SM1500-Series

- **SM 15-100**
- **SM 35-45**
- **SM 52-30**
- **SM 70-22**
- **SM 120-13**
- **SM 300-5**

Safety Instructions

Caution.

The following safety precaution 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 tree 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.

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.

Safety instructions

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 2000m
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)

DESCRIPTIONS

1) OUTPUT

The SM15-100, SM35-45, SM52-30, SM70-22, SM120-13 and SM300-5 can either be used as a constant voltage source with current limiting or as a constant current source with voltage limiting.

The change of mode occurs sharply at the crossing of the voltage and current settings. Fig. 2 - 1 shows the output operating area.

° 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 units can also be used as a DC/DC converter.
° At line voltages below about 120 VAC the output power has to be derated, see Fig. 2 - 2

3) INPUT CURRENT

The units have active power factor correction (PFC). The input current will therefore almost be a sine wave. This means that the rms-value and the harmonic distortion of the input current will be relatively low.
° At low line voltages, the input current is electronically limited to about 16Arms by reducing the output power.
° The peak inrush current is electronically limited. Switching on and off repeatedly will not result in excessive currents like with NTC circuits.

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 for switching on and off.

5) EFFICIENCY

The efficiency is very high and constant over a wide output current range. High efficiency also means low power loss and low heat generation.

6) CV REGULATION

The CV-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!).
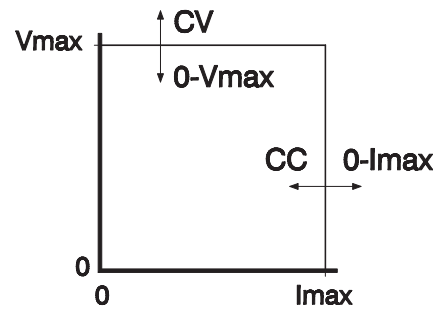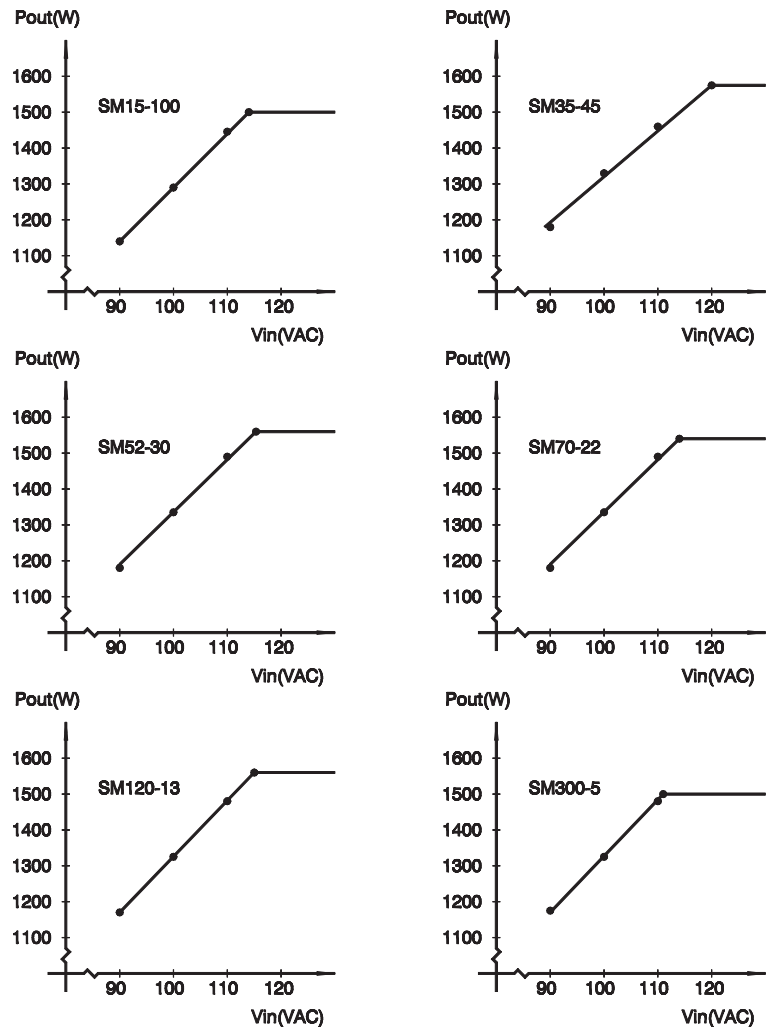

fig. 3 - 1
Output operating area

fig. 3 - 2
Output power derating vs AC input voltage

7) CC REGULATION

For accurate CC-load regulation, do not use external voltage sensing.
A voltage between S- and minus output will create an error of about 0.04 % per volt. A voltage between S+ and + is not critical.
The CC-stability is also affected by external voltage sensing.

Note: when the unit operates in CC-mode, the **DCF-LED** can be burning.

8) 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 - 3 and fig. 2 - 4.

° LOW TEMPERATURE
At –20 °C the typical increase for the CV ripple is 3 - 5 times.

9) PROGRAMMING INPUTS

The output voltage and current can be programmed by an external analog voltage. This programming is very accurate and linear. The levels are all standardised on 5V. Always use a **shielded cable** for programming.

The inputs have a protection circuit formed by a series resistor and a parallel zener, see fig. 2 - 5. 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 dip switches SWA-1 and SWA-2 which are situated on the rear panel, see fig. 2 - 8.

10) IEEE 488 / RS232 PROGRAMMING

Both the Delta Elektronika **PSC488 INT** and the **PSC232 INT** controllers can be built inside the unit.

Voltage and current can easily be programmed and read back, also the CC and LIM status can be read by the computer. With the PSC232 INT the computer can also read the ACF, DCF and OT status. Always use a **shielded cable** for programming.

11) 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 - 7. The monitor outputs are buffered by op-amp's and protected by zeners in parallel, see fig. 2 - 9. The table in fig. 2 - 11 shows the impedance of the monitoring outputs. The monitoring and the reference outputs are stable for capacitive loads up to 2 μF, for larger values a 22 Ohm resistor should be put in series.

Note: in case of a **pulsating load**, the I monitor voltage will not exactly match the output current. This is mainly caused by the current through the output capacitors. Remote sensing will worsen this effect.

12) +12V ON PROGRAMMING CONNECTOR

The +12V on the programming connector can be used for supplying external circuits like isolation amplifiers. The output is current limited, but should not be overloaded. The fuse F10_3 on P517 could blow. The fuse F10_3 also protects the internal circuit, in case an external high voltage is applied by accident. Note: this fuse is a special 600V type, always replace with the same type.

13) 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.

The **LIM-status** is "1" in case the output voltage or current reaches the limit setting. Which limit circuit is active can be seen on the front panel LED's or by combining the CC-status output.

The **OT status** is "1" in case of an over temperature. As a pre-warning the signal is intermittent (the OT-LED blinks). A continuous "1" means shutdown of the power supply.

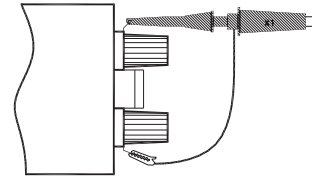The **CC-status** output is "1" when the unit is in CC-mode.
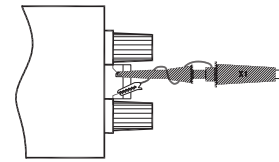

fig. 3 - 3
measuring ripple voltage
WRONG !

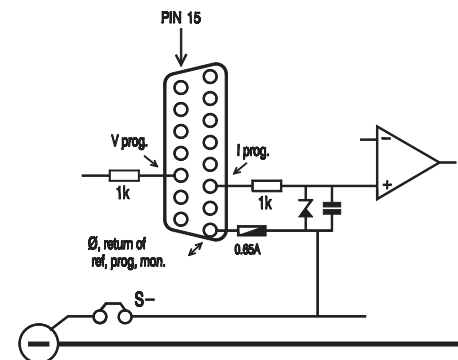fig. 3 - 4
measuring ripple voltage
RIGHT !

fig. 3 - 5
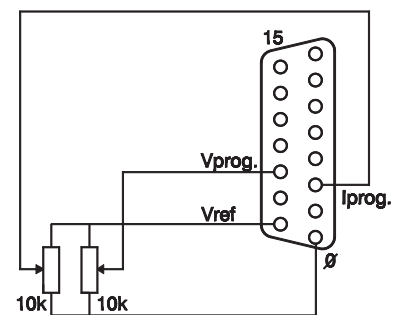*programming inputs*
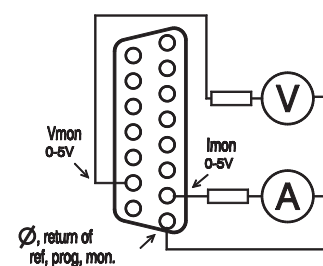*(internal circuit)*

fig. 3 - 6
external potmeters

fig. 3 - 7
external meters
using monitor outputs

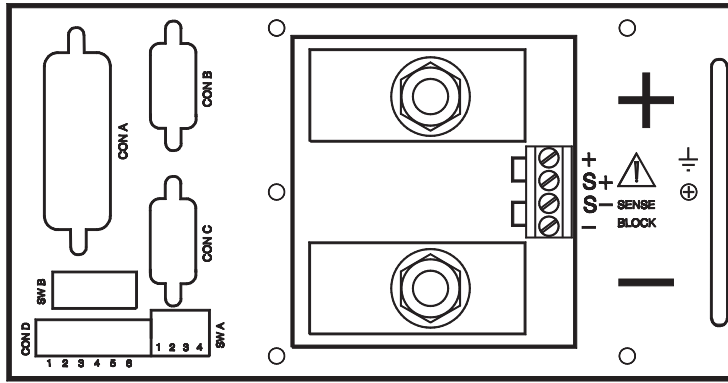*fig. 3 - 8*
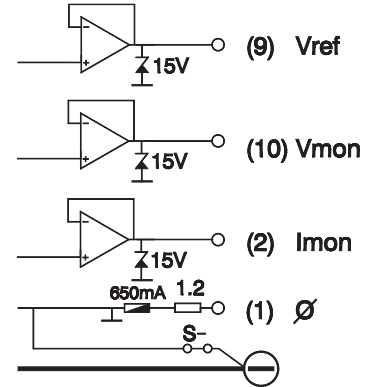*location of output terminals and analog prog. connector on rear panel*

fig. 3 - 9

CON A	Analog Programming Connector
CON B	PSC 232P CARD (optional)
CON C	PSC 232P CARD (optional)
CON D	Relay Outputs, contacts 1 - 6
SW A	Remote and Status function switches
SW B	PSC 232P CARD (optional)

fig. 3 - 10   connectors and switches on the rear panel

output	pin	Ro	Io max
Vref	9	2 Ohm	4 mA
Vmon	10	2 Ohm	4 mA
Imon	2	2 Ohm	4 mA
+12V	7	3 Ohm	200 mA
Ø	1	2 Ohm	

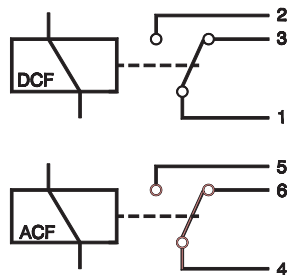*fig. 3 - 11   outputs on programming connector*

fig. 3 - 12   status Relay Outputs

The **ACF-status** output gives fault information about the input voltage. The signal can be inverted by SWA-3. The ACF-status changes when the input voltage is below 120V (peak, not rms) for more than 10 ms. Note that if you want the ACF-status to switch before the DCF-status, the hold-up time has to be > 10 ms. This can be achieved by reducing the load, see 23)

The **DCF-status** output gives fault information about the output voltage. The signal can be inverted by SWA-4. The DCF-status changes when the output voltage is either 5% below or above the set point.

14)   STATUS RELAY OUTPUTS

The power supply has 2 status relay outputs, with each a change-over contact. They are connected to connector CON D. The pins 1,2,3 are connected to the DCF-relay and pins 4,5,6 to the ACF-relay. See fig. 2 - 12.
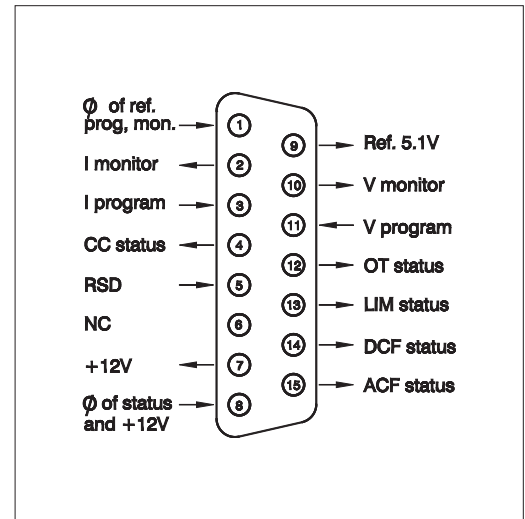
pin	description
1	Ø, return of reference, prog. inputs and monitor outputs.
2	current monitor output (0 - 5V)
3	current programming input (0 - 5V)
4	CC status output, logic 1 = CC mode (5 V / 10 mA)
5	Remote shutdown (+5V / 1mA)
6	NC
7	+12 V output (0.2 A)
8	Ø, return of status outputs and +12 V
9	reference voltage 5.1 V
10	voltage monitor output (0 - 5V)
11	voltage programming input (0 - 5V)
12	OT - status output (5 V / 10 mA)
13	LIM - status output (5 V / 10 mA)
14	DCF - status output (5 V / 10 mA)
15	ACF - status output (5 V / 10 mA)

fig. 3 - 13
connections ANALOG PROG CONN (CON A)

15) REMOTE AND STATUS FUNCTION SWITCHES

The dipswitches SW A 1-4 have the following function:

Switch no.	Off position	On position	Default Setting
SW A - 1	Manual CC-control	CC-programming	Off (up)
SW A - 2	Manual CV-control	CV-programming	Off (up)
SW A - 3	ACF inverted	ACF normal	Off (up)
SW A - 4	DCF inverted	DCF normal	Off (up)

	Normal Operation	Output error	Input error	Mains off
ACF-led	off	-	on	-
ACF-status				
SWA-3=off	1	-	0	0
SWA-3=on	0	-	1	0
ACF-relay				
SWA-3=off	4 - 5 closed	-	4 - 6 closed	4 - 6 closed
SWA-3=on	4 - 6 closed	-	4 - 5 closed	4 - 6 closed
DCF-led	off	on	-	-
DCF-status				
SWA-4=off	1	0	-	0
SWA-4=on	0	1	-	0
DCF-relay				
SWA-4=off	1 - 2 closed	1 - 3 closed	-	1 - 3 closed
SWA-4=on	1 - 3 closed	1 - 2 closed	-	1 - 3 closed

16) REMOTE SHUTDOWN (RSD)

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 Remote ShutDown (pin 9 and 5).
Note: The Remote ShutDown will also cause the Remote-LED to burn.

17) PROGRAMMING RESPONSE TIME

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

18) PULSATING LOAD

To avoid overheating the output capacitors, the AC component of the load current should be limited. See fig. 3 - 14. One method of decreasing the AC current through the output capacitor is by using a large external electrolytic capacitor in parallel with the load.

When using **remote sensing** on a pulsating load (e.g. a DC-motor) use a capacitor between S+ and + and between S- and - and a series resistor in the sense leads. See fig. 3 - 15. Like this the AC-component is filtered

19) 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 for 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). See also fig. 3 - 16.

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 pevent high peak currents, which could destroy the power supply. Make sure to have discharged the capacitors completely before using it again.
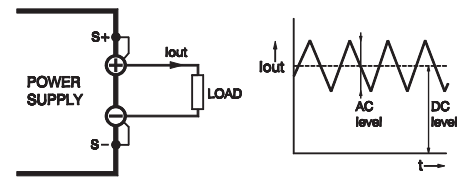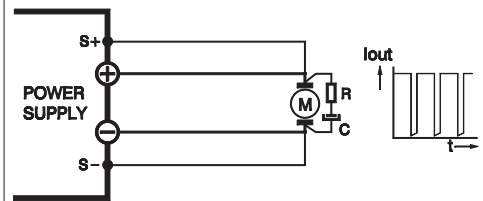

fig. 3 - 14
pulsating load current
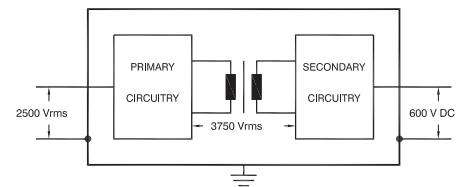

fig. 3 - 15
remote sensing on a pulsating load
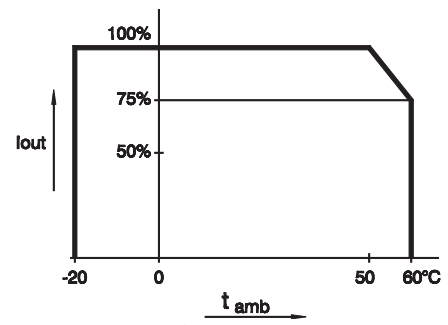

fig. 3 - 16
insulation test voltages

fig. 3 - 17
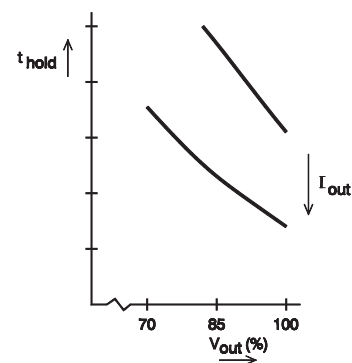*operating temperature ranges*

fig. 3 - 18
hold-up time vs Vout with Iout as a parameter

20) 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.

The combination of RFI filters and the closed metal case results in a low radiated RFI.

21) OPERATING TEMP

At full power the operating temperature range is –20 to +50 °C. From 50 to 60 °C the output current has to be derated linearly to 75 % at 60 °C. See fig. 2 - 17. These temperatures hold for normal use, i.e. the ventilation openings on the left and right side must be free.

22) THERMAL PROTECTION

A thermal switch shuts down the output in case of insufficient cooling. After cooling down the unit will start working again.

The OT-led on the front panel will burn and the OT-status signal will be "1" in case of a tripped thermal protection.

As a pre-warning the signal is intermittent (the OT-LED blinks), this will start before the power supply shuts down.

23) 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. The influence of the line input voltage is limited because of the active PFC.

24) TURN ON DELAY

The output voltage is available 0.3 sec after mains switch on.

25) INRUSH CURRENT

The inrush current is electronically limited to about 22A. Repeatedly switching on and off does not change the maximum peak current. Switching on and off at a fast rate can overheat the inrush current limiter. With the result that the power does not start anymore. After cooling down (mains switched off) it will be OK again.

26) SERIES OPERATION

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

27) PARALLEL OPERATION

Paralleling of the units has no limitations. The power supplies can be connected in parallel without special precautions.

Parallel operation of fast programming versions can give problems, each combination has to be tested first in combination with the load.

28) MASTER / SLAVE OPERATION

For easier control, Master / Slave operation is recommended (fig. 2 - 19 and 20). The resulting combination behaves like one power supply and can be programmed on the master.

M / S series operation is allowed up to 600V total voltage. The power supplies can be connected with the **MASTER / SLAVE SERIES ADAPTER (δ-product)**. The master controls one slave, which in its turn controls the second slave and so on. The result is true voltage sharing.

For **M / S parallel operation** connections can easily be made on the analog programming connector. The master controls all slaves. The result is true current sharing.

Mixed M / S parallel - series operation is also possible (fig. 3 - 21). Fig. 3 - 22 shows a computer controlled M / S parallel combination.

Note: M / S parallel operation is not recommended for:
° fast programming versions
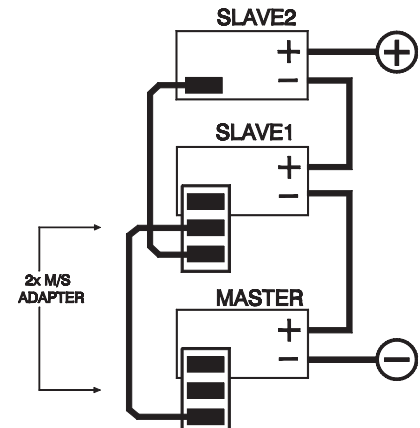° more than 4 units, consult factory for a solution
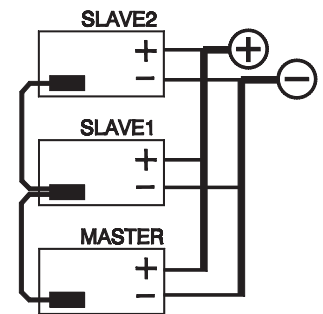

fig 3 - 19
Master / Slave Series operation

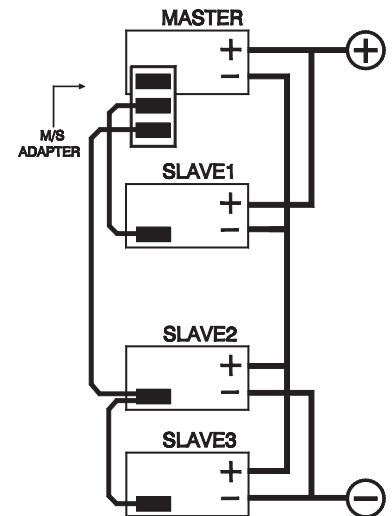

fig 3 - 20
Master / Slave Parallel operation

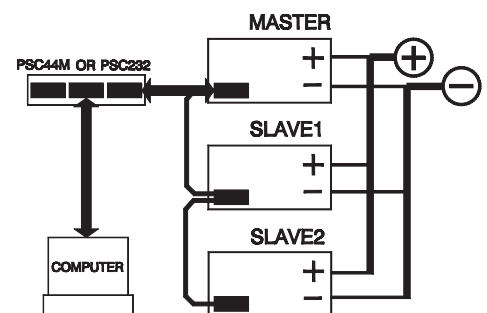*fig. 3 - 21*
Master / Slave mixed Series-Parallel

fig. 3 - 22
the Master / Slave combination can also be
programmed with the interfaces PSC44M or
the PSC232

29) 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 by a few millivolts. Always use a **shielded cable** for sensing.

In order to compensate for the voltage drop in the load leads the unit will have to supply a higher voltage = the voltage drop in each lead + the voltage across the load, see fig. 2 - 23.

The Voltage Limit reads the voltage directly at the output and the setting must be increased by the total voltage drop on 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 recommended to place an electrolytic capacitor in parallel with a pulsating load. This reduces problems of the inductance in a long lead. Care must be taken so that the capacitor in combination with the lead inductance will not form a series resonant circuit. See also par.18) of this chapter.
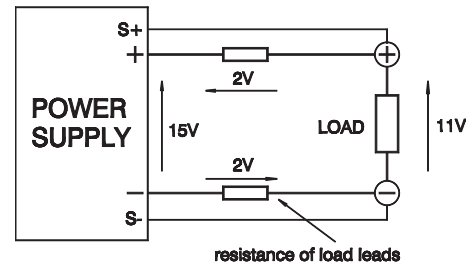
30) OVP, OVL, OCL

OVP = Over Voltage Protection
OVL = Over Voltage Limit
OCL = Over Current Limit

The OVP or OVL 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, a programming error or a defect in the power supply. The OVP or OVL circuit uses a separate voltage devider connected directly to the output terminals.

The OCL protects your circuit from unwanted high currents.

The OVP, OVL, OCL limit the output to a safe preset value. It does not trip, so no resetting is needed after a fault. It can be very handy when the power supply is programmed, to have hardware limits.

The limits can easily be set by pressing the DISPLAY CV/CC LIMITS button and adjusting the trimpotmeters by screwdriver. The LED's next to the potmeters indicate the activity of each limit, also the LIM-status output will be "1".
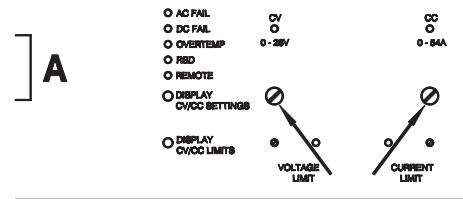
31) POTENTIOMETERS

- ° 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 - 24.

32) COOLING

A low noise blower cools the unit. The speed of the fan depends on the temperature of the internal heat sink. At room temperature and full load the fan will run at a very low speed. The fan does normally not operate at no load. Since the fan is over-rated it will still have enough capacity to cool the unit when dust partially obstructs the fins of the heat sinks.

A special feature is that the fan blows through a tunnel where the heat sinks are situated, the delicate control circuitry is separated and will not be in the airflow path, see fig. 2 - 25.

Because the air enters at the left and exits at the right side it is possible to stack the power supplies, no distance between the units is required. Only the ventilation openings at the left and right side should be free.
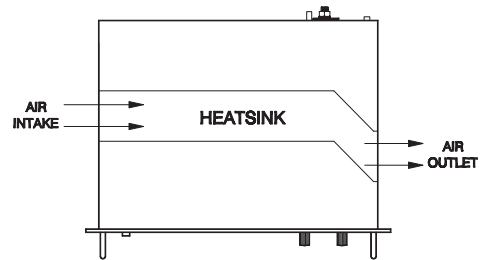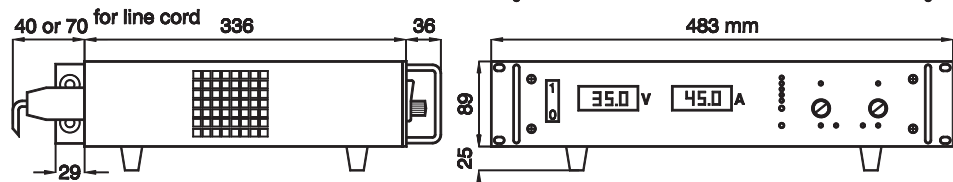
33) DIMENSIONS

fig. 3 - 23
remote sensing, voltage drop in load leads subtracts from max. output

fig. 3 - 24
screwdriver adjustment at front panel

fig. 3 - 25
the fan blows through a tunnel, where the heatsinks are situated

OPERATING MANUAL

1) OPERATING THE UNIT FOR THE FIRST TIME

- ° 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. SW A-1 and SW A-2 off (upward). Factory default.
- ° Check that there is a link between + and S+ and between – and S– on the SENSE BLOCK (on rear panel). Factory default.
- ° Set LIMIT potentiometers (on front panel) to maximum (fully clockwise), Factory default. Use a small screwdriver.
- ° 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 CV/CC LIMITS button the meters will show the setting of the CV-limit and CC-limit potentiometer.
- ° When the power supply is used on a fixed output voltage it is rec-ommended to set the Over Voltage Limit (Protector) (OVL or OVP). Set the limit about 2 - 5% above Vout.
- ° Check that the cooling of the unit is not obstructed.

2) ANALOG PROGRAMMING

- ° Put the appropriate switch(es) in the position PROGRAM (SWA1,2).
- ° Connect the programming voltage source(s) (0 - 5 V) to the ana-log prog. connector CON A on the rear panel. See fig. 3 - 1 and fig. 3 - 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 de-sirable 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 (F10_1 on P517), see fig. 3 - 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) IEEE 488 / RS232 PROGRAMMING

- ° Set both prog. switches to the position program.
- ° Both CV and CC can be programmed and read back. The CC and LIM status can also be read by the computer. With the PSC232 INT the computer can also read the ACF, DCF and OT status.

4) MONITORING OUTPUTS

- ° The 5 V level is compatible with most interfaces.
- ° The monitoring outputs can drive a meter directly, fig. 3 - 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 (F10_2 on P517).
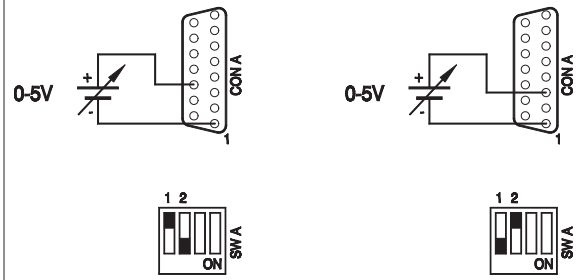

fig. 4 - 1
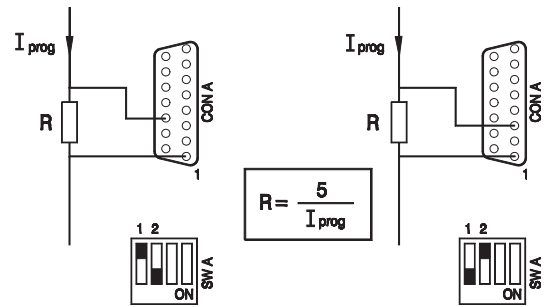*programming by voltage*
left voltage -, right current programming

$$R = \frac{5}{I_{prog}}$$

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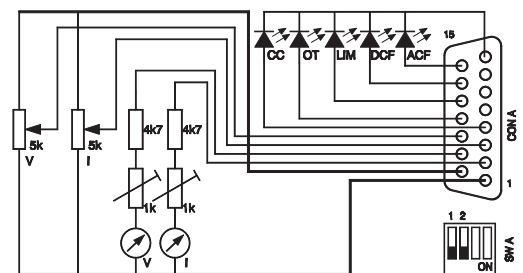*left voltage -, right current programming*

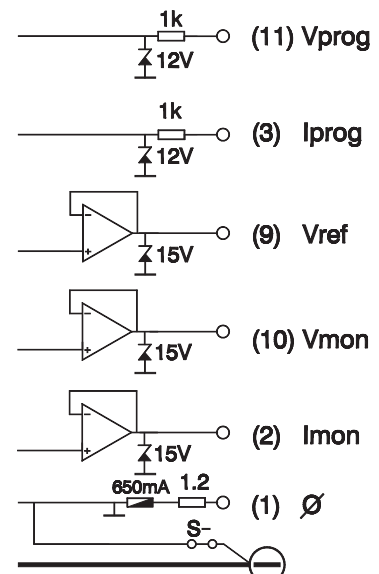*fig. 4 - 3*
remote control

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

6) REMOTE SENSING

° Remove the links on the SENSE BLOCK (on rear panel) and connect sense leads (thin **shielded** measuring wires) to S+ and S–. See fig 3 - 5 and fig. 3 - 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. 3 - 23 it can be seen that on a 15V power supply only 11V will be available on the load when 2x 2V compensation is used.

° 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 load 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 OVL or OVP measures the voltage on the output terminals, so the 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. 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.
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
SM15-100	E 81 B 100	AEG	
SM35-45	S281 UC-Z 50	ABB	
SM52-30	S281 UC-Z 32	ABB	**extra parallel diode on output needed BVY255V-200**
SM70-22	S281 UC-Z 25	ABB	
SM120-13	S281 UC-Z 16	ABB	**extra parallel diode on output needed BVY255V-200**
SM300-5	S282 UC-Z 6	ABB	2 poles in series, **extra parallel diode on output needed 2xBYT261PIV400**

° **Remote sensing** is not 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. 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 **SM120-13 and SM300-5** need an extra parallel diode on the output, without this diode the internal diode will still blow in case of wrong connection.
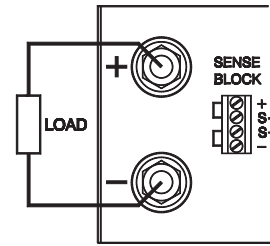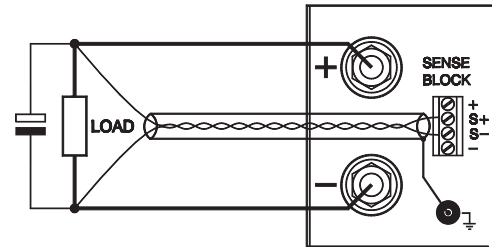

fig. 4 - 5
local sensing
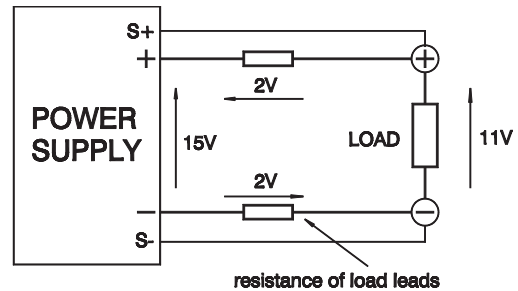

fig. 4 - 6
remote sensing with shielded wires

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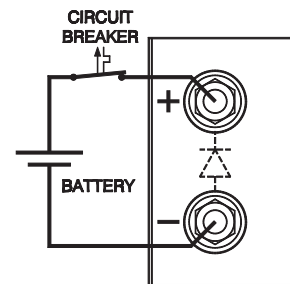*remote sensing, voltage drop in load leads subtracts from max. output*

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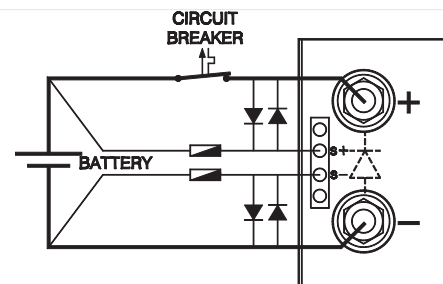*charging battery with a circuit-breaker in series*

fig. 4 - 9
protecting sense wires with diodes

8) REMOTE SHUTDOWN (RSD)

○ The Remote ShutDown can be operated with +5V or a relay contact, fig. 3 - 10.
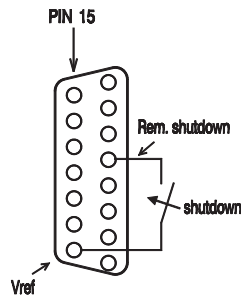

fig. 4 - 10
Remote ShutDown with switch

9) MASTER / SLAVE SERIES OPERATION

○ For series operation the **MASTER / SLAVE SERIES ADAPTER (δ-product)** must be used. With this adapter the master can be the upper or lower unit which, in particular for higher voltages (e.g. 120V and 300V) is an advantage. Other advantages are the fast and easy way of connecting.

○ First, connect output terminals and test the system in **normal series** operation. Ensure that all (output) power connections are reliable.

○ Second, switch off all units. Connect units as shown in fig. 4 - 11. Use standard 15 pole (1:1) **shielded cables**. Both prog. switches of the slave(s) should be in the position PROGRAM.

○ The max. number of slaves is only limited by the max. total voltage of 600 V.

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 the 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 - 12 (buss bar topology). Always use a **shielded cable**. The shielding must be connected to the case of the supply.
Disconnect the link between the S– and – **of the slaves only**. If not removed the current sharing will not be proportional.
Both prog. switches of the slaves should be in the position PROGRAM (SW A-1 and SW A-2 on).

○ The purpose of the link between pin 9 and 11 is to set the voltage limit of the slaves at maximum.

○ 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 F10_1 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.

○ **Note:** because all the slaves are operating in CC-mode, the **DCF-LED** can be on.

11) PARALLEL OPERATION OF FAST PROGRAMMING VERSIONS:

○ Master / Slave operation is not recommended.

○ Normal parallel operation can give problems, each combination has to be tested first in combination with the load.
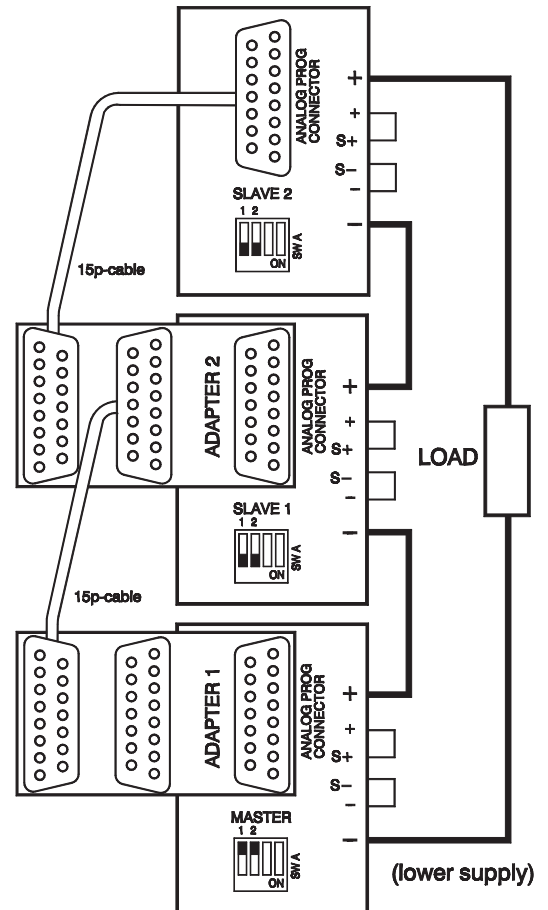

fig. 4 - 11
master slave series connection with
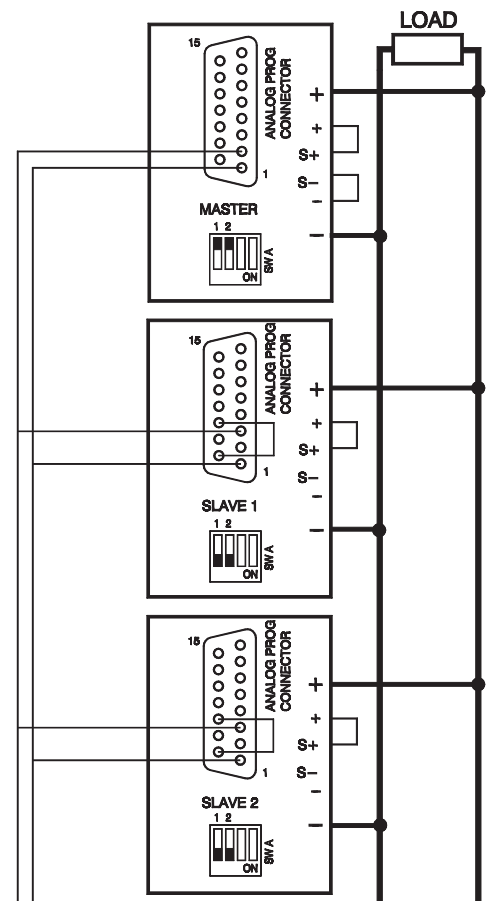***two M / S SERIES ADAPTERS***

fig. 4 - 12
master slave parallel connections

12) **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 - 13 for an example of how to connect 2 units in series in parallel with 2 units in series, controlled by 1 master.
- ° **Note:** A Master / Slave combination can always be programmed, also with the **IEEE488 / RS232** controllers (**PSC 488 EXT / RS 232 EXT (δ-products)**).

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 AIR-INTAKE and AIR-OUTLET are unobstructed and the temperature of the AIR-INTAKE is not higher than +50 °C.
- ° **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-INTAKE should be kept low and avoid a short circuit in the airflow i.e. the hot air leaving the AIR-OUTLET entering the AIR-INTAKE 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 increasing .
  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 tracks 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.

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.

2) COOLING FAN

- ° The built up of dust on the impeller of the fan and the heat sink fins depends on the environment. Since the fan has over-capacity dust will not present a problem very quickly.
- ° The internal construction of the power supply is such that no dust will reach the sensitive control circuitry, only the heat sinks in a tunnel are cooled by forced air, see fig. 4 - 14
- ° The thermal protection will shut down the output in case of overheating, so no damage will be done to the power supply.
- ° It is advisable to inspect the fan and the heat sinks regularly.
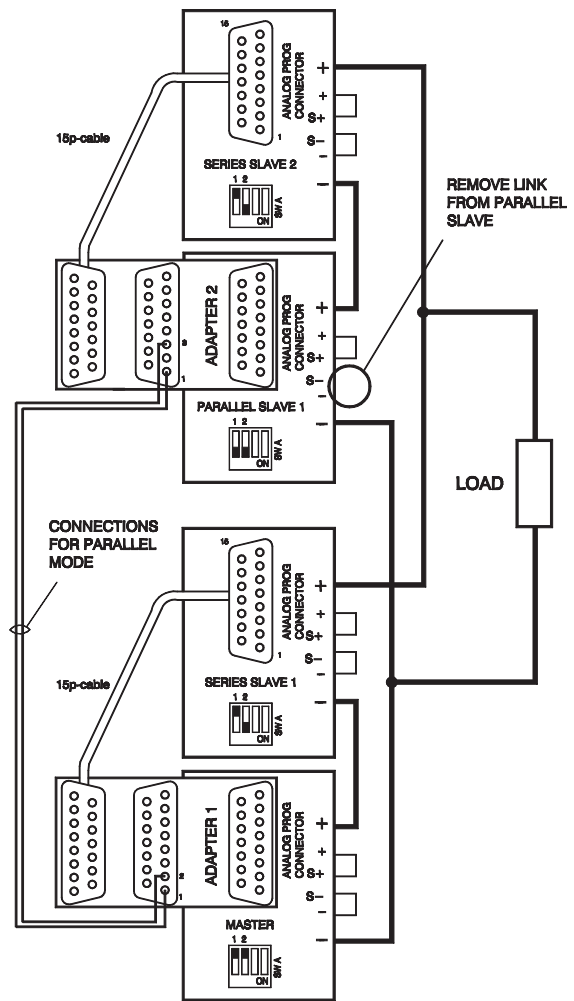

fig. 4 - 13
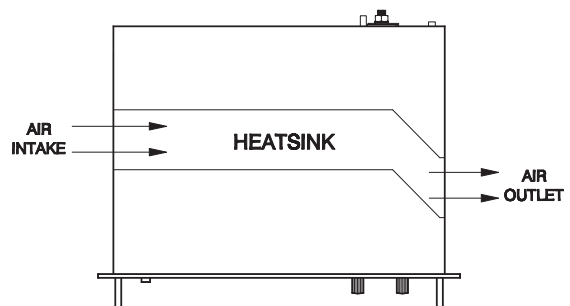*master slave mixed series - parallel connections with two **M / S SERIES ADAPTERS***

fig. 4 - 14
the fan blows through an internal tunnel, where the heat sinks are situated

TROUBLE SHOOTING

1) 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.

2) NO OUTPUT (normal operation)

° Check position of prog. switches at the rear panel, they should be on MANUAL. SW A-1 and SW A-2 off.

° Check the connections on the SENSE BLOCK (at rear panel), there should be a link between + and S+ and between – and S–. See fig. 3 - 17.

° Set both the CV- and CC-limit potentiometer (at front panel) at maximum (fully clock wise).

° Switch on unit.

° Turn both the CV and CC potentiometers a few turns clock-wise. 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 (CON A) tripped, the fuse (F10_1 = 650 mA) is a self-resetting type. See fig. 3 - 15.

° To check the fuse (F10_1) 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 programming connector.
Please check why current is flowing through pin 1, see also next part and fig. 3 - 16

4) PROGRAMMING OFFSETS

° **Unwanted offsets in the programming can be caused by earth loops.**
Fig. 3 - 16 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 $\Delta V1$. Connecting the minus or zero to a separate earth connection can give a voltage drop of $\Delta V2$. Because the internal wires of the programming input are thin, the voltage drops $\Delta V1$ and $\Delta V2$ 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 F10_2 in series with Ø (pin 8 of CON A), see fig. 3 - 15. To check the fuse measure the voltage between Ø and the minus output, a high voltage means too much current flowing through the fuse. F10_2 = 650 mA, self resetting.

6) MASTER / SLAVE PARALLEL PROBLEMS

° Accidental interruption of a minus lead of a unit during operation will cause fuse F10_1 to blow. See fig. 3 - 15.

° 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.
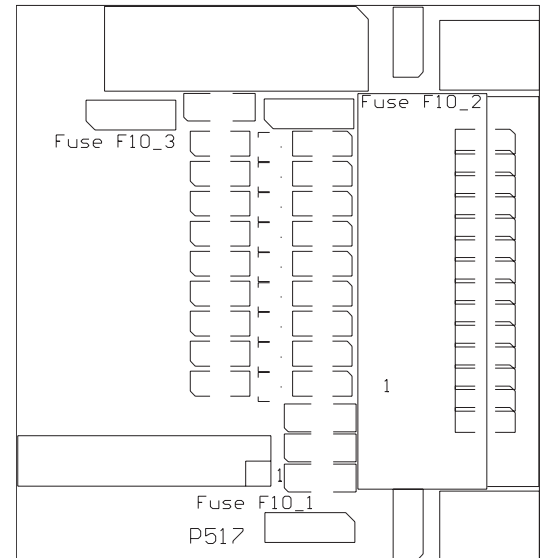

fig. 4 - 15
location of programming fuses on P517
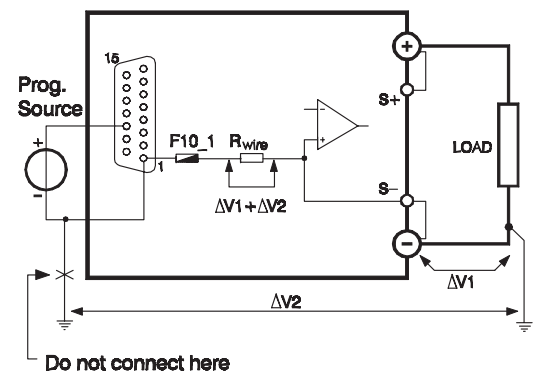*P517 is situated on the rear panel*

fig. 4 - 16
unwanted programming offsets

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) **OT LED burns.**

   ° Check if the cooling fan is running.
   ° Check if the air temperature of the air inlet (left) is below 50 °C

9) **OT LED blinks.**

   ° The temperature of the internal heat sink is getting too high, a further increase will shut down the power supply.
   ° Check if the cooling fan is running properly.
   ° Check if the air temperature of the air inlet (left) is below 50 °C

10) **ACF LED burns**

   ° The input voltage is too low
   ° The mains was intermittent because of a bad connection. Disconnect the mains, wait a few minutes and try again
   ° Internal error.

11) **NO LEDS burn.**

   ° Check input power
   ° Check fuses F5_1 ... F5_4 on P501
   ° The auxiliary power supply (board P508) is defect. Do not try to repair, but send for repair or ask for replacement.
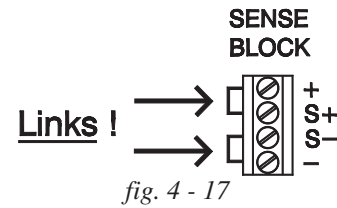

fig. 4 - 17
for normal operation links should be connected between S+ and + and between S- and -

CALIBRATION

1) GENERAL

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

2) METER CALIBRATION

° DIGITAL METERS
The full scale indication can be calibrated with R7_54 and R7_55 on P507 (fig. 3 - 18).

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 R12_30, located on P513 or P541. See fig. 3 - 19.
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 (zero flux) current sensor. Calibrate the current with R12_30 exactly on the rated max. current.
Warning! Wrong calibration can damage the unit.

° CALIBRATING THE CC MONITOR OFFSET.
With R12_29 on P513 or P541 the offset of the CC monitor voltage can be calibrated. See fig. 3 - 19. Disconnect the load, the output voltage set on zero. The unit has to be on room temperature. Wait some minutes to let the offset stabilise. Measure the offset voltage of the CC monitor on the 2 terminals on P513 or P541. Calibrate the offset below 0.05 mV, use a slow (integrating) meter.
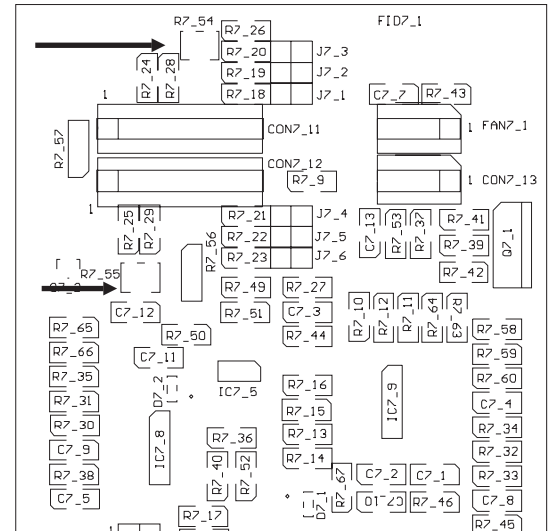**Warning!** wrong calibration can damage the unit.
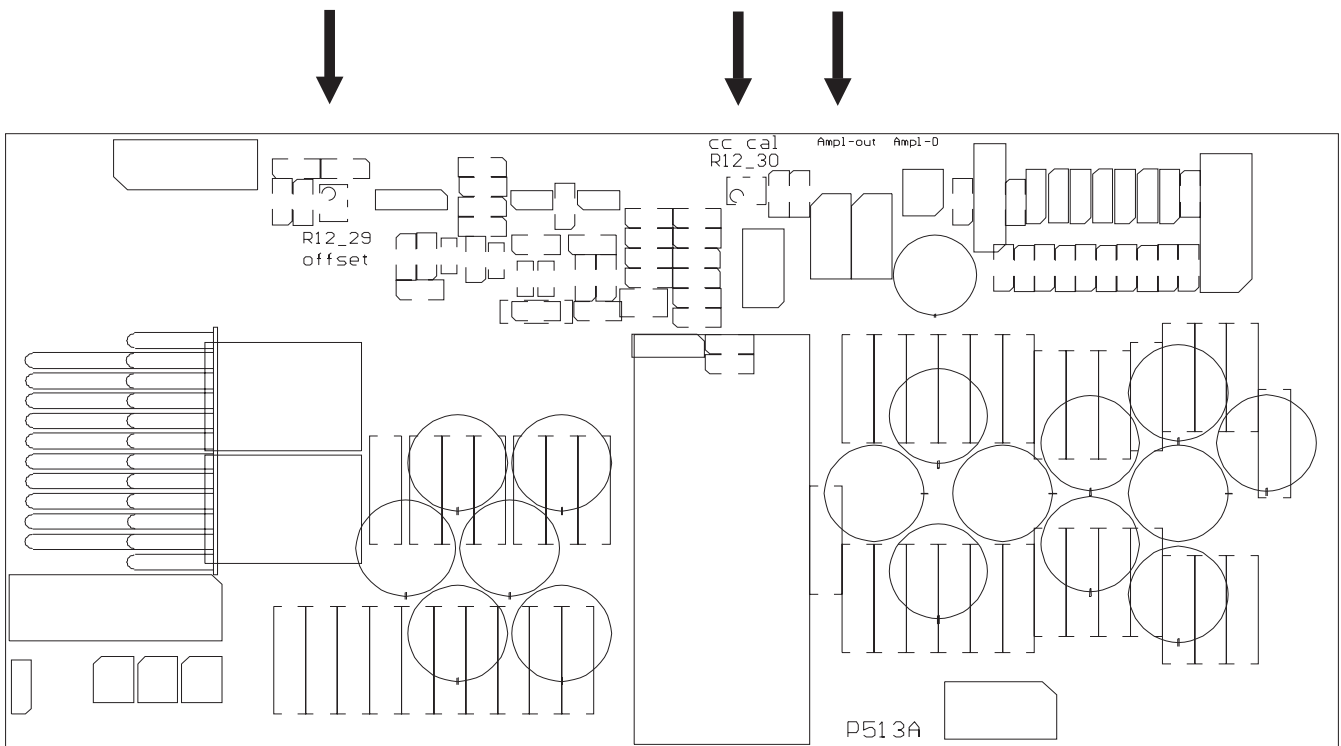

fig. 4 - 18
meter calibration, P507

fig. 4 - 19
calibrating CC-full scale and CC-offset
P513 and P541