

# SH Series 8 kW to 40 kW Regulated High Voltage DC Power Supplies

## 1 kV to 100 kV Rack Mount

## CE and Semi S2-93 Compliant

## Fully RoHS Compliant

The SH family of power supplies are sophisticated, 8 kW through 40 kW, high voltage power supplies with low ripple and noise. They are air insulated fast response units with tight regulation and extremely low arc discharge currents.

Please refer to Technology > Applications page on our web site for typical applications.

The SH Series, are fully compliant with the following European Directives:

- EN61010/ IEC61010, Safety
- EN61000-6-4, Conducted and Radiated Emissions
- EN61000-6-2:2005, Conducted and Radiated Immunity
- 2011/65/EU, Restriction of the use of Hazardous Substances (RoHS)



Models from 0 to 1 kV through 0 to 100 kV.  
8kW models are 17.5"H x 24.0" D. Weight is only 110 lbs.

### Features:

**Arc Quench.** The HV output is inhibited for a short period after each load arc to quickly extinguish the arc.

**Arc Count.** Internal circuitry constantly senses and integrates arcs that occur over a given time. In the event a system or load arcing problem develops and exceeds factory-set parameters, the power supply will cycle off in an attempt to clear the fault and then automatically restart after a preset "off dwell time".

**Pulse-Width Modulation.** Off-the-line pulse-width modulation provides high efficiency and a reduced parts count for improved reliability.

**Air Insulated.** The SH Series features "air" as the primary dielectric medium. No oil or encapsulation is used to impede serviceability or increase weight.

**Constant Voltage/Constant Current Operation.** Automatic crossover from constant-voltage to constant-current regulation provides protection against overloads, arcs, and short circuits.

**Current Trip.** This feature may be substituted for constant-current operation by a rear panel selector switch.

**Redundant Thermal Overload Protection.** Thermostats and tachometer fan RPM sensing shut down the power supply due to over temperature or reduced fan speeds.

**Low Ripple.** Typically, ripple is less than 0.025% rms of rated voltage at full load.

**Tight Regulation.** Voltage regulation is typically better than 0.01% for allowable line and load variations. Current regulation is better than 0.1% from short circuit to rated voltage.

**Higher Power Capability.** Power supply modules can be paralleled up to 40 kW output power utilizing one master control module and up to four slave modules.

**Differentially Coupled Analog Control Signals.** All voltage and current programming and monitoring signals are coupled to the user interface by true differential amplifiers. This provides for the ability to return the program and monitor commons to ground or system common at the source. This arrangement isolates the return wires and eliminates errors due to unwanted return currents flowing in these connections.

**Warranty.** All power supplies are warranted for three years. A formal warranty statement is available.

## Specifications

### Specifications for 8 kW Power Supplies

(Specifications apply from 5% to 100% of rated voltage. Operation is guaranteed down to zero with a slight degradation of performance.)

(For 16 kW power supplies, unless otherwise indicated, the performance specification limits could be increased by a factor of up to 30%. For power supplies over 16 kW consult the factory.)

**Input:** 187-228 V rms, three-phase, 48-63 Hz, 12,000 VA maximum at full load (less than 35 A per phase). Inrush current is less than 45 A with a nominal decay time constant of 60 ms. Four 10-32 studs for AC line connection with a safety cover and strain relief are provided. For systems 16 kW and greater, a separate AC input connection is required for each additional slave chassis

**Mains service must be protected with fuses or circuit breakers with a maximum rating of 125 A.**

**Efficiency:** Typically 85% at full load.

**Output:** Continuous, stable adjustment from 0 to rated voltage/current by means of panel-mounted 10-turn potentiometers (0.05% resolution), or external 0 to +10 V signals. Repeatability better than 0.1% of setting.

**Voltage programming accuracy:** 0.5% of setting + 0.2% of rated output.

Resolution is a function of the programming method used.

Voltage and current external programming are differentially coupled with a maximum common mode voltage of  $\pm 3$  VDC.

**Voltage Regulation:** Better than  $\pm 0.005\%$  for specified line variations and  $0.01\% + 10$  mV/A for no load to full load variations. For 80 to 100 kV models, V-Load regulation is 0.025%

**Current Regulation:** From short circuit to rated voltage at any load condition:

- 1 kV to 6 kV: Better than 0.5%.
- 8 kV to 100 kV: Better than 0.2%

**Voltage Monitor:** 0 to +10 V equivalent to 0 to rated voltage. Accuracy: 0.5% of reading + 0.2% of rating. Output impedance is 10 k $\Omega$  differentially coupled.

**Current Monitor:** 0 to +10 V equivalent to 0 to rated current. Accuracy:

- 1 kV to 6 kV: 1.5% of reading plus 0.5% of rated output.
- 8 kV to 100 kV: 1% of reading plus 0.2% of rated output.

Output impedance is 10 k $\Omega$ , differentially coupled.

**Ripple:** Better than 0.025% of rated voltage +1 V RMS at full load.

**Stored Energy:** See Models chart.

**Stability:** 0.01% per hour after 1/2 hour warm-up, 0.05% per 8 hours.

**Voltage Rise Time Constant:** 200 ms for 8 kV to 100 kV models and 50 ms for 1 kV to 6 kV models typical, using either HV enable or remote programming control.

**Voltage Decay time constant:** Decay time constant is a function of the applied load. The decay time constant will be equal to the rise time constant with a minimum load of 5% of rated maximum.

**Temperature Coefficient:** 0.01%/°C.

**Ambient Temperature:** -20 to +40° C, operating; -40 to +85° C, storage.

**Polarity:** Available with either Positive, Negative, or Reversible polarity with respect to chassis ground.

**Protection:** Automatic current regulation protects against all overloads, including arcs and short circuits. Thermal switches and rpm sensing fans protect against thermal overload. Circuit breaker, fuses, surge-limiting resistors, and low energy components provide ultimate protection.

**Arc Quench.** Optional on models 1 kV through 6 kV; standard on models 8 kV through 100 kV. An arc quench feature provides sensing of each load arc and quickly inhibits the HV output for approximately 20 ms after each arc.

**Arc Count.** Optional on models 1 kV through 6 kV; standard on models 8 kV through 100 kV. Internal circuitry senses the number of arcs caused by external load discharges. If the rate of consecutive arcs exceeds approximately one arc per second for five arcs, the supply will turn off for approximately five seconds to allow clearance of the fault. After this period, the supply will return automatically to the programmed output voltage value with the voltage rise time constant indicated. If the load fault still exists, the above cycle will be repeated.

**Current Limit:** In current limit mode the power supply will regulate the load current at the programmed current level with automatic crossover between voltage and current regulating modes.

**Current Trip:** A switch located on the rear of the control panel assembly allows the selection of current limit or current trip operation. When the switch is set to current trip mode, the HV output will disable and latch off when the load current reaches the programmed current level. Reset is accomplished by either cycling the AC power, toggling the HV enable signal, or by pushing the HV off/reset and then the HV on switches.

**Front Panel Elements.** The front panel contains all local control functions and remote/local selector switches. These control functions are: AC power on/off circuit breaker and indicator light, separate 10-turn controls with locking vernier dials used to set voltage and current levels, high voltage on switch, and high voltage off/reset switch. LED's indicate: when high voltage is on, output polarity, interlock, fault status, and whether the supply is operating in a voltage or current regulating mode. Output levels are indicated by voltage and current digital meters. Remote/local switches are provided for voltage and current programming and HV on/off functions.

**Slave Front Panel Elements.** (When applicable). AC power breaker/switch and indicator. Bias, tracking (overvoltage), and thermal overload/low fan speed indicators. Slave current and voltage service test points.

**Remote Control Interface.** All standard SH family power supplies provide a user's remote interface. The signals provided are:

#### Inputs:

Safety interlock, output voltage and current program signals, high voltage enable and connections for remote HV on and off pushbuttons.

#### Outputs:

Output voltage and current monitor signals, HV enable status, I/V regulation mode status, fault status, and a +10 V reference source.

Signal common and ground reference terminals are also provided.

Toggle switches on the rear of the control chassis select either current limit or current trip operation and local or remote HV enable.

**External Interlock:** Open = off, closed = on. Normally latching except for "NC" option supplies where it is non-latching. The interlock indicator LED is lit when the interlock is open.

#### HV Enable:

**Remote Mode:** 0 - 1.5 V = OFF, 2.5 - 15 V = ON.

**Local Mode:** The HV output is permanently enabled.

**HV Enable, Fault and I/V Regulation Status:** Each are a set of form "C" relay contacts.

**Accessories:** Detachable, 8 foot, shielded high voltage coaxial cable provided. Models 16 kW and above are provided with an additional HV cable per slave module. A 25 pin D-subminiature connector for customer interface is provided. All chassis interconnection cables are provided.

## Options

Symbol	Description
ZR	Zero start interlock. Voltage control, local or remote, must be at zero before HV will enable.
SS	Slow start ramp. Specify standard times of 5, 10, 15, 20, or 30 seconds $\pm$ 20% .
5VC	0-5 V voltage and current program/monitor.
NC	Blank front panel. Panel contains AC power breaker/switch and indicator, HV ON, HV OFF, interlock and fault indicators, and output current and voltage service test points.
ARC	For 1 to 6 kV models. Arc quench and arc sensing are provided as described in specifications for 8 to 100 kV models.
K01	RS-232/USB control and monitor
K02	RS-232/USB/Ethernet control and monitor

Please consult factory for special requirements.

## 8 kW Models

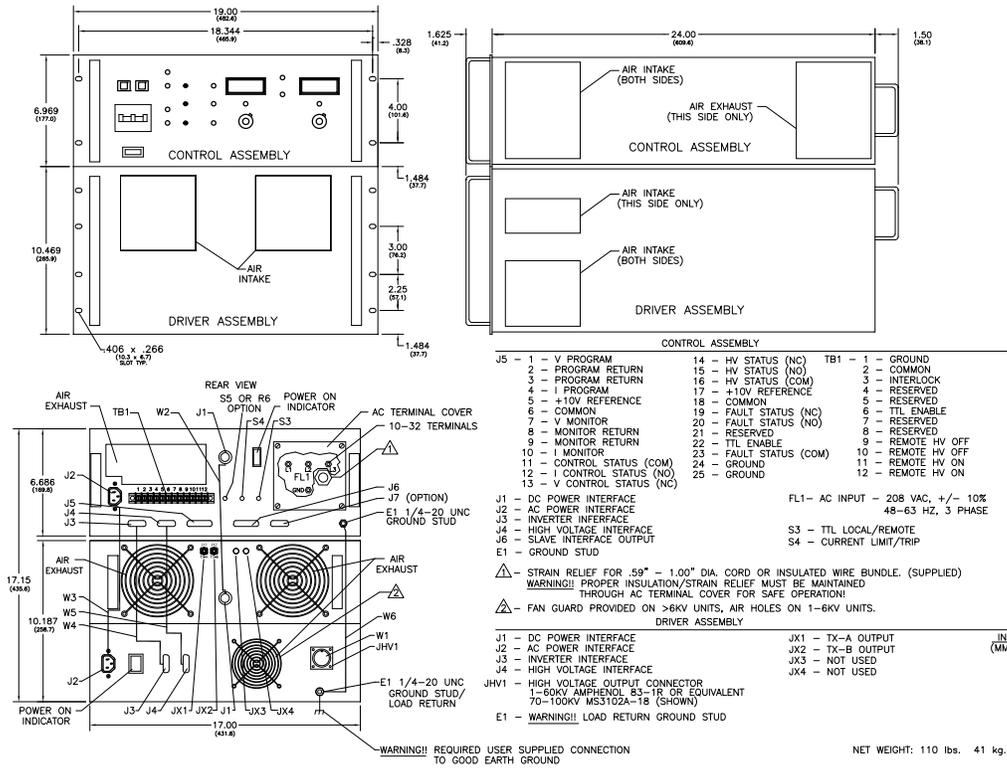
Positive Polarity	Negative Polarity	Reversible Polarity	Output Voltage	Output Current	Stored Energy (J)	Output Cable
Reversible Polarity Only		SH1R8.0	0 – 1kV	0 – 8.0A	8	RG-8U
		SH1.5R5.3	0 – 1.5kV	0 – 5.3A	7.8	RG-8U
		SH2R4.0	0 – 2kV	0 – 4.0A	7.5	RG-8U
		SH3R2.7	0 – 3kV	0 – 2.7A	8	RG-8U
		SH5R1.6	0 – 5kV	0 – 1.6A	7	RG-8U
		SH6R1.3	0 – 6kV	0 – 1.3A	8	RG-8U
SH8P1.0	SH8N1.0	SH8R1.0	0 – 8kV	0 – 1000mA	10	RG-8U
SH10P800	SH10N800	SH10R800	0 – 10kV	0 – 800mA	12	RG-8U
SH12P670	SH12N670	SH12R670	0 – 12kV	0 – 670mA	12	RG-8U
SH15P530	SH15N530	SH15R530	0 – 15kV	0 – 530mA	10	RG-8U
SH20P400	SH20N400	SH20R400	0 – 20kV	0 – 400mA	18	RG-8U
SH25P320	SH25N320	SH25R320	0 – 25kV	0 – 320mA	13	RG-8U
SH30P270	SH30N270	SH30R270	0 – 30kV	0 – 270mA	18	RG-8U
SH40P200	SH40N200	SH40R200	0 – 40kV	0 – 200mA	16	RG-8U
SH50P160	SH50N160	SH50R160	0 – 50kV	0 – 160mA	20	RG-8U
SH60P130	SH60N130	SH60R130	0 – 60kV	0 – 130mA	24	RG-8U
SH70P110	SH70N110	SH70R110	0 – 70kV	0 – 110mA	28	DS2121
SH80P100	SH80N100	SH80R100	0 – 80kV	0 – 100mA	32	DS2121
SH100P80	SH100N80	SH100R80	0 – 100kV	0 – 80mA	40	DS2121

## 16 kW Models

For Models Greater Than 16 kW, Please Consult Factory.

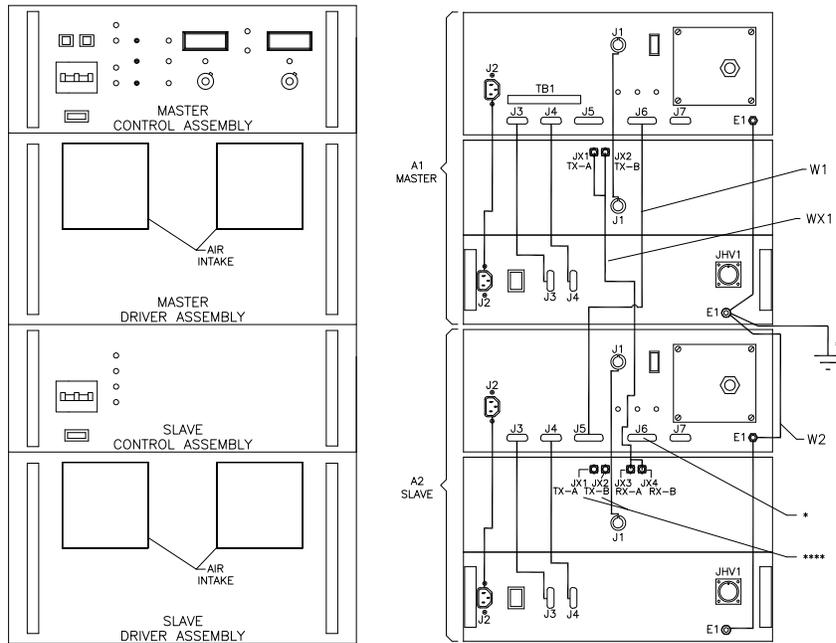
Positive Polarity	Negative Polarity	Reversible Polarity	Output Voltage	Output Current	Stored Energy (J)	Output Cable
Reversible Polarity Only		SH1R16.0	0 – 1kV	0 – 16.0A	16	2X RG-8U
		SH1.5R10.6	0 – 1.5kV	0 – 10.6A	15.6	2X RG-8U
		SH2R8.0	0 – 2kV	0 – 8.0A	15	2X RG-8U
		SH3R5.4	0 – 3kV	0 – 5.4A	16	2X RG-8U
		SH5R3.2	0 – 5kV	0 – 3.2A	14	2X RG-8U
		SH6R2.6	0 – 6kV	0 – 2.6A	16	2X RG-8U
SH8P2.0	SH8N2.0	SH8R2.0	0 – 8kV	0 – 2.0A	20	2X RG-8U
SH10P1.6	SH10N1.6	SH10R1.6	0 – 10kV	0 – 1.6A	24	2X RG-8U
SH12P1.3	SH12N1.3	SH12R1.3	0 – 12kV	0 – 1.3A	24	2X RG-8U
SH15P1.06	SH15N1.06	SH15R1.06	0 – 15kV	0 – 1060mA	20	2X RG-8U
SH20P800	SH20N800	SH20R800	0 – 20kV	0 – 800mA	36	2X RG-8U
SH25P640	SH25N640	SH25R640	0 – 25kV	0 – 640mA	26	2X RG-8U
SH30P540	SH30N540	SH30R540	0 – 30kV	0 – 540mA	36	2X RG-8U
SH40P400	SH40N400	SH40R400	0 – 40kV	0 – 400mA	32	2X RG-8U
SH50P320	SH50N320	SH50R320	0 – 50kV	0 – 320mA	40	2X RG-8U
SH60P260	SH60N260	SH60R260	0 – 60kV	0 – 260mA	48	2X RG-8U
SH70P220	SH70N220	SH70R220	0 – 70kV	0 – 220mA	56	2X DS2121
SH80P200	SH80N200	SH80R200	0 – 80kV	0 – 200mA	64	2X DS2121
SH100P160	SH100N160	SH100R160	0 – 100kV	0 – 160mA	80	2X DS2121

## 8 kW Models



## 16 kW Models

SEE MAIN OUTLINE DRAWING FOR ALL OTHER CONNECTIONS



- NOTES**
- \* - J6 OF SLAVE TO BE TERMINATED WITH CONNECTOR PROVIDED.
  - \*\* - REQUIRED USER SUPPLIED CONNECTION TO GOOD EARTH GROUND.
  - \*\*\*\* - JX1 & JX2 OF SLAVE TO BE CAPPED WITH COVERS PROVIDED.

- MASTER**
- J6 - SLAVE INTERFACE OUTPUT
- SLAVE**
- J5 - SLAVE INTERFACE INPUT