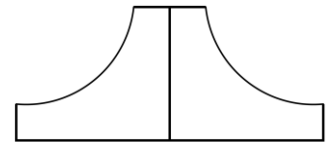




## SM15K - Series 15kW DC POWER SUPPLIES

### Bi-Directional - Constant Power

Models	Voltage range	Current range
SM70-CP-450	0 – 70 V	- 450 – 450 A
SM210-CP-150	0 – 210 V	-150 – 150 A
SM500-CP-90	0 – 500 V	-90 – 90 A
SM1000-CP-45	0 – 1000V	-45 – 45 A
SM1500-CP-30	0 – 1500 V	-30 – 30 A



### Features

- Bi-directional power supply, standard 15kW Source & Sink
- Flexible output with constant power characteristic
- Power regeneration technology: sink power is not dissipated but fed back into the grid
- Designed for long life at continuous full power
- Excellent dynamic response to load changes, digital controlled with the possibility to adapt to the type of load
- Very low heat dissipation, efficiency 95% or more
- Protected against all overload and short circuit conditions

### Functionalities

- Operation on a wide range of three phase AC input voltages
- Standard ethernet & web interface
- EMC surpasses CE requirements: low emission & high immunity
- Low audible noise: temperature controlled cooling fans
- Durable digital encoders for voltage & current adjustment and menu operation
- Large user display, menu driven operations

	SM70-CP-450	SM210-CP-150	SM500-CP-90	SM1000-CP-45	SM1500-CP-30
<b>Output rating</b>					
Voltage range	0 - 70 V	0 - 210 V	0 - 500 V	0 - 1000 V	0 - 1500 V
Current range	-450 - 450 A	-150 - 150 A	-90 - 90 A	-45 - 45 A	-30 - 30 A
<b>Regenerative mode</b>					
Minimum sink voltage	1.2 V @ -450 A	3.0 V @ -150 A	7.0 V @ -90 A	12.0 V @ -45 A	19.5 V @ -30 A
<i>Note: Unit switches automatically between source ↔ sink.</i>	0.8 V @ -215 A	1.5 V @ -75 A	5.0 V @ -30 A	8.5 V @ -15 A	14 V @ -10 A
Absolute maximum sink voltage	0.8 V @ -45 A	1.5 V @ -15 A	2.0 V @ -10 A	2.5 V @ -5 A	4.5 V @ -3 A
Minimum sink current	74 V	220 V	525 V	1050 V	1575 V
Minimum sink power	0.4%	0.4%	0.4%	0.4%	0.4%
	0.8%	0.8%	1.2%	1.2%	1.2%
<b>AC Input</b>					
Rated voltage range	380 - 480 V				
Rated frequency	50 / 60 Hz				
Rated current	Maximum 27 A				
Current, 15kW	23 A				
Power factor, 15kW / 7.5kW	0.996 / 0.988				
Internal fuses	30 AT				
Standby input power ( $V_o=I_o=0$ ) <sup>1</sup>	100 W				
Standby input power ( $V_o=V_{max}$ ) <sup>1</sup>	180 W				
<b>Efficiency (Sink &amp; Source mode):</b>					
15 kW, $I_{out}=100\%$	95 %				
15 kW, $U_{out}=100\%$	96 %				
<b>Regulation</b>					
Load 0 - 100% <b>CV</b>	6 mV	5 mV	4 mV	10mV	10 mV
Line 342 - 528 $V_{AC}$ <sup>2</sup> <b>CV</b>	< 1 mV	< 1 mV	< 1 mV	<1mV	< 1 mV
Load 0 - 100% <b>CC</b>	35 mA	12 mA	8 mA	2mA	2 mA
Line 342 - 528 $V_{AC}$ <sup>1,3</sup> <b>CC</b>	4 mA	3 mA	1 mA	1mA	1 mA
<b>Ripple + noise</b> <sup>5</sup>					
Source mode:	33 V / 450 A	100 V / 150 A	167 V / 90 A	333V / 45A	500 V / 30 A
rms (BW=300 kHz) <b>CV</b>	10 mV	30 mV	10 mV	25mV	25 mV
p-p (BW=20 MHz) <b>CV</b>	60 mV	150 mV	55 mV	150mV	150 mV
rms (BW=300 kHz) <b>CC</b>	100 mA	-	45 mA	45mA	12 mA
p-p (BW=20 MHz) <b>CC</b>	-	-	200 mA	200mA	70 mA
rms (BW=300 kHz) <b>CV</b>	70 V / 215 A	210 V / 71.5 A	500 V / 30 A	1000V / 15A	1500 V / 10 A
p-p (BW=20 MHz) <b>CV</b>	10 mV	20 mV	25mV	35mV	35mV
p-p (BW=20 MHz) <b>CV</b>	60 mV	125 mV	115mV	250mV	250mV
rms (BW=300 kHz) <b>CC</b>	100 mA	-	45 mA	45mA	5 mA
p-p (BW=20 MHz) <b>CC</b>	-	-	200 mA	200mA	25 mA
Sink mode:	33 V / 450 A	100 V / 150 A	167 V / 90 A	333V / 45A	500 V / 30 A
rms (BW=300 kHz) <b>CV</b>	8 mV	30 mV	7 mV	15mV	15 mV
p-p (BW=20 MHz) <b>CV</b>	50 mV	150 mV	35 mV	75mV	130 mV
rms (BW=300 kHz) <b>CC</b>	100 mA	-	45 mA	60mA	10 mA
p-p (BW=20 MHz) <b>CC</b>	-	-	200 mA	-	60 mA
rms (BW=300 kHz) <b>CV</b>	70 V / 215 A	210 V / 71.5 A	500 V / 30 A	1000V / 15A	1500 V / 10 A
p-p (BW=20 MHz) <b>CV</b>	8 mV	20 mV	10 mV	25mV	25 mV
p-p (BW=20 MHz) <b>CV</b>	50 mV	125 mV	50 mV	125mV	200 mV
rms (BW=300 kHz) <b>CC</b>	100 mA	-	90 mA	60mA	3 mA
p-p (BW=20 MHz) <b>CC</b>	-	-	320 mA	-	12 mA
<b>Programming &amp; monitoring accuracy</b> <sup>4</sup>					
Voltage	± 0.08%				
Current	± 0.15%				
<b>Temperature coefficient, per °C</b> <sup>1,5</sup>					
<b>CV</b>	20 ppm				
<b>CC</b>	50 ppm				
<b>Stability over 8 hours</b> <sup>1,5</sup>					
<b>CV</b>	50 ppm				
<b>CC</b> <sup>3</sup>	80 ppm				

<sup>1</sup> After 1 hour warm up<sup>2</sup> Remote voltage sense<sup>3</sup> Local voltage sense<sup>4</sup> Excluding INT MOD ANA<sup>5</sup> Measured at full load

	SM70-CP-450	SM210-CP-150	SM500-CP-90	SM1000-CP-45	SM1500-CP-30
<b>Programming speed</b> <sup>6, 7</sup>					
<b>Rise time (10 - 90%)</b>					
Output voltage step	0 → 33 V	0 → 100 V	0 → 167 V	0 → 333 V	0 → 500 V
Load = 15 kW	2.2 ms	1.6 ms	1.5 ms	1.5 ms	1.5 ms
Load = 1500 W	1.5 ms	1.3 ms	1 ms	1 ms	1 ms
Output voltage step	0 → 70 V	0 → 210 V	0 → 500 V	0 → 1000 V	0 → 1500 V
Load = 15 kW	5.5 ms	3 ms	4.5 ms	4.5 ms	4.5 ms
Load = 1500 W	3.5 ms	2.7 ms	3.5 ms	3.5 ms	3.5 ms
<b>Fall time (90 - 10%)</b>					
Output voltage step	33 → 0 V	100 → 0 V	167 → 0 V	333 → 0 V	500 → 0 V
Load = 15 kW	1.5 ms	1.3 ms	0.8 ms	0.9 ms	0.8 ms
Load = 1500 W	1.5 ms	1.3 ms	0.9 ms	1.0 ms	0.9 ms
Output voltage step	70 → 0 V	210 → 0 V	500 → 0 V	1000 → 0 V	1500 → 0 V
Load = 15 kW	2.6 ms	2.5 ms	2.5 ms	2.8 ms	2.8 ms
Load = 1500 W	3.5 ms	2.5 ms	3.5 ms	3.5 ms	3.5 ms
<b>Recovery time</b> <sup>8, 9</sup>					
Condition	33V, 225 → 450A	100V, 75 → 150A	167V, 45 → 90A	333V, 22.5 → 45A	500V, 15 → 30A
Recovery within	100 mV	500 mV	750 mV	2.5 V	2.8 V
di/dt of load step	5 A/μs	2.4 A/μs	0.8 A/μs	0.4 A/μs	0.25 A/μs
Time	100 μs	100 μs	100 μs	100 μs	100 μs
Maximum deviation	0.8 V	1.4 V	2.8 V	9.0 V	9.0 V
Condition	70V, 112 → 215A	210V, 36 → 72A	500V, 15 → 30A	1000V, 7.5 → 15A	1500V, 5 → 10A
Recovery within	100 mV	250 mV	500 mV	1 V	1.2 V
di/dt of load step	2 A/μs	1.15 A/μs	0.25 A/μs	0.15 A/μs	0.085 A/μs
Time	100 μs	100 μs	150 μs	150 μs	150 μs
Maximum deviation	0.3 V	0.75 V	1.2 V	3.0 V	3.5 V
<b>DC output capacitance</b>					
X-capacitors (typical)	22000 μF	1170 μF	560 μF	141 μF	58 μF
Y-capacitors (typical)	950 nF	950 nF	145 nF	145 nF	145 nF
<b>Output impedance</b> <sup>10</sup>					
0-1 kHz	< 0.75 mΩ	< 5 mΩ	< 16 mΩ	< 150 mΩ	< 250 mΩ
1-100 kHz	< 40 mΩ	< 40 mΩ	< 160 mΩ	< 800 mΩ	< 2 Ω
<b>Pulsating load</b>					
Max. tolerable AC component of load current					
f > 1 kHz	60 A <sub>RMS</sub>	15 A <sub>RMS</sub>	15 A <sub>RMS</sub>	3 A <sub>RMS</sub>	2.5 A <sub>RMS</sub>
f < 1 kHz	450 A <sub>pk</sub>	150 A <sub>pk</sub>	90 A <sub>pk</sub>	45 A <sub>pk</sub>	30 A <sub>pk</sub>
<b>Hold-up time</b>					
V <sub>out</sub> = 100%, P <sub>out</sub> = 15 kW	10 ms	10 ms	15 ms	15 ms	15 ms
I <sub>out</sub> = 100%, P <sub>out</sub> = 15 kW	10 ms	10 ms	15 ms	15 ms	15 ms
V <sub>out</sub> = 100%, P <sub>out</sub> = 7.5 kW	25 ms	20 ms	35 ms	35 ms	35 ms
<b>Turn on delay</b> <sup>11</sup>	2.5 s after mains switch is turned on, the rated output voltage is reached				
<b>Inrush current</b> <sup>10</sup>	23 A				
<b>Safety standards</b>	EN 60950 / EN 61010				
<b>Insulation</b>					
AC / DC terminals	3750V <sub>RMS</sub> (1 min.)				3750 V <sub>RMS</sub> (1 min.)
Creepage / clearance	8 mm				8 mm
AC power terminals / case	2500 V <sub>RMS</sub>				2500 V <sub>RMS</sub>
DC power terminals / case	1000 V <sub>DC</sub> <sup>12</sup>				1500 V <sub>DC</sub> <sup>12</sup>
<b>EMC</b>					
Emission	EN 61326-1, class B equipment(for use in domestic establishments)				
Immunity	EN 61326-1, equipment for use in industrial and domestic establishments				
<b>Environmental conditions</b>					
Storage temperature	- 40 to + 70 °C				
Operating temperature	- 20 to + 50 °C, Derate output to 75% at 60 °C				
Output automatically disabled at overtemperature					
Humidity	Maximum 95% RH, non condensing, up to 40 °C Maximum 75% RH, non condensing, up to 50 °C				
IP Rating	IP20				
Pollution degree	2				
<b>MTBF</b>	500 000 hrs				

<sup>6</sup> Measured on resistive load with power supply in CV mode, different conditions may influence the specified speed

<sup>7</sup> Signal latency depends on the interface used & data traffic

<sup>8</sup> Local voltage sense

<sup>9</sup> Remote sensing and long wiring may influence the values

<sup>10</sup> Typical

<sup>11</sup> Unit should be configured to switch on the output at startup

<sup>12</sup> See "Safety Instructions"

	SM70-CP-450	SM210-CP-150	SM500-CP-90	SM1000-CP-45	SM1500-CP-30
<b>Series operation</b> Maximum total voltage Master / slave operation	Series operation not allowed		750V <sup>13</sup> 1000V <sup>14</sup> Maximum 6 units <sup>15</sup>	Series operation not allowed	
<b>Parallel operation</b> Master / slave operation	Maximum 60 units				
<b>Remote sensing</b> Maximum voltage drop per load lead	Default 1 V, can be set to 10 V				
<b>Limits</b> Adjustable Voltage Current Power Fixed Voltage OverLoad level Voltage Self-Protection level			0 - 101 % 0 - 101 % 0 - 101 %		
<b>Potentiometers</b> Front panel control knob resolution	15 bits				
<b>Meter scale</b> Voltage Current Power Accuracy read output	4 digit 0.00 - 70.00V -450.0 - 450.0A -15000 - 15000W 0.2% + 2 digit	4 digit 0.0 - 210.0V -150.0 - 150.0A -15000 - 15000W 0.2% + 2 digit	4 digit 0.0 - 500.0V -90.0 - 90.0A -15000 - 15000W 0.2% + 2 digit	4 digit 0 - 1000V -45.00 - 45.00A -15000 - 15000W 0.2% + 2 digit	4 digit 0 - 1500V -30.00 - 30.00A -15000 - 15000W 0.2% + 2 digit
<b>Mounting</b>	Stacking of units allowed				
<b>AC terminals (CON A)</b>	Screw terminals for wire 4 mm <sup>2</sup> , 3 phase + earth (no neutral)				
<b>DC terminals (CON B1 &amp; B2)</b>	M12 bolts	M8 bolts			
<b>Programming connectors (LAN)</b>	Standard with RJ45-connector for Ethernet at rear panel, 100 Mb/s, full-duplex				
<b>Interlock (CON F)</b>	Input for contact at rear panel				
<b>Cooling</b> Audio noise level Airflow direction Thermal protection	Low noise, fan speed adapts to temperature of internal system ca. 50 dBA at full load, 25 °C ambient temperature, 1 m distance ca. 65 dBA at full load, 50 °C ambient temperature, 1 m distance From left to right Output shuts down in case of insufficient cooling (over temperature indication in display)				
<b>Dimensions</b> Front panel: h x w behind front panel: h x w x d	132 x 483 mm (19", 3 U) 128 x 448 x 591 mm (excluding feet) <i>No additional depth is required with optional interfaces assembled</i>				
<b>Weight</b>	27 kg				

CV = Constant Voltage

CC = Constant Current

CP = Constant Power

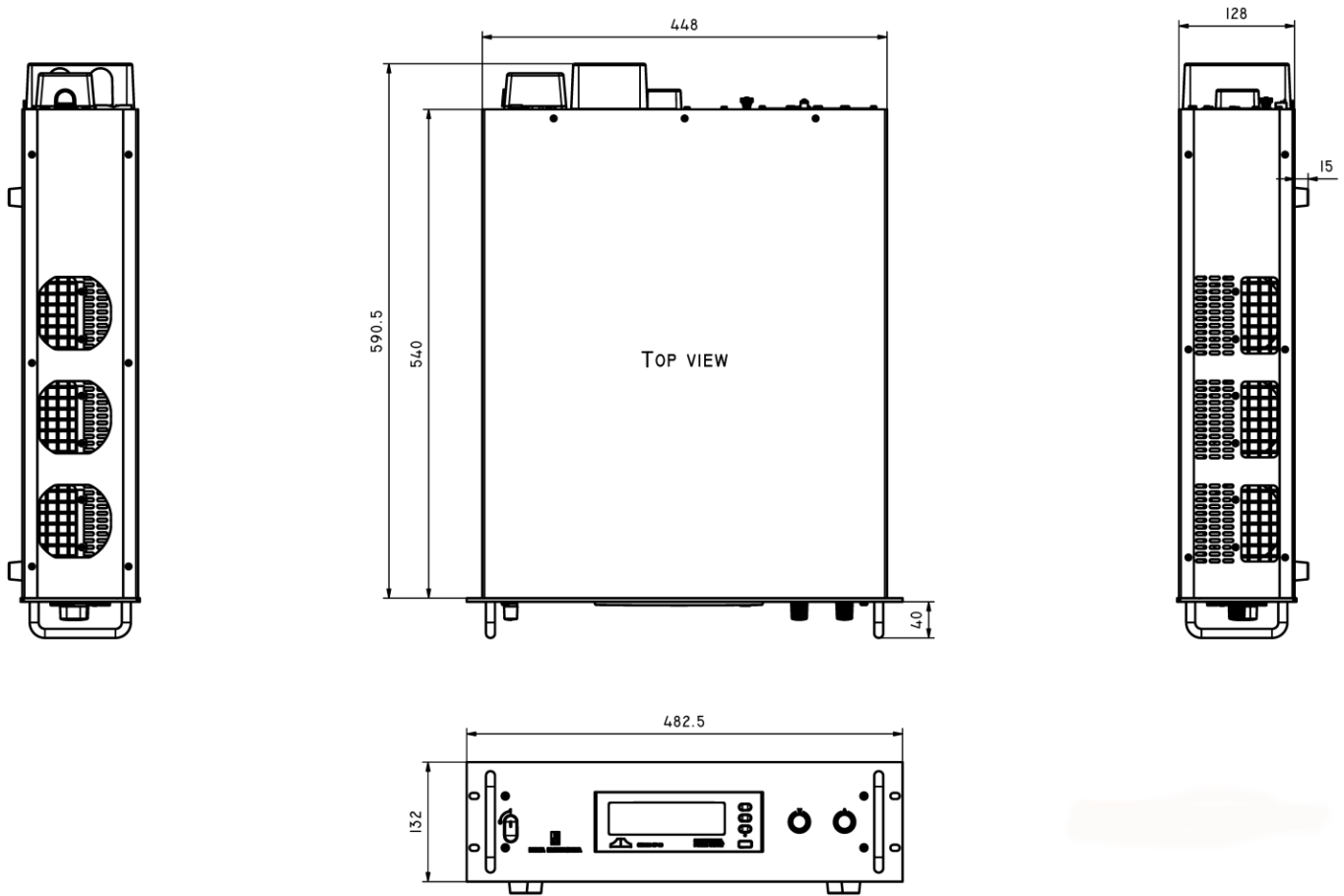
Specifications measured at  $T_{amb} = 25 \pm 5 \text{ }^\circ\text{C}$  and  $V_{in} = 400 V_{AC}$ , 3 phase, 50 Hz unless otherwise noted. The information in this document is subject to change without notice.

<sup>13</sup> Units delivered before Q4 / 2018. Contact factory for upgrading to enable 1000V series operation for older units.

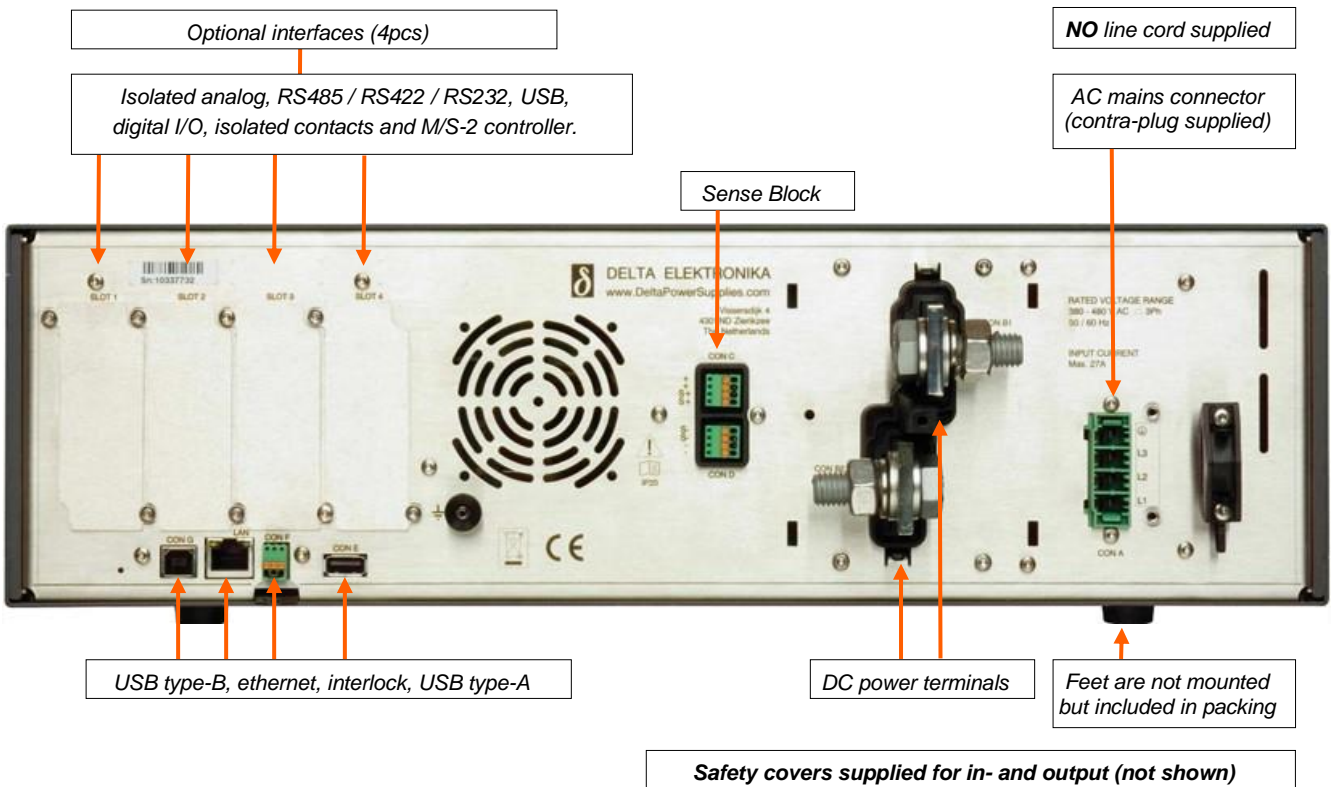
<sup>14</sup> Units delivered in Q4 / 2018 or later.

<sup>15</sup> See "Safety Instructions"

**Dimensions**



**Rear view**



## Typical Applications

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

## Standard Features



### Bi-Directional Two-Quadrant Output

Full power Bi-Directional two quadrant operation maintains the DC output voltage constant whether the output power is positive or negative. Ideal for PWM-speed controlled DC-Motors and ATE systems.



### Digital CV-, CC- and CP-Settings

Reliable, long-life digital encoders are mounted 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.



### High Voltage Isolation

A high DC output isolation allows floating operation up to 1000 V for SM70-CP-450, SM210-CP-150, SM500-CP-90 and SM1000-CP-45 and up to 1500 V for SM1500-CP-30.



### Sequencer

Arbitrary Waveform generator or standalone automation.



### Ethernet Interface

Ethernet interface for programming and monitoring



### USB-Input

Not yet available: USB-Input for exchange of settings or for controlling the unit.

## Options



### Software control and Interfaces

Field installable interfaces:

- Master / Slave controller
- Isolated Contacts
- Serial controller with multiple protocols: RS 232, RS 485, RS 422 and USB (Device)
- Digital I/O
- Isolated Analog Programming

Order Codes:

- INT MOD M/S-2
- INT MOD CON
- INT MOD SER
- INT MOD DIG
- INT MOD ANA