DELTA ELEKTRONIKA BV

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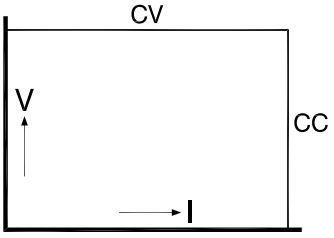
SM 6000 - series

6000 watts DC POWER SUPPLIES

Three phase input

SM 15-400	**0 - 15 V**	**0 - 400 A**
SM 30-200	**0 - 30 V**	**0 - 200 A**
SM 45-140	**0 - 45 V**	**0 - 140 A**
SM 60-100	**0 - 60 V**	**0 - 100 A**
SM 70-90	**0 - 70 V**	**0 - 90 A**
SM 120-50	**0 - 120 V**	**0 - 50 A**
SM 300-20	**0 - 300 V**	**0 - 20 A**
SM 600-10	**0 - 600 V**	**0 - 10 A**



- Efficiency up to 90 %
- Weight 27 kg
- 3 phase 380 V, 400 V, 415 V AC input
  480 V optional
  (48 - 62 Hz, line to line voltage)
- Active Power Factor Correction, PF=0.98
- 200 kHz MOSFET power conversion technique
- 0 - 5 V analog programmable
  (on both voltage and current)
- Isolated analog programming with optional ISO AMP CARD to prevent earth loops
- **Ethernet**, **CAN/PROFI-Bus, IEEE488** or **RS232** programming with optional interface cards
- Very low HF-emission, OK for **light** industrial environment, immunity OK for **industrial** environment
- Very low output ripple and spikes
- Very stable output voltage or current (5.10^{-5} - 10^{-4})
- Excellent dynamic response to load changes
- Master / Slave parallel and series operation with equal current and voltage sharing
- Can be used as a building block to form a high power unit
- Designed for long life at full power
- Protected against all overload and short circuit conditions
- V and I control with 10-turn potentiometers, resolution 0.03 %. Optional with digital encoders
- Silent blower, only runs when needed, variable speed
- Output On/Off button, Interlock-connector

	SM 15-400	SM 30-200	SM 45-140	SM 60-100	SM 70-90	SM 120-50	SM 300-20	SM600-10
Output								
voltage	0 - 15 V	0 - 30 V	0 - 45 V	0 - 60 V	0 - 70 V	0 - 120 V	0 - 300 V	0-600 V
current	0 - 400 A	0 - 200 A	0 - 140 A	0 - 100 A	0 - 90 A	0 - 50 A	0 - 20 A	0-10 A
Input								
AC 3 phase, 48 - 62 Hz								
for use at 380 V, 400 V, 415 V nominal line - line voltage	342 - 457 V	342 - 457 V	342 - 457 V	342 - 457 V	342 - 457 V	342 - 457 V	342 - 457 V	342 - 457 V
Option P165								
for use at 440 V, 480 V (USA) (operates from 360 V, but at derated output, 5300 W@360 V)	396 - 519 V	396 - 519 V	396 - 519 V	396 - 519 V	396 - 519 V	396 - 519 V	396 - 519 V	396 - 519 V
current (400 V / 3 ph, full load)	10.2 A	10 A	10.3 A	10 A	10.4 A	9.9 A	10 A	10 A
power factor, 100%, 50% load	0.98, 0.97	0.98, 0.97	0.98, 0.97	0.98, 0.97	0.98, 0.97	0.98, 0.97	0.98, 0.97	0.98, 0.97
internal fuses	15 AT	15 AT	15 AT	15 AT	15 AT	15 AT	15 AT	15 AT
standby input power (V_o=I_o=0)	55 W	55 W	55 W	55 W	55 W	55 W	55 W	55 W
standby input power (V_o=V_{max})	110 W	110 W	110 W	110 W	130 W	130 W	120 W	130 W
Efficiency								
400 V AC, 3 ph input, full load	87 %	89 %	90 %	89 %	89 %	89 %	89 %	89 %
Regulation								
Load 0 - 100% **CV**	2.5 mV	5 mV	5 mV	5 mV	5 mV	8 mV	15 mV	20 mV
Line 342 - 457 V AC **CV** (external voltage sense)	0.2 mV	0.5 mV	1 mV	2 mV	2 mV	2 mV	3 mV	4 mV
Load 0 - 100% **CC**	24 mA	12 mA	9 mA	6 mA	5 mA	3 mA	1.2 mA	1.0 mA
Line 342 - 457 V AC **CC** (internal voltage sense, after warm-up)	4 mA	2 mA	1.5 mA	1 mA	1 mA	0.5 mA	0.2 mA	0.2 mA
Ripple + noise								
rms (BW=300 kHz) **CV**	0.8 mV	1 mV	1.5 mV	2 mV	2 mV	3 mV	5 mV	10 mV
p-p (BW=50 MHz) **CV**	8 mV	8 mV	10 mV	10 mV	10 mV	25 mV (20 mV @ full load)	50 mV (30 mV @ full load)	100 mV (80 mV @ full load)
rms (BW=300 kHz) **CC**	100 mA	20 mA	8 mA	3 mA	3 mA	3 mA	2 mA	2 mA
p-p (BW=50 MHz) **CC**	300 mA	60 mA	25 mA	10 mA	10 mA	10 mA	5 mA	5 mA
CC-ripple at full load								
Temp. coeff., per °C **CV**	35.10^{-6}							
CC	60.10^{-6}							
Stability								
after 1 hr warm-up								
during 8 hrs **CV**	5.10^{-5}							
CC	10.10^{-5}							
t_{amb} = 25 ± 1 °C, V_{in} = 400 V AC internal voltage sensing for CC-stab.								

Analog Programming *Note: for specifications SM600-10 see below at ISO AMP.*	**CV**	**CC**
Programming inputs		
input range	0 - 5 V	0 - 5 V
accuracy	± 0.2%	± 0.5%
offset	- 0.1 ... +1.3 mV (on 5V)	0 ... +2.2 mV (on 5V)
temp. coeff. offset	10 µV / °C	50 µV / °C
input impedance	> 1 MOhm	> 1 MOhm
Monitoring outputs		
output range	0 - 5 V	0 - 5 V
accuracy	± 0.2%	± 0.5%
offset	- 1... 0 mV (on 5V)	- 1.1 ... 0 mV (on 5V)
temp. coeff. offset	3 µV / °C	60 µV / °C
output impedance	2 Ohm / max. 4 mA	2 Ohm / max. 4 mA
ISO AMP, Option P154	Isolated 0 - 5 V / 200 kOhm or 0 - 10 V / 400 kOhm programming input range. See datasheet ISO AMP on www.DeltaPowerSupplies.com for accuracy, offset etc. *Note that SM600-10 has standard "isolated" analog programming.*	

Reference voltage		
on prog. connector	V_{ref}	5.114 ± 15 mV (Ro = 2 Ohm, max. 4 mA)
	TC	20 ppm / °C
+12 V output	V_o	12 V ± 0.2 V
on prog. Connector	I_{max}	0.2 A
	R_o	3 Ohm

Status outputs			
CC - status	CC - operation	5 V = logic 1	(R_o = 500 Ohm)
LIM - status	CV or CC limit	5 V = logic 1	(R_o = 500 Ohm)
OT - status	Over Temperature	5 V = logic 1	(R_o = 500 Ohm)
PSOL - status	Power Sink Overload	5 V = logic 1	(R_o = 500 Ohm)
ACF - status	AC - Fail	5 V = logic 1	(R_o = 500 Ohm)
DCF - status	DC - Fail [1])	5 V = logic 1	(R_o = 500 Ohm)
Relay Outputs			
ACF	AC - Fail	both NO and NC contact	
DCF	DC - Fail [1])	both NO and NC contact	[1]) output ± 5% beyond set point
Remote ShutDown	with + 5V, 1 mA or relay contact		
Interlock	contact at rear panel, see photo of rear panel on page 1-6		
Indicators (front panel)	AC-Fail, DC-Fail, Over Temperature, Power Sink Overload, Remote-ShutDown, Remote-CV, Remote-CC, Output On, CV-limit, CC-limit, CV- and CC- mode		
Controls (front panel)	Mains on/off, CV-and CC-potmeter, CV- and CC-limit-potmeter, Display-Settings button, Display-Limits button, Remote/Local, Output On/Off, Front panel Lock		

Programming speed *Standard Version* (resistive load)	**SM 15-400**	**SM 30-200**	**SM 45-140**	**SM 60-100**	**SM 70-90**	**SM 120-50**	**SM 300-20**	**SM 600-10**
Rise time (10 - 90%)								
output voltage step	0 → 15 V	0 → 30 V	0 → 45 V	0 → 60 V	0 → 70 V	0 → 120 V	0 → 300 V	0 → 600 V
time, (100 % load)	3.3 ms	6.4 ms	2.7 ms	5.4 ms	6.8 ms	5.1 ms	8.5 ms	12 ms
time, (10 % load)	1.3 ms	2.5 ms	1.1 ms	2.2 ms	2.8 ms	1.9 ms	3.2 ms	4.8 ms
Fall time (90 - 10%)								
output voltage step	15 → 0 V	30 → 0 V	45 → 0 V	60 → 0 V	70 → 0 V	120 → 0 V	300 → 0 V	600 → 0 V
time, (100 % load)	3.5 ms	6.7 ms	2.9 ms	5.8 ms	7.7 ms	4.9 ms	8.3 ms	12 ms
time, (10 % load)	34 ms	67 ms	32 ms	59 ms	77 ms	52 ms	83 ms	120 ms
Programming speed *High Speed Version* (resistive load)	**SM 15-400** *Option P166*	**SM 30-200** *Option P167*	**SM 45-140** *Option P168*	**SM 60-100** *Option P169*	**SM 70-90** *Option P170*	**SM 120-50** *Option P171*	**SM 300-20** *Option P172*	**SM 600-10** *Option P270*
Rise time (10 - 90%)								
output voltage step	0 → 15 V	0 → 30 V	0 → 45 V	0 → 60 V	0 → 70 V	0 → 120 V	0 → 300 V	0 → 600 V
time, (100 % load)	0.40 ms	0.41 ms	0.53 ms	0.44 ms	0.62 ms	0.57 ms	1.1 ms	1.9 ms
time, (10 % load)	0.38 ms	0.38 ms	0.16 ms	0.41 ms	0.40 ms	0.19 ms	0.44 ms	0.80 ms
Fall time (90 - 10%)								
output voltage step	15 → 0 V	30 → 0 V	45 → 0 V	60 → 0 V	70 → 0 V	120 → 0 V	300 → 0 V	600 → 0 V
time, (100 % load)	0.39 ms	0.41 ms	0.26 ms	0.57 ms	0.50 ms	0.38 ms	1.0 ms	2.2 ms
time, (10 % load)	1.5 ms	3.6 ms	10 ms	5.6 ms	6.2 ms	4.2 ms	10 ms	20 ms
Ripple @ full load								
typical (rms / pp)	6/20mV	28/80mV	34/80mV	34/90mV	38/100mV	30/120mV	48/150mV	35/220mV
Output Capacitance (typical)	1200 µF	800 µF	520 µF	330 µF	290 µF	73 µF	32 µF	19 µF

	SM 15-400	**SM 30-200**	**SM 45-140**	**SM 60-100**	**SM 70-90**	**SM 120-50**	**SM 300-20**	**SM 600-10**
Recovery time								
recovery within	60 mV	50 mV	100 mV	100 mV	100 mV	0.5 V	1 V	1 V
di/dt of load step	5 A/µs	2.5 A/µs	1.8 A/µs	1.3 A/µs	1.7 A/µs	1 A/µs	0.25 A/µs	0.125 A/µs
output voltage	13 V	25 V	40 V	55 V	65 V	110 V	280 V	560 V
time, @ 50 - 100% load step	120 µs	100 µs	100 µs	100 µs	100 µs	100 µs	100 µs	100 µs
max. deviation	320 mV	260 mV	380 mV	250 mV	280 mV	1 V	1.8 V	1.8 V
Output impedance								
CV, 0-1 kHz	< 0.5 mΩ	< 1.2 mΩ	< 1.7 mΩ	< 1.5 mΩ	< 1.8 mΩ	< 11 mΩ	< 34 mΩ	< 70 mΩ
CV, 1-100 kHz	< 2.3 mΩ	< 5 mΩ	< 10 mΩ	< 12 mΩ	< 12 mΩ	< 90 mΩ	< 330 mΩ	< 700 mΩ
Pulsating load								
max. tolerable AC component of load current								
f > 1 kHz	30 Arms	35 Arms	20 Arms	20 Arms	20 Arms	10 Arms	5 Arms	2.5 Arms
f < 1 kHz	400 Apeak	200 Apeak	140 Apeak	100 Apeak	90 Apeak	50 Apeak	20 Apeak	10 Apeak

Insulation		
input / output	3750 Vrms (1 min.)	
creepage / clearance	8 mm	
input / case	2500 Vrms	
output / case	600 V DC	(1200 V DC for SM600-10)
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 **Generic Immunity**	**EN 61000-6-3**, residential, **light** industrial environment (EN 55022 **B**) **EN 61000-6-2**, industrial environment
Operating Temperature at full load	– 20 to + 50 °C derate output to 75% at 60 °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

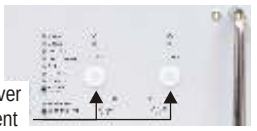
	SM 15-400	**SM 30-200**	**SM 45-140**	**SM 60-100**	**SM 70-90**	**SM 120-50**	**SM 300-20**	**SM 600-10**
Hold-Up time V_{out} = 100%, I_{out} = 100% V_{out} = 85%, I_{out} = 100% V_{out} = 100%, I_{out} = 50% *@ 400 V AC input*	11 ms 23 ms 33 ms	11 ms 23 ms 28 ms	11 ms 23 ms 27 ms	11 ms 24 ms 28 ms	13 ms 23 ms 30 ms	13 ms 24 ms 32 ms	12 ms 24 ms 28 ms	11 ms 23 ms 27 ms
Turn on delay after mains switch on	200 ms							
Inrush current	20 A (electronic limit)							
Phase loss	Output shuts down in case of phase loss							

Series operation max. total voltage Master / Slave operation	600 V yes	600 V yes	600 V yes	600 V yes	600 V yes	600 V yes	600 V yes	1200V yes
Parallel operation Normal Master / Slave operation	no limit max. 3 units							
Remote sensing max. voltage drop per load lead	2 V							
Limits Voltage adjust range **Current** adjust range	0 - 102% 0 - 102%							
Potentiometers & Encoders front panel control with knobs resolution screwdriver adjustment digital encoders	standard 0.03 % (10 turns) Option P001 (at front panel) Option P220							
Meters scale voltage scale current accuracy read output read limit setting (d = digit)	3.5 digit 0 - 15.00 V 0 - 400 A 0.5% + 2 d 2% + 2 d	3.5 digit 0 - 30.0 V 0 - 200 A 0.5% + 2 d 2% + 2 d	3.5 digit 0 - 45.0 V 0 - 140.0 A 0.5% + 2 d 2% + 2 d	3.5 digit 0 - 60.0 V 0 - 100.0 A 0.5% + 2 d 2% + 2 d	3.5 digit 0 - 70.0 V 0 - 90.0 A 0.5% + 2 d 2% + 2 d	3.5 digit 0 - 120.0 V 0 - 50.0 A 0.5% + 2 d 2% + 2 d	3.5 digit 0 - 300 V 0 - 20.0 A 0.5% + 2 d 2% + 2 d	3.5 digit 0 - 600 V 0 - 10.0 A 0.5% + 2 d 2% + 2 d

Mounting	Stacking of units allowed, air flow is from left to right.							
Input Terminals	Screw Terminals for cable 2.5 - 4 mm^2, 3 phase + earth (no neutral required)							
Output Terminals	M12 bolts	M10 bolts	M10 bolts	M10 bolts	M10 bolts	M8 bolts	M8 bolts	M8 bolts
Programming connector	15 pole D-connector at rear panel (FEMALE)							
Cooling audio noise level airflow	Low noise blower, fan speed adapts to temperature of internal heatsink. ca. 56 dBA at full load, 25 °C ambient temperature, 1 m distance ca. 62 dBA at full load, 50 °C ambient temperature, 1 m distance From left to right							
Enclosure degree of protection	IP20							
Dimensions behind front panel: h x w x d front panel: h x w	177 x 443 x 500 mm 177 x 483 mm (19", 4 U)							
Weight	27 kg							

Digital Encoders — OPTION P220

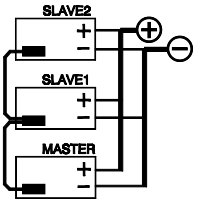
- CV and CC encoders with a very long life time and intelligent functions (e.g. Keylock).



Screwdriver adjustment standard potentiometers — OPTION P001

- CV and CC knobs are moved backwards to avoid accidental adjusting.

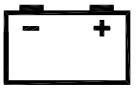
Master / Slave operation



- 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).
- Easy to connect in Master / Slave mode, using standard UTP-cables (RJ45).

Standard on all SM6000 units, no special option required.

Battery Charging



- 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 45-140	SM 120-50	SM 300-20
Option	P151	P152	P153

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 **SM30-200 P069 output 32 V**.

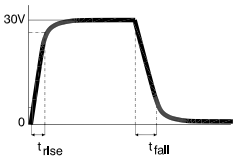
For exact details consult the technical department, email 'Support@Delta-Elektronika.nl'.

Enforced secondary isolation 1000 V — OPTION P089

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

Note that the SM600-10 standard has 1200 V isolation voltage.

High Speed Programming



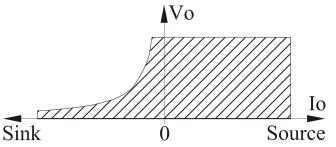
- The speed is **10 - 20 times higher** because of the smaller output capacitors.
- Relatively low current overshoots (if any) in case of sudden voltage variations caused by the load, this is of great advantage for laser diode applications.

Applications:

- **Laser diode** power supply, continuous or pulsed.
- Test systems requiring a fast settling time to improve throughput of factory.
- A constant current source with a low parallel capacitance: plasma, load sensitive to current overshoots, etc.
- A constant current source on a load with **fast voltage variations**.
- *Ordering information:*

	SM 15-400	SM 30-200	SM 45-140	SM 60-100	SM 70-90	SM 120-50	SM 300-20	SM 600-10
Option	P166	P167	P168	P169	P170	P171	P172	P270

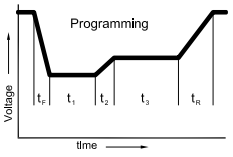
Power Sink for 2 quadrant operation



- Can absorb **700 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:*

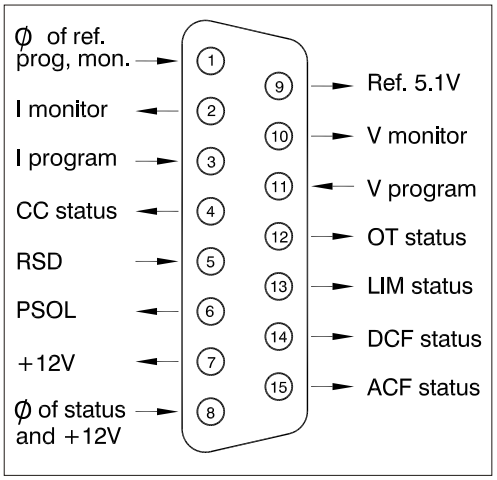
	SM 15-400	SM 30-200	SM 45-140	SM 60-100	SM 70-90
Option	P230	P231	P232	P233	P234

Built-in ISO AMP CARD for isolated analog programming — OPTION P154
Built-in RS232 Power Supply Controller — OPTION P155
Built-in IEEE488 Power Supply Controller — OPTION P156
Built-in Ethernet Power Supply Controller — OPTION P157
Built-in Profibus Power Supply Controller — OPTION P277
Built-in CANopen Power Supply Controller — OPTION P278



440 and 480 V AC input (USA) — OPTION P165

Notes: 1. Download special datasheets about High Speed Programm., Power Sink and Battery Charging from www.DeltaPowerSupplies.com.
2. There is only room for one of the interfaces in a unit (P154, P155, P156, P157, P277 or P278).
*3. SM600-10 is standard equipped with P154 (ISO AMP), this can be **replaced** by P155, P156, P157, P277 or P278.*



Connections analog programming connector

CV= Constant Voltage
CC= Constant Current

Specifications measured at
t_{amb} *= 25 ± 5 °C and Vin = 400 V AC, 50 Hz, 3 phase, unless otherwise noted.*

The information in this document is subject to change without notice