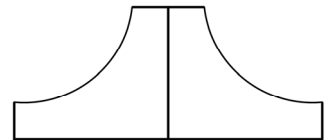




## SM15K - Series 15kW DC POWER SUPPLIES

### Bi-Directional - Constant Power

| Models        | Voltage range | Current range |
|---------------|---------------|---------------|
| SM 70-CP-450  | 0 - 70 V      | -450 - 450 A  |
| SM 210-CP-150 | 0 - 210 V     | -150 - 150 A  |
| SM 500-CP-90  | 0 - 500 V     | -90 - 90 A    |
| SM 1500-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         | SM1500-CP-30    |
|---|-----------|-----------------|-----------------|---------------------|-----------------|
| <b>DC Power terminals</b>   |           |                 |                 |                     |                 |
| voltage   |           | 0 - 70 V        | 0 - 210 V       | 0 - 500 V           | 0 - 1500 V      |
| current   |           | - 450 - 450 A   | - 150 - 150 A   | - 90 - 90 A         | - 30 - 30 A     |
| <b>AC Input</b>   |           |                 |                 |                     |                 |
| 3 phase, 48 - 62 Hz   |           |                 |                 | 342 - 528 V         |                 |
| rated voltage range   |           |                 |                 | 380 - 480 V         |                 |
| rated frequency   |           |                 |                 | 50 / 60 Hz          |                 |
| rated current   |           |                 |                 | maximum 27 A        |                 |
| current (400 V / 3 ph, 15kW)  |           |                 |                 | 23 A                |                 |
| power factor, 15kW, 7.5kW   |           |                 |                 | 0.996 / 0.988       |                 |
| internal fuses  |           |                 |                 | 30 AT               |                 |
| standby input power ( $V_o=I_o=0$ )   |           |                 |                 | 96 W                |                 |
| standby input power ( $V_o=V_{max}$ )   |           |                 |                 | 180 W               |                 |
| <b>Efficiency</b>   |           |                 |                 |                     |                 |
| Sink & Source mode:   |           |                 |                 |                     |                 |
| 400 V AC, 3 ph input,   |           |                 |                 | 95 %                |                 |
| 15 kW, $I_{out}=100\%$  |           |                 |                 | 96 %                |                 |
| 15 kW, $U_{out}=100\%$  |           |                 |                 |                     |                 |
| <b>Regulation</b>   |           |                 |                 |                     |                 |
| Load 0 - 100%   | <b>CV</b> | 6 mV            | 5 mV            | 4 mV                | 10 mV           |
| Line 342 - 528 V AC   | <b>CV</b> | < 1 mV          | < 1 mV          | < 1 mV              | < 1 mV          |
| (external voltage sense)  |           |                 |                 |                     |                 |
| Load 0 - 100%   | <b>CC</b> | 35 mA           | 12 mA           | 8 mA                | 2 mA            |
| Line 342 - 528 V AC   | <b>CC</b> | 4 mA            | 3 mA            | 1 mA                | 1 mA            |
| (internal voltage sense, after warm up)   |           |                 |                 |                     |                 |
| <b>Ripple + noise</b>   |           |                 |                 |                     |                 |
| Source mode:  |           | 33 V / 450 A    | 100 V / 150 A   | 167 V / 90 A        | 500 V / 30 A    |
| rms (BW=300 kHz)  | <b>CV</b> | 10 mV           | 30 mV           | 10 mV               | 25 mV           |
| p-p (BW=20 MHz)   | <b>CV</b> | 60 mV           | 125 mV          | 55 mV               | 150 mV          |
| rms (BW=300 kHz)  | <b>CC</b> | 100 mA          | t.b.d.          | 45 mA               | 12 mA           |
| p-p (BW=20 MHz)   | <b>CC</b> | -               | -               | 200 mA              | 70 mA           |
| Source mode:  |           | 70 V / 215 A    | 210 V / 71.5 A  | 500 V / 30 A        | 1500 V / 10 A   |
| rms (BW=300 kHz)  | <b>CV</b> | 10 mV           | 20 mV           | 25mV                | 35mV            |
| p-p (BW=20 MHz)   | <b>CV</b> | 60 mV           | 100 mV          | 115mV               | 250mV           |
| rms (BW=300 kHz)  | <b>CC</b> | 100 mA          | t.b.d.          | 45 mA               | 5 mA            |
| p-p (BW=20 MHz)   | <b>CC</b> | -               | -               | 200 mA              | 25 mA           |
| Sink mode:  |           | 33 V / 450 A    | 100 V / 150 A   | 167 V / 90 A        | 500 V / 30 A    |
| rms (BW=300 kHz)  | <b>CV</b> | 8 mV            | 30 mV           | 7 mV                | 15 mV           |
| p-p (BW=20 MHz)   | <b>CV</b> | 50 mV           | 125 mV          | 35 mV               | 130 mV          |
| rms (BW=300 kHz)  | <b>CC</b> | 100 mA          | t.b.d.          | 45 mA               | 10 mA           |
| p-p (BW=20 MHz)   | <b>CC</b> | -               | -               | 200 mA              | 60 mA           |
| Sink mode:  |           | 70 V / 215 A    | 210 V / 71.5 A  | 500 V / 30 A        | 1500 V / 10 A   |
| rms (BW=300 kHz)  | <b>CV</b> | 8 mV            | 20 mV           | 10 mV               | 25 mV           |
| p-p (BW=20 MHz)   | <b>CV</b> | 50 mV           | 100 mV          | 50 mV               | 200 mV          |
| rms (BW=300 kHz)  | <b>CC</b> | 100 mA          | t.b.d.          | 90 mA               | 3 mA            |
| p-p (BW=20 MHz)   | <b>CC</b> | -               | -               | 320 mA              | 12 mA           |
| <i>CC-ripple at full load</i>   |           |                 |                 |                     |                 |
| <b>Programming &amp; monitoring accuracy</b> (excluding INT MOD ANA)  |           |                 |                 |                     |                 |
| Voltage   |           |                 |                 | ± 0.08%             |                 |
| Current   |           |                 |                 | ± 0.15%             |                 |
| <b>Minimum Sink Voltage</b>   |           |                 |                 |                     |                 |
| @ Sink current:   |           | 1.2 V @ - 450 A | 3.0 V @ - 150 A | 5.5 V @ - 90 A      | 16.0 V @ - 30 A |
|   |           | 0.8 V @ - 215 A | 1.5 V @ - 75 A  | 3.0 V @ - 30 A      | 7.0 V @ - 10 A  |
|   |           | 0.8 V @ - 45 A  | 1.5 V @ - 15 A  | 1.0 V @ - 10 A      | 2.0 V @ - 3 A   |
| <b>Temp. coeff., per °C</b>   | <b>CV</b> |                 |                 | 20.10 <sup>-6</sup> |                 |
|   | <b>CC</b> |                 |                 | 50.10 <sup>-6</sup> |                 |
| <b>Stability</b> <sup>1</sup>   |           |                 |                 |                     |                 |
| after 1 hr warm-up  |           |                 |                 | 50.10 <sup>-6</sup> |                 |
| during 8 hrs  | <b>CV</b> |                 |                 | 80.10 <sup>-6</sup> |                 |
|   | <b>CC</b> |                 |                 |                     |                 |
| $t_{amb} = 25 \pm 1 \text{ }^\circ\text{C}$ , $V_{in} = 400 \text{ VAC}$<br>(internal voltage sensing for CC-stab.) |           |                 |                 |                     |                 |

Notes: 1. Measured at full load. 2. Signal latency depends on the interface used &amp; data traffic.

3. See "Safety Instructions"

| Programming speed <sup>2</sup><br>(resistive load)  | SM70-CP-450                  | SM210-CP-150                  | SM500-CP-90                   | SM1500-CP-30                   |
|---|------------------------------|-------------------------------|-------------------------------|--------------------------------|
| <b>Rise time (10 - 90%)</b><br>output voltage step<br>time, (load = 15 kW)<br>time, (load = 1500 W) | 0 → 33 V<br>2.2 ms<br>1.5 ms | 0 → 100 V<br>1.6 ms<br>1.3 ms | 0 → 167 V<br>1.5 ms<br>1 ms   | 0 → 500 V<br>1.5 ms<br>1 ms    |
| output voltage step<br>time, (load = 15 kW)<br>time, (load = 1500 W)                                | 0 → 70 V<br>5.5 ms<br>3.5 ms | 0 → 210 V<br>3 ms<br>2.7 ms   | 0 → 500 V<br>4.5 ms<br>3.5 ms | 0 → 1500 V<br>4.5 ms<br>3.5 ms |
| <b>Fall time (90 - 10%)</b><br>output voltage step<br>time, (load = 15 kW)<br>time, (load = 1500 W) | 33 → 0 V<br>1.5 ms<br>1.5 ms | 100 → 0 V<br>1.3 ms<br>1.3 ms | 167 → 0 V<br>0.8 ms<br>0.9 ms | 500 → 0 V<br>0.8 ms<br>0.9 ms  |
| output voltage step<br>time, (load = 15 kW)<br>time, (load = 1500 W)                                | 70 → 0 V<br>2.6 ms<br>3.5 ms | 210 → 0 V<br>2.5 ms<br>2.5 ms | 500 → 0 V<br>2.5 ms<br>3.5 ms | 1500 → 0 V<br>2.8 ms<br>3.5 ms |
| <b>DC Output Capacitance</b><br>X-capacitors (typical)<br>Y-capacitors (typical)                    | 22000 µF<br>950 nF           | 1170 µF<br>950 nF             | 560 µF<br>145 nF              | 58 µF<br>145 nF                |

|   | SM70-CP-450  | SM210-CP-150   | SM500-CP-90  | SM1500-CP-30   |
|---|--|--|--|--|
| <b>Recovery time</b> output voltage<br>recovery within<br>di/dt of load step<br>time, @ 50 - 100% load step<br>max. deviation | 33 V, 225 → 450 A<br>100 mV<br>5 A/µs<br>100 µs<br>0.8 V | 100 V, 75 → 150 A<br>500 mV<br>2.4 A/µs<br>100 µs<br>1.4 V | 167 V, 45 → 90 A<br>750 mV<br>0.8 A/µs<br>100 µs<br>2.8 V  | 500 V, 15 → 30 A<br>2.8 V<br>0.25 A/µs<br>100 µs<br>9.0 V  |
| output voltage<br>recovery within<br>di/dt of load step<br>time, @ 50 - 100% load step<br>max. deviation                      | 70 V, 112 → 215 A<br>100 mV<br>2 A/µs<br>100 µs<br>0.3 V | 210V, 36 → 72 A<br>250 mV<br>1.15 A/µs<br>100 µs<br>0.75 V | 500 V, 15 → 30 A<br>500 mV<br>0.25 A/µs<br>150 µs<br>1.2 V | 1500 V, 5 → 10 A<br>1.2 V<br>0.085 A/µs<br>150 µs<br>3.5 V |
| <b>Pulsating load</b><br>max. tolerable AC component<br>of load current<br>f > 1 kHz<br>f < 1 kHz                             | 60 Arms<br>450 Apeak                                     | 15 Arms<br>150 Apeak                                       | 15 Arms<br>90 Apeak  | 5 Arms<br>30 Apeak   |

|  |  |   |
|--|--|---|
| <b>Insulation</b><br>AC power terminals / DC pwr terminals<br>creepage / clearance<br>AC power terminals / case<br>DC power terminals / case | 3750 Vrms (1 min.)<br>8 mm<br>2500 Vrms<br>1000 V DC <sup>3</sup>  | 3750 Vrms (1 min.)<br>8 mm<br>2500 Vrms<br>1500 V DC <sup>3</sup> |
| <b>Safety</b>  | EN 60950 / EN 61010  |   |
| <b>EMC</b> Generic Emission<br>Generic Immunity  | EN 61000-6-3, residential, light industrial environment (EN 55022 B)<br>EN 61000-6-2, industrial environment |   |
| <b>Operating Temperature at full load</b>  | - 20 to + 50 °C<br>derate output to 75% at 60 °C   |   |
| <b>Humidity</b>  | maximum 95% RH, non condensing, up to 40 °C<br>maximum 75% RH, non condensing, up to 50 °C                   |   |
| <b>Storage temperature</b>   | - 40 to + 85 °C  |   |
| <b>Thermal protection</b>  | output shuts down in case of insufficient cooling  |   |
| <b>MTBF</b>  | 500 000 hrs  |   |

|   | SM70-CP-450             | SM210-CP-150            | SM500-CP-90             | SM1500-CP-30            |
|---|-------------------------|-------------------------|-------------------------|-------------------------|
| <b>Hold-Up time</b> (@ 400 VAC input)<br>V <sub>out</sub> = 100%, P <sub>out</sub> = 15 kW<br>I <sub>out</sub> = 100%, P <sub>out</sub> = 15 kW<br>V <sub>out</sub> = 100%, P <sub>out</sub> = 7.5 kW | 10 ms<br>10 ms<br>25 ms | 10 ms<br>10 ms<br>20 ms | 15 ms<br>15 ms<br>35 ms | 15 ms<br>15 ms<br>35 ms |
| <b>Turn on delay</b><br>after mains switch on   | 2.5 s                   |                         |                         |                         |
| Inrush current  | 23 A                    |                         |                         |                         |

Notes: 1. Measured at full load. 2. Signal latency depends on the interface used & data traffic.

3. See "Safety Instructions"

|   | SM70-CP-450  | SM210-CP-150   | SM 500-CP-90   | SM 1500-CP-30   |
|---|--|--|--|---|
| <b>Series operation</b><br>max. total voltage   | Not possible   | Not possible   | 750V*<br>1000V**   | Not possible  |
| Master / Slave operation  |  |  | maximum 6 units <sup>3</sup><br><br>*) units delivered before Q4 / 2018<br>**) units delivered Q4 / 2018 or newer<br>Contact factory for upgrading to enable 1000V series operation for older units. |   |
| <b>Parallel operation</b><br>Master / Slave operation   | maximum 60 units   |  |  |   |
| <b>Remote sensing</b><br>max. voltage drop per load lead  | default 1 V, can be set to 10 V  |  |  |   |
| <b>Limits</b><br><b>Voltage</b> adjust range<br><b>Current</b> adjust range<br><b>Power</b> adjust range<br><b>Voltage</b> OverLoad level<br><b>Voltage</b> Self-Protection level | 0 - 101 %<br>0 - 101 %<br>0 - 101 %<br>102.5 % - unit will continue to operate (OL-indication in display)<br>105 % - output is automatically disabled (PROT-indication in display) |  |  |   |
| <b>Potentiometers</b><br>front panel control with knobs<br>resolution   | 15 bits  |  |  |   |
| <b>Meters</b><br>scale voltage<br>scale current<br>scale power<br>accuracy read output  | 4 digit<br>0.00 - 70.00 V<br>- 450.0 - 450.0 A<br>- 15000 - 15000 W<br>0.2% + 2 digit  | 4 digit<br>0.0 - 210.0 V<br>- 150.0 - 150.0 A<br>- 15000 - 15000 W<br>0.2% + 2 digit | 4 digit<br>0.0 - 500.0 V<br>- 90.0 - 90.0 A<br>- 15000 - 15000 W<br>0.2% + 2 digit   | 4 digit<br>0 - 1500 V<br>- 30.00 - 30.00 A<br>- 15000 - 15000 W<br>0.2% + 2 digit |

|  |  |          |  |  |
|--|--|----------|--|--|
| <b>Mounting</b>  | stacking of units allowed, air flow is from left to right  |          |  |  |
| <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  |          |  |  |
| <b>Interlock (CON F)</b>   | input for contact at rear panel  |          |  |  |
| <b>Cooling</b><br>audio noise level<br><br>air flow                      | low noise blower, fan speed adapts to temperature of internal system<br>ca. 50 dBA at full load, 25 °C ambient temperature, 1 m distance<br>ca. 65 dBA at full load, 50 °C ambient temperature, 1 m distance<br>From left to right |          |  |  |
| <b>Enclosure</b> degree of protection                                    | IP20   |          |  |  |
| <b>Dimensions</b><br>front panel: h x w<br>behind front panel: h x w x d | 132 x 483 mm (19", 3 U)<br>128 x 448 x 591 mm (excluding feet)<br>no extra depth is required with optional interfaces assembled  |          |  |  |
| <b>Weight</b>  | 27 kg  |          |  |  |

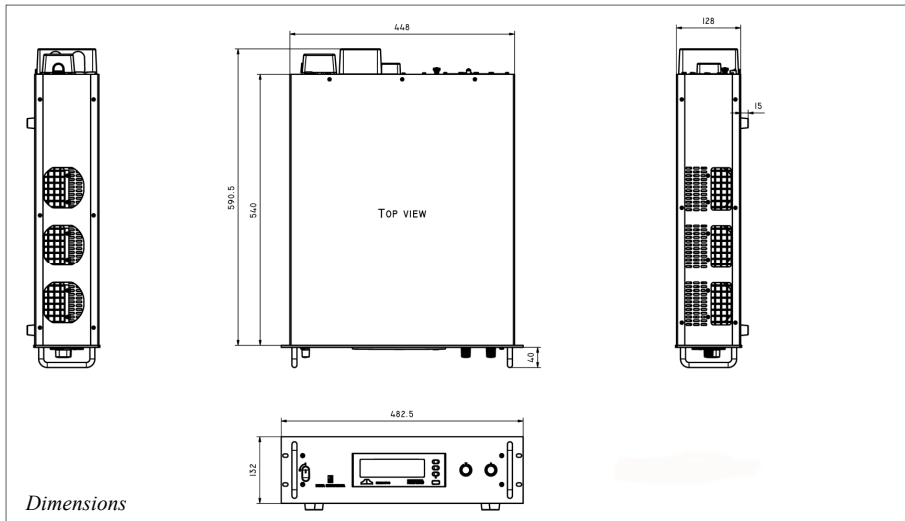
CV = Constant Voltage  
CC = Constant Current  
CP = Constant Power

Specifications measured at  
 $t_{amb} = 25 \pm 5 \text{ }^\circ\text{C}$  and  $V_{in} = 400 \text{ VAC}$ ,  
50 Hz unless otherwise noted.

The information in this document is  
subject to change without notice.

Notes:

1. Measured at full load.
2. Signal latency depends on the interface used and data traffic.
3. See safety Instructions in the operating manual.



## 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 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.



### Sequencer

Arbitrary Waveform generator or standalone automation.



### High Voltage Isolation

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



### Ethernet Interface

Ethernet interface for programming and monitoring



### USB-Input

Not yet available: Front and rear panel USB-Input for exchange of settings and waveforms (Host / Type-A), or for controlling the unit (Device / Type-B).

## 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

