

Visserdijk 4
4301 ND Zierikzee
The Netherlands

Tel. +31 111 413656
Fax. +31 111 416919
www.deltapowersupplies.com



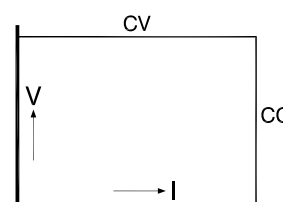
DELTA ELEKTRONIKA B.V.



SM 6000 - Series 6000 W DC POWER SUPPLIES

Three phase input

Models	Voltage range	Current range
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



Features

- cTUVus safety approval
- Designed for long life at full power
- Excellent dynamic response to load changes
- Protected against all overload and short circuit conditions
- EMC surpasses CE requirements: low emission & high immunity
- Low audible noise: temperature controlled fans
- Available options: analog & digital Interfaces, High Speed Programming, Digital Encoders, Sequencer, Power Sink etc.

Functionalities

- Master/Slave parallel and series operation with voltage and current sharing
- Stacking is allowed, space between units is not required
- High power system configuration from multiple units
- 19" rack mounting or laboratory use (feet included)
- Remote sensing
- Interlock

	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 current	0 - 15 V 0 - 400 A	0 - 30 V 0 - 200 A	0 - 45 V 0 - 140 A	0 - 60 V 0 - 100 A	0 - 70 V 0 - 90 A	0 - 120 V 0 - 50 A	0 - 300 V 0 - 20 A	0-600 V 0-10 A
Input AC 3 phase, 48 - 62 Hz rated voltage range rated frequency rated current	342 - 528 V 380 - 480 V 50 / 60 Hz Max. 12.2 A	342 - 528 V 380 - 480 V 50 / 60 Hz Max. 12.2 A	342 - 528 V 380 - 480 V 50 / 60 Hz Max. 12.2 A	342 - 528 V 380 - 480 V 50 / 60 Hz Max. 12.2 A	342 - 528 V 380 - 480 V 50 / 60 Hz Max. 12.2 A	342 - 528 V 380 - 480 V 50 / 60 Hz Max. 12.2 A	342 - 528 V 380 - 480 V 50 / 60 Hz Max. 12.2 A	342 - 528 V 380 - 480 V 50 / 60 Hz Max. 12.2 A
current (400 V / 3 ph, full load) power factor, 100%, 50% load	10.2 A 0.98, 0.97	10 A 0.98, 0.97	10.3 A 0.98, 0.97	10 A 0.98, 0.97	10.4 A 0.98, 0.97	9.9 A 0.98, 0.97	10 A 0.98, 0.97	10 A 0.98, 0.97
internal fuses standby input power ($V_o=I_o=0$) standby input power ($V_o=V_{max}$)	15 AT 55 W 110 W	15 AT 55 W 110 W	15 AT 55 W 110 W	15 AT 55 W 110 W	15 AT 55 W 130 W	15 AT 55 W 130 W	15 AT 55 W 120 W	15 AT 55 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 Line 342 - 457 V AC CV (external voltage sense)	2.5 mV 0.2 mV	5 mV 0.5 mV	5 mV 1 mV	5 mV 2 mV	5 mV 2 mV	8 mV 2 mV	15 mV 3 mV	20 mV 4 mV
Load 0 - 100% CC Line 342 - 457 V AC CC (internal voltage sense, after warm-up)	24 mA 4 mA	12 mA 2 mA	9 mA 1.5 mA	6 mA 1 mA	5 mA 1 mA	3 mA 0.5 mA	1.2 mA 0.2 mA	1.0 mA 0.2 mA
Ripple + noise rms (BW=300 kHz) CV p-p (BW=20 MHz) CV	0.8 mV 8 mV	1 mV 8 mV	1.5 mV 10 mV	2 mV 10 mV	2 mV 10 mV	3 mV 25 mV (20 mV @ full load)	5 mV 50 mV (30 mV @ full load)	10 mV 100 mV (80 mV @ full load)
rms (BW=300 kHz) CC p-p (BW=20 MHz) CC CC-ripple at full load	100 mA 300 mA	20 mA 60 mA	8 mA 25 mA	3 mA 10 mA	3 mA 10 mA	3 mA 10 mA	2 mA 5 mA	2 mA 5 mA
Temp. coeff., per °C CV CC	35.10 ⁻⁶ 60.10 ⁻⁶							
Stability after 1 hr warm-up during 8 hrs CV CC $t_{amb} = 25 \pm 1 \text{ °C}$, $V_{in} = 400 \text{ V AC}$ internal voltage sensing for CC-stab.	5.10 ⁻⁵ 10.10 ⁻⁵							

Analog Programming <i>Note: for SM300-20 / SM600-10 see ISO AMP</i>	CV	CC
Programming inputs input range accuracy offset temp. coeff. offset input impedance	0 - 5 V $\pm 0.2\%$ - 0.1 ... +1.3 mV (on 5V) 10 $\mu\text{V} / \text{°C}$ > 1 MOhm	0 - 5 V $\pm 0.5\%$ 0 ... +2.2 mV (on 5V) 50 $\mu\text{V} / \text{°C}$ > 1 MOhm
Monitoring outputs output range accuracy offset temp. coeff. offset output impedance	0 - 5 V $\pm 0.2\%$ - 1... 0 mV (on 5V) 3 $\mu\text{V} / \text{°C}$ 2 Ohm / max. 4 mA	0 - 5 V $\pm 0.5\%$ - 1.1 ... 0 mV (on 5V) 60 $\mu\text{V} / \text{°C}$ 2 Ohm / max. 4 mA
ISO AMP Programming <i>optional for low volt. units up to 120V (P154), standard on SM300-20 and SM600-10.</i>	Isolated analog programming, range 0 - 5 V / 200 kOhm or 0 - 10 V / 400 kOhm. See datasheet ISO AMP on www.DeltaPowerSupplies.com for accuracy, offset etc.	

Reference voltage on prog. connector	V_{ref} TC	5.114 $\pm$ 15 mV ($R_o = 2 \text{ Ohm}$, max. 4 mA) 20 ppm / °C
+12 V output on prog. Connector	V_o I_{max} R_o	12 V $\pm$ 0.2 V 0.2 A 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 <i>Standard Version</i> (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 time, (100 % load) time, (10 % load)	0 → 15 V 3.3 ms 1.3 ms	0 → 30 V 6.4 ms 2.5 ms	0 → 45 V 2.7 ms 1.1 ms	0 → 60 V 5.4 ms 2.2 ms	0 → 70 V 6.8 ms 2.8 ms	0 → 120 V 5.1 ms 1.9 ms	0 → 300 V 8.5 ms 3.2 ms	0 → 600 V 12 ms 4.8 ms
Fall time (90 - 10%) output voltage step time, (100 % load) time, (10 % load)	15 → 0 V 3.5 ms 34 ms	30 → 0 V 6.7 ms 67 ms	45 → 0 V 2.9 ms 32 ms	60 → 0 V 5.8 ms 59 ms	70 → 0 V 7.7 ms 77 ms	120 → 0 V 4.9 ms 52 ms	300 → 0 V 8.3 ms 83 ms	600 → 0 V 12 ms 120 ms
Programming speed <i>High Speed Version</i> (resistive load)	SM 15-400 <i>Option P166</i>	SM 30-200 <i>Option P167</i>	SM 45-140 <i>Option P168</i>	SM 60-100 <i>Option P169</i>	SM 70-90 <i>Option P170</i>	SM 120-50 <i>Option P171</i>	SM 300-20 <i>Option P172</i>	SM 600-10 <i>Option P270</i>
Rise time (10 - 90%) output voltage step time, (100 % load) time, (10 % load)	0 → 15 V 0.40 ms 0.38 ms	0 → 30 V 0.41 ms 0.38 ms	0 → 45 V 0.53 ms 0.16 ms	0 → 60 V 0.44 ms 0.41 ms	0 → 70 V 0.62 ms 0.40 ms	0 → 120 V 0.57 ms 0.19 ms	0 → 300 V 1.1 ms 0.44 ms	0 → 600 V 1.9 ms 0.80 ms
Fall time (90 - 10%) output voltage step time, (100 % load) time, (10 % load)	15 → 0 V 0.39 ms 1.5 ms	30 → 0 V 0.41 ms 3.6 ms	45 → 0 V 0.26 ms 10 ms	60 → 0 V 0.57 ms 5.6 ms	70 → 0 V 0.50 ms 6.2 ms	120 → 0 V 0.38 ms 4.2 ms	300 → 0 V 1.0 ms 10 ms	600 → 0 V 2.2 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 di/dt of load step output voltage time, @ 50 - 100% load step max. deviation	60 mV 5 A/µs 13 V 120 µs 320 mV	50 mV 2.5 A/µs 25 V 100 µs 260 mV	100 mV 1.8 A/µs 40 V 100 µs 380 mV	100 mV 1.3 A/µs 55 V 100 µs 250 mV	100 mV 1.7 A/µs 65 V 100 µs 280 mV	0.5 V 1 A/µs 110 V 100 µs 1 V	1 V 0.25 A/µs 280 V 100 µs 1.8 V	1 V 0.125 A/µs 560 V 100 µs 1.8 V
Output impedance CV, 0-1 kHz CV, 1-100 kHz	< 0.5 mΩ < 2.3 mΩ	< 1.2 mΩ < 5 mΩ	< 1.7 mΩ < 10 mΩ	< 1.5 mΩ < 12 mΩ	< 1.8 mΩ < 12 mΩ	< 11 mΩ < 90 mΩ	< 34 mΩ < 330 mΩ	< 70 mΩ < 700 mΩ
Pulsating load max. tolerable AC component of load current f > 1 kHz f < 1 kHz	30 Arms 400 Apeak	35 Arms 200 Apeak	20 Arms 140 Apeak	20 Arms 100 Apeak	20 Arms 90 Apeak	10 Arms 50 Apeak	5 Arms 20 Apeak	2.5 Arms 10 Apeak

Insulation input / output creepage / clearance input / case output / case	3750 Vrms (1 min.) 8 mm 2500 Vrms 600 V DC (1200 V DC for SM300-20 and SM600-10)
Safety	cTUVus / 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	1200 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%							
Front panel CV/CC-controls resolution knob operation screwdriver adjustment Lock function for CV/CC-settings Selectable Start-up at 0V / 0A or at last settings	analog potentiometers ¹⁾ 10 turns (0.03%) standard optional (P001) no no ¹⁾ optional with digital encoders (P220) : specifications for controls are similar to SM300-20 and SM600-10.						digital encoders 10 or 64 turns ²⁾ standard no yes yes ²⁾ variable pitch depending on operation speed	
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							

Typical Applications

- Solar inverter testing, PV-Simulation
- Controlled Battery (dis)charging
- Plasma chambers
- Lasers
- Hybrid Car test systems
- Driving PWM-Controlled DC motors
- ATE in industrial production lines
- Accurate current sources
- Automotive battery simulations
- Aerospace and military equipment

Available Options



Increased Output Power

The conservatively rated unit allows to deliver extra output with the same reliability.

At some derating, either the maximum output voltage or the maximum output current can be increased by about 10%.

- Order Code - P069



High Speed Programming

A 10 to 20 times higher programming speed (down to 0.4 ms rise time at full load)

and lower output capacitance ¹⁾. Excellent for laser applications, test systems or as current source with low parallel capacitance as used in plasma chambers.

- Order Codes:

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



Two-Quadrant Output: Power sink

Two quadrant operations maintains the output voltage constant

regardless the output power is positive or negative ¹⁾. Ideal for PWM-speed controlled DC-motors and ATE systems.

- Order Codes:

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



Sequencer

Arbitrary Waveform generator or standalone automation. The sequencer is integrated in the Ethernet controller.

- Order Code - P157



High Voltage Isolation

A higher output isolation allows series operation up to 1200V. Is standard on SM300-20 and SM600-10.

- Order Code - P089



High Input Voltage

All units standard have a rated input voltage range of 380...480 V AC. Option P165 has become obsolete.

For older units, the nominal input voltage was 440 V AC, and option P165 was needed for operation at 480 V AC (check rear panel).



Software control and Interfaces

Factory installed programming interfaces ²⁾:

- ISO AMP Card - isolated analog - P154 ³⁾
- RS232 controller - P155
- IEEE488 controller - P156
- Ethernet contr. (incl. sequencer) - P157
- PROFIBUS controller - P277
- CANBUS controller - P278



Digital Voltage and Current Setting

Reliable, longlife digital encoders can be implemented at the front panel.

Includes total front panel lock (also for CV/CC-knobs) and a coarse or fine pitch adjustment depending on the turning speed. Is standard on SM300-20 and SM600-10.

- Order Code - P220

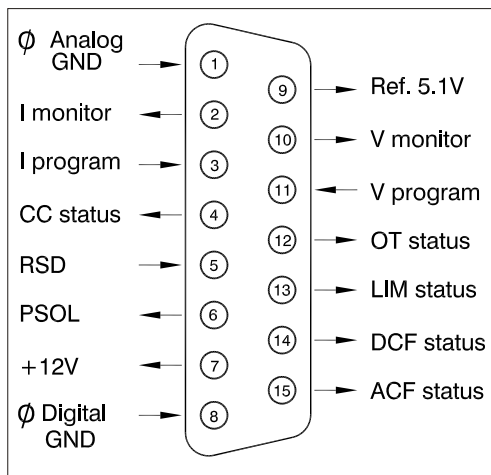


Secured Voltage and Current Setting

For a maximum security, the CV/CC settings can be adjusted with a screwdriver only and are protected with a plastic cap from accidental adjusting. SM300-20, SM600-10 and units with option P220 already have secured settings.

- Order Code - P001

Notes: 1. Download special datasheets about High Speed Progr., 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. SM300-20 and SM 600-10 standard equipped with ISO AMP, this can be replaced by P155, P156, P157, P277 or P278.



Connections analog programming connector

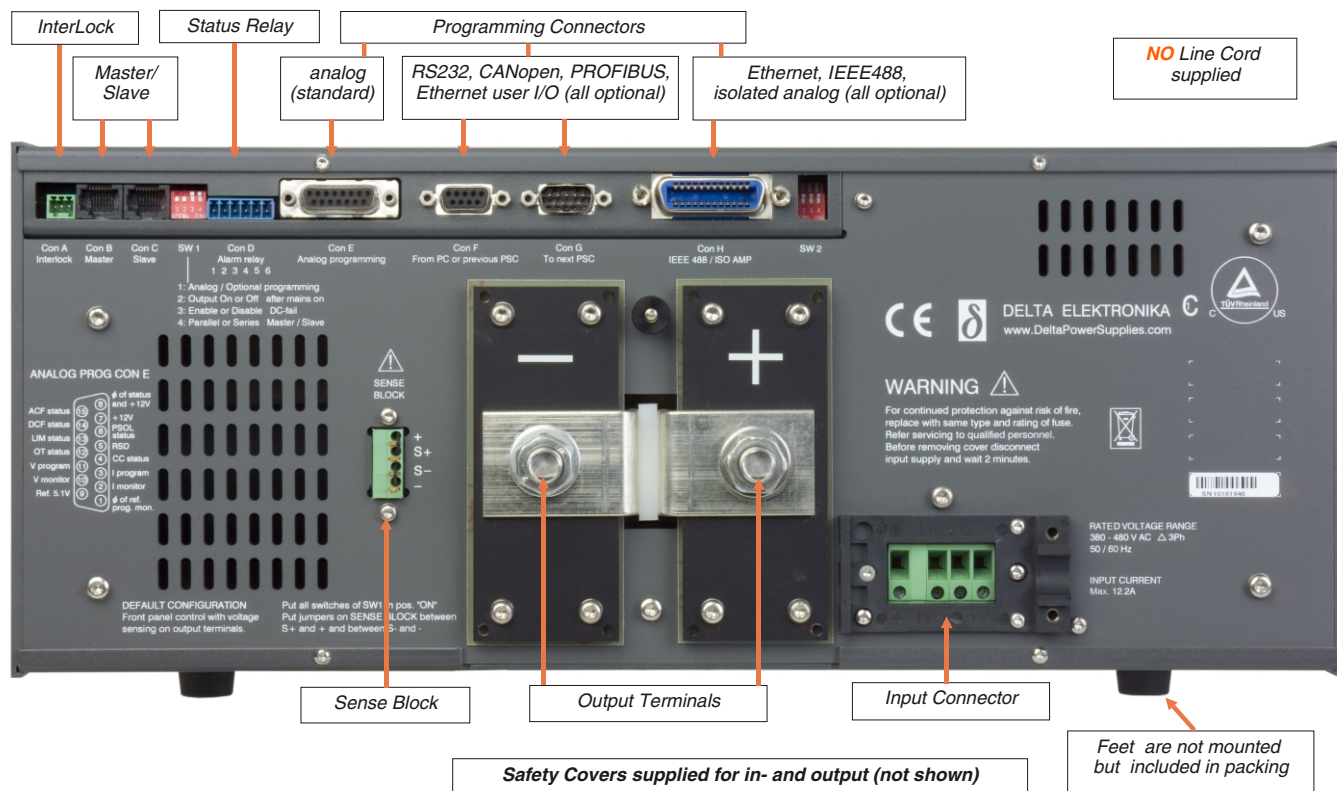
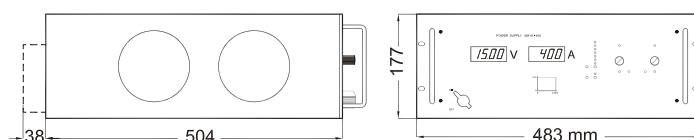
CV= Constant Voltage

CC= Constant Current

Specifications measured at

 $t_{amb} = 25 \pm 5^\circ C$ and $V_{in} = 400 V AC$, 50 Hz, 3 phase, unless otherwise noted.

The information in this document is subject to change without notice



Note: SM300-20 and SM 600-10 standard with isolated analog programming via ISO AMP on CON H (CON E is not available).