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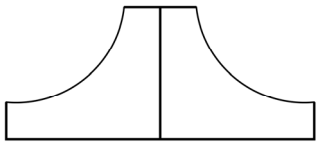
SM15K - Series 15kW DC POWER SUPPLIES

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

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		SM70-CP-450	SM210-CP-150	SM500-CP-90	SM1500-CP-30
DC Power terminals					
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
AC Input					
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			
Efficiency					
Sink & Source mode:					
400 V AC, 3 ph input,					
15 kW, I_{out}=100%		95 %			
15 kW, U_{out}=100%		96 %			
Regulation					
Load 0 - 100%	**CV**	6 mV	5 mV	4 mV	10 mV
Line 342 - 528 V AC (external voltage sense)	**CV**	< 1 mV	< 1 mV	< 1 mV	< 1 mV
Load 0 - 100%	**CC**	35 mA	12 mA	8 mA	2 mA
Line 342 - 528 V AC (internal voltage sense, after warm up)	**CC**	4 mA	3 mA	1 mA	1 mA
Ripple + noise					
Source mode:		33 V / 450 A	100 V / 150 A	167 V / 90 A	500 V / 30 A
rms (BW=300 kHz)	**CV**	10 mV	30 mV	10 mV	25 mV
p-p (BW=20 MHz)	**CV**	60 mV	125 mV	55 mV	150 mV
rms (BW=300 kHz)	**CC**	100 mA	t.b.d.	45 mA	12 mA
p-p (BW=20 MHz)	**CC**	-	-	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)	**CV**	10 mV	20 mV	25mV	35mV
p-p (BW=20 MHz)	**CV**	60 mV	100 mV	115mV	250mV
rms (BW=300 kHz)	**CC**	100 mA	t.b.d.	45 mA	5 mA
p-p (BW=20 MHz)	**CC**	-	-	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)	**CV**	8 mV	30 mV	7 mV	15 mV
p-p (BW=20 MHz)	**CV**	50 mV	125 mV	35 mV	130 mV
rms (BW=300 kHz)	**CC**	100 mA	t.b.d.	45 mA	10 mA
p-p (BW=20 MHz)	**CC**	-	-	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)	**CV**	8 mV	20 mV	10 mV	25 mV
p-p (BW=20 MHz)	**CV**	50 mV	100 mV	50 mV	200 mV
rms (BW=300 kHz)	**CC**	100 mA	t.b.d.	90 mA	3 mA
p-p (BW=20 MHz)	**CC**	-	-	320 mA	12 mA
CC-ripple at full load					
Programming & monitoring accuracy *(excluding INT MOD ANA)*					
Voltage		± 0.08%			
Current		± 0.15%			
Minimum Sink Voltage					
@ 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
Temp. coeff., per °C	**CV**	20.10^{-6}			
	CC	50.10^{-6}			
Stability [1]					
after 1 hr warm-up					
during 8 hrs	**CV**	50.10^{-6}			
	CC	80.10^{-6}			
t_{amb} = 25 ± 1 °C, V_{in} = 400 VAC (internal voltage sensing for CC-stab.)					

Notes: 1. Measured at full load. 2. Signal latency depends on the interface used & data traffic. 3. See "Safety instructions"

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

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

Insulation		
AC power terminals / DC pwr terminals	3750 Vrms (1 min.)	3750 Vrms (1 min.)
creepage / clearance	8 mm	8 mm
AC power terminals / case	2500 Vrms	2500 Vrms
DC power terminals / case	1000 V DC [3]	1500 V DC [3]
Safety	EN 60950 / EN 61010	
EMC Generic Emission	**EN 61000-6-3,** residential, **light** industrial environment (EN 55022 **B**)	
Generic Immunity	**EN 61000-6-2,** industrial environment	
Operating Temperature at full load	– 20 to + 50 °C derate output to 75% at 60 °C	
Humidity	maximum 95% RH, non condensing, up to 40 °C maximum 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	

	SM70-CP-450	**SM210-CP-150**	**SM500-CP-90**	**SM1500-CP-30**
Hold-Up time (@ 400 VAC input)				
V_{out} = 100%, P_{out} = 15 kW	10 ms	10 ms	15 ms	15 ms
I_{out} = 100%, P_{out} = 15 kW	10 ms	10 ms	15 ms	15 ms
V_{out} = 100%, P_{out} = 7.5 kW	25 ms	20 ms	35 ms	35 ms
Turn on delay 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	SM500-CP-90	SM1500-CP-30
Series operation max. total voltage Master / Slave operation	Not possible	Not possible	750V* 1000V** maximum 6 units [3] **) units delivered before Q4 / 2018* ***) units delivered Q4 / 2018 or newer* *Contact factory for upgrading to enable 1000V series operation for older units.*	Not possible
Parallel operation Master / Slave operation	maximum 6 units *contact factory for more units*	t.b.d.	maximum 60 units	maximum 60 units
Remote sensing max. voltage drop per load lead	default 1 V, can be set to 10 V			
Limits **Voltage** adjust range **Current** adjust range **Power** adjust range **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 with knobs resolution	15 bits			
Meters scale voltage scale current scale power accuracy read output	4 digit 0.00 - 70.00 V – 450.0 - 450.0 A – 15000 - 15000 W 0.2% + 2 digit	4 digit 0.0 - 210.0 V – 150.0 - 150.0 A – 15000 - 15000 W 0.2% + 2 digit	4 digit 0.0 - 500.0 V – 90.0 - 90.00 A – 15000 - 15000 W 0.2% + 2 digit	4 digit 0 - 1500 V – 30.00 - 30.00 A – 15000 - 15000 W 0.2% + 2 digit

Mounting	stacking of units allowed, air flow is from left to right	
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	
Interlock (CON F)	input for contact at rear panel	
Cooling audio noise level air flow	low noise blower, 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	
Enclosure degree of protection	IP20	
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) no extra depth is required with optional interfaces assembled	
Weight	27 kg	

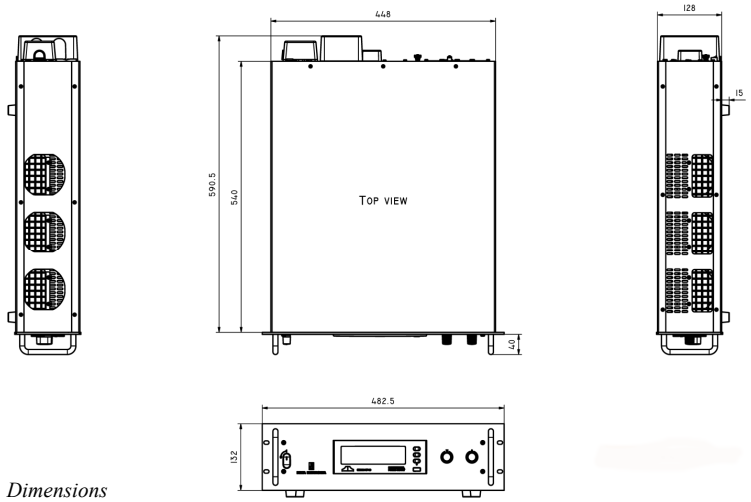
CV = Constant Voltage
CC = Constant Current
CP = Constant Power

Specifications measured at t_{amb} = 25 ± 5 °C and Vin = 400 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.*



Dimensions

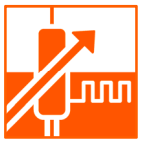
Typical Applications

- 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

Optional Interfaces (4pcs)

Isolated Analog, RS485 / RS422 / RS232, USB, Digital I/O, Isolated Contacts and M/S-2 Controller.

***NO** Line Cord supplied*

AC Mains Connector (contra-plug supplied)

Sense Block

USB type-B, Ethernet, Interlock, USB type-A

DC Power Terminals

Feet are not mounted but included in packing

Safety Covers supplied for in- and output (not shown)

SM15K - Interface modules

Models	Description
INT MOD M/S-2	Master/Slave interface SM15K
INT MOD CON	Isolated contacts interface
INT MOD SER	Multi-protocol serial interface
INT MOD DIG	Digital I/O interface
INT MOD ANA	Isolated analog interface

General Features

- Plug and Play for the SM15K series power supplies
- Multiple interfaces possible per power supply
- Isolated from the output voltage Working voltage 1000V or 1500V depending on type of unit
- Floating with respect to earth

Features INT MOD M/S-2

Master Slave interface SM15K

- Easy control of series or parallel operation.
- Multiple power supplies behave as one power supply.
- Large systems, up to 300kW

Features INT MOD CON

Isolated contacts

- 4 relays with make-and-break contacts
- Additional (floating) Interlock with 24V enable system
- Programmable via Ethernet

Features INT MOD SER

Serial controller interface SM15K

- Multi protocol RS232, RS485, RS422, USB
- Web based configuration
- Speeds up to 115.2 kbps

Features INT MOD DIG

Digital (user) I/O

- 8 inputs Logic high = 2.5 … 30V, Logic low = 0V
- 8 Open Drain outputs 0 - 30V, max. 200mA
- Programmable via Ethernet or sequences

Features INT MOD ANA

Analog controller interface

- High accuracy, low drift
- 16 bit AD and DA conversion
- Compatible with other Delta Elektronika 15p analog interfaces
- Factory calibrated for optimum accuracy

Master Slave Interface - INT MOD M/S-2

Typical Applications

- Applications where more current or voltage is required than one power supply can deliver
- Applications where a symmetrical power supply is needed

Specifications

	SM70-CP-450	SM500-CP-90	SM1500-CP-30
M/S Parallel operation Max. devices	maximum 6 units	maximum 60 units	
Recovery time	3x the values of a single unit	2x the values of a single unit	
Ripple + noise	Values of a single unit		
Programming Speed	Values of a single unit		
Typical additional programming time	20 µs		
Programming cable	Modular connector calbe S/FTP CAT6 8P8C		
Max. cable length	2m		

	SM70-CP-450	SM500-CP-90	SM1500-CP-30
M/S Series operation Max. voltage Max. devices	Not possible	750V* 1000V** maximum 6 units **) units delivered before Q4 / 2018* ***) units delivered Q4 / 2018 or newer* *Contact factory for upgrading to enable 1000V series operation for older units.*	Not possible
Typical additional programming time		20 µs	
Programming cable		Modular connector calbe S/FTP CAT6 8P8C	
Max. cable length		2m	

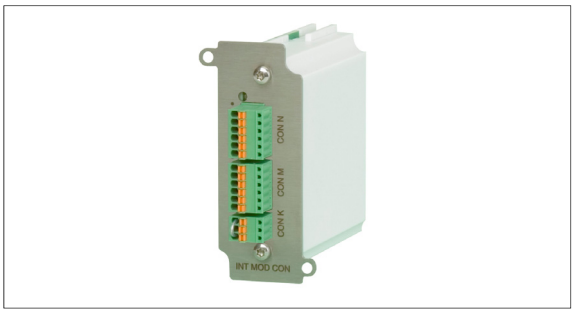
Safety	EN 60950 / EN 61010
Operating Temperature	– 20 to + 50 °C
Humidity	max. 95% RH, non condensing, up to 40 °C max. 75% RH, non condensing, up to 50 °C
Storage temperature	– 40 to + 85 °C

Assembly	Pluggable, SM15K interface slot 3 or slot 4. See paragraph 'Hardware Installation' in the operating manual. Note 1: max 1pcs INT MOD M/S-2 per unit.
Weight	70 g

Isolated Contacts - INT MOD CON

Typical Applications

- Trigger an external safety alarm
- Interact in automated processes
- Switch the output On/Off with a remote 24Vdc signal
- Using a floating signal for triggering the Interlock function



Specifications

Relay contacts 1... 4	
Contact voltage	60 V
Contact current	2 A
Maximum switching capacity	60 W
Floating Interlock	
Open circuit voltage	5 V
Floating Enable	
Nominal input voltage	24 VDC
Input voltage range	15 - 30 VDC
Input impedance	12kOhm

Insulation	
progr.connectors - internal circuits	1000 VDC Reinforced isolation acc. EN60950-1 / EN61010-1 with the exception of 1500 VDC for SM1500-CP-30
prog.connectors - earth	max. 60 VDC
Safety	EN 60950 / EN 61010
Operating Temperature	– 20 to + 50 °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

Mounting	Pluggable, SM15K interface slots 1, 2, 3 and slot 4. See paragraph 'Hardware Installation' in the operating manual. Maximum 4pcs per unit.
Programming connector	Relay 1 & 2, via a 6 pole push wire or so-called push in connector. Relay 3 & 4, via a 6 pole push wire / push in connector. Interlock and Enable via a 3 pole push wire / push in connector. For all 3 connectors there's a contra header supplied.
Weight	0.14 kg

Serial Interface (multi-protocol) - INT MOD SER

Typical Applications

- RS232 Programming
- Balanced RS422 Programming
- USB Programming
- Balanced RS485 Bi-directional Programming

Specifications

Communication speeds (bps)	2400, 4800, 9600, 19200, 38400, 57600, 115200
Insulation progr.connectors - internal circuits	1000 VDC Reinforced isolation acc. EN60950-1 / EN61010-1 with the exception of 1500 VDC for SM1500-CP-30
prog.connectors - earth	max. 60 VDC
Safety	EN 60950 / EN 61010
Operating Temperature	– 20 to + 50 °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

Mounting	Pluggable, SM15K interface slots 1, 2, 3 and slot 4. See paragraph 'Hardware Installation' in the operating manual. Maximum 4pcs per unit.
Programming connector	RS422 & RS485 wires via push wire or so-called push in connector (contra header supplied) RS232 via 9 pole D-connector (female), USB socket type B.
Weight	0.14 kg

Digital User I/O - INT MOD DIG

Typical Applications

- Hardware triggering of sequences
- Interaction with other equipment
- Stand-alone automation
- Safety or Alarm indications

Specifications

Logic inputs 1... 8	
Input range	2 - 30V
Input impedance	Rin = 22kOhm
Load current +5V	100mA
Logic outputs 1 ... 8	
Output type	Open Drain (True = 0V, False = open)
Output impedance	7 Ohm (max 30V/200mA)

Insulation	
progr.connectors - internal circuits	1000 VDC Reinforced isolation acc. EN60950-1 / EN61010-1 with the exception of 1500 VDC for SM1500-CP-30
prog.connectors - earth	max. 60 VDC
Safety	EN 60950 / EN 61010
Operating Temperature	– 20 to + 50 °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

Mounting	Pluggable, SM15K interface slots 1, 2, 3 and slot 4. See paragraph 'Hardware Installation' in the operating manual. Maximum 4pcs per unit.
Programming connector	User Outputs via 15 pole D-connector High Density (female), User Inputs via 15 pole D-connector High Density (female).
Weight	0.14 kg

Isolated Analog Controller Interface - INT MOD ANA

Typical Applications

- Analog programming of voltage and current
- Analog monitoring of voltage and current
- Remote monitoring of the status signals: OverTemp, Limit
- Remote Shut down of the power output using a 5V signal

Specifications

Analog Programming	CV	CC
Programming inputs		
input range	0 - 5 / 0 - 10 V	0 - 5 / 0 - 10 V *
accuracy	± 0.2%	± 0.2%
offset	– 1 ... + 1 mV (on 5 V)	– 1 ... + 1 mV (on 5 V)
temp. coeff. offset	10 µV / °C	10 µV / °C
input impedance	10 MOhm	10 MOhm
		** CC-prog input (pin3) sets both CC+ and CC- with 1 signal.*
Monitoring output		
output range	0 - 5 / 0 - 10 V	– 5 to + 5 V / – 10 to + 10 V
accuracy	± 0.2%	± 0.2%
offset	– 1 ... + 1 mV (on 5 V)	– 1 ... + 1 mV (on 5 V)
temp. coeff. offset	3 µV / °C	60 µV / °C
output impedance	2 Ohm / max. 4 mA	2 Ohm / max. 4 mA

Reference voltage			
on prog. connector	V_{ref}	5.114 ±15 mV (Ro = 2 Ohm, max. 4 mA)	
	TC	20 ppm	
+12 V output	V_o	12 V ± 0.2 V	
on prog. Connector	I_{max}	0.2 A	
	R_o	5 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)
ACF - status		AC - Fail	5 V = logic 1 (R^o = 500 Ohm)
DCF - status		DC - Fail [2]	5 V = logic 1 (R^o = 500 Ohm) [2] V_{out} ±5% beyond set point
PSOL - status		*Although present on the interface, for SM15K the PSOL-status is not used, it is only for SM3300.*	
Remote Shutdown		with +5 V, 1 mA or relay contact	

Insulation	
progr.connectors - internal circuits	1000 VDC Reinforced isolation acc. EN60950-1 / EN61010-1 with the exception of 1500 VDC for SM1500-CP-30
prog.connectors - earth	max. 60 VDC
Safety	EN 60950 / EN 61010
Operating Temperature	– 20 to + 50 °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

Mounting	Pluggable, SM15K interface slots 1, 2, 3 and slot 4. See paragraph 'Hardware Installation' in the operating manual. Maximum 1pcs INT MOD ANA per unit.
Programming connector	15 pole D-connector (female)
Weight	0.14 kg