

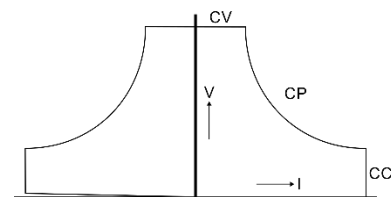


SM15K - Series 15kW DC POWER SUPPLIES



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 - 10 mV 60 mV 100 mA - 33 V / 450 A 8 mV 50 mV 100 mA - 8 mV 50 mV 100 mA -	100 V / 150 A 30 mV 150 mV - - 20 mV 125 mV - - 100 V / 150 A 30 mV 150 mV - - 20 mV 125 mV - -	167 V / 90 A 10 mV 55 mV 45 mA 200 mA 25mV 115mV 7 mV 35 mV 45 mA 200 mA 167 V / 90 A 7 mV 35 mV 45 mA 200 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 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 up² Remote voltage sense³ Local voltage sense⁴ Excluding INT MOD ANA⁵ 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 Load = 15 kW Load = 1500 W Output voltage step Load = 15 kW Load = 1500 W Fall time (90 - 10%) Output voltage step Load = 15 kW Load = 1500 W Output voltage step Load = 15 kW Load = 1500 W	0 → 33 V 2.2 ms 1.5 ms 0 → 70 V 5.5 ms 3.5 ms 33 → 0 V 1.5 ms 1.5 ms 70 → 0 V 2.6 ms 3.5 ms	0 → 100 V 1.6 ms 1.3 ms 0 → 210 V 3 ms 2.7 ms 100 → 0 V 1.3 ms 1.3 ms 210 → 0 V 2.5 ms 2.5 ms	0 → 167 V 1.5 ms 1 ms 0 → 500 V 4.5 ms 3.5 ms 167 → 0 V 0.8 ms 0.9 ms 500 → 0 V 2.5 ms 3.5 ms	0 → 333 V 1.5 ms 1 ms 0 → 1000 V 4.5 ms 3.5 ms 333 → 0 V 0.9 ms 1.0 ms 1000 → 0 V 2.8 ms 3.5 ms	0 → 500 V 1.5 ms 1 ms 0 → 1500 V 4.5 ms 3.5 ms 500 → 0 V 0.8 ms 0.9 ms 1500 → 0 V 2.8 ms 3.5 ms
Recovery time ^{8, 9} Condition Recovery within di/dt of load step Time Maximum deviation Condition Recovery within di/dt of load step Time Maximum deviation	33V, 225 → 450A 100 mV 5 A/μs 100 μs 0.8 V 70V, 112 → 215A 100 mV 2 A/μs 100 μs 0.3 V	100V, 75 → 150A 500 mV 2.4 A/μs 100 μs 1.4 V 210V, 36 → 72A 250 mV 1.15 A/μs 100 μs 0.75 V	167V, 45 → 90A 750 mV 0.8 A/μs 100 μs 2.8 V 500V, 15 → 30A 500 mV 0.25 A/μs 150 μs 1.2 V	333V, 22.5 → 45A 2.5 V 0.4 A/μs 100 μs 9.0 V 1000V, 7.5 → 15A 1 V 0.15 A/μs 150 μs 3.0 V	500V, 15 → 30A 2.8 V 0.25 A/μs 100 μs 9.0 V 1500V, 5 → 10A 1.2 V 0.085 A/μs 150 μs 3.5 V
DC output capacitance X-capacitors (typical) Y-capacitors (typical)	22000 μF 950 nF	1170 μF 950 nF	560 μF 145 nF	141 μF 145 nF	58 μF 145 nF
Output impedance ¹⁰ 0-1 kHz 1-100 kHz CV CV	< 0.75 mΩ < 40 mΩ	< 5 mΩ < 40 mΩ	< 16 mΩ < 160 mΩ	< 150 mΩ < 800 mΩ	< 250 mΩ < 2 Ω
Pulsating load Max. tolerable AC component of load current f > 1 kHz f < 1 kHz	60 A _{RMS} 450 A _{pk}	15 A _{RMS} 150 A _{pk}	15 A _{RMS} 90 A _{pk}	3 A _{RMS} 45 A _{pk}	2.5 A _{RMS} 30 A _{pk}
Hold-up time V _{out} = 100%, P _{out} = 15 kW I _{out} = 100%, P _{out} = 15 kW V _{out} = 100%, P _{out} = 7.5 kW	10 ms 10 ms 25 ms	10 ms 10 ms 20 ms	15 ms 15 ms 35 ms	15 ms 15 ms 35 ms	15 ms 15 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 Creepage / clearance AC power terminals / case DC power terminals / case	3750V _{RMS} (1 min.) 8 mm 2500 V _{RMS} 1000 V _{DC} ¹²				3750 V _{RMS} (1 min.) 8 mm 2500 V _{RMS} 1500 V _{DC} ¹²
EMC Emission Immunity	EN 61326-1 , class B equipment(for use in domestic establishments) EN 61326-1 , equipment for use in industrial and domestic establishments				
Environmental conditions Storage temperature Operating temperature Output automatically disabled at overtemperature Humidity IP Rating Pollution degree	- 40 to + 70 °C - 20 to + 50 °C, Derate output to 75% at 60 °C Maximum 95% RH, non-condensing, up to 40 °C Maximum 75% RH, non-condensing, up to 50 °C IP20 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

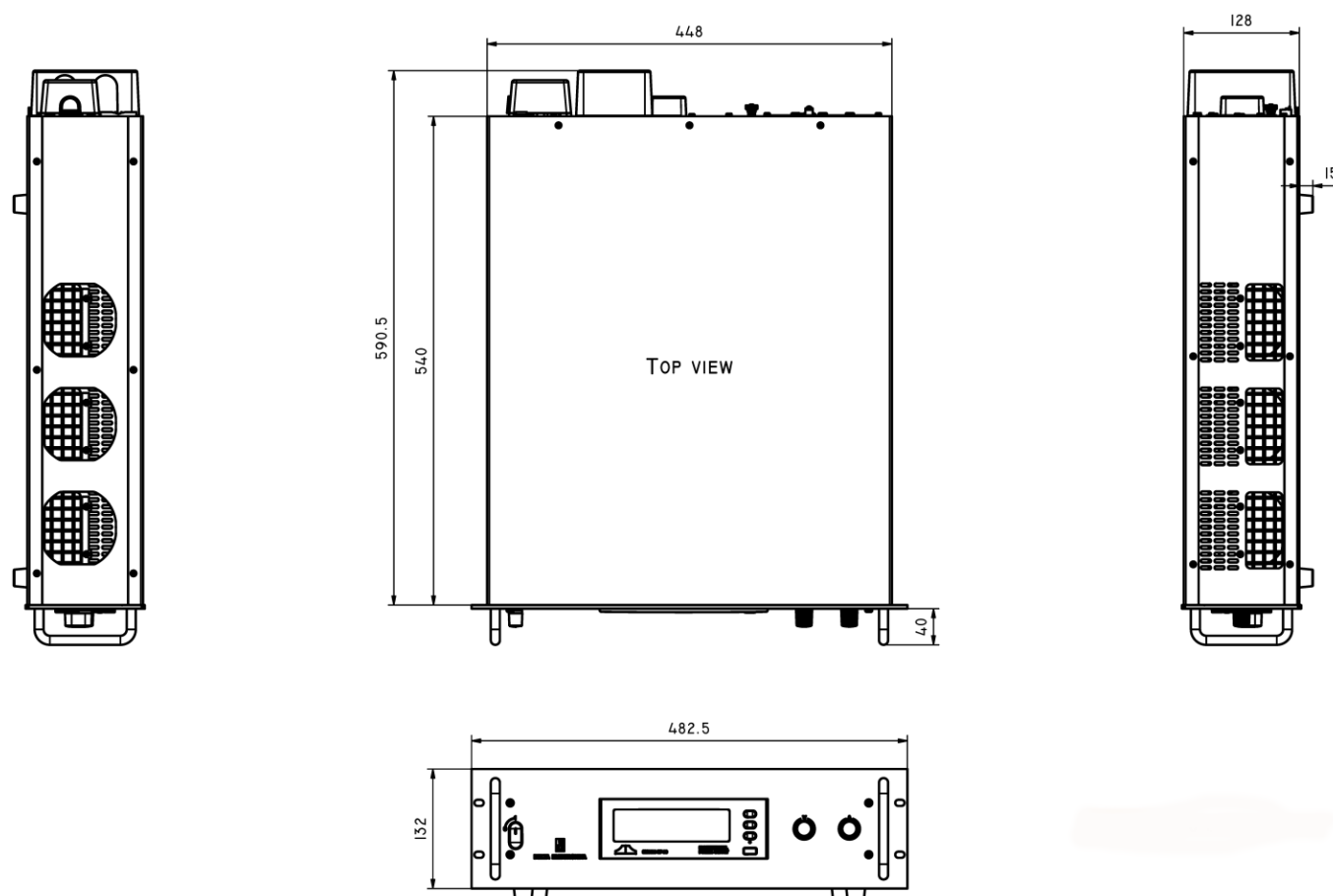
Specifications measured at $T_{amb} = 25 \pm 5 \text{ °C}$ and $V_{in} = 400 \text{ V}_{AC}$, 3 phase, 50 Hz unless otherwise noted. The information in this document is subject to change without notice.

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

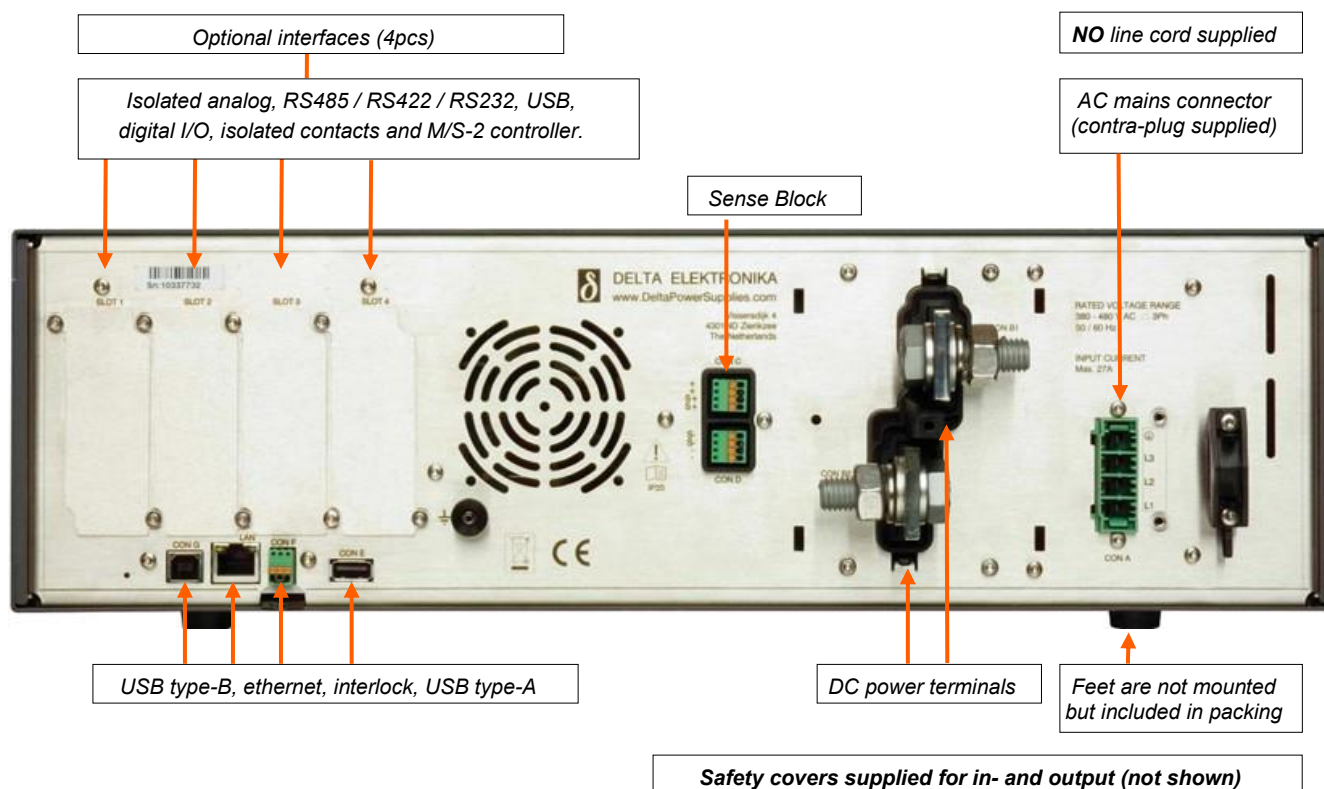
¹⁴ Units delivered in Q4 / 2018 or later.

¹⁵ See "Safety Instructions"

Dimensions



Rear view



Typical Applications

- PV-Simulation and inverter testing
- Automotive battery simulations
- PWM-controlled DC motor testing
- Car testing systems
- Controlled battery (dis)charging
- Accurate current sources
- ATE in industrial production lines
- Lasers
- Aerospace
- Plasma chambers
- Sustainable energy
- Military

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- and CC-Settings

Reliable, long-life digital encoders are 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.



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

Feature not yet available.
Front and rear panel USB inputs (Host / Type-A) are planned for the exchange of settings and waveforms. A web interface is available for uploading sequences.

Interfaces



Plug-and-play extension modules

Interfacing and functional capabilities of the power supply can be extended at any time by inserting modules. Four slots are available at the rear of the power supply unit. Consult the [interfaces data sheet](#) for more information.

Modules:

- **Analog programming**
(INT MOD ANA)
High speed and accuracy
- **Digital I/O**
(INT MOD DIG)
Interacts with sequencer
- **Master/Slave**
(INT MOD M/S-2)
Series/parallel output configuration
- **Anybus carrier**
(INT MOD ANY)
Carrier for Anybus CompactCom 40 fieldbus modules:
CANopen, EtherCAT, Ethernet/IP, Modbus-TCP, POWERLINK, PROFIBUS, PROFINET
- **Isolated contacts**
(INT MOD CON)
Relay and interlock contacts
- **Serial communication**
(INT MOD SER)
RS232, RS485, RS422, USB