B	=	FUSE 5X20 16T	110V
F101A	=	FUSE 5X20 8T	220V
F101B	=	FUSE 5X20 16T	110V
F300	=	FUSE 6X32 6.3FF	
F500	=	FUSE 5X20 1T	
F501	=	FUSE PICO 0.25F	
F600	=	FUSE PICO 0.25F	
F601	=	FUSE PICO 0.25F	
IC500	=	UC3842	UNITRODE
IC602	=	TL084BCN	TEXAS
IC603	=	TL084BCN	TEXAS
IC604	=	OP177GP	
IC605	=	REF02HP	
IC606	=	TL084BCN	TEXAS
IC700	=	TL084BCN	TEXAS
IC701	=	L7805CV	ST



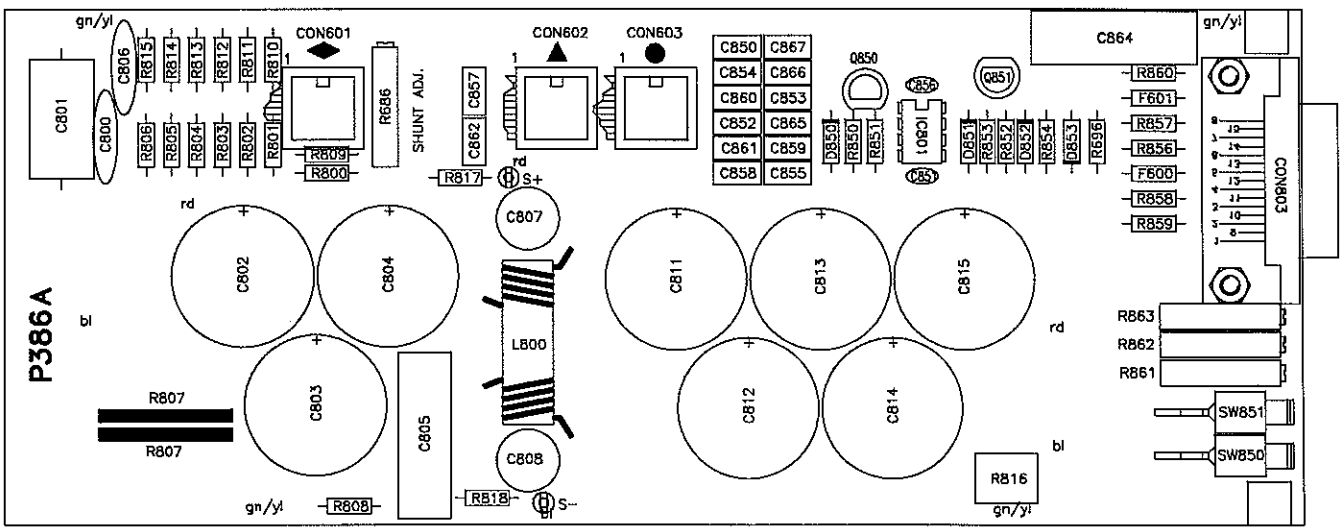
IC702	=	L7905CV	ST
IC900	=	HEF4046 BP	PHILIPS
IC901	=	HEF4011BD	PHILIPS
IC902	=	HEF4069UBD	PHILIPS
L100	=	XL257	DELTA
L101	=	XL257	DELTA
L102	=	XL258	DELTA
L300	=	XL259	DELTA
L301	=	XL260	DELTA
L302	=	XL260	DELTA
L303	=	XL237	DELTA
L600	=	XL245	DELTA
L601	=	15UH	SIEMENS
M1	=	3.5 DIGIT LED DPM	
M2	=	3.5 DIGIT LED DPM	
Q300	=	IRFP350	IR
Q301	=	IRFP350	IR
Q302	=	IRFP350	IR
Q303	=	IRFP350	IR
Q307	=	IRF9520	IR
Q308	=	IRF512	IR
Q309	=	BST100	PHILIPS
Q310	=	BST70	PHILIPS
Q500	=	BUK444-800B	PHILIPS
Q609	=	BS170	ITT
Q611	=	2N2907A	ST
Q612	=	2N2222A	PHIL
Q613	=	2N2222A	PHIL
Q614	=	2N2222A	PHIL
Q615	=	BS170	ITT
Q616	=	BS170	ITT
Q617	=	BS170	ITT
Q618	=	BS250	ITT
Q619	=	2N2222A	PHIL
Q900	=	2N2222A	PHIL
Q901	=	BS170	ITT
Q902	=	BS170	ITT
Q903	=	2N2907A	ST
Q904	=	2N2222A	PHIL
Q905	=	2N2222A	PHIL
Q906	=	2N2907A	ST
Q907	=	BS250	ITT
Q908	=	2N2222A	PHIL
Q909	=	2N2222A	PHIL
Q910	=	2N2907A	ST
R100	=	TNR23G471K	MARCON
R101	=	2.21M	MF/0.25W/1600V
R102	=	3.3	MF/2.5W/500V
R103	=	3.3	MF/2.5W/500V
R104	=	120	MF/2.0W/500V
R105	=	15	WW/9.0W/500V
R106	=	15	WW/9.0W/500V
R107	=	47	WW/6.0W/200V
R200	=	39.2K	MF/0.6W/350V

R201	=	39.2K	MF/0.6W/350V
R202	=	39.2K	MF/0.6W/350V
R203	=	39.2K	MF/0.6W/350V
R300	=	6.81	MF/0.6W/350V
R301	=	6.81	MF/0.6W/350V
R302	=	150	MF/2.0W/500V
R303	=	150	MF/2.0W/500V
R304	=	6.81	MF/0.6W/350V
R305	=	6.81	MF/0.6W/350V
R308	=	2.21	MF/0.6W/350V
R309	=	4.75K	MF/0.6W/350V
R310	=	2.21	MF/0.6W/350V
R311	=	10K	MF/0.6W/350V
R500	=	33.2K	MF/0.6W/350V
R501	=	33.2K	MF/0.6W/350V
R502	=	33.2K	MF/0.6W/350V
R503	=	33.2K	MF/0.6W/350V
R504	=	6.81	MF/0.6W/350V
R505	=	68.1K	MF/0.6W/350V
R506	=	15K	MF/0.6W/350V
R507	=	392K	MF/0.6W/350V
R508	=	8.25K	MF/0.6W/350V
R509	=	CR	MF/0.6W/250V
R510	=	681K	MF/0.6W/350V
R511	=	475	MF/0.6W/350V
R512	=	221	MF/0.6W/350V
R513	=	10K	MF/0.6W/350V
R514	=	5.62	MF/0.6W/350V
R515	=	2.2K	MF/2.0W/500V
R516	=	2.2K	MF/2.0W/500V
R628	=	562K	MF/0.6W/350V
R629	=	10K	MF/0.6W/350V
R630	=	12.1K	MF/0.6W/350V
R631	=	100K	MF/0.6W/350V
R632	=	10K	MF/0.6W/350V
R633	=	56.2K	MF/0.6W/350V
R634	=	10K	MF/0.6W/350V
R635	=	332	MF/0.6W/350V
R636	=	22.1	MF/0.6W/350V
R637	=	681	MF/0.6W/350V
R638	=	681	MF/0.6W/350V
R639	=	2.21K	MF/0.6W/350V
R640	=	6.81K	MF/0.6W/350V
R641	=	1K	MF/0.6W/350V
R642	=	1K	MF/0.6W/350V
R644	=	4.75K	MF/0.6W/350V
R646	=	10K	MF/0.6W/350V
R647	=	4.75K	MF/0.6W/350V
R649	=	4.75K	MF/0.6W/350V
R650	=	4.75K	MF/0.6W/350V
R651	=	82.5K	MF/0.6W/350V
R652	=	10K TRIMPOTM 20 TURNS	
R653	=	100K	MF/0.6W/350V
R654	=	100K	MF/0.6W/350V
R655	=	825	MF/0.6W/350V
R656	=	825	MF/0.6W/350V



R657	=	10	MF/0.6W/350V
R658	=	10	MF/0.6W/350V
R659	=	10K	MF/0.6W/350V
R660	=	10K	MF/0.6W/350V
R662	=	1K	MF/0.6W/350V
R663	=	4.75K	MF/0.6W/350V
R665	=	332	MF/0.6W/350V
R666	=	825	MF/0.6W/350V
R667	=	10K	MF/0.6W/350V
R668	=	1K	MF/0.6W/350V
R669	=	10K	MF/0.6W/350V
R670	=	2.21K	MF/0.6W/350V
R671	=	2.21K	MF/0.6W/350V
R672	=	2.21K	MF/0.6W/350V
R673	=	2.21K	MF/0.6W/350V
R674	=	2.21K	MF/0.6W/350V
R675	=	475	MF/0.6W/350V
R676	=	10K	MF/0.6W/350V
R677	=	3.32K	MF/0.6W/350V
R678	=	4.75K	MF/0.6W/350V
R679	=	4.75K	MF/0.6W/350V
R680	=	4.75K	MF/0.6W/350V
R681	=	6.81K	MF/0.6W/350V
R682	=	2.21M	MF/0.25W/1600V
R683	=	4.75K	MF/0.6W/350V
R684	=	4.75K	MF/0.6W/350V
R685	=	2.21K	MF/0.6W/350V
R686	=	10K TRIMPOTM 20 TURNS	
R687	=	1K	MF/0.6W/350V
R688	=	150K	MF/0.6W/350V
R689	=	4.75K	MF/0.6W/350V
R690	=	4.75K	MF/0.6W/350V
R691	=	2.21M	MF/0.25W/1600V
R692	=	332	MF/0.6W/350V
R693	=	1K	MF/0.6W/350V
R694	=	10K	MF/0.6W/350V
R695	=	26.7K	MF/0.6W/350V
R696	=	475	MF/0.6W/350V
R697	=	1K	MF/0.6W/350V
R698	=	47.5	MF/0.6W/350V
R699	=	47.5K	MF/0.6W/350V
R700	=	5K POTM 10 TURNS	
R701	=	5K POTM 10 TURNS	
R702	=	5K POTM 10 TURNS	
R703	=	1K	MF/0.6W/350V
R704	=	4.75K	MF/0.6W/350V
R705	=	3.92K	MF/0.6W/350V
R706	=	2K TRIMPOTM 20 TURNS	
R707	=	3.92K	MF/0.6W/350V
R708	=	2K TRIMPOTM 20 TURNS	
R709	=	CR	MF/0.6W/250V
R710	=	1K	MF/0.6W/350V
R711	=	1M	MF/0.25W/1600V
R712	=	10K TRIMPOTM 20 TURNS	
R713	=	CR	MF/0.6W/250V
R714	=	1K	MF/0.6W/350V

R715	=	1M	MF/0.25W/1600V
R716	=	10K TRIMPOTM 20 TURNS	
R717	=	562	MF/0.6W/350V
R718	=	562	MF/0.6W/350V
R856	=	12.1	MF/0.6W/350V
R857	=	12.1	MF/0.6W/350V
R858	=	12.1	MF/0.6W/350V
R859	=	12.1	MF/0.6W/350V
R860	=	12.1	MF/0.6W/350V
R861	=	5K TRIMPOT	OPTION
R862	=	5K TRIMPOT	OPTION
R863	=	5K TRIMPOT	OPTION
R900	=	100	MF/0.6W/350V
R901	=	332	MF/0.6W/350V
R902	=	332	MF/0.6W/350V
R903	=	56.2K	MF/0.6W/350V
R904	=	CR	MF/0.6W/250V
R905	=	12.1K	MF/0.6W/350V
R906	=	12.1K	MF/0.6W/350V
R907	=	12.1K	MF/0.6W/350V
R908	=	10K	MF/0.6W/350V
R909	=	10K	MF/0.6W/350V
R910	=	10K	MF/0.6W/350V
R911	=	10K	MF/0.6W/350V
R912	=	10K	MF/0.6W/350V
R913	=	475	MF/0.6W/350V
R914	=	475	MF/0.6W/350V
R915	=	1.82K	MF/0.6W/350V
R916	=	2.21K	MF/0.6W/350V
R917	=	18.2	MF/0.6W/350V
R918	=	6.81K	MF/0.6W/350V
R919	=	1K	MF/0.6W/350V
R920	=	1K	MF/0.6W/350V
R921	=	3.32K	MF/0.6W/350V
R922	=	3.32K	MF/0.6W/350V
R923	=	100	MF/0.6W/350V
R924	=	10K	MF/0.6W/350V
R925	=	12.1K	MF/0.6W/350V
R926	=	100	MF/0.6W/350V
R927	=	8.25K	MF/0.6W/350V
R928	=	18.2	MF/0.6W/350V
R929	=	12.1K	MF/0.6W/350V
R930	=	2.21K	MF/0.6W/350V
R931	=	1K	MF/0.6W/350V
R932	=	1K	MF/0.6W/350V
R933	=	3.92	MF/0.6W/350V
R934	=	10K	MF/0.6W/350V
R935	=	56.2K	MF/0.6W/350V
SW100	=	SWITCH DPST 15A TGL	
SW101	=	VOLTAGE SELECT 110/220V	
SW600	=	SWITCH THERM 90 DEGR C	
SW700	=	SWITCH DPDT 1A PUSH	
SW701	=	SWITCH DPDT 1A PUSH	
SW850	=	SWITCH SPDT 3A SLVE	
SW851	=	SWITCH SPDT 3A SLVE	



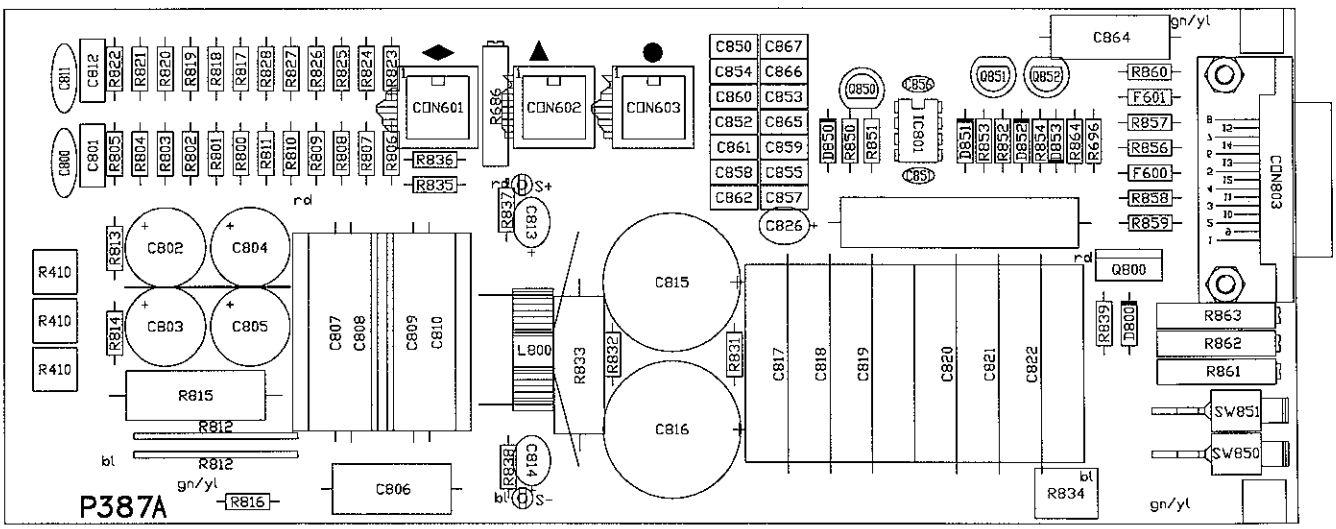
T300	=	XT265	DELTA
T301	=	XT242	DELTA
T303	=	XT265	DELTA
T500	=	XT239	DELTA

OUTPUT SECTION SM1540

C400	=	5000PF 250V	CERAMIC
C401	=	10NF 1000V	MET POLYES
C402	=	10NF 1000V	MET POLYES
C800	=	10NF 250V	MET POLYES
C801	=	10NF 1000V	MET POLYES
C802	=	1800UF 25V	SPRAGUE
C803	=	1800UF 25V	SPRAGUE
C804	=	1800UF 25V	SPRAGUE
C805	=	0.22UF 250V RMS	X2
C806	=	10NF 250V	MET POLYES
C807	=	15UF 16V	SOLID ALU
C808	=	15UF 16V	SOLID ALU
C809	=	0.1UF 630V	MET POLYES
C810	=	0.1UF 630V	MET POLYES
C811	=	1800UF 25V	SPRAGUE
C812	=	1800UF 25V	SPRAGUE
C813	=	1800UF 25V	SPRAGUE
C814	=	1800UF 25V	SPRAGUE
C815	=	1800UF 25V	SPRAGUE
C816	=	0.33UF 100V	MULT LAYR
C817	=	0.33UF 100V	MULT LAYR
C818	=	0.33UF 100V	MULT LAYR
C851	=	100PF 400V	CERAMIC
C856	=	100PF 400V	CERAMIC
D400	=	60HQ100	IR
D401	=	60HQ100	IR
D402	=	60HQ100	IR
D403	=	60HQ100	IR
D850	=	BZX55-C3V3	ITT
D851	=	1N4148	PHILIPS
D852	=	1N4148	PHILIPS
D853	=	BZX55-C8V2	ITT
IC801	=	LM358	ST
L400	=	XL270	DELTA
L401	=	XL298	DELTA
L800	=	XL275	DELTA
L801	=	XL279	DELTA
Q850	=	BS170	ITT
Q851	=	BSS92	PHILIPS
R400	=	18	MF/2.5W/500V
R401	=	18	MF/2.5W/500V
R402	=	PTC 70	C880 SIEMENS
R800	=	2.74K	MF/0.1%/TC=25
R801	=	2.74K	MF/0.1%/TC=25
R802	=	2.74K	MF/0.1%/TC=25
R803	=	0.137	R/M
R804	=	1.0	MF/0.6W/350V
R805	=	2.74K	MF/0.6W/350V
R806	=	2.74K	MF/0.6W/350V
R807	=	2.74K	MF/0.6W/350V
R808	=	562	MF/0.6W/350V
R809	=	100	MF/0.6W/350V
R810	=	TNR12G821K	MARCON
R811	=	1.0	MF/0.6W/350V
R812	=	1.0	MF/0.6W/350V
R835	=	475K	MF/0.6W/350V
R836	=	1.0	MF/0.6W/350V
R850	=	3.32K	MF/0.6W/350V
R851	=	10K	MF/0.6W/350V
R852	=	3.32K	MF/0.6W/350V
R853	=	1K	MF/0.6W/350V
R854	=	10K	MF/0.6W/350V
T302	=	XT264	DELTA

OUTPUT SECTION SM7020

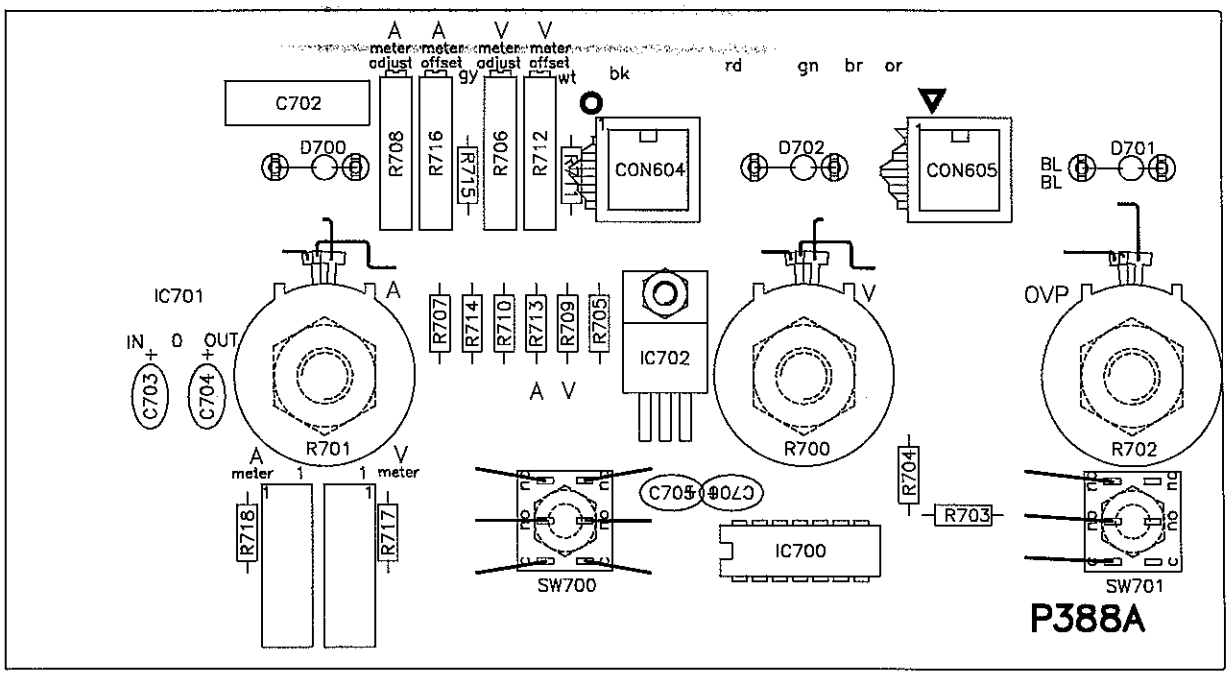
C400	=	1000PF 1000V	CERAMIC
C401	=	1000PF 1000V	CERAMIC
C402	=	4700PF 63V	POLYPROP
C403	=	4700PF 63V	POLYPROP
C404	=	4700PF 63V	POLYPROP
C405	=	220PF 100V	POLYPROP
C406	=	10NF 250V	MET POLYES
C407	=	10NF 250V	MET POLYES
C408	=	10NF 1000V	MET POLYES
C409	=	10NF 1000V	MET POLYES
C410	=	15UF 16V	SOLID ALU
C800	=	5000PF 250V	CERAMIC
C801	=	0.1UF 630V	MET POLYES
C802	=	220UF 100V	SPRAGUE
C803	=	220UF 100V	SPRAGUE
C804	=	220UF 100V	SPRAGUE
C805	=	0.22UF 250V RMS	X2
C806	=	5000PF 250V	CERAMIC
C807	=	22UF 100V	ERO
C808	=	22UF 100V	ERO
C809	=	0.1UF 630V	MET POLYES
C810	=	0.1UF 630V	MET POLYES
C811	=	220UF 100V	SPRAGUE
C812	=	220UF 100V	SPRAGUE
C813	=	220UF 100V	SPRAGUE
C814	=	220UF 100V	SPRAGUE
C815	=	220UF 100V	SPRAGUE
C816	=	0.22UF 100V	MULT LAYR
C817	=	0.22UF 100V	MULT LAYR
C818	=	0.22UF 100V	MULT LAYR
C851	=	100PF 400V	CERAMIC



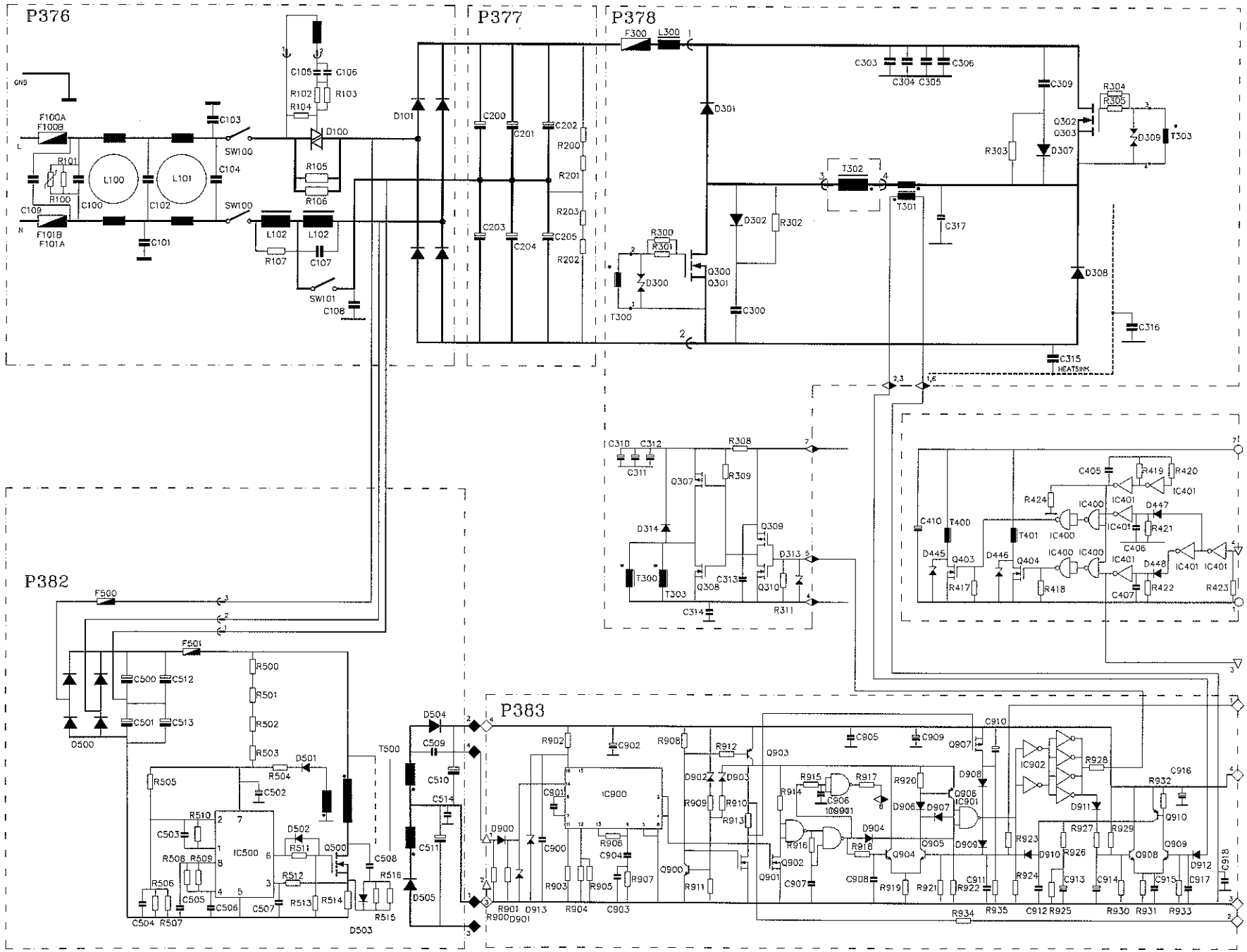
C856	=	100PF 400V	CERAMIC
D400	=	BYV52-PI-200	ST
D402	=	BYV52-PI-200	ST
D404	=	BZX85-C51	ITT
D405	=	BZX85-C51	ITT
D406	=	BZX85-C51	ITT
D407	=	BZX85-C15	ITT
D408	=	BZX85-C15	ITT
D409	=	BZX85-C15	ITT
D410	=	1N4148	PHILIPS
D411	=	1N4148	PHILIPS
D412	=	1N4148	PHILIPS
D445	=	BZX85-C36	ITT
D446	=	BZX85-C36	ITT
D447	=	1N4148	PHILIPS
D448	=	1N4148	PHILIPS
D850	=	BZX55-C3V3	ITT
D851	=	1N4148	PHILIPS
D852	=	1N4148	PHILIPS
D853	=	BZX55-C8V2	ITT
IC400	=	HEF4011BD	PHILIPS
IC401	=	HEF4069UBD	PHILIPS
IC801	=	LM358	ST
L400	=	XL266	DELTA
L401	=	XL266	DELTA
L402	=	XL266	DELTA
L403	=	XL266	DELTA
L404	=	XL268	DELTA
L800	=	XL273	DELTA
L801	=	XL277	DELTA
Q400	=	IRFIZ44	IR
Q401	=	IRFIZ44	IR
Q402	=	IRFIZ44	IR
Q403	=	BS170	ITT
Q404	=	BS170	ITT
Q850	=	BS170	ITT
Q851	=	BSS92	PHILIPS
R400	=	68	MF/2.5W/500V
R401	=	68	MF/2.5W/500V
R402	=	1K	MF/0.6W/350V
R403	=	1K	MF/0.6W/350V
R404	=	1K	MF/0.6W/350V
R405	=	PTC 600	C884 SIEMENS
R406	=	PTC 600	C884 SIEMENS
R417	=	10K	MF/0.6W/350V
R418	=	10K	MF/0.6W/350V
R419	=	2.21K	MF/0.6W/350V
R420	=	4.75K	MF/0.6W/350V
R421	=	6.81K	MF/0.6W/350V
R422	=	6.81K	MF/0.6W/350V
R423	=	10K	MF/0.6W/350V
R424	=	10K	MF/0.6W/350V
R800	=	1.82M	MF/0.25W/1600V
R801	=	8.25K	MF/0.6W/350V
R802	=	8.25K	MF/0.6W/350V
R803	=	6.81K	MF/0.6W/350V
R804	=	6.81K	MF/0.6W/350V
R805	=	5.62K	MF/0.6W/350V
R806	=	2.74K	MF/0.6W/350V
R807	=	0.137 R/M	
R808	=	1.0	MF/0.6W/350V
R809	=	1.0	MF/0.6W/350V
R810	=	5.62K	MF/0.1%/TC= 25
R811	=	7.50K	MF/0.1%/TC= 25
R812	=	7.50K	MF/0.1%/TC= 25
R813	=	7.50K	MF/0.1%/TC= 25
R814	=	7.50K	MF/0.1%/TC= 25
R815	=	2.74K	MF/0.1%/TC= 25
R816	=	TNR12G821K	MARCON
R817	=	4.75K	MF/0.6W/350V
R818	=	100	MF/0.6W/350V
R850	=	3.32K	MF/0.6W/350V
R851	=	10K	MF/0.6W/350V
R852	=	3.32K	MF/0.6W/350V
R853	=	1K	MF/0.6W/350V
R854	=	10K	MF/0.6W/350V
T302	=	XT262	DELTA
T400	=	XT271	DELTA
T401	=	XT272	DELTA

OUTPUT SECTION SM3004

C400	=	100PF 1000V	CERAMIC
C401	=	100PF 1000V	CERAMIC
C402	=	4700PF 63V	POLYPROP
C403	=	68NF 250V RMS	X2
C404	=	10NF 1000V	MET POLYES
C405	=	220PF 100V	POLYPROP
C407	=	10NF 250V	MET POLYES
C410	=	15UF 16V	SOLID ALU
C800	=	2500PF 250V	CERAMIC
C801	=	47NF 250V	MET POLYES
C802	=	15UF 200V	SPRAGUE
C803	=	15UF 200V	SPRAGUE
C804	=	15UF 200V	SPRAGUE
C805	=	15UF 200V	SPRAGUE
C806	=	68NF 250V RMS	X2
C807	=	1UF 400V	MET POLYES
C808	=	1UF 400V	MET POLYES
C809	=	1UF 400V	MET POLYES
C810	=	1UF 400V	MET POLYES
C811	=	2500PF 250V	CERAMIC
C812	=	47NF 250V	MET POLYES
C813	=	15UF 16V	SOLID ALU
C814	=	15UF 16V	SOLID ALU
C815	=	220UF 200V	SPRAGUE
C816	=	220UF 200V	SPRAGUE



C817	=	1UF 400V MET POLYES
C818	=	1UF 400V MET POLYES
C819	=	1UF 400V MET POLYES
C820	=	1UF 400V MET POLYES
C821	=	1UF 400V MET POLYES
C822	=	1UF 400V MET POLYES
C823	=	68NF 250V RMS X2
C824	=	1UF 400V MET POLYES
C825	=	68NF 250V RMS X2
C826	=	15UF 16V SOLID ALU
C851	=	100PF 400V CERAMIC
C856	=	100PF 400V CERAMIC
C864	=	10NF 1000V MET POLYES
D400	=	BYW81-PI-200 ST
D401	=	BYW81-PI-200 ST
D402	=	BYW81-PI-200 ST
D403	=	BYW81-PI-200 ST
D404	=	BYW81-PI-200 ST
D405	=	ZPU180 ITT
D406	=	ZPU180 ITT
D407	=	ZPU180 ITT
D408	=	ZPU180 ITT
D409	=	ZPU180 ITT
D410	=	BYW81-PI-200 ST
D411	=	BYW81-PI-200 ST
D412	=	BYW81-PI-200 ST
D413	=	BYW81-PI-200 ST
D414	=	BYW81-PI-200 ST
D415	=	ZPU180 ITT
D416	=	ZPU180 ITT
D417	=	ZPU180 ITT
D418	=	ZPU180 ITT
D419	=	ZPU180 ITT
D420	=	BYW81-PI-200 ST
D421	=	BYW81-PI-200 ST
D422	=	BYW81-PI-200 ST
D423	=	BYW81-PI-200 ST
D424	=	BYW81-PI-200 ST
D425	=	ZPU180 ITT
D426	=	ZPU180 ITT
D427	=	ZPU180 ITT
D428	=	ZPU180 ITT
D429	=	ZPU180 ITT
D430	=	BYW81-PI-200 ST
D431	=	BYW81-PI-200 ST
D432	=	BYW81-PI-200 ST
D433	=	BYW81-PI-200 ST
D434	=	BYW81-PI-200 ST
D435	=	ZPU180 ITT
D436	=	ZPU180 ITT
D437	=	ZPU180 ITT
D438	=	ZPU180 ITT
D439	=	ZPU180 ITT
D440	=	BYT08PI400 ST
D442	=	BYT08PI400 ST
D443	=	BZX85-C15 ITT
D444	=	1N4148 PHILIPS
D446	=	BZX85-C36 ITT
D448	=	1N4148 PHILIPS
D800	=	1N4148 PHILIPS
D850	=	BZX55-C3V3 ITT
D851	=	1N4148 PHILIPS
D852	=	1N4148 PHILIPS
D853	=	BZX55-C8V2 ITT
IC400	=	HEF4011BD PHILIPS
IC401	=	HEF4069UBD PHILIPS
IC801	=	LM358 ST
L400	=	XL267 DELTA
L401	=	XL267 DELTA
L402	=	XL269 DELTA
L403	=	XL280 DELTA
L404	=	XL280 DELTA
L405	=	XL300 DELTA
L800	=	XL274 DELTA
L801	=	XL279 DELTA
Q400	=	IRF740FI ST
Q404	=	BS170 ITT
Q800	=	IRF740FI ST
Q850	=	BS170 ITT
Q851	=	BFP26 SIEMENS
Q852	=	BFP26 SIEMENS
R400	=	270 MF/2.0W/500V
R401	=	270 MF/2.0W/500V
R402	=	270 MF/2.0W/500V
R403	=	270 MF/2.0W/500V
R404	=	270 MF/2.0W/500V
R405	=	270 MF/2.0W/500V
R406	=	270 MF/2.0W/500V
R407	=	270 MF/2.0W/500V
R408	=	1K MF/0.6W/350V
R410	=	PTC 5K A1502 SIEMENS
R411	=	PTC 5K A1502 SIEMENS
R412	=	PTC 5K A1502 SIEMENS
R418	=	10K MF/0.6W/350V
R419	=	2.21K MF/0.6W/350V
R420	=	4.75K MF/0.6W/350V
R422	=	6.81K MF/0.6W/350V
R423	=	10K MF/0.6W/350V
R424	=	10K MF/0.6W/350V
R800	=	15K MF/0.6W/350V
R801	=	15K MF/0.6W/350V
R802	=	18.2K MF/0.6W/350V
R803	=	18.2K MF/0.6W/350V
R804	=	18.2K MF/0.6W/350V
R805	=	2.74K MF/0.6W/350V
R806	=	1.82K MF/0.6W/350V
R807	=	15K MF/0.6W/350V
R808	=	15K MF/0.6W/350V
R809	=	15K MF/0.6W/350V
R810	=	15K MF/0.6W/350V
R811	=	15K MF/0.6W/350V
R812	=	SHUNT 50MV DELTA
R813	=	150K MF/0.6W/350V
R814	=	150K MF/0.6W/350V
R815	=	0.39 WW/6.0W/200V
R816	=	1.0 MF/0.6W/350V
R817	=	14.7K MF/0.1%/TC= 25
R818	=	14.7K MF/0.1%/TC= 25
R819	=	14.7K MF/0.1%/TC= 25
R820	=	14.7K MF/0.1%/TC= 25
R821	=	14.7K MF/0.1%/TC= 25
R822	=	2.74K MF/0.1%/TC= 25
R823	=	14.7K MF/0.1%/TC= 25
R824	=	14.7K MF/0.1%/TC= 25
R825	=	14.7K MF/0.1%/TC= 25
R826	=	14.7K MF/0.1%/TC= 25
R827	=	14.7K MF/0.1%/TC= 25
R828	=	14.7K MF/0.1%/TC= 25
R831	=	150K MF/0.6W/350V
R832	=	150K MF/0.6W/350V
R833	=	0.39 WW/6.0W/200V
R834	=	TNR12G821K MARCON
R835	=	5.62M MF/0.25W/1600V
R836	=	1.0 MF/0.6W/350V
R837	=	8.25K MF/0.6W/350V
R838	=	100 MF/0.6W/350V
R839	=	56.2K MF/0.6W/350V
R850	=	3.32K MF/0.6W/350V
R851	=	10K MF/0.6W/350V
R852	=	3.32K MF/0.6W/350V
R853	=	1K MF/0.6W/350V
R854	=	10K MF/0.6W/350V
R864	=	10K MF/0.6W/350V
R865	=	1K2 WW/9.0/500V
T302	=	XT263 DELTA
T401	=	XT272 DELTA


P376
P377
P378
P382
P383
GND
F100A
F100B
F101B
F101A
L100
L101
L102
L102
SW100
SW100
SW101
C100
C101
C102
C103
C104
C105
C106
C107
C108
C109
R100
R101
R102
R103
R104
R105
R106
R107
D100
D101
C200
C201
C202
C203
C204
C205
R200
R201
R202
R203
F300
L300
C303
C304 C305
C306
C309
R304
R305
D301
T302
T301
C317
D302
R302
R300
R301
Q300
Q301
D300
T300
C300
R303
Q302
Q303
D307
D309
T303
D308
C316
C315
HEATSINK
C310
C312
C311
R308
R309
Q307
D314
Q309
T300
T303
C313
Q308
Q310
D313
C314
R311
C405
R419
R420
IC401
R424
IC400
IC401
D447
C410
T400
T401
IC400
IC401
R421
C406
D445
Q403
D446
Q404
IC400
IC400
IC401
D448
IC401
IC401
R417
R418
C407
R422
R423
F500
F501
D500
C500
C512
C501
C513
R500
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R502
R503
D501
R504
C502
R505
R510
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IC500
R508
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D502
R511
Q500
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C505
C506
C507
R512
R513
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R516
R515
C504
R507
D503
T500
D504
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C514
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C902
R908
R912
Q903
C905
C909
Q907
C910
IC902
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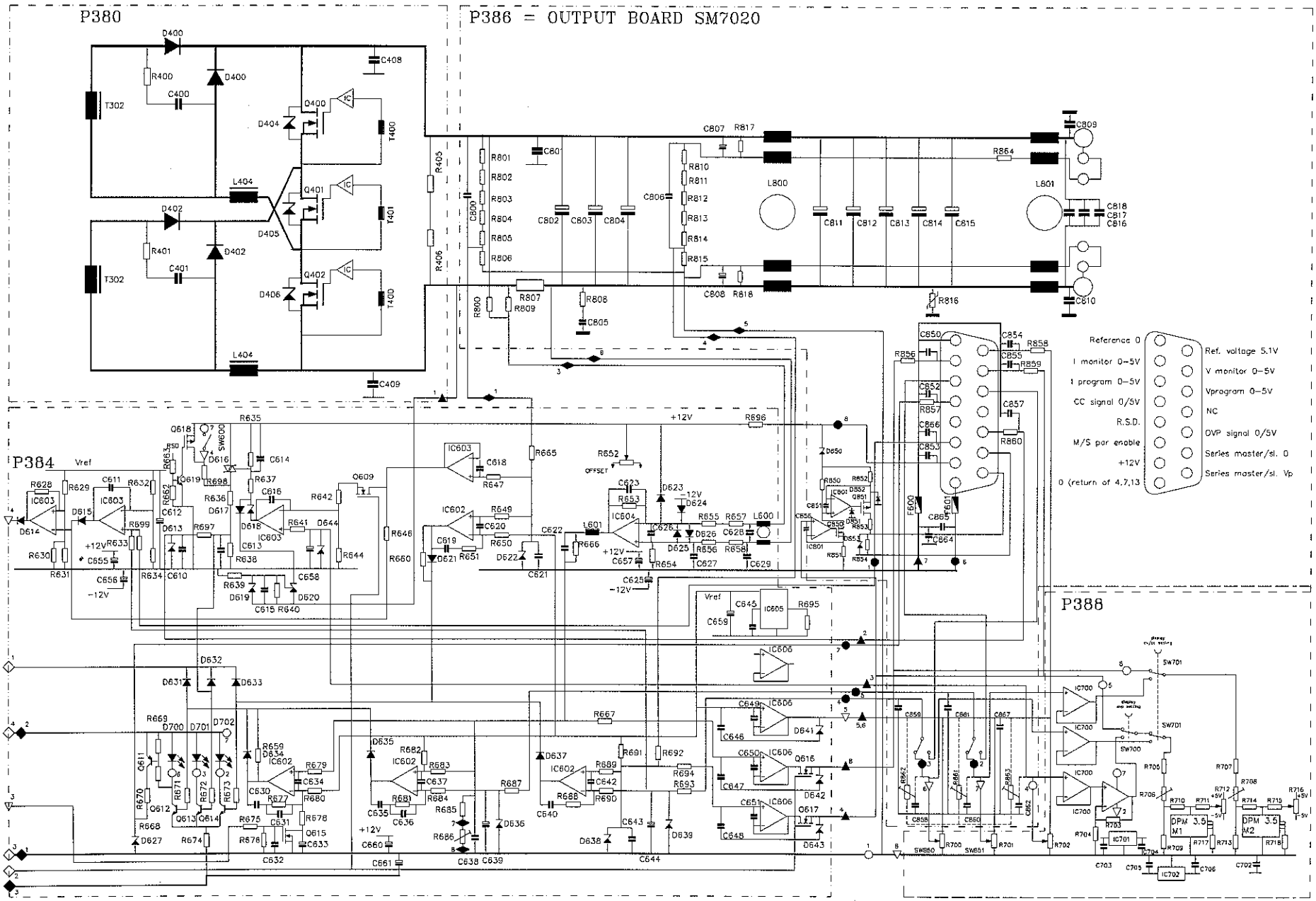
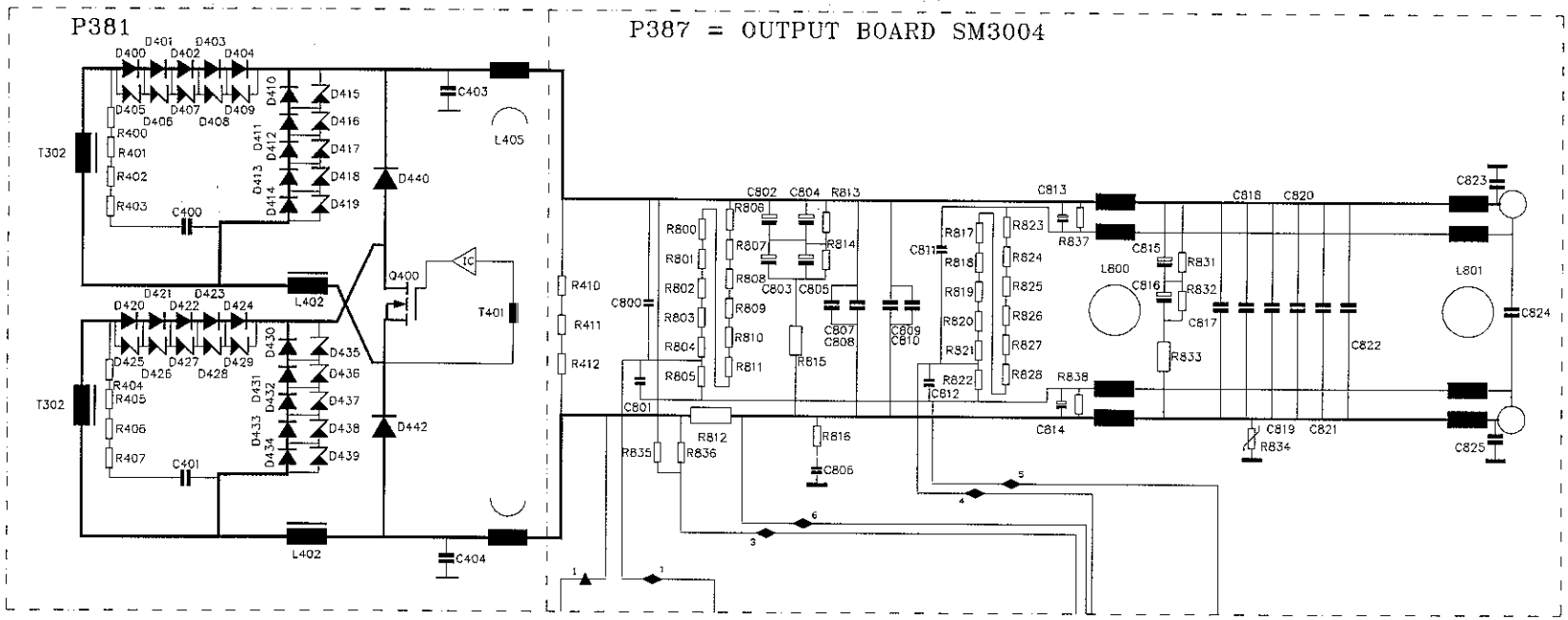
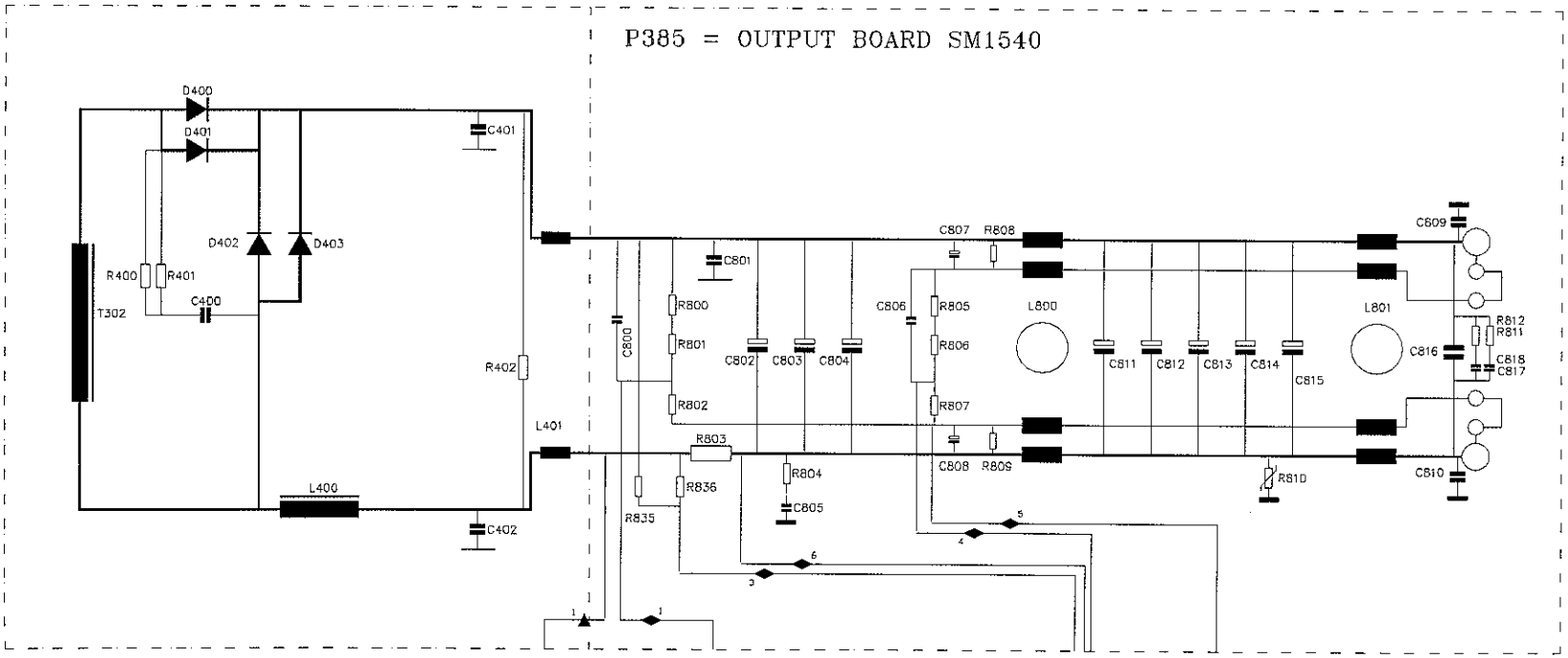
C916
R932
Q910
D911
R927
R929
Q909
D912
C918
C917
C915
C914
C913
R924
R926
D910
Q908
R923
C901
IC900
D902
D903
R909
R910
R913
R914
R915
R917
C906
D906
D907
IC901
D908
D906
R920
D900
C900
R906
C904
R907
R903
R905
Q900
R911
Q901
Q902
C907
C908
R916
R918
Q904
Q905
D904
D909
R919
R921
C911
R922
R934
R935
C912
R925
R930
R931
R933
R901
D913
R900
D901
R904
C903


P380
P386 = OUTPUT BOARD SM7020
P384
P388
Reference 0
I monitor 0-5V
I program 0-5V
CC signal 0/5V
R.S.D.
M/S par enable
+12V
0 (return of 4,7,13
Ref. voltage 5.1V
V monitor 0-5V
Vprogram 0-5V
NC
OVP signal 0/5V
Series master/sl. 0
Series master/sl. Vp


P381
P387 = OUTPUT BOARD SM3004
T302
T401
Q400
IC
L402
L405
C400
C401
C403
C404
D440
D442
R400
R401
R402
R403
R404
R405
R406
R407
R410
R411
R412
C800
C801
C802
C803
C804
C805
C806
C807
C808
C809
C810
C811
C812
C813
C814
C815
C816
C817
C818
C819
C820
C821
C822
C823
C824
C825
L800
L801
R800
R801
R802
R803
R804
R805
R806
R807
R808
R809
R810
R811
R812
R813
R814
R815
R816
R817
R818
R819
R820
R821
R822
R823
R824
R825
R826
R827
R828
R831
R832
R833
R834
R835
R836
R837
R838


P385 = OUTPUT BOARD SM1540
T302
D400
D401
D402
D403
R400
R401
R402
C400
C401
C402
L400
L401
C800
C801
C802
C803
C804
C805
C806
C807
C808
C809
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R800
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R805
R806
R807
R808
R809
R810
R811
R812
R835
R836

DELTA ELEKTRONIKA BV

Vissersdijk 4
P.O. Box 27
4300 AA Zierikzee
Netherlands

EC Declaration of Conformity

We

Delta Elektronika
P.O. BOX 27
4300 AA Zierikzee
The Netherlands

declare under sole responsibility that the following Power Supplies:

SM 1540-D
SM 7020-D
SM 3004-D

meet the intent of Directives 89/336/EEC; 92/31/EEC; 93/68/EEC for Electromagnetic Compatibility and Directives 73/23/EEC; 93/68/EEC regarding Electrical Safety. Compliance was demonstrated to the following specification as listed in the official Journal of the European Communities:

EN 50081-1 Generic Emissions: (residential, light industrial)

EN 55022	Radiated, Class B
EN 55022	Conducted, Class B

EN 50082-1 Generic Immunity: (residential, light industrial)

EN 50082-2 Generic Immunity: (industrial environment)

EN 61000-4-2	Electrostatic Discharge	Level 3.
EN 61000-4-4	Electrical Fast Transients / Bursts	Level 4.
ENV 50140	Radiated electromagnetic fields	Level 3.
ENV 50141	Conducted electromagnetic fields	Level 3.
EN 61000-4-5	Surge on DC output	Level 3, differential mode.
EN 61000-4-5	Surge on DC output	Level 2, common mode.
EN 61000-4-5	Surge on line input	Level 4.
EN 61000-4-11	Voltage variations and dips	

EN 60950 Safety of IT equipment

Managing director

SM 700 - series

- SM 1540-D
- SM 7020-D
- SM 3004-D

DELTA ELEKTRONIKA BV

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NETHERLANDS
TEL. +31 111 413656
FAX. +31 111 416919
www.DeltaPowerSupplies.com

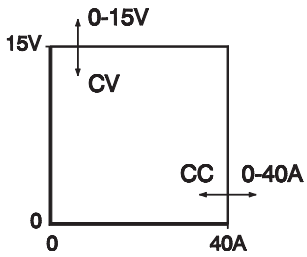
SM 700 - series

600 / 700 watts DC POWER SUPPLIES

CE

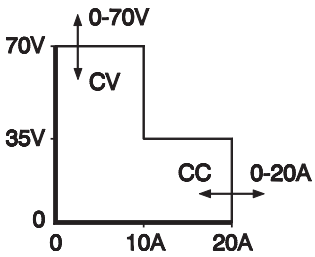
SM 1540-D

* 600 W
* 0 - 15 V 0 - 40 A



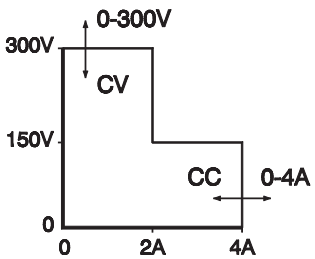
SM 7020-D

* 700 W
* AUTORANGING
  0 - 35 V 0 - 20 A
  35 - 70 V 0 - 10 A



SM 3004-D

* 600 W
* AUTORANGING
  0 - 150 V 0 - 4 A
  150 - 300 V 0 - 2 A



- Efficiency 90 %
- Weight only 7.4 kg
- 100 kHz MOSFET power conversion technique
- 0 - 5 V analog programmable (voltage and current)
- Isolated analog programming with ISO AMP MODULE to prevent earth loops
- **IEEE488, RS232** or **Ethernet** programming with external interface PSC-488 module, PSC-232 module, PSC-ETH module (pin compatible)
- Master / Slave parallel and series operation with equal current and voltage sharing
- Input / output insulation 3750 Vrms
- Designed for long life at full power
- Voltage and current control with 10 turn potentiometers, resolution 0.03%
- Natural convection cooling, no blower, no noise
- 48 hours burn-in

	SM 1540-D	SM 7020-D	SM 3004-D
Output			
voltage range	0 - 15 V	0 - 70 V	0 - 300 V
current range	0 - 40 A	0 - 20 A	0 - 4 A
max. output power	600 W	700 W	600 W
AUTORANGING (2 ranges)	no	yes	yes
max. output **current** / volt. range	40 A / 0 - 15 V	20 A / 0 - 35 V	4 A / 0 - 150 V
	-	10 A / 35 - 70 V	2 A / 150 - 300 V
Input			
AC input, 48 - 62 Hz 110 V range	90 - 132 V	95 - 132 V	95 - 132 V
230 V range	185 - 265 V	192 - 265 V	192 - 265 V
current (110 V AC)	8.4 Arms	9.6 Arms	8.3 Arms
current (230 V AC)	3.9 Arms	4.5 Arms	3.9 Arms
DC input	contact factory	contact factory	contact factory
fuses 230 / 110 V	8 AT / 16 AT	8 AT / 16 AT	8 AT / 16 AT
standby input power (V_o=I_o=0)	7.5 W	7.5 W	7.5 W
standby input power (V_o=$V_{max.}$)	13.5 W	16.5 W	21.5 W
Efficiency			
AC input, full load	87 %	89 %	88 %
Regulation			
Load 0 - 100% **CV**	5 mV	5 mV	20 mV
Line 192 - 265 V AC **CV**	5 mV	5 mV	20 mV
Load 0 - 100% **CC**	25 mA	12 mA	3 mA
Line 192 - 265 V AC **CC**	25 mA	12 mA	3 mA
Ripple + noise			
rms (BW=300 kHz) **CV**	2 mV	3 mV	10 mV
pp (BW=50 MHz) **CV**	10 mV	15 mV	50 mV
rms (BW=300 kHz) **CC**	10 mA	5 mA	1 mA
pp (BW=50 MHz) **CC**	25 mA	15 mA	3 mA
Temp. coeff., per °C **CV**	5.10^{-5}		
CC	1.10^{-4}		
Stability			
during 8 hrs after **CV**	3.10^{-4}		
1 hr warm-up and t_{amb} = 25 ± 1 °C **CC**	1.10^{-3}		

Analog Programming	**CV**	**CC**
Programming inputs		
input range	0 - 5 V	0 - 5 V
accuracy	± 0.2% + 0 mV ... + 8 mV (on 5 V)	± 0.5% + 0 mV ... + 20 mV (on 5 V)
temp. coeff. offset	10 µV / °C	150 µV / °C
input impedance	1 MOhm	1 MOhm
Monitoring output		
output range	0 - 5 V	0 - 5 V
accuracy	± 0.2% – 3 mV ... + 11 mV (on 5 V)	± 0.5% – 5 mV ... + 0 mV (on 5 V)
temp. coeff. offset	10 µV / °C	150 µV / °C
output impedance	20 Ohm	20 Ohm

Reference voltage	
on prog. connector V_{ref}	5.165 ± 31 mV
TC	typical 12 ppm / max. 30 ppm
Status outputs	
CC-status	5 V / 10 mA = logic 1
OVP / OVL-status	5 V / 10 mA = logic 1
Remote ShutDown	with + 5 V or relay contact

Programming speed	SM 1540-D		SM 7020-D		SM 3004-D	
programming UP						
settling within	50 mV	500 mV	50 mV	1 V	200 mV	5 V
output voltage step	0 → 15 V	0 → 15 V	0 → 35 V	0 → 35 V	0 → 150 V	0 → 150 V
time, (100 % load)	30 ms	18 ms	50 ms	12 ms	50 ms	14 ms
time, (10 % load)	30 ms	10 ms	50 ms	12 ms	40 ms	12 ms
output voltage step	-	-	0 → 70 V	0 → 70 V	0 → 300 V	0 → 300 V
time, (100 % load)	-	-	100 ms	40 ms	100 ms	60 ms
time, (10 % load)	-	-	100 ms	12 ms	60 ms	16 ms
programming DOWN						
settling within	50 mV	500 mV	50 mV	1 V	200 mV	5 V
output voltage step	15 → 0.5 V	15 → 0.5 V	35 → 2 V	35 → 2 V	150 → 10 V	150 → 10 V
time, (100 % load)	30 ms	20 ms	50 ms	10 ms	50 ms	14 ms
time, (10 % load)	200 ms	200 ms	200 ms	100 ms	180 ms	120 ms
output voltage step	-	-	70 → 2 V	70 → 2 V	300 → 10 V	300 → 10 V
time, (100 % load)	-	-	100 ms	55 ms	100 ms	70 ms
time, (10 % load)	-	-	800 ms	120 ms	800 ms	700 ms
Programming bandwidth						
small signal	50 Hz		50 Hz		50 Hz	
large signal, 100 % load	50 Hz		50 Hz		50 Hz	
large signal, 10 % load	5 Hz		5 Hz		5 Hz	

	SM 1540-D	SM 7020-D	SM 3004-D
Recovery time			
recovery within	50 mV	50 mV	300 mV
di/dt of load step	4 A/µs	2 A/µs	0.5 A/µs
time, @ 50 - 100% load step	100 µs	150 µs	100 µs
max. deviation(high / low outp. range)	200 mV	80 / 150 mV	450 / 900 mV
@230 V AC input, internal sensing			
Noise suppression			
line - line ⇒ output	88 dB	82 dB	75 dB
line - earth ⇒ output	88 dB	88 dB	75 dB
Output impedance			
CV, 0-100 kHz	< 40 mOhm	< 60 mOhm	< 700 mOhm
Pulsating load			
max. tolerable AC component of load current			
f > 1 kHz	10 Arms	5 Arms	1 Arms
f < 1 kHz	40 A peak	20 / 10 A peak	4 / 2 A peak

Insulation	
input / output	3750 Vrms (1 min.)
creepage / clearance	8 mm
input / case	2500 Vrms (1 min.)
output / case	600 V DC
Safety	EN 60950 / EN 61010
EMC Power Supply Standard	**EN 61204-3**, Emission: residential, **light** industrial environment (CISPR22-Class **B**) Immunity: industrial environment
Generic Emission	**EN 61000-6-3**, residential, **light** industrial environment (EN 55022**B**)
Generic Immunity	**EN 61000-6-2**, industrial environment
Operating Temperature at full load	– 20 to + 50 °C
Humidity	max. 95% RH, non condensing, up to 40 °C max. 75% RH, non condensing, up to 50 °C
Storage temperature	– 40 to + 85 °C

Thermal protection	Output shuts down in case of insufficient cooling
MTBF	500 000 hrs

Hold-Up time 100% load Vin = 230 V AC 50% load Vin = 230 V AC	 20 ms 45 ms
Turn on delay after mains switch on	 500 ms
Inrush current	6,5 A @ 230 V AC input 30 A @ 110 V AC input

	SM 1540-D	**SM 7020-D**	**SM 3004-D**
Series operation max. total voltage Master / Slave operation	 600 V yes	 600 V yes	 600 V yes
Parallel operation max. total current Master / Slave operation	 no limit yes	 no limit yes	 no limit yes
Remote sensing max. voltage drop per load lead	2 V => total voltage drop will substract from max. available Vout		not available
OVP / OVL adjust range	0 - 17 V	0 - 80 V	0 - 350 V

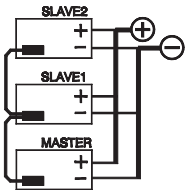
Potentiometers front panel control with knobs resolution screwdriver adjustment at front panel at rear panel	 standard 0.03 % Option P001 Option P002	 standard 0.03 % Option P001 Option P002	 standard 0.03 % Option P001 Option P002
Meters scale voltage scale current accuracy	3.5 digit 0 - 15.00 V 0 - 40.0 A 0.5% + 2 digits	3.5 digit 0 - 70.0 V 0 - 20.0 A 0.5% + 2 digits	3.5 digit 0 - 300 V 0 - 4.00 A 0.5% + 2 digits

Input Terminals input connections	10 Amp / 65 °C Euro-connector at rear panel		
Output Terminals at rear panel	M8 bolts	6 mm bind post	4 mm bind post
Programming connector	15 pole D-connector at rear panel (FEMALE)		
Cooling	convection cooling		
Enclosure degree of protection	IP20		
Dimensions behind front panel (h x w x d) front panel (h x w)	89 x 428 x 257 mm (with Option P099, feet are removed) 89 x 483 mm (19", 2 U)		
Weight	7.4 kg		

Screwdriver adjustment OPTION P001

- For a **fixed setting** of the output values, avoids accidental adjusting of the CV and CC settings.
- The potmeters are moved backwards just behind the front panel and plastic caps are inserted to cover the holes, see picture.

Master / Slave operation



- Parallel and Series operation with equal Current and Voltage sharing.
- This way two or more SM-units can be used together as one high power unit.
- Voltage and current of the units is controlled by the master (by potentiometers or by programming).
- For Parallel operation use 15 pole shielded cables, no special option required.
- For Series operation use the **Master / Slave Series Adapter** together with 15p shielded cables (1:1)

Battery Charging OPTION P021/022

- The CV / CC regulated power supplies are ideal battery chargers.
  Once set at the correct output voltage, the battery will charge constantly without overcharging.
  This can be useful for **emergency power systems**.
- Use a circuit breaker in series to protect the internal diode from reverse connection of the battery.
- Some units need an **external diode set** on the output as extra protection for the internal diode.
- *Ordering information for diode set:*

	SM 7020-D	SM 3004-D
option number	P021	P022

Download the special datasheet for more details from 'www.DeltaPowerSupplies.com'.

Increased max. output voltage/current OPTION P069

- The maximum output voltage or current can be increased by approximately 10%.
  Normally this results in a derating of the maximum ambient temperature or other parameters.
- Always add increased value for voltage or current in ordercode, for example **SM 7020-D P069 output 76 V**

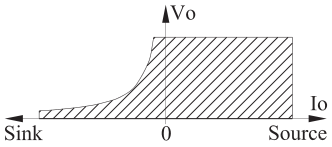
For exact details consult the technical department, email 'Support@Delta-Elektronika.nl'.

Enforced secondary isolation 1000 V OPTION P089

- The secondary isolation between output and ground is increased from standard 600 V to 1000 V .

Power Sink for 2 quadrant operation OPTION P140/141

- Can absorb **70 W peak power.**
- Maintains output voltage regardless output power is positive or negative (source & sink).
- Ideal solution for supplying **electric motors** with PWM-speed control.
- Fast down programming at no load conditions.
- *Ordering information:*



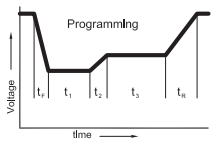
	SM 1540-D	SM 7020-D
option number	P140	P141

Download the special datasheet for more details from 'www.DeltaPowerSupplies.com'.

External ISO AMP for isolated analog programming ISO AMP Module

- Provides galvanic isolation when programming and monitoring.
- Prevents problems with earth loops and common mode voltages.
- Pin compatible with the programming connector on the rear side.
- Bench operation and rail mounting.

External Ethernet Power Supply Controller PSC-ETH module



- External Ethernet compatible Controller to program a unit by a computer.
- Pin compatible with the programming connector on the rear side.
- Bench operation and rail mounting.
- *Available at the end of 2005.*

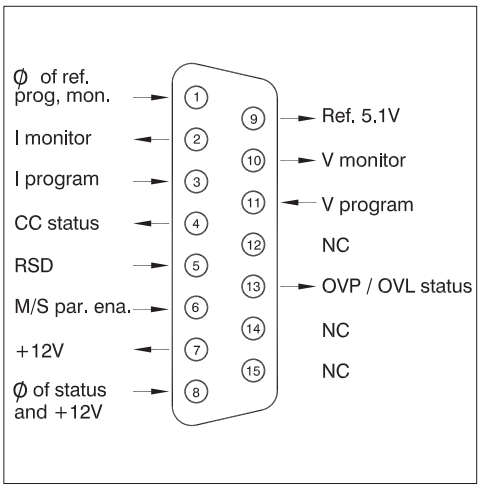
External RS232 Power Supply Controller PSC-232 module

- External RS232 compatible Controller to program a unit by a computer.
- Pin compatible with the programming connector on the rear side.
- Bench operation and rail mounting.

External IEEE488 Power Supply Controller PSC-488 module

- External IEEE488 compatible Controller to program a unit by a computer.
- Pin compatible with the programming connector on the rear side.
- Bench operation and rail mounting.

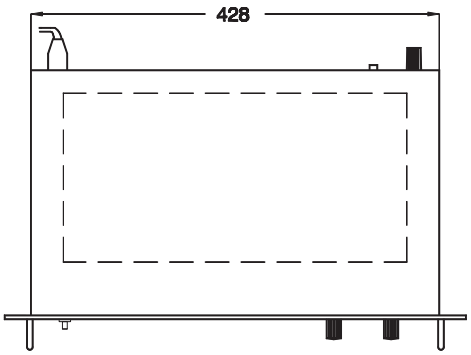
Note: there is only room to connect one of the external modules to the programming connector.

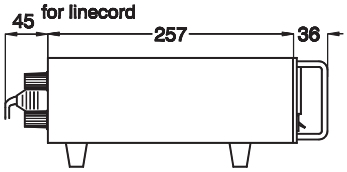


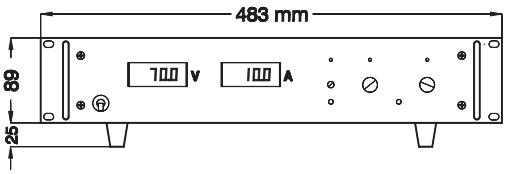
Connections programming connector

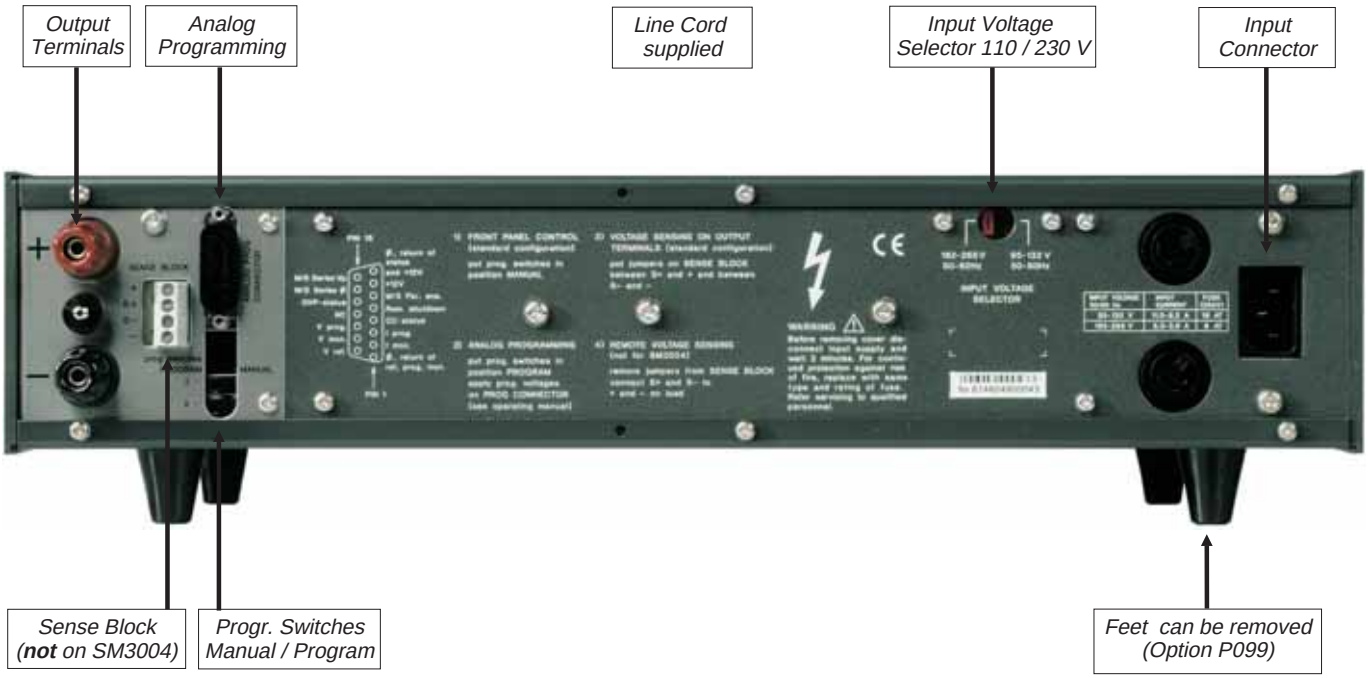
CV= Constant Voltage
CC=Constant Current
OVL=Over Voltage Limit=
OVP=Over Voltage Protection

Specifications measured at
t_{amb} *= 25 ± 5 °C and Vin = 230 V AC, 50 Hz unless otherwise noted.*









Safety Instructions

Caution

The following safety precautions must be observed during all phases of operation, service and repair of this equipment. Failure to comply with the safety precautions or warnings in this document violates safety standards of design, manufacture and intended use of this equipment and may impair the built-in protections within. Delta Elektronika shall not be liable for user's failure to comply with these requirements.

Installation Category

The Delta Elektronika power supplies have been evaluated to installation category II (Over voltage category II).

Grounding

This product is a safety Class 1 instrument. To minimize shock hazard, the instrument chassis must be connected to the AC Power Supply mains through a three or four conductor power cable for resp. a single or three phase unit, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet.
For instruments designed to be hard-wired to supply mains, the protective earth terminal must be connected to the safety electrical ground before another connection is made. Any interruption of the protective ground conductor, or disconnection of the protective earth terminal will cause a potential shock hazard that might cause personal injury.

Remote Control

Analog and digital controls, outputs and interfaces are either connected directly to the minus output of the power supply or separated with operational isolation.

When the minus output of the unit exceeds 60Vdc or 42.4Vpk in respect to ground, additional, external measures need to be taken to ensure safety isolation of the analog and digital controls.

Fuses

Fuses must be changed by authorized Delta Elektronika service personnel only, for continued protection against risk of fire.

Input Ratings

Do not use an AC Supply which exceeds the input voltage and frequency rating of this instrument. The input voltage and frequency rating of the Delta Elektronika power supply series are stated in de accompanying datasheet.

Live Circuits

Operating personnel must not remove the instrument cover. No internal adjustment or component replacement is allowed by non Delta Elektronika qualified personnel. Never replace components with the power cable connected. To avoid injuries, always disconnect power, discharge circuits and remove external voltage sources before touching components.

Parts Substitutions & Modifications

Parts substitutions and modifications are allowed by authorized Delta Elektronika service personnel only. For repairs or modifications the unit must be returned to a Delta Elektronika service facility.

Environmental Conditions

The Delta Elektronika power supplies safety approval applies to the following operating conditions:

Indoor use
Ambient temperature : –20 to 50 °C
Maximum relative humidity : 95%, non condensing, up to 40 °C
: 75%, non condensing, up to 50 °C
Altitude: up to 2000 m
Pollution degree 2

Caution risk of electrical Shock

Instruction manual symbol. The instrument will be marked with this symbol when it is necessary for the user to refer to the instruction manual

Protective ground conductor terminal

O Off (supply)

I On (Supply)

WEEE

(Waste Electrical & Electronic Equipment)

Correct Disposal of this Product

Applicable in the European Union.

This marking shown on the product, its packing or its literature indicates that it should not be disposed with other wastes at the end of its working life, but should be collected separately to recycle it responsibly to promote the sustainable reuse of material resources.

DESCRIPTIONS

1) OUTPUT

The SM7020-D and SM3004-D feature an AUTORANGING faciliy where the power supply automatically switches over between two current ranges. This switching, which is unnoticeable the user, results in a versatile power supply with **twice the output voltage range**. This means for the SM7020-D: the maximum output power (700 W) is available at both 35 V and 70 V. For the SM3004-D: 600 W at both 150 V and 300 V. Fig. 3 - 1 shows the output ranges.

Note: the voltage and current settings will never be altered by the AUTORANGING, only the maximum attainable current will change. E.g. on the SM3004-D, with an initial setting of 1.5 A. When the voltage is decreased from 200 V to 150 V the max. current output remains 1.5 A as originally set.

- DISPLAY CV/CC SETTING FUNCTION

The setting of the voltage and current control can be observed on the front panel meters by pressing the Display CV/CC Setting button. This allows the current limit to be set when operating in the CV mode without shorting the output terminals, and the voltage limit to be set when operating in the CC mode without opening the load leads.

- OVERLOAD PROTECTION

The power supply is fully protected against all overload conditions, including short circuit.

2) INPUT VOLTAGE

The power supplies have a wide input voltage range. The 2 ranges (110 V / 220 V) are selectable with a switch on the rear panel, see fig. 3 - 2. In the 220 V position the units can also be used as a DC/DC converter.

- nonstandard line input voltage

The units will still operate at a line input voltage lower than standard, but with a reduction in output power. Fig. 3 - 3 shows the max. output current as a function of output voltage with AC or DC line input voltage as a parameter.
Example: When the required output voltage is 12.5 V at a line input voltage of 150 V AC.
Fig. 3 - 4 shows the maximum current for the SM1540-D to be 32.8 A.

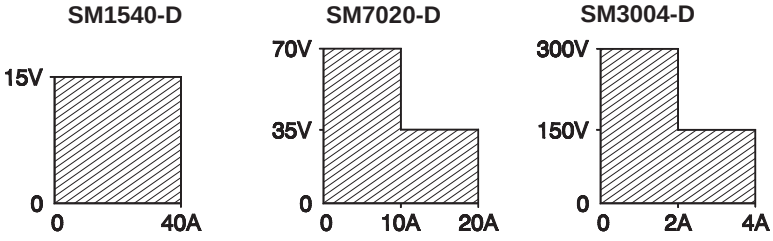
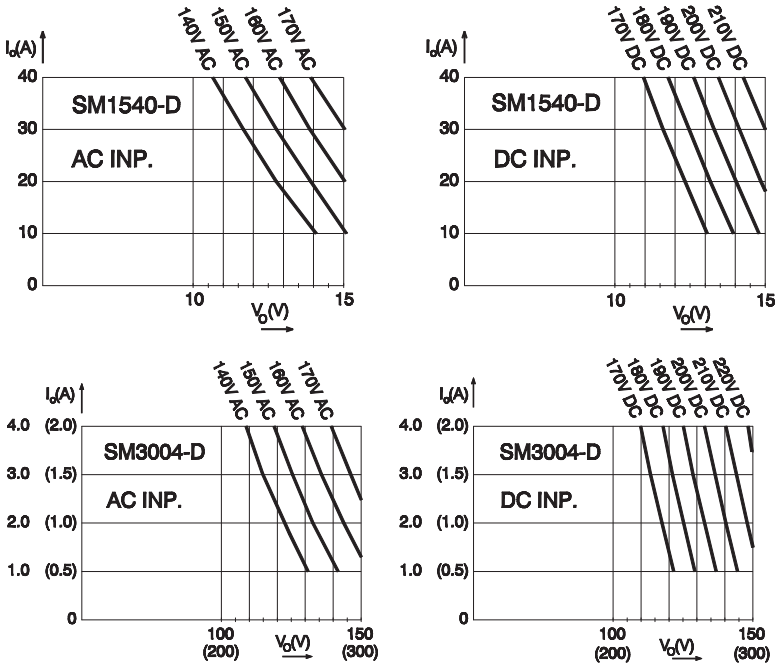


fig. 3 - 1
The output ranges
Every point in hatched area can be used

fig. 3 - 2
Input voltage selector at rear panel



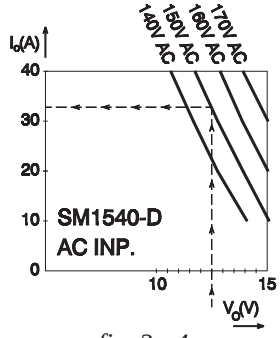


fig. 3 - 4
Example how to use the graph

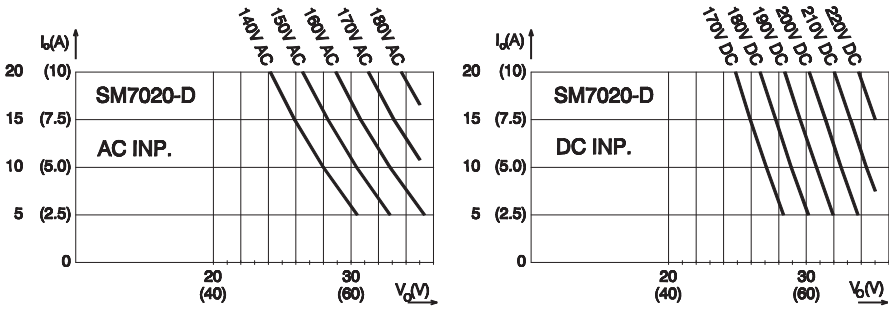


fig. 3 - 3
Max. output current vs output voltage with AC or DC line input voltage as a parameter

3) INPUT CURRENT

The input circuit has a large series choke to improve the waveform. The result is: a lower rms input current, less mains distortion and no large peak currents. The units also have an inrush current limiter and a soft start circuit, for smooth switch on.

- FUSES- At 220 V: 8 A Slow blow, at 110 V: 16 A Slow blow.

4) STANDBY INPUT POWER

The unit consumes very little power when in standby. This makes it possible to leave the input power on and use the Remote ShutDown input (pin 5 on prog. connector rear panel) to disable the output.

5) EFFICIENCY

The efficiency is very high and constant over a wide output current range, see fig. 3 - 5. High efficiency also means low power loss and low heat generation.

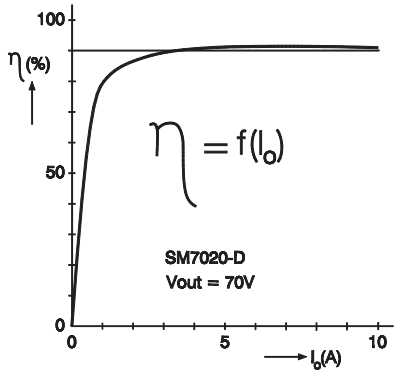


fig. 3 - 5
Efficiency vc output current, SM7020-D DC input, Vout = 70 V

6) REGULATION

The load regulation should be measured directly on the output terminals. A few cm of cable can have a voltage drop of several mV (at high current!).

7) RIPPLE & NOISE

The output ripple is very low with almost no spikes.
The ripple voltage has to be measured directly on the output terminals using a probe with very short connections (to avoid pick up of magnetic fields). See fig. 3 - 6 and fig. 3 - 7.

- LOW TEMPERATURE

At –20 °C the CV ripple increases to the following values:

	SM1540-D	SM7020-D	SM3004-D
CV ripple (rms/pp) @ –20 °C	6 / 20 mV	10 / 35 mV	no change

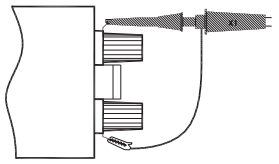


fig. 3 - 6
Measuring ripple voltage WRONG !

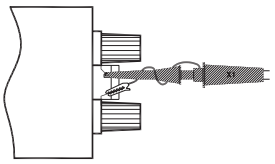


fig. 3 - 7
Measuring ripple voltage RIGHT !

8) PROGRAMMING INPUTS

The output voltage and current can be programmed by an external analog voltage. This programming is very accurate and linear, (non-linearity < 0.15%). The levels are all standardized on 5 V. Always use a **shielded cable** for programming.

The inputs have a protection circuit formed by a series resistor and a parallel zener, see fig. 3 - 8. The capacitor limits the speed to a safe value. Note that the analog inputs (and outputs) are **not floating, but the common is connected to the negative output terminal.** Wrong connection of Ø can cause earth loops which can trip the fuse. After removing the fault, the fuse will reset (PTC-fuse). To prevent earth loops, use isolated programming with the **ISO AMP MODULE (δ-product)**.

The programming mode (program and manual) can be selected by means of the prog. switches which are situated below the programming connector, see fig. 3 - 10.

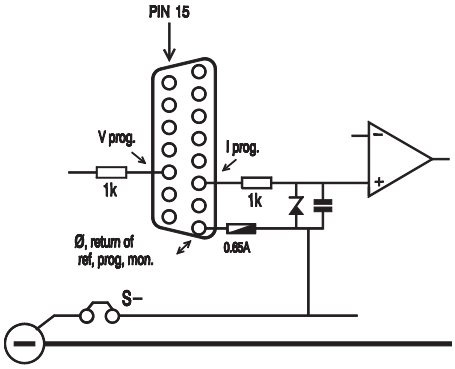


fig. 3 - 8
Programming inputs (internal circuit)

9) IEEE488 / RS232 PROGRAMMING

The prog. connector on the power supply is both pin and level compatible with the interfaces **PSC-488 module** and **PSC-232 module (both δ-products)**.

Voltage and current can easily be programmed and read back, also the CC and OVP status can be read by the computer. Always use a **shielded cable** for programming.

10) MONITORING OUTPUTS

The monitor outputs give a voltage 0 - 5 V proportional to the output current or voltage. The output current can easily be measured without an external shunt using the I monitor, see fig. 3 - 9. The monitor outputs are buffered by op-amp's and protected by series resistors and parallel zeners see fig. 3 - 11. The table in fig. 3 - 12 shows the impedance levels of the monitoring outputs.

Note: in case of a **pulsating load**, the I monitor voltage will not exactly

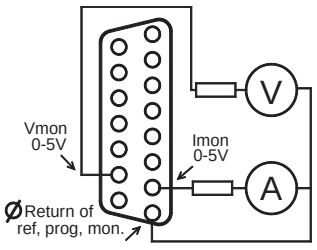


fig. 3 - 9
External meters using monitor outputs

fig. 3 - 10 Location of output terminals, Sense Block, analog prog. connector and PROG. / MAN. switches on rear panel (SM3004-D has no sense block).

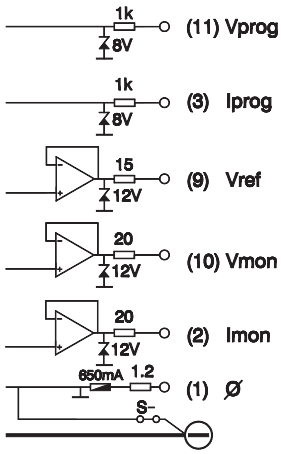


fig. 3 - 11
Buffered monitor outputs (internal circuit)

Output	pin	Ro	Io max
Vref	9	15 Ohm	10 mA
Vmon	10	20 Ohm	10 mA
Imon	2	20 Ohm	10 mA
+12V	7	500 Ohm	25 mA
Ø	1	1.2 Ohm	

fig. 3 - 12 Outputs on programming connector

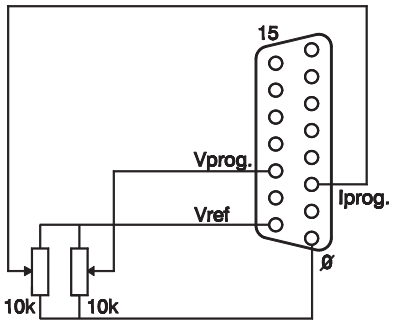


fig. 3 - 14 External potmeters

match the output current. This is mainly caused by the current through the output capacitors. Remote sensing will worsen this effect.

11) STATUS OUTPUTS

The status outputs have an open output voltage of 5 V and a short circuit current of 10 mA. This makes it possible to drive directly: an opto-coupler, a TTL gate or a CMOS gate (put leakage resistor to Ø).

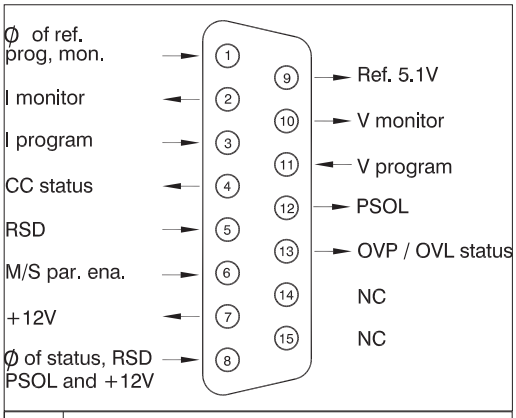
12) REMOTE SHUTDOWN (RSD)

A voltage of +5 V on the Remote ShutDown input on the programming connector will switch off the power circuit of the unit. In standby mode the power supply consumes very little power.

It is also possible to use a relay contact or a switch to shutdown the unit: connect a switch between Vref and Rem. ShutD. (pin 9 and 5). Note: The Remote ShutDown will also cause the OVP-led to burn and the OVP-status will be high.

13) PROGRAMMING RESPONSE TIME

The response time is measured with a step waveform at the CV prog. input. Programming from a low to a high output voltage is nearly load independent, but programming down to a low voltage takes more time



pin	description
1	Ø, return of reference, prog. inputs and monitor outputs.
2	current monitor output (0 - 5V)
3	current programming input (0 - 5V)
4	CC status output, logic 1 = CC mode (5 V / 10 mA)
5	Remote ShutDown
6	M/S parallel, slave enable (only for autoranging)
7	+12 V output (Ri = 500 Ohm)
8	Ø, return of status outputs, +12 V and remote ShutDown
9	reference voltage 5.1 V
10	voltage monitor output (0 - 5V)
11	voltage programming input (0 - 5V)
12	PSOL status output (optional)
13	OVP status output, logic 1 = OVP mode (5 V / 10 mA)
14	NC
15	NC

fig. 3 - 13
Connections ANALOG PROG. CONN.

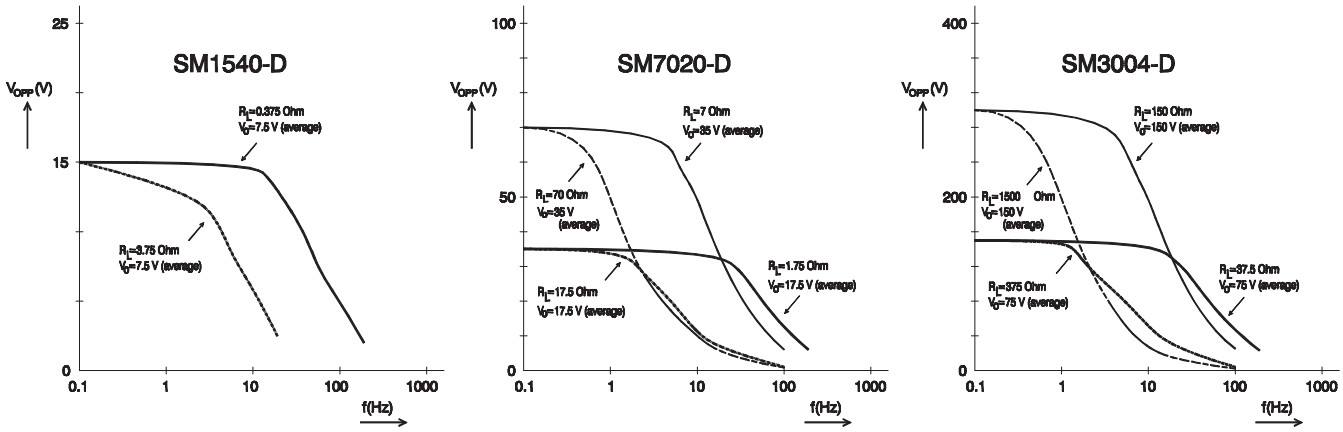


fig. 3 - 15
Max. peak to peak output voltage swing vs frequency

on lighter loads. This is caused by the output capacitors, which can only be discharged by the load because the power supply cannot sink current.

14) PROGRAMMING BANDWIDTH

For small signals the bandwidth is 50 Hz, but for large signals there is a limitation in the maximum amplitude of the output waveform. The output capacitors limit the max. slew rate. Fig. 3 - 15 shows the maximum peak to peak output voltage swing as a function of frequency, with the load as a parameter. The higher the load resistance the lower the max. amplitude. The measurements were carried out using a sine wave. The DC level of the output is 50 % of the max. output voltage. On the SM7020-D and SM3004-D measurements were also carried out at 25 % of the max. output voltage.

15) RECOVERY TIME

Fig. 3 - 16 shows the recovery time for the SM7020-D at 25 °C, a 50 – 100 % load step and at maximum output voltage. At –20 °C the recovery time increases by 100 µs.

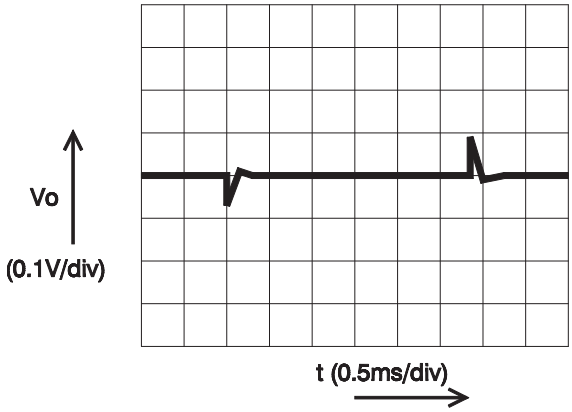


fig. 3 - 16
Recovery time SM7020-D
50 - 100 % load step, Vo = 70 V

16) NOISE SUPPRESSION (input / output)

The input / output noise suppression is measured with a pulse generator (a) in series with the line input or (b) between input and case (earth). The generator should produce a high energy pulse of about 300 V. If there is an electrical connection between the output and the input through the oscilloscope, you will get a false reading. The suppression for the SM3004-D is lower, but the relative disturbance on the output is comparable to the SM1540-D.

17) PULSATING LOAD

To avoid overheating the output capacitors, the AC component of the load current should be limited. See fig. 3 - 17.

One method of decreasing the AC current through the output capacitor is by using a large external electrolytic capacitor in parallel with the load. Care must be taken so that the capacitor in combination with the lead inductance will not form a series resonant circuit!

	SM1540-D	SM7020-D	SM3004-D
AC-level max.	10 Arms	5 Arms	1 Arms

When using **remote sensing** on a pulsating load (for instance a DC-motor), use a capacitor between S+ and + and between S- and - and a series resistor in the sense leads. See fig. 3 - 18. Like this the AC-component caused by the voltage drop across the load leads, is filtered.

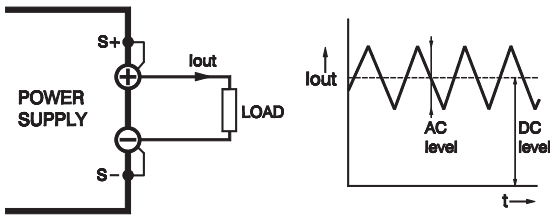


fig. 3 - 17
Pulsating load current

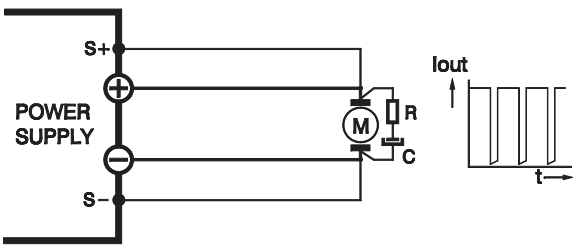


fig. 3 - 18
Remote sensing on a pulsating load

18) INSULATION

For safety the insulation of the separating components (transformers) between input and output is tested at 3750 Vrms during 1 minute. This is tested before assembling.

Warning! The 3750 Vrms cannot be tested afterwards on the assembled unit because the insulation between the components on the input side to the case (like the bridge rectifier) is specified at 2500 Vrms. Since the insulation output - case is low (only 600 V DC) the insulation of the primary components to case will break down when 3750 Vrms is applied between input and output (2500 Vrms + 600 V DC < 3750 Vrms). See also fig. 3 - 19.

Note: when testing the insulation, take care to charge and discharge the capacitors between input - case and output - case slowly (e.g. in one second). This to prevent high peak currents, which could destroy the power supply. Make sure to have discharged the capacitors completely before using it again.

19) RFI SUPPRESSION

Both the input and output have RFI filters, resulting in very low conducted RFI to the line and load. Due to the output filter the output voltage is very clean, having almost no spikes.

20) OPERATING TEMP

At full power the operating temperature range is –20 to +50 °C. From 50 to 75 °C the output current has to be derated linearly to 20 % at 75 °C. See fig. 3 - 20. These temperatures hold for normal use, i.e. the air must be able to pass freely vertically along and through the unit.

21) THERMAL PROTECTION

A thermal switch shuts down the output in case of insufficient cooling. After cooling down the unit will start working again. In this condition the OVP led on the front panel will burn, and the OVP status output will be high.

22) HOLD - UP TIME

The hold - up time depends on the load, output voltage and line input voltage. A lighter load, a lower output voltage or a higher line input voltage all result in a longer hold - up time, see fig. 3 - 21. For example: the SM1540-D at 220 VAC input and 12 V / 40 A output will have a hold-up time of 50 ms.

23) TURN ON DELAY

The output voltage is available 0.5 sec after mains switch on.

24) INRUSH CURRENT

The inrush current is limited by a 50 Ohm PTC resistor, resulting in a very low current during switch on. The input current during switch on will be lower than during operation at full load.

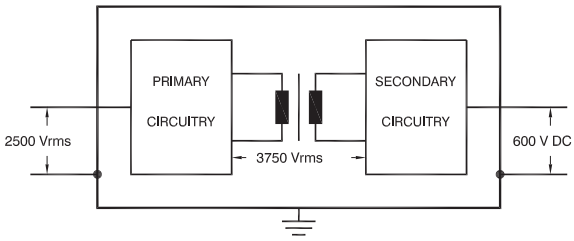


fig. 3 - 19
Insulation test voltages

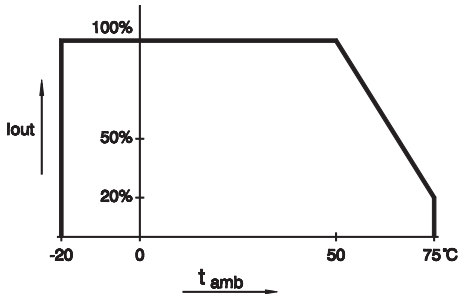


fig. 3 - 20
Operating temperature ranges

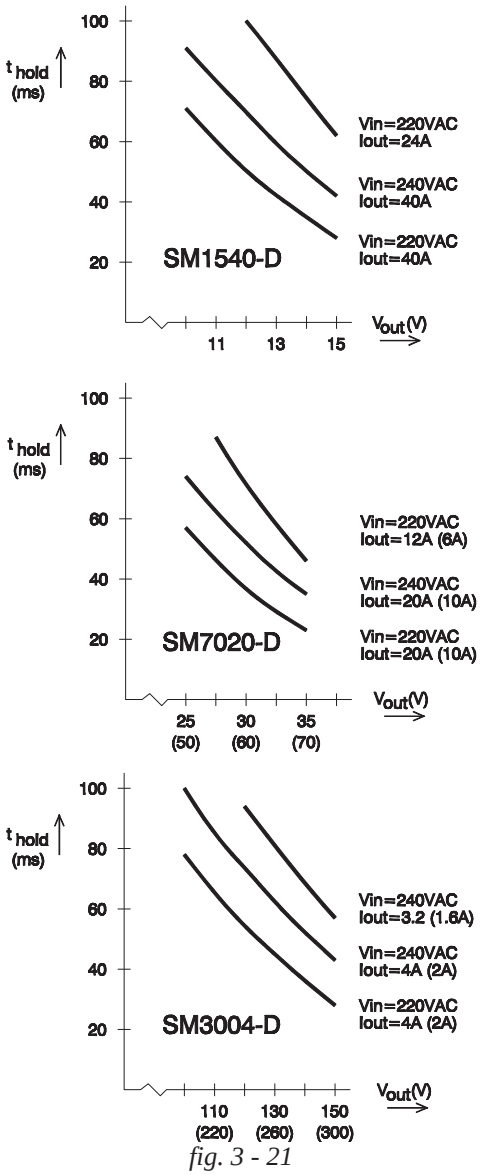


fig. 3 - 21
Holdup time vs Vout with line input and Iout as parameter

25) SERIES OPERATION

Series operation is allowed up to 600 V total voltage. The power supplies can be connected in series without special precautions.

For easier control, Master / Slave operation is recommended (fig. 3- 23). By using the Master / Slave series feature a **dual tracking** power supply can be made with one unit as master and one as slave.

For series operation in combination with **Power Sink** option, all units must have a Power Sink built inside otherwise no power can be absorbed.

26) PARALLEL OPERATION

Paralleling of the units has no limitations. The power supplies can be connected in parallel without special precautions.For easier control, Master / Slave operation is recommended (fig. 3 - 24).

Normal parallel operation of **Fast Programming** units can give problems, each combination has to be tested first, in combination with the load !

For parallel operation in combination with **Power Sink** option, only one unit can have a Power Sink. Refer to Power Sink manual for details and restrictions.

27) MASTER / SLAVE OPERATION

The Master / Slave feature makes it possible to use the power supplies as building blocks to form one large unit, see fig. 3 - 23 and fig. 3 - 24.

The resulting combination of units behaves like one power supply and can be programmed on the master. In the Master / Slave mode the autoranging feature still works. Fig. 3 - 26 shows a computer controlled M / S parallel combination.

Mixed parallel - series operation is also possible (fig. 3 - 25), to a maximum of 600 V.Here the **MASTER / SLAVE SERIES ADAPTER (δ-product)** must be used. For parallel operation connections can easily be made on the analog programming connector.

In series mode the master controls one slave, which in turn controls the second slave and so on. In parallel mode the master controls all the slaves. The result is true **current or voltage sharing** in the parallel or series mode respectively.

Note: Master / Slave parallel operation is not recommended for more than 3 units or in combination with Fast Programming option. Consult factory for a solution.

28) REMOTE SENSING

The voltage at the load can be kept constant by remote sensing. This feature is not recommended for normal use but only when the load voltage is not allowed to vary a few millivolts. Always use a **shielded cable** for sensing. Note that the SM3004-D has no remote sensing.

In order to compensate for the voltage drop across the load leads, the unit will have to supply a higher voltage: U_{out} = (voltage drop across each lead) + (voltage across the load), see fig. 3 - 27. The **OVP** reads the voltage directly at the output and the setting must be increased by the total voltage drop across the load leads.

The voltmeter is connected to the sense leads and therefore reads the voltage across the load and **not** the voltage on the output terminals.

The sense leads are protected for **accidental interruption**, in which case the output voltage will go to a max. of 115% of the set value.

Warning: Do not interrupt the minus lead while the S– lead is still connected to the load, during operation. It is possible that the capacitor C808 on P385 or P386 will be damaged.

For sensing on a **pulsating load** see par.17) of this chapter.

29) OVP

The Over Voltage Protector will protect your circuit from unwanted high voltages.

A high output voltage could be caused by accidental interruption of leads, accidentally turning up the voltage potmeter or a defect in the power supply. The OVP circuit uses a separate voltage devider connected directly to the output terminals.

The OVP limits the output voltage to a value which can be set by the OVP potmeter on the front panel. While doing this, press the DISPLAY OVP SETTING button to read the limit value in the left display. The led on the front panel will indicate whether the OVP has reached the limit. The OVP status output will give a logic 1 (+5 V)

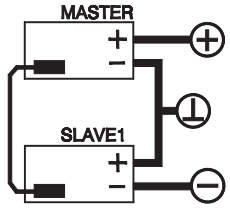


fig. 3 - 22
Dual tracking power supply

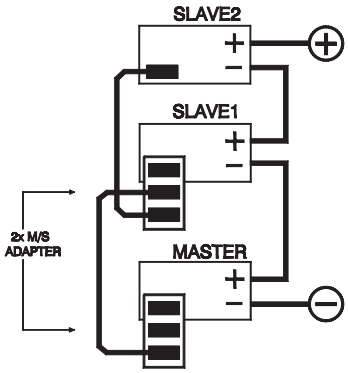


fig. 3 - 23
Master / Slave series operation

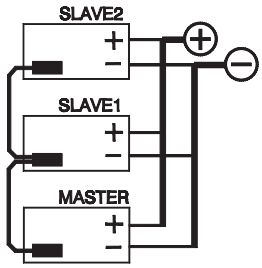


fig. 3 - 24
Master / Slave parallel operation

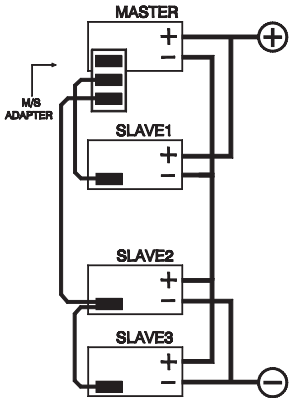


fig. 3 - 25
Master / Slave mixed Series-Parallel

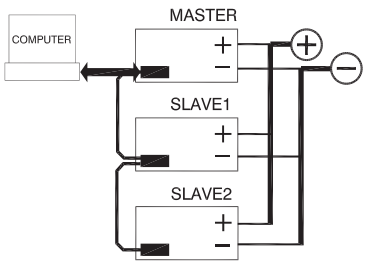


fig. 3 - 26
The Master / Slave combination can also be programmed with the interfaces PSC-488 or the PSC-232

Note: The Thermal ShutDown and Remote ShutDown will also cause the OVP-led to burn and the OVP-status will be high.

When the OVP status output is used as an indication for accidental interruption of leads, a defect in the power supply etc., it is recommended to set the limit well above the working output voltage to avoid accidental limiting. The recommended OVP set voltages can be read from the following table:

Unit:	SM1540-D	SM7020-D range 0 - 35 V	SM7020-D range 35 - 70 V	SM3004-D range 0-150 V	SM3004-D range 150-300 V
Vovp	Vout + 2 V	Vout + 3 V	Vout + 5 V	Vout + 10 V	Vout + 25 V

Example: For a SM7020-D set at 24 V output voltage it is recommended to set the OVP on 24 + 3 = 27 V.

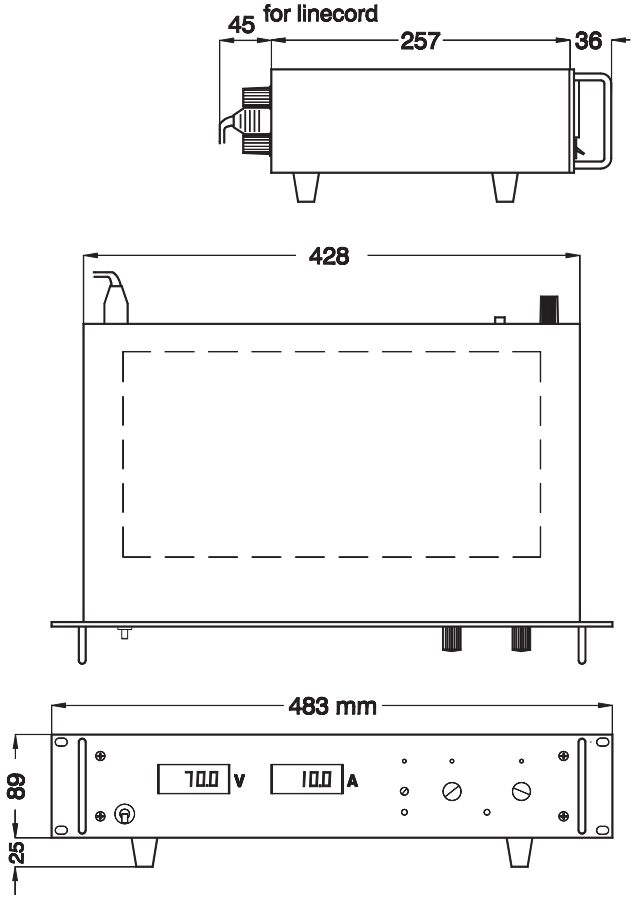
30) POTENTIOMETERS

- Standard: - CV and CC potentiometers with knobs at front panel, OVP potentiometer with screwdriver adjustment at the front panel.
- Option P001: - Screwdriver adjustment for CV, CC and OVP at the front panel, fig. 3 - 28.
- Option P002: - Screwdriver adjustment for CV, CC and OVP at the rear panel (no potentiometers at front panel), fig. 3 - 29.

31) COOLING

The cooling is by natural convection, **no noisy blowers** are present. The unit should have sufficient free space to let the air flow vertically through the unit. See fig. 3 - 30. A distance of minimum 5 cm around the unit is recommended.

For long life the temperature of the air entering the unit, should be below *35* °C under normal conditions.
Under extreme conditions it should be below *50* °C.



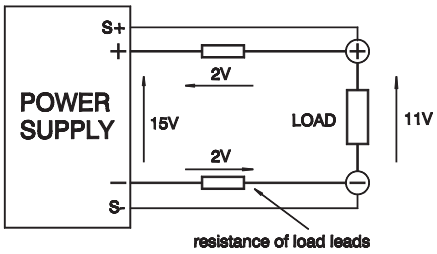


fig. 3 - 27
Remote sensing, voltage drop in load leads subtracts from max. output

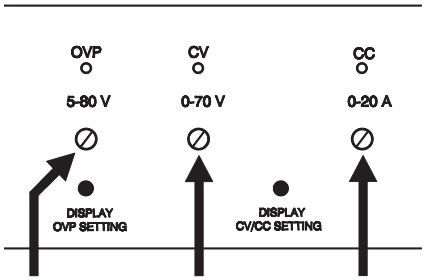


fig. 3 - 28
Optional screwdriver adjustment at front panel

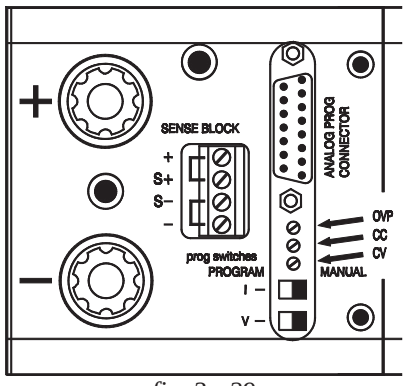


fig. 3 - 29
Optional screwdriver adjustment at rear panel

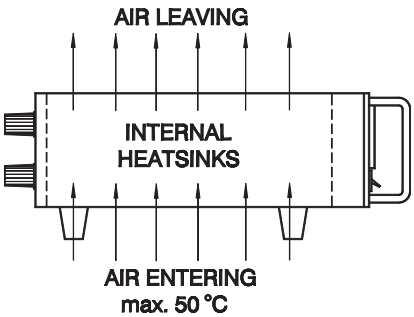


fig. 3 - 30
Vertical airflow through the unit

CIRCUIT DESCRIPTION

The 220 V AC line voltage is rectified by a bridge rectifier and smoothed by a large electrolytic capacitor. The 50 Hz choke in the input circuit improves the waveform of the input, so that no low frequency distortion is produced on the line voltage.

Carefully designed RFI filters protect the line and the load from the high frequency interference produced inside the power supply.

When the unit is switched on, the electrolytic capacitor is charged via the resistor of the SOFT START circuit, so no large inrush current will flow. As soon as the voltage is sufficiently high the power supply starts working and the series resistor is bypassed by a triac.

The operating switching frequency of 100 kHz has many advantages like small size, light weight, low ripple and fast regulation.

The rectified 220 V (300 V DC) is chopped by the transistors and transformed to a lower voltage. This 100 kHz power converter is of the feed forward type. The regulation is achieved by pulse width modulation.

Careful design, over-rating of vital components, several built-in protections and cool operation (because of the very high efficiency) make the SM series very reliable power supplies which can be used continuously at maximum rating.

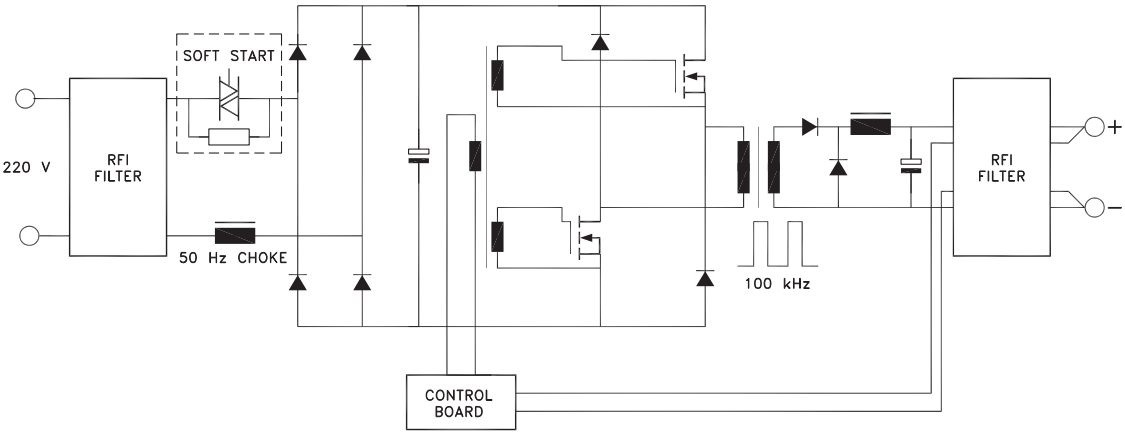


fig. 3 - 31 Simplified functional diagram of SM1540-D, SM7020-D, SM3004-D

OPERATING MANUAL

1) OPERATING THE UNIT FOR THE FIRST TIME

- Set the **input voltage selector** switch found on the rear panel to the required input voltage (110/230 V). A wrong setting can seriously damage the unit. Do **not** switch the selector switch when the unit is in use.
- Check input fuses. For 110 V operation fuses have to be replaced. See text at rear panel.
- Check that there is no condensation on the unit. If there is, allow some time to dry.
- Set the prog. switches on the rear panel on MANUAL.
- Check that there is a link between + and S+ and between – and S– on the SENSE BLOCK (on rear panel).
  SM3004-D has no remote sensing!
- Set OVP potentiometer (on front panel) to maximum (fully clockwise), Use a screwdriver to set the OVP voltage.
- With **high output current** (SM1540-D!) make sure to use low resistive connections between the power supply and the load:
  - Mount the cable lugs between the two nuts and washers .
  - Only use nuts and washers supplied with the unit (tinned brass).
  - Never use extra washers, spring washers , serrated locks etc.
- Switch on unit.
- Turn both the CV and CC potentiometer a few turns clockwise. A voltage should now be present on the output.
- By pressing the DISPLAY CV/CC SETTING button the meters will show the setting of the CV and CC potentiometer.
- By pressing the DISPLAY OVP SETTING button the volt meter will show the setting of the OVP potentiometer.
- When the power supply is used on a fixed output voltage it is highly recommended to set the Over Voltage Protector. As set out in the following table:

SM1540-D	SM7020-D range 0 - 35V	SM7020-D range 35 - 70V	SM3004-D range 0 - 150V	SM3004-D range 150 - 300V
Vout + 2V	Vout + 3V	Vout + 5V	Vout + 10V	Vout + 25V

  Example: For a SM7020-D set at 24 V output voltage it is recommended to set the OVP on 24 + 3 = 27 V.
- Check that the cooling of the unit is not obstructed.

2) ANALOG PROGRAMMING

- Put the appropriate switch(es) in the position PROGRAM.
- Connect the programming voltage source(s) (0 - 5 V) to the ANALOG PROG. CONNECTOR on the rear panel (see fig. 4 - 1 and fig. 4 - 2). Always use a **shielded cable** for programming.
- If only the voltage is programmed, the maximum current can still be set with the CC potentiometer and vice versa. If this is not desirable the CC or CV can be set with an external potentiometer, in order to have a fixed setting.
- **CAUTION**: The analog inputs are not isolated from the output. The Ø of the prog. input (pin 1) is internally connected to the S–, the S– is connected to the negative output. To protect the internal wiring a 650 mA self-resetting fuse is connected in series (F600 on P385, P386 or P387), see fig. 4 - 4.
  For isolated analog programming the **ISO AMP MODULE (δ-product)** is recommended to avoid earth loops.
- To avoid hum or noise, the programming cable may have to be twisted in some cases.
- To program the unit by current instead of voltage, simply use a parallel resistor as a current to voltage converter.

3) IEEE488 / RS232 PROGRAMMING

- With the external IEEE488 /RS232 interface **PSC-488 module / PSC-232 module (both δ-products)** simply connect the prog. connector of the power supply with the mating connector of the PSC-488 / PSC-232 (pin compatible). Always use a **shielded cable**.
- Set both prog. switches to the position program.
- Both CV and CC can be programmed and read back. The CC and OVP status can also be read by the computer.

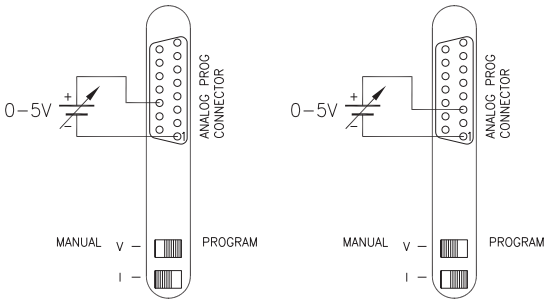


fig. 4 - 1
Programming by voltage
left voltage -, right current programming

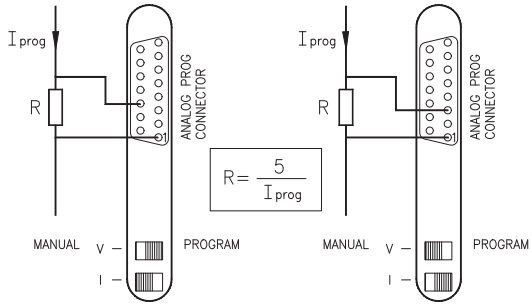


fig. 4 - 2
Programming by current
left voltage -, right current programming

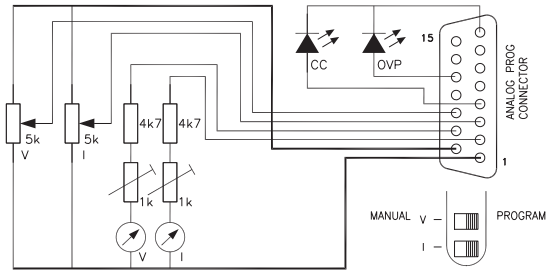


fig. 4 - 3
Remote control

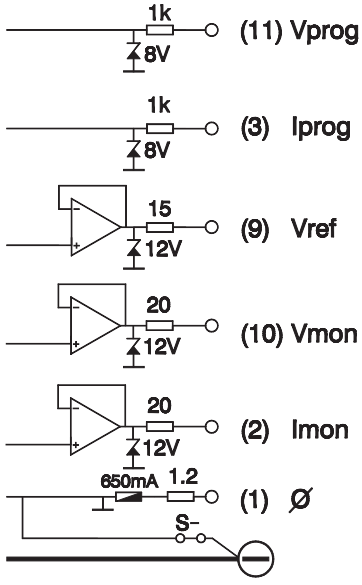


fig. 4 - 4
Internal circuit of programming inputs and outputs

4) MONITORING OUTPUTS

- The 5 V level is compatible with most interfaces.
- The monitoring outputs can drive a meter directly, fig. 4 - 3.

5) STATUS OUTPUTS

- The status outputs have a separate Ø connection (pin 8) to avoid unwanted offsets in the programming. This pin is protected with a 650 mA fuse (F601 on P385, P386 or P387).

6) REMOTE SENSING

- Not available on SM3004-D.
- Remove the links on the SENSE BLOCK (on rear panel) and connect sense leads (thin **shielded** measuring wires) to S+ and S–. See fig. 4 - 5 and fig. 4 - 6.
- With remote sensing the voltage on the load can be kept constant. The voltage drop in the load leads will be compensated. This feature is not recommended for normal use, because it can easily give problems.
- Max. 2 V per load lead can be compensated. Note that the voltage drop in the leads decreases the max. output voltage rating. In fig. 4 - 27 it can be seen that on a 15 V power supply only 11 V will be available on the load when 2x 2 V compensation is used.
- In order to prevent interference it is advisable to twist the sense leads. To minimize the inductance in the load leads keep the leads close to each other. The inductance of the loads leads could give a problem with pulsating loads. In this case a large electrolytic capacitor in parallel with the load will help. Check that the capacitor in combination with the load leads does not form a resonant circuit resulting in a large AC current flowing in the leads.
- Since the **voltmeter** is internally connected to the sensing terminals, it will automatically indicate the **voltage on the load**. Note that the voltage measured on the load will be lower than on the output terminals.
- The Over Voltage Protector measures the voltage on the output terminals, so the OVP setting should be increased by the total voltage drop in the load leads.

7) BATTERY CHARGER

- The CV / CC regulated power supplies are ideal battery chargers. Once the output is set at the correct voltage the battery will charge constantly without overcharging. This can be useful for emergency power systems.
- **Protective measures**
  Use a CIRCUIT BREAKER in series in order to protect the power supply from **accidental reverse connection**, see fig. 4 - 8. The circuit breaker should have a DC voltage rating 2x the battery voltage. Use the very fast type (Z), a type meant for protecting semiconductors.
  The unit has a reverse diode in parallel with the output, this diode and the wiring cannot withstand the thousands of amperes supplied by a wrongly connected battery.

Suggested Circuit Breakers for protection power supply			
Model	Type number Circuit Breaker	Brand	Remarks
SM1540-D	S281 UC-Z 40	ABB	
SM7020-D	S281 UC-Z 20	ABB	**extra parallel diode on output = Option P021**
SM3004-D	S282 UC-Z 4	ABB	2 poles in series, **extra parallel diode on output = Option P022**

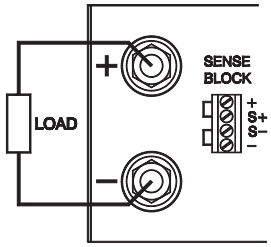


fig. 4 - 5
Local sensing

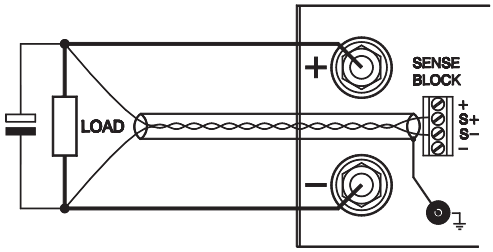


fig. 4 - 6
Remote sensing with shielded wires

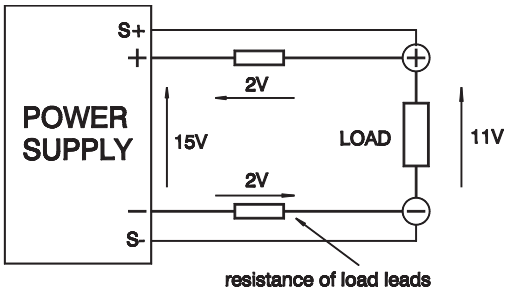


fig. 4 - 7
Remote sensing, voltage drop in load leads subtracts from max. output

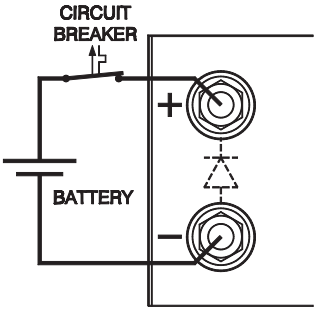


fig. 4 - 8
Charging battery with a circuit breaker in series

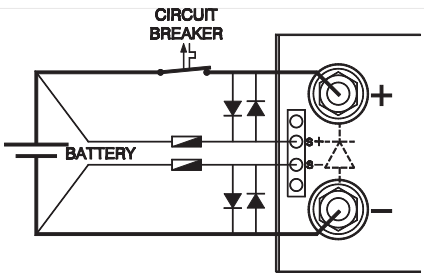


fig. 4 - 9
Protecting sense wires with diodes

- **Remote sensing** cannot be recommended, because it easily causes defects inside the power supply in case of wrong connection.
  If you really need remote sensing, please use the circuit in fig. 4 - 9. The internal circuit can be protected by relatively small anti-parallel diodes. To protect the anti-parallel diodes, please connect the fuses in series as indicated in fig. 4 - 9 . A practical choice for the fuses is 250 mA, the diodes can be any normal 3 or 5 A type.
- Note: The **SM7020-D and SM3004-D** need an extra parallel diode on the output, without this diode the internal diode will still blow. The diode should have a surge current rating of resp. 2000 and 3000 amps during 1msec (I_{FSM} = 2000 / 3000 A). For the SM7020-D 2x BYT52PI200 and for the SM3004-D 2x BYT261PIV400 from ST will work. The SM7020-D with Option P021 and the SM3004-D with Option P022 have an extra diode built-in.

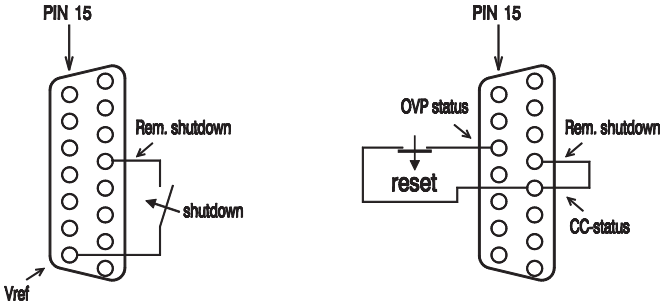


fig. 4 - 10
Left: remote ShutDown with switch,
Right: Over Current Trip

8) REMOTE SHUTDOWN / OVER CURRENT TRIP

- The remote ShutDown can be operated with +5 V or a relay contact, fig. 4 - 10.
- Using the remote ShutDown input, an **Over Current Trip** could be made., fig. 4 - 10.

9) MASTER / SLAVE SERIES OPERATION

- For series operation the **MASTER / SLAVE SERIES ADAPTER (δ-product)** must be used, see fig. 4 - 11.
  The advantage is that the masters position can be the upper or the lower unit (in particular for higher voltages; 150 V and 300 V). Other advantages are the fast and easy way of connecting.
- First, connect output terminals and test system in **normal series** operation. Ensure that all (output) power connections are reliable. An interruption of one of the power leads can cause a fuse to blow in the unit, see "trouble shooting".
- The voltage drop in the connecting leads between the units should be kept < 10 mV.
- Second, switch off all units. Connect units as shown in fig. 4 - 12. Use standard 15 pole (1:1) **shielded cables**.
- The max. number of slaves is only limited by the max. total voltage of 600 V.
- The AUTORANGING feature still works

10) MASTER / SLAVE PARALLEL OPERATION

- **Note: Master / Slave parallel is not recommended for more than 4 units, consult factory for using more than 4 power supplies in parallel.**
- First connect output terminals and test system in **normal parallel** operation. Ensure that all power connections are reliable. An interruption of one of the (output) power leads can cause a fuse to blow in the unit, see “trouble shooting”.
- Second, switch off all units. Plug in prog. connectors with the connections according to fig. 4 - 13 (buss bar topology). Always use a **shielded cable**. The shielding must be connected to the case of the supply.
  Disconnect the links between the S– and – **of the slaves only**.

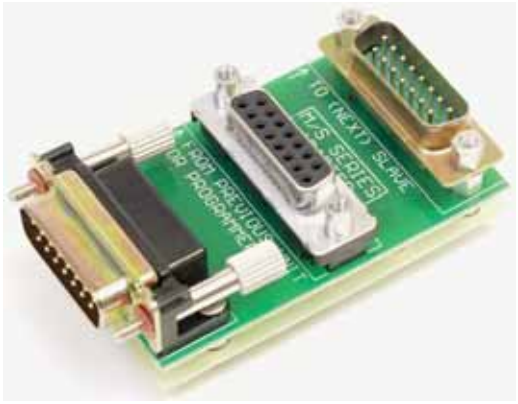


fig. 4 - 11
The Master / Slave Series Adapter,
supplied by Delta Elektronika

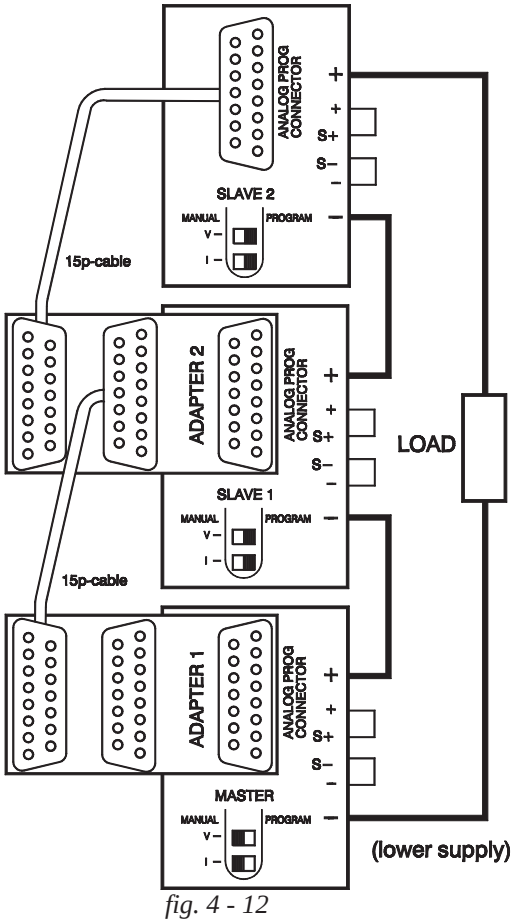


fig. 4 - 12
Master / Slave series connection with
*two **M/S SERIES ADAPTERS***

If not removed the current sharing will not be proportional. Both prog. switches of the slaves should be in the position PROGRAM.

- The purpose of the link between pin 9 and 11 is to set the voltage limit of the slaves at maximum.
- an extra link on the slaves (between pin 6 and 8) is needed for the AUTORANGING feature.
- Keep the load close to the master. Keep wiring between master and slaves short. The voltage drop between a unit and the buss bar should be kept < 10 mV.
- Accidental interruption of a negative load lead of a unit during operation will cause fuse F600 to blow, see section 'trouble shooting'.
- The S- and S+ could be connected to the load if desired, but this is not recommended because of the complexity.

11) MASTER / SLAVE MIXED SERIES / PARALLEL OPERATION

- For complex combinations as mixed series - parallel always use the **MASTER / SLAVE SERIES ADAPTER (δ-product)**.
- See fig. 4 - 14 for an example of how to connect 2 units in series in parallel with 2 units in series, controlled by 1 master.
- On the parallel slave1, fully open the CV-potmeter.
- Note: A Master / Slave combination can always be programmed, also with the **IEEE488 / RS232** controller (**PSC-488 module / PSC-232 module (both δ-products)**).

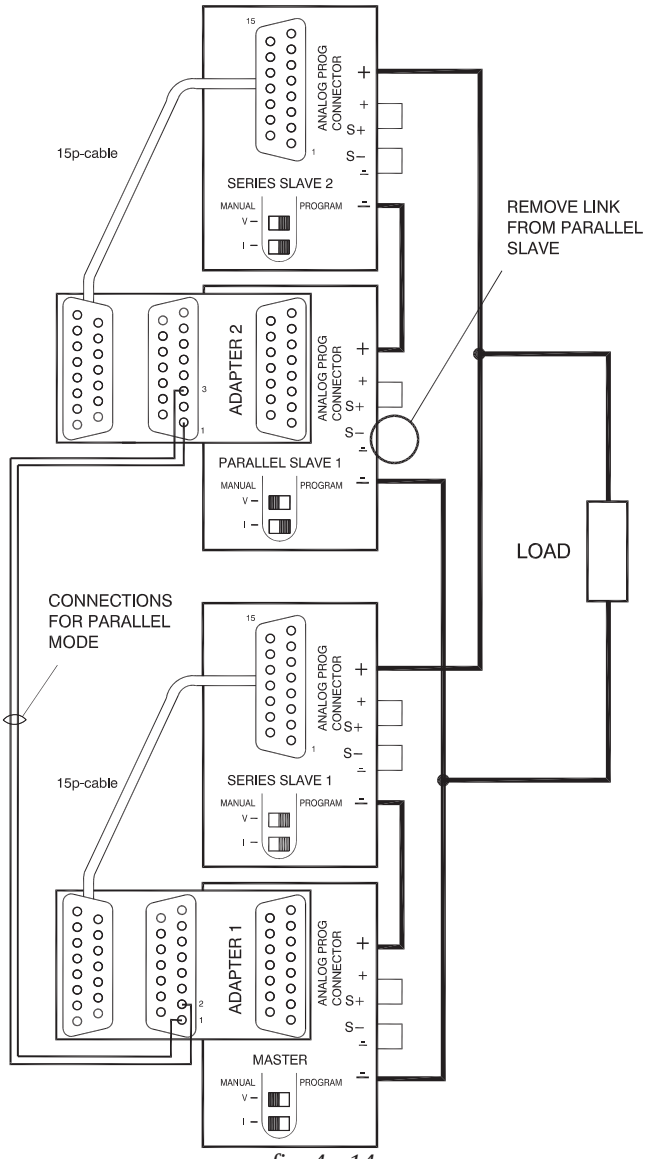


fig. 4 - 14
*Master / Slave mixed series - parallel connections with two **M / S SERIES ADAPTERS***

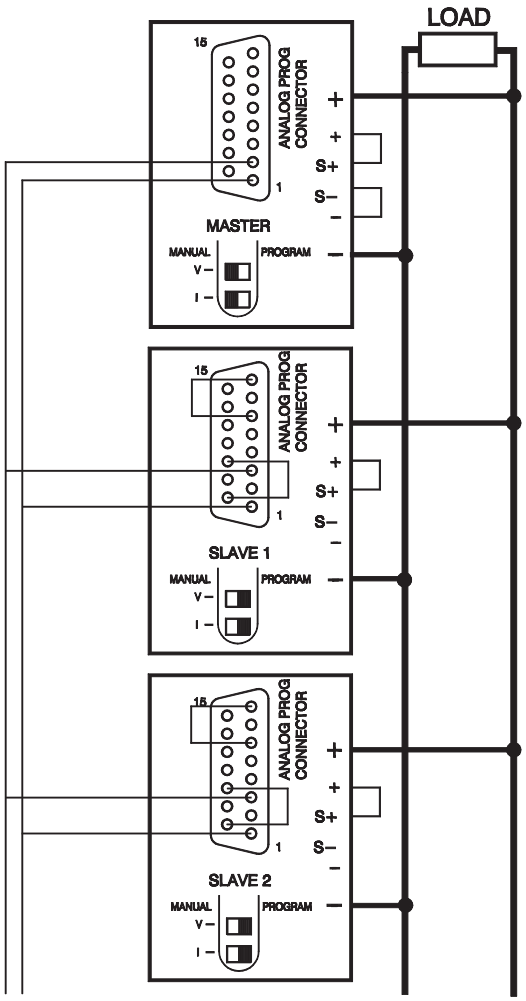


fig. 4 - 13
Master / Slave parallel connections

OPERATING AND STORAGE CONDITIONS

1) TEMPERATURE

- The operating temperature range at full load is -20 to +50 °C. But this temperature range only holds when the perforated bottom and cover are unobstructed and the temperature of the air entering is not higher than +50 °C. See fig. 4 - 15.
- **Please note: a lower temperature extends the life of the power supply.**
- When the power supply is **mounted in a cabinet** please note that the temperature of the air entering should be kept low. Also avoid a short circuit in the airflow i.e. hot air leaving the perforated cover entering the bottom again.
- The storage temperature range is -40 to +85 °C.

2) HUMIDITY

- During normal operation humidity will not harm the power supply, provided the air is not aggressive. The heat normally produced in the power supply will keep it dry.
- **Condensation.** Avoid condensation inside the power supply, break-down could be the result.
  Condensation can occur during a period the power supply is switched off (or operating at no load) and the ambient temperature is decreasing .
  Always allow the power supply to dry before switching it on again.

3) GALVANIC INDUSTRY

- For using the power supplies in the galvanic industry it is strongly recommended to take precautions against an aggressive environment.
- An aggressive environment with acid, salt, etc. can harm the electronic components. Sometimes even the copper traces of the pc-boards dissolve.
- To avoid problems the power supplies should be mounted in a relative clean room, or mounted in a cabinet receiving clean air with over pressure. Or a cabinet with a heat exchanger.

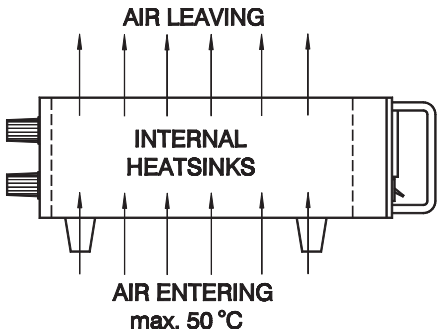


fig. 4 - 15
Leave enough space below and above the unit the let the air flow through it.

MAINTENANCE

1) GENERAL

- The SM-series power supplies normally need no maintenance or calibration. Only care must be taken that the cooling of the unit is not obstructed.

TROUBLE SHOOTING

1) GENERAL

- In case you need assistance for repairing a unit, please contact our engineers using the address "Support@Delta-Elektronika.nl".
- In case you want us to repair the unit, please first fill out the RMA-form before sending the unit to us. Adding a detailed fault description will help us to repair the unit as soon as possible.
  On our website *www.DeltaPowerSupplies.com* the RMA-form can be found under 'Support'.

2) NO OUTPUT (normal operation)

- Check input voltage selector at rear panel. Wrong selection can cause serious damage to the unit. Do not operate the selector switch when the unit is switched on.
- Check input fuses. For 110 V operation fuses have to be replaced. See text at rear panel for values.
- Check position of prog. switches at the rear panel, they should be on MANUAL.
- Check the connections on the SENSE BLOCK (at rear panel), there should be a link between + and S+ and between – and S–.

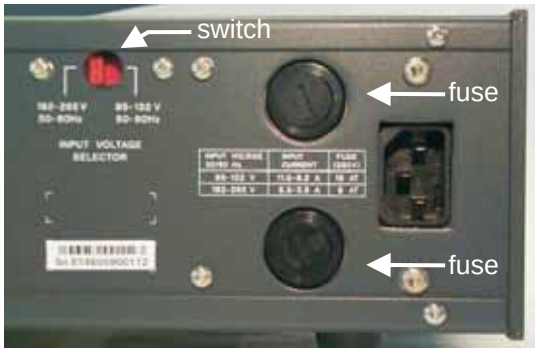


fig. 4 - 16
Location of the input Selector Switch and the input fuses at the rear panel

- Set OVP potentiometer at front panel to max (fully clockwise).
- Switch on unit.
- Turn both the CV and CC potentiometer a few turns clockwise. A voltage should be present on the output.

3) PROGRAMMING DOES NOT WORK OK

- Check position of prog. switches at rear panel.
- **The unit works OK in manual control,** but in programming mode the output voltage / current has a large error. Probably the fuse in series with Ø (pin 1) of prog. connector tripped, the fuse (F600 = 650 mA) is a self-resetting type. See fig.4 - 18.
- To check the fuse (F600) measure the voltage between Ø and the minus output, during the fault condition. The voltage should only be a few mV, a high voltage means that an unwanted current is flowing through pin 1 of the prog. connector. Please check why current is flowing through pin 1, see also next paragraph 'programming offsets' and fig. 4 - 19.

4) PROGRAMMING OFFSETS

- **Unwanted offsets in the programming can be caused by earth loops.** Fig. 4 - 19 shows a typical earthing problem. In case the load has a connection to earth and the programming source as well, problems could occur. Improper choice of the earthing point of the load can give a voltage drop of ΔV1. Connecting the minus or zero to a separate earth connection can give a voltage drop of ΔV2. Because the internal wires of the programming input are thin, the voltage drops ΔV1 and ΔV2 will be across the internal wiring as well. Resulting in a error voltage in series with the programming voltage.
- The best **solution** for this is using a floating programming source with the help of the **ISO AMP MODULE (δ-product)** or a floating load.

5) STATUS OUTPUTS FAIL

- Check fuse F601 in series with Ø (pin 8), see fig. 4 - 18. To check the fuse (F601) measure the resistance between Ø and the minus output, an open circuit means a blown fuse. F601 = 650 mA.

6) MASTER / SLAVE PARALLEL PROBLEMS

- Accidental interruption of a minus lead of a unit during operation will cause fuse F600 to blow. See fig. 4 - 18. To check the fuse (F600) measure the resistance between Ø (pin 1 of prog. conn.) and the minus output, the fuse is a self resetting type. F600 = 650 mA
- AUTORANGING behaves abnormally. Check link between pin 6 and 8 on the prog. connector of the **slaves.**
- Check link between pin 9 and 11 on the prog. connector of the **slaves**
- Current sharing is not ok. Probably the links between S– and – of the **slaves** are not removed.

7) OUTPUT VOLTAGE IS HIGHER THAN SET VALUE

- Check connections on SENSE BLOCK (on rear panel), For normal operation there should be a link between + and S+ and between – and S–. See also fig. 4 - 17. When remote sensing is used, check the wires of the sensing.

8) OVP LED on.

- Check OVP setting.
- Overheating also causes the OVP led to be on (see fig. 4 - 21), cooling down will reset the thermal protection.
- You are using Remote Sensing. Even a short voltage pulse > 3 V between – and S – causes the OVP circuit to limit the output voltage.
- Remote ShutDown voltage is applied to the prog. connector.

fig. 4 - 18 Location of programming fuses on output board P385, P386 or P387.

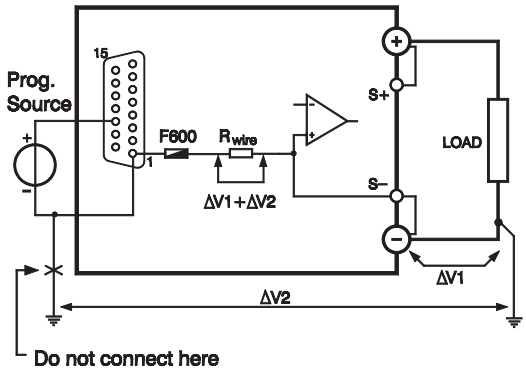


fig. 4 - 19
Unwanted programming offsets

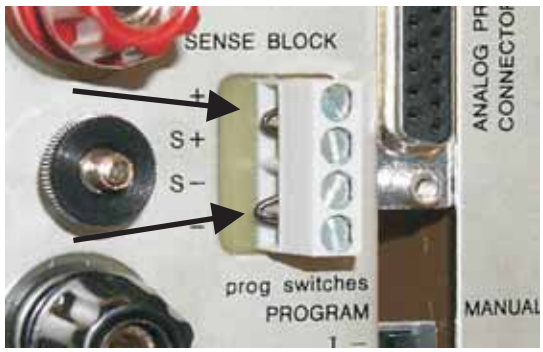
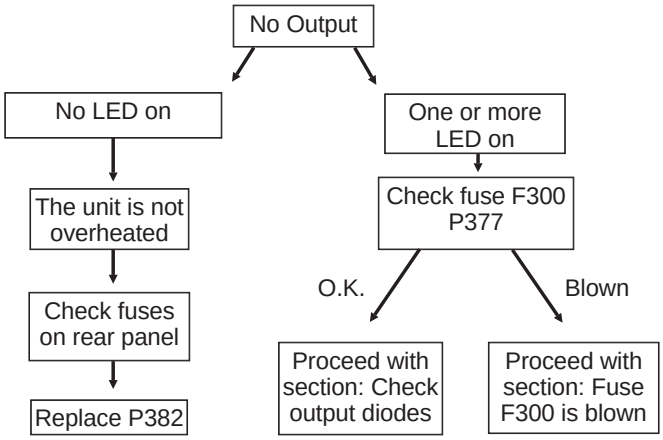


fig. 4 - 17
For normal operation links should be connected between S+ and + and between S- and -

9) **NO LEDS on.**



- Overheating can be the cause, cooling down will reset the thermal protection.
- Check input power and input fuses (on rear panel)

10) **CHECK POINTS IN CASE OF A SERIOUS FAILURE**

- Check output diodes. Defective diodes give a short.
  SM1540-D Check diodes D400 - D403
  SM7020-D Check diodes D400 and D402 on P380
  SM3004-D Check diodes D400 - D404, D410 - D414, D420 - D424, D440 - D434 on P381
  Replace defective parts.
- Fuse F300 is blown. Do not replace F300 until unit is repaired. Probably defect on P378. First check output diodes, see above.
- Repairing P378.
  Check diodes D301 - D308, check transistors Q300 - Q303. When defective they usually give a short. Replace defective components.
- If necessary, send P378 for repair.

fig. 4 - 21 Location of OVP, CV and CC LED's

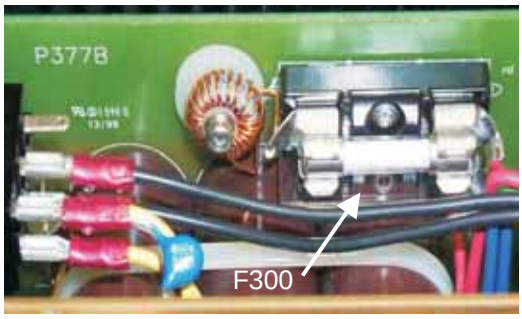


fig. 4 - 20 Location of F300 on P377

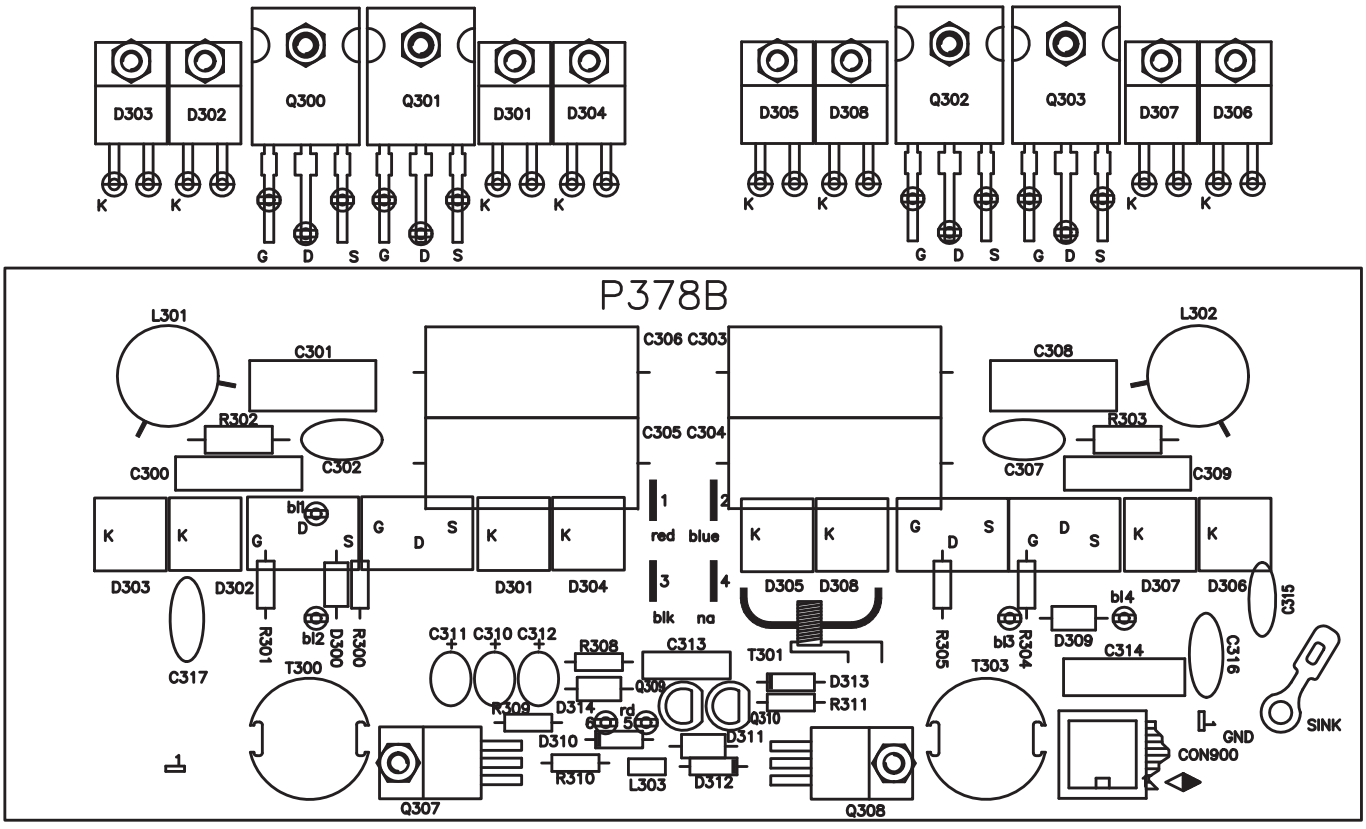


fig. 4 - 22 P378: indicated are the polarity of the diodes (K) and the FET's (G/D/S)

CALIBRATION

1) GENERAL

- The power supplies are factory calibrated and normally need no further calibration.

2) METER CALIBRATION

- DIGITAL METERS
  The zero indication can be calibrated with R712 and R716, the full scale indication can be calibrated with R706 and R708 on P388 (fig. 4 - 23).

3) SPECIAL CALIBRATIONS

- The following calibrations must be done by qualified personnel only. Wrong calibration causes malfunction. These calibrations are only needed after special repairs.
  Warning ! Damage caused by wrong calibration is not warranted.
- CALIBRATING MAX. CURRENT RANGE or CALIBRATING CC MONITOR FULL SCALE.
  The max. output current can be calibrated with R686. R686 is located on P385, P386 or P387. See fig. 4 - 24.
  Program CC input with exactly 5.00 V. Set output voltage to a low value, ensuring the power supply is in CC mode. Measure the output current with an accurate shunt. Calibrate the current with R686 exactly on the rated max. current.
  Warning! Wrong calibration can damage the unit.

- CALIBRATING THE CC MONITOR OFFSET.
  With R652 on P384 the offset of the CC monitor voltage can be calibrated. See fig. 4 - 25. The unit has to be unloaded, the output voltage set on a low value. Measure the offset voltage of the CC monitor on the prog. connector. Calibrate the offset on a negative value between –10 mV and zero mV.
  Warning! wrong calibration can damage the unit.

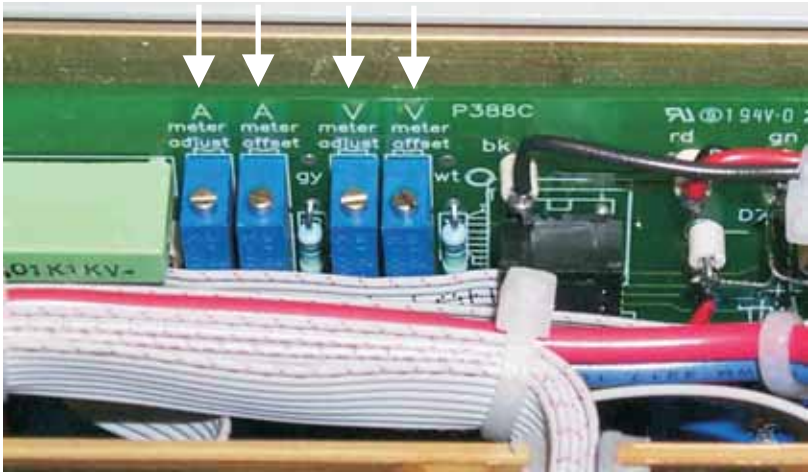


fig. 4 - 23 Meter calibration with 25-turn potmeters on P388

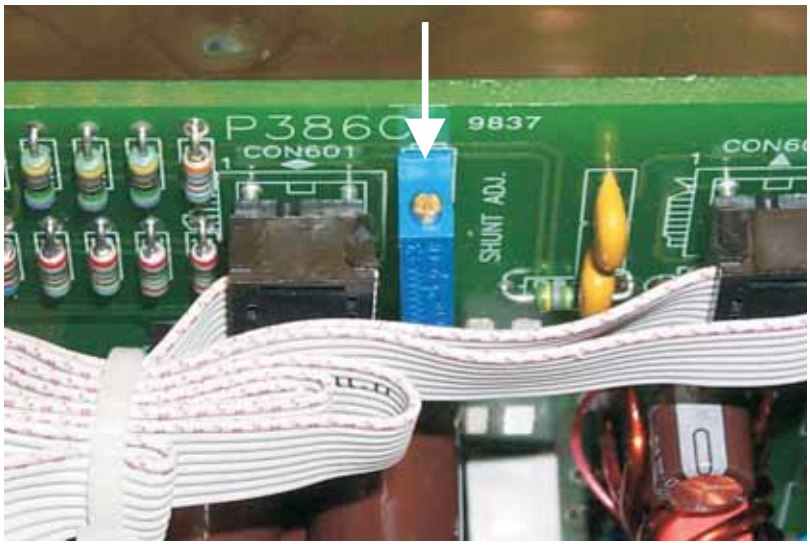


fig. 4 - 24 Calibrating max current P385, P386 or P387

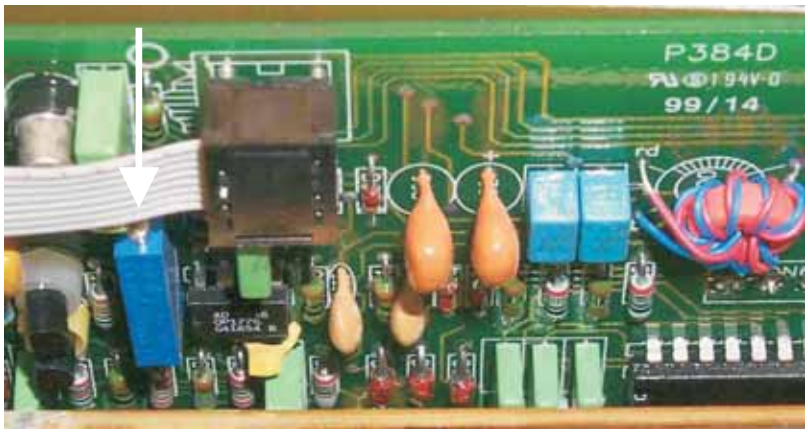


fig. 4 - 25 After lifting P384, CC monitor can be calibrated

SPARE PARTS

- When ordering spare parts please state: Model, Serial number, Component number and Component description.
  example:

- Model SM7020-D
  Serial no.....814605900112
  Component no. D402
  Component descr..BYV52-PI-200

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EC Declaration of Conformity

We

Delta Elektronika
P.O. BOX 27
4300 AA ZIERIKZEE
The Netherlands

declare under sole responsibility that the following Power Supplies:

SM 1540-D
SM 7020-D
SM 3004-D

meet the intent of Directives 2004/108/EC; 92/31/EEC; 93/68/EEC for Electromagnetic Compatibility and
Directives 73/23/EEC; 93/68/EEC regarding Electrical Safety. (Low Voltage Directive)
Compliance was demonstrated to the following specification as listed in the official Journal of the European Communities:

EN 61204-3 EMC, low voltage power supplies

EN 61000-6-3 Generic Emissions: (residential, light industrial)

EN 55022 Radiated and conducted, Class **B**
EN 61000-3-2 Power Harmonics
EN 61000-3-3 Voltage fluctuation and flicker

EN 61000-6-1 Generic Immunity: (residential, light industrial)

EN 61000-6-2 Generic Immunity: (industrial environment)

EN 61000-4-2 Electrostatic Discharge
EN 61000-4-3 Radiated electromagnetic fields
EN 61000-4-4 Electrical Fast Transients / Bursts
EN 61000-4-5 Surge Immunity
EN 61000-4-6 RF common mode, conducted
EN 61000-4-11 Voltage variations and dips

EN 60950 Safety of IT equipment

EN 61010 Safety of electrical equipment for measurement, control and laboratory use

Managing director