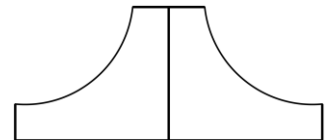




SM15K - Series 15kW DC POWER SUPPLIES

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

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

	SM70-CP-450	SM210-CP-150	SM500-CP-90	SM1000-CP-45	SM1500-CP-30
Programming speed ^{6, 7}					
Rise time (10 - 90%)					
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
Fall time (90 - 10%)					
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
Recovery time ^{8, 9}					
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
DC output capacitance					
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
Output impedance ¹⁰					
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
Pulsating load					
Max. tolerable AC component of load current					
f > 1 kHz	60 A _{RMS}	15 A _{RMS}	15 A _{RMS}	3 A _{RMS}	2.5 A _{RMS}
f < 1 kHz	450 A _{pk}	150 A _{pk}	90 A _{pk}	45 A _{pk}	30 A _{pk}
Hold-up time					
V _{out} = 100%, P _{out} = 15 kW	10 ms	10 ms	15 ms	15 ms	15 ms
I _{out} = 100%, P _{out} = 15 kW	10 ms	10 ms	15 ms	15 ms	15 ms
V _{out} = 100%, P _{out} = 7.5 kW	25 ms	20 ms	35 ms	35 ms	35 ms
Turn on delay ¹¹	2.5 s after mains switch is turned on, the rated output voltage is reached				
Inrush current ¹⁰	23 A				
Safety standards	EN 60950 / EN 61010				
Insulation					
AC / DC terminals	3750V _{RMS} (1 min.)				3750 V _{RMS} (1 min.)
Creepage / clearance	8 mm				8 mm
AC power terminals / case	2500 V _{RMS}				2500 V _{RMS}
DC power terminals / case	1000 V _{DC} ¹²				1500 V _{DC} ¹²
EMC					
Emission	EN 61326-1, class B equipment(for use in domestic establishments)				
Immunity	EN 61326-1, equipment for use in industrial and domestic establishments				
Environmental conditions					
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				
MTBF	500 000 hrs				

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

⁷ Signal latency depends on the interface used & data traffic

⁸ Local voltage sense

⁹ Remote sensing and long wiring may influence the values

¹⁰ Typical

¹¹ Unit should be configured to switch on the output at startup

¹² See "Safety Instructions"

	SM70-CP-450	SM210-CP-150	SM500-CP-90	SM1000-CP-45	SM1500-CP-30
Series operation Maximum total voltage Master / slave operation	Series operation not allowed		750V ¹³ 1000V ¹⁴ Maximum 6 units ¹⁵	Series operation not allowed	
Parallel operation Master / slave operation	Maximum 60 units				
Remote sensing Maximum voltage drop per load lead	Default 1 V, can be set to 10 V				
Limits Adjustable Voltage Current Power Fixed Voltage OverLoad level Voltage Self-Protection level			0 - 101 % 0 - 101 % 0 - 101 %	102.5 % - unit will continue to operate (OL-indication in display) 105 % - output is automatically disabled (PROT-indication in display)	
Potentiometers Front panel control knob resolution	15 bits				
Meter scale Voltage Current Power Accuracy read output	4 digits 0.00 - 70.00V -450.0 - 450.0A -15000 - 15000W 0.2% + 2 digit	4 digits 0.0 - 210.0V -150.0 - 150.0A -15000 - 15000W 0.2% + 2 digit	4 digits 0.0 - 500.0V -90.0 - 90.0A -15000 - 15000W 0.2% + 2 digit	4 digits 0 - 1000V -45.00 - 45.00A -15000 - 15000W 0.2% + 2 digit	4 digits 0 - 1500V -30.00 - 30.00A -15000 - 15000W 0.2% + 2 digit
Mounting	Stacking of units allowed				
AC terminals (CON A)	Screw terminals for wire 4 mm ² , 3 phase + earth (no neutral)				
DC terminals (CON B1 & B2)	M12 bolts	M8 bolts			
Programming connectors (LAN)	Standard with RJ45-connector for Ethernet at rear panel, 100 Mb/s, full-duplex				
Interlock (CON F)	Input for contact at rear panel				
Cooling 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)				
Dimensions 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>				
Weight	27 kg				

CV = Constant Voltage

CC = Constant Current

CP = Constant Power

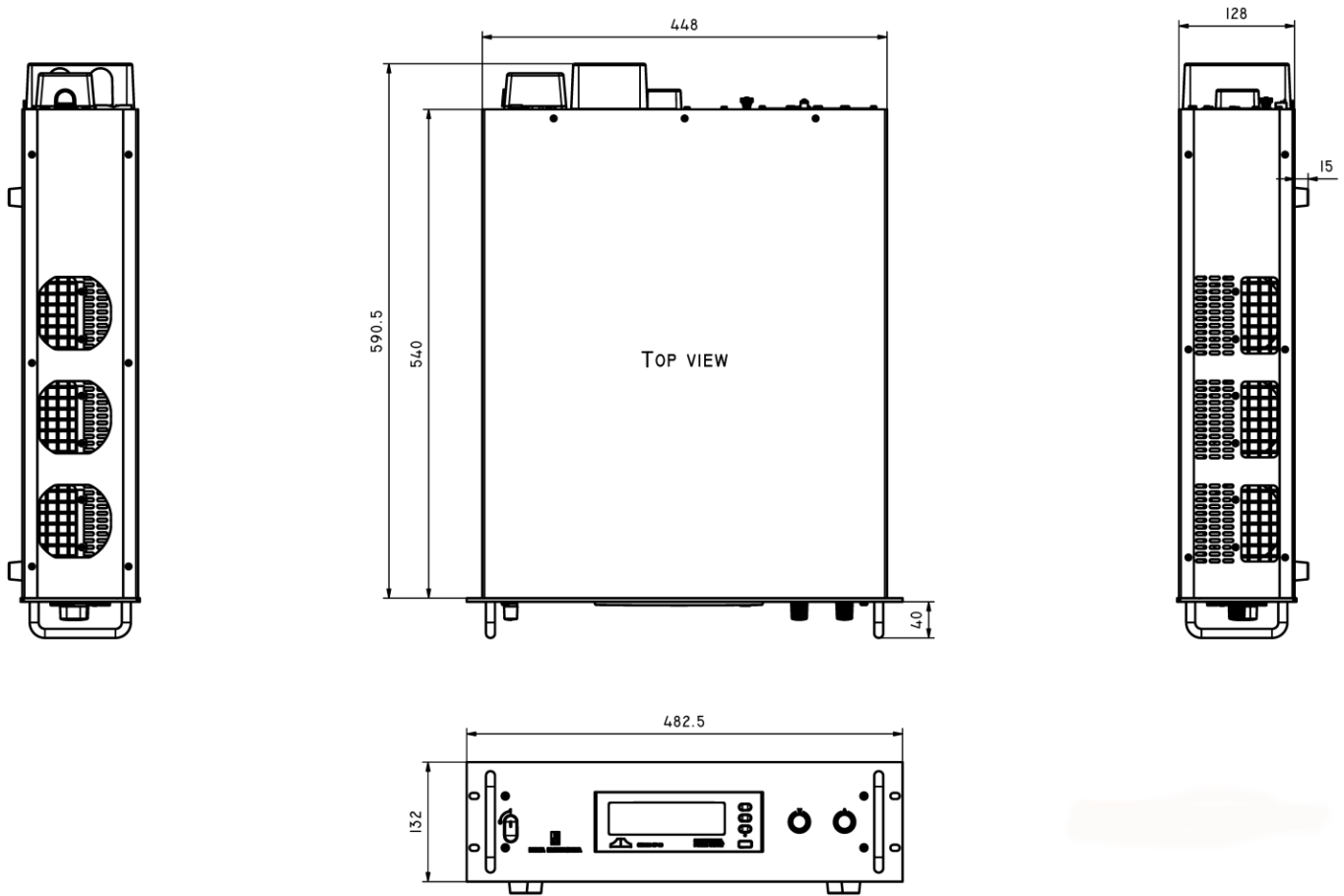
Specifications measured at $T_{amb} = 25 \pm 5 \text{ }^\circ\text{C}$ and $V_{in} = 400 \text{ V}_{AC}$, 3 phase, 50 Hz unless otherwise noted. The information in this document is subject to change without notice.

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

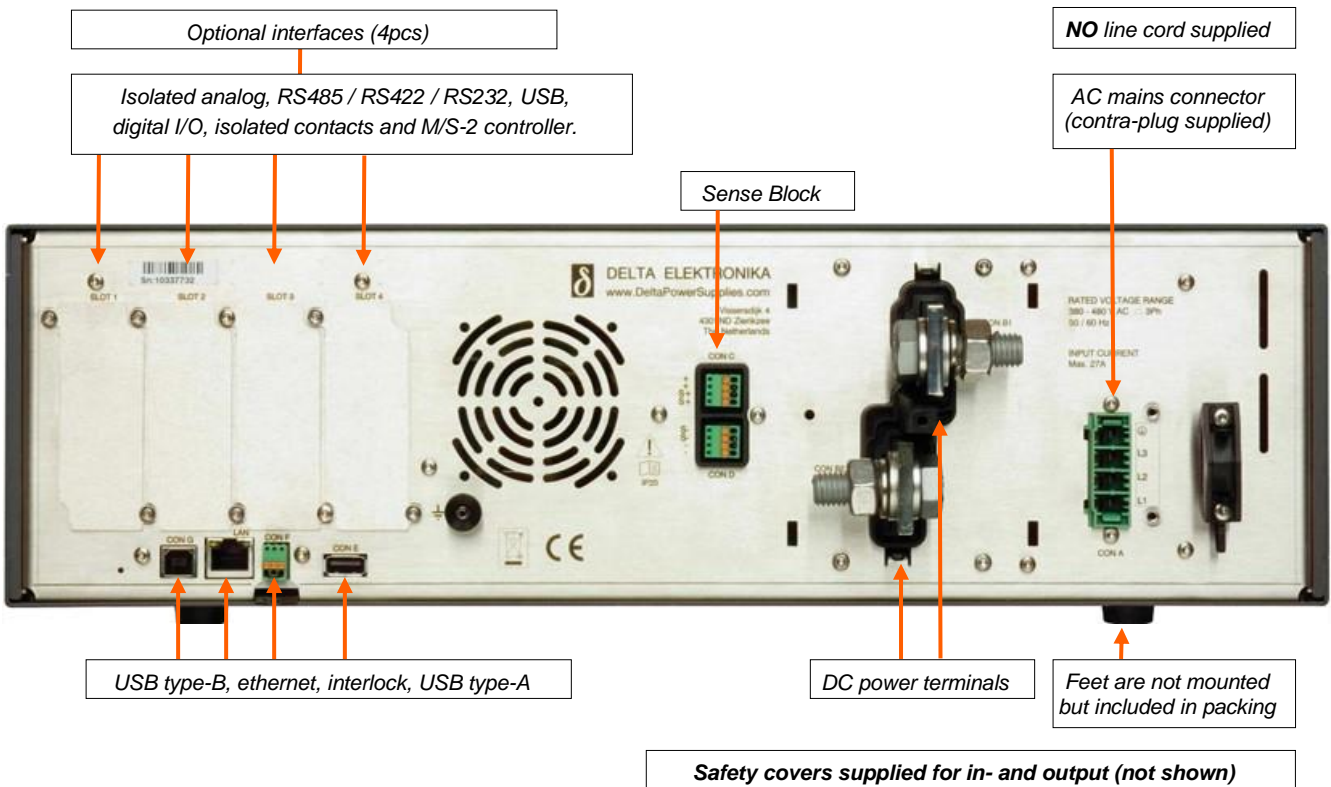
¹⁴ Units delivered in Q4 / 2018 or later.

¹⁵ See "Safety Instructions"

Dimensions



Rear view



Typical Applications

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

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