SWITCHBACK 6600 CE

Reliable, Ripple-free DC Power to both Cool and Heat

REAR VIEW

FRONT VIEW

Product Manual

Solid State
COOLING SYSTEMS
Precision Control. Precisely.

Solid State
COOLING SYSTEMS
*Temperature Control...***Precisely.**

CE Declaration of Conformity

We: Solid State Cooling Systems
167 Myers Corners Road
Wappingers Falls, NY 12590
USA

declare under our sole responsibility that the

Switchback 6600 CE Bipolar DC Power Supply

meets the provisions of the directives:

89/336/EEC with amendments 92/31/EEC and 93/68/EEC — EMC Directive

73/23/EEC — Low Voltage Directive

EN 50081-2: 1993 Emissions
EN 61000-6-2: 1999 Immunity

EN 61010-1+A1+A2: 1995 Safety Low Voltage Directive Safety requirements for electrical equipment for measurement, control, and laboratory use.

Lloyd F Wright Chief Technology Officer	
Date	December 4, 2000

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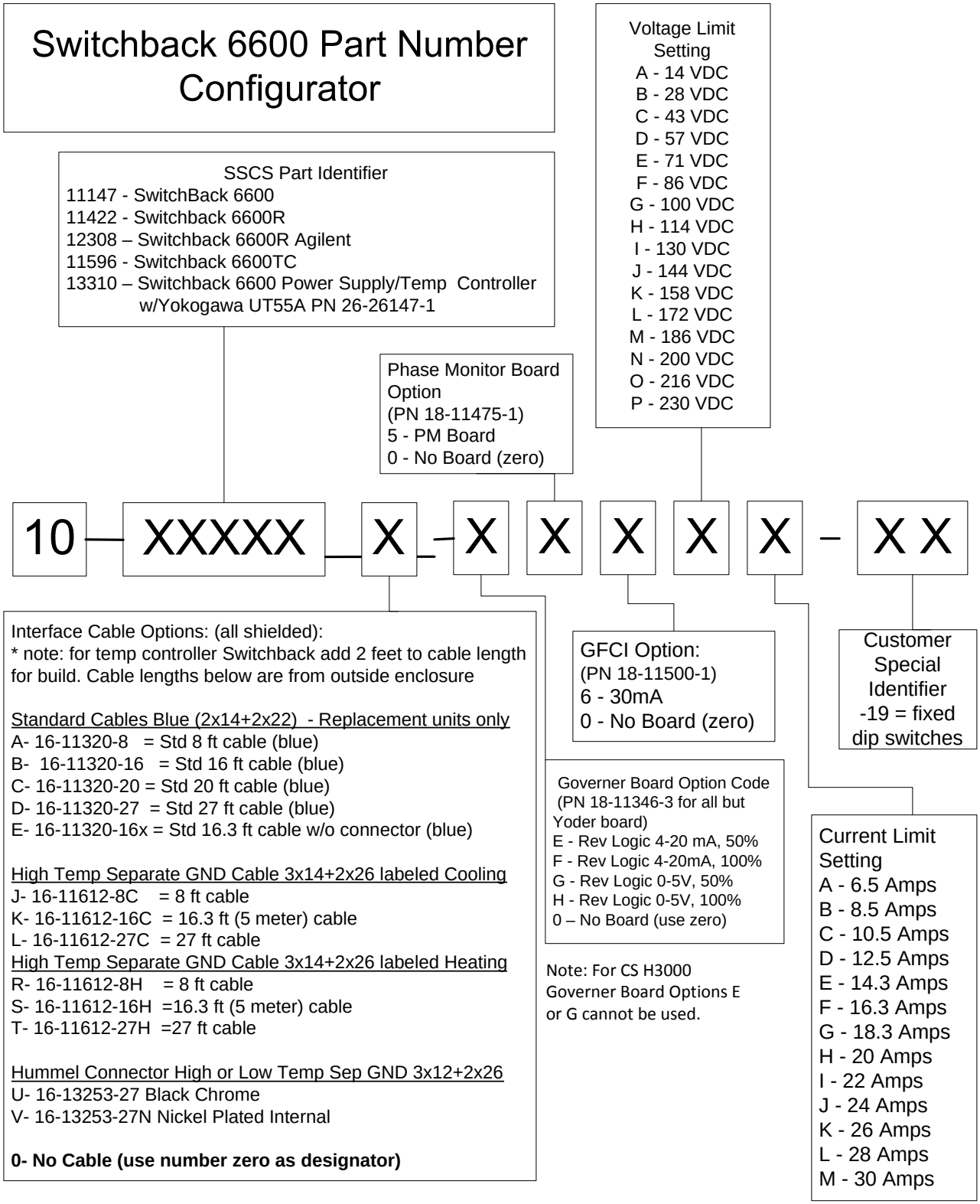
SWITCHBACK 6600 CE POWER SUPPLY CONFIGURATOR



SYMBOLS USED ON POWER SUPPLY

To avoid electric shock, disconnect all power prior to servicing. The power supply DC output is not isolated from the AC input. Input power must be disconnected to prevent hazardous potentials (approximately 145 volts) from appearing at the output, even when voltage between output terminals is zero.

Caution. Risk of electric shock. Disconnect all power prior to servicing.

Direct current.

Three-phase alternating current.

Protective conductor terminal.

SYMBOLS USED IN THIS MANUAL

The red CAUTION equilateral triangle symbol appears throughout the manual. Please follow the important instructions accompanying this symbol to avoid significant damage to the power supply.

The red WARNING equilateral triangle symbol appears throughout the manual accompanying certain maintenance and repair activities. Please follow the important instructions accompanying this symbol to avoid situations that could cause injury to the operator or other personnel.

The red DANGER equilateral triangle symbol appears throughout the manual accompanying certain maintenance and repair activities. Please follow the important instructions accompanying this symbol to avoid injury to the operator. Only trained personnel should undertake any activity marked by the red DANGER triangle.

CAUTION

- The output of the power supply MUST NOT be connected to secondary referenced circuitry. Input voltage must be disconnected to prevent hazardous potentials from appearing at the output. DC control and logic circuits are isolated from the AC line and DC output.

- Do not operate the Switchback 6600 Power Supply at ambient air temperatures above 40°C (104 °F) or below -10°C (14°F) as damage to the power supply could result.

- With AC power disconnected, the power supply's enclosure may be removed temporarily to adjust the current or voltage output limit dipswitch. Operation of the Switchback CE power supply with a non-original enclosure or any replacement components will immediately void both Solid State Cooling Systems' warranty and CE Mark.

- If the power supply is turned on as per table 4, but the setpoint signal being used (pin 23 or 16) is disconnected, the setpoint signal can float up to 5 V on its own causing maximum DC output. To avoid this:

  1) Never disconnect the local or remote setpoint signal being used.
  2) If using only remote setpoint, tie the local setpoint to signal ground.

Solid State COOLING SYSTEMS
*Temperature Control...***Precisely.**

PRODUCT
Manual

Switchback 6600 CE
Bipolar DC Power Supply

1.0 INTRODUCTION AND GENERAL DESCRIPTION

1.1 PURPOSE AND CAPABILITIES

The Switchback 6600 CE power supply is designed as a bipolar current-controlled power supply for use with thermoelectric systems or other predominately resistive loads. It provides a variable output current in user-programmable ranges from 0-6.5 to 0-30 A at voltages up to 230 VDC, with output current proportional to a 0-5 VDC input signal. The maximum output voltage is also user-programmable from 14 to 230 VDC. The output is bipolar to allow both heating and cooling in a thermoelectric system. This power supply also meets all CE Mark (see declarations page at front of this manual) and Semi S2-0200 safety, emissions, and immunity requirements. The Switchback 6600 CE readily interfaces with a temperature controller (available separately) to give a complete control system.

1.2 OPTIONAL FEATURES

The Switchback 6600CE power supply has four hardware options that offer additional features over the standard model:

1.2.1 GOVERNOR BOARD

This feature "governs" the output current rate of change to a maximum of 3% per second. When connected to a thermoelectric temperature control system, this limit ensures maximum thermoelectric life by not shocking the thermoelectric modules with sudden changes in DC current or polarity. The governor board has a removable jumper to allow use with the standard 0-5 VDC/digital polarity set-point signals or with the dual 4-20 mA set-point signals.

The governor board has an additional jumper that allows the user to limit the (-) polarity to 50% of maximum current. This feature can be employed to match a thermoelectric systems heating and cooling output, where, in the standard configuration, cooling is normal (+) polarity and heating is (-) polarity.

This feature may be purchased with the standard Switchback 6600 CE or in conjunction with the Phase Monitor.

1.2.2 PHASE MONITOR

Operation of the Switchback 6600CE power supply on only two phases causes the output to approximate a 100-120 Hz rounded edge square wave. The optional phase monitor will shut off the Switchback 6600CE if one or more input phase falls below 180 VAC. The phase monitor board has a normally closed 0.5 amp 250 VAC dry contact available on the output signal connector for external use. When the voltage on the low phase increases to over 180 VAC the phase monitor will automatically restart the power supply.

Note: Since phase alignment is not important to the Switchback 6600 CE Power Supply, the phase monitor does not check phase alignment.

This feature may be purchased with the standard Switchback 6600 CE or in conjunction with the Governor Board.

1.2.4 GROUND FAULT INTERRUPT

This feature adds a ground fault interrupt circuit that shuts off the power supply in the event of a ground fault. Power to the supply must be cycled to restart after a ground fault.

The ground fault interrupt circuit trips at 30mA AC.

The GFCI option also adds an additional over voltage shutdown circuit should the output voltage of the Switchback 6600 CE exceed 250 VDC.

This feature may be purchased with the standard Switchback 6600 CE or in conjunction with the Governor Board, and/or Phase Monitor.

2.0 INSTALLATION

2.1 INSPECTION

Inspect the shipping carton for possible damage before unpacking the unit. Carefully unpack the equipment. Save all packing materials until inspection is complete. Verify that all items listed on the packing slips have been received. Visually inspect all exterior surfaces for broken connectors, terminal blocks, dents or other damage. External damage may be an indication of internal damage. If any damage is evident, immediately contact the carrier who delivered the unit and submit a damage report. Failure to do so could invalidate future claims.

2.2 MOUNTING

The Switchback 6600 has two mounting flanges, one at each end (see Figures 1 and 2) for mounting with 10-32 or M5 screws. The power supply may be oriented in any direction.

******Important: Do not block the air intake or output areas.***
One inch (2.5 cm.) clearance is required around these areas. ***

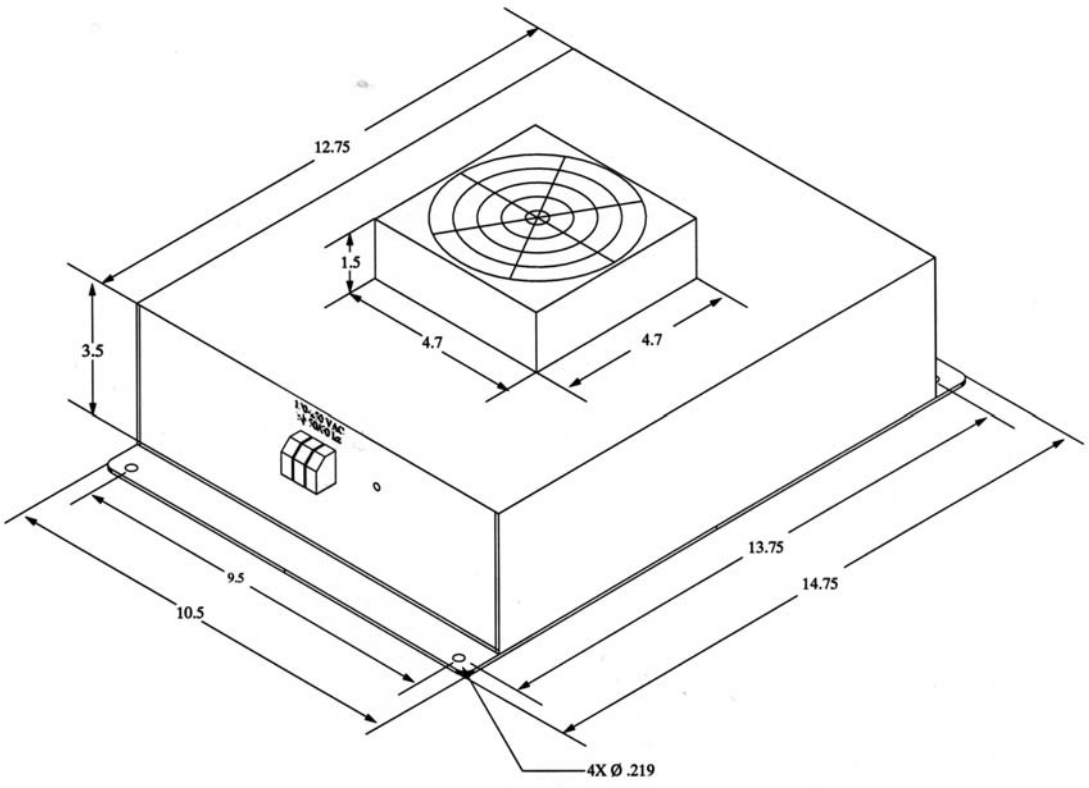


Figure 1: Switchback 6600 Enclosure, Front Perspective

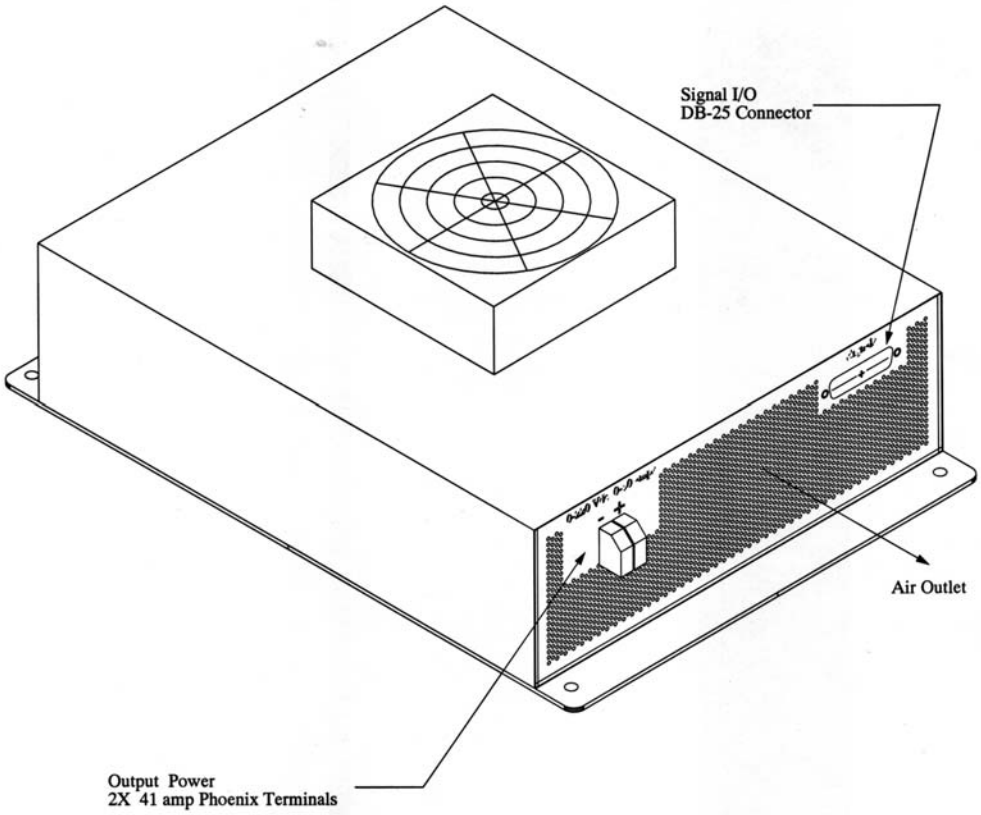


Figure 2: Switchback 6600 Enclosure, Rear Perspective

3.0 HOOKUP

3.1 POWER HOOKUP

Figure 3 shows the 200-240 VAC, 3-phase connections for Input Power. Figure 4 shows the DC output connections.

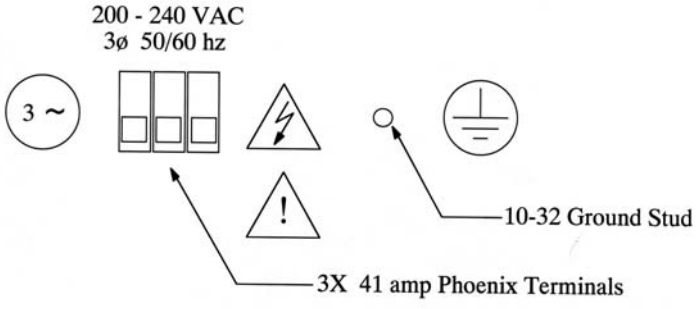


Figure 3: Input Power Connections

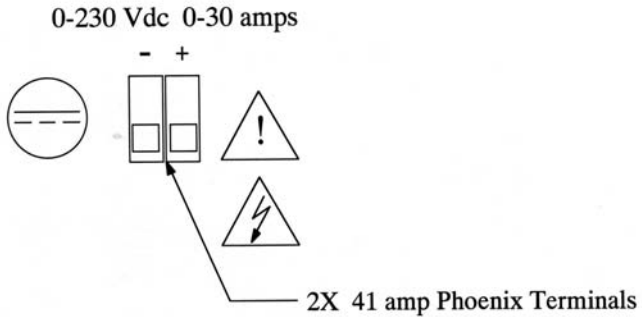


Figure 4: Output Power Connections

Notice to Users Required to Meet CE Emissions:

Two clamp-on ferrite beads are included with your Switchback 6600 Bipolar DC Power Supply. To meet CE conducted emissions, you must thread your two DC output wires through the cylindrical ferrite bead and clamp the square ferrite bead around your 3-phase AC input wires. The ferrite beads should be placed within one foot of the power supply case.

Radiated emissions from an installed Switchback 6600 Bipolar DC Power Supply are affected by the length of the DC output wires. To ensure the installed unit meets CE radiated emissions specifications, the DC output wires should be placed inside a flexible metallic sheath, such as BX cable.

3.2 MINIMUM SIGNAL HOOKUP REQUIRED

(See figures 5A & 5B)

In addition to the power connections, operation of the Switchback 6600 CE from one source of control signals requires three signals: Local On/Off (pin 19), Local Set point (pin 23) and Local Polarity Control (pin 22); or if using one of the 4-20 mA versions, Local On/Off (pin 19) normal (Cool) Set point (pins 1 & 2) and reverse (Heat) Set point (pins 16 &17).

3.3 HOOKUP FOR TWO SOURCES OF CONTROL SIGNALS

(Not available on 4-20 mA versions)

The Switchback 6600 CE is designed to operate from two sources of input, for example, the equipment front user interface or rear maintenance panel. Local operation overrides remote operation. Local operation may occur with remote operation off, but remote operation may not occur unless local operation is on also. See Table 4 (Section 5.0) for details. Minimum hookup for two sources of input requires four signals in addition to the three signal described in Section 3.2: Remote/Local (pin 20), Remote On/Off (pin 18), Remote Set point (pin 16) and Remote Polarity (pin 17).

WARNING!
If the power supply is turned on as per Table 4 (Section 5), but the set point signal being used (pin 23 or 16) is disconnected, the set point signal can float up to 5 V on its own, causing maximum DC output. To avoid this:

1) ***Never disconnect the local or remote set point signal being used.***
2) ***If using only remote set point, tie the local set point to signal ground.***

3.4 INPUT PROTECTION

A suitable 3-phase, 250 V, 30 amp, AC protector, such as circuit UL 489 rated circuit breaker, **SHOULD** be provided by the user to protect against failures in the regulator.

Figure 5A
Standard Signal Connector
25 pin D-subminiature Receptacle

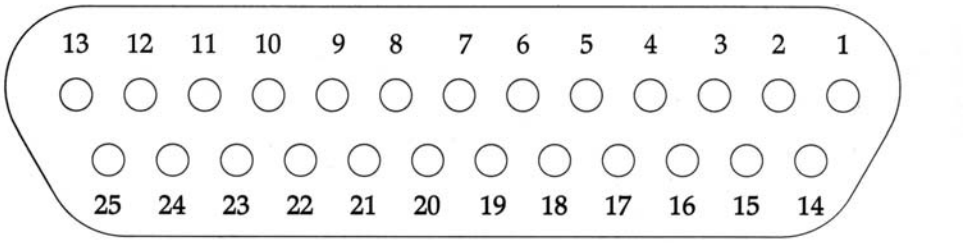


Table 1A: DB-25 Signal Connector Pin Descriptions

Pin Number	Description
1	Optional NC Phase loss Dry Contact (0.5 A)
2	Optional NC Phase loss Dry Contact (0.5 A)
3	Signal Ground
4	Signal Ground
5	Signal Ground
6	Signal Ground
7	Signal Ground
8	Signal Ground
9	Signal Ground
10	+ 5 VDC
11	Spare
12	Spare
13	Spare
14	Bi-Directional Fault Signal
15	+ 12 VDC
16	Remote Set point
17	Remote Polarity Control
18	Remote On/Off
19	Local On/Off
20	Remote/Local Operation
21	Proportional Output Current
22	Local Polarity Control (TTL)
23	Local Set point (0-5 VDC)
24	Spare
25	Spare

Figure 5B
Signal Connector – Governor Board
25 pin D-subminiature Receptacle

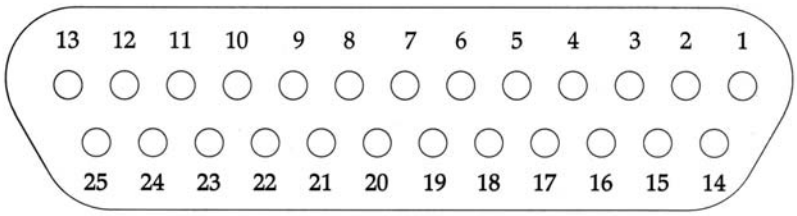


Table 1C: DB-25 Signal Connector Pin Descriptions

Pin No.	Description (4-20 mA Set point)	Description (0-5 VDC Set point)
1	Cool 4-20 mA (+)	Spare
2	Cool 4-20 mA (-)	Spare
3	Signal Ground	Signal Ground
4	Signal Ground	Signal Ground
5	Signal Ground	Signal Ground
6	Signal Ground	Signal Ground
7	Signal Ground	Signal Ground
8	Signal Ground	Signal Ground
9	Signal Ground	Signal Ground
10	+ 5 VDC	+ 5 VDC
11	Spare	Spare
12	Spare	Spare
13	Spare	Spare
14	Bi-Directional Fault Signal	Bi-Directional Fault Signal
15	+ 12 VDC	+ 12 VDC
16	Heat 4-20 mA (+)	Spare
17	Heat 4-20 mA (-)	Spare
18	Spare	Spare
19	Local On/Off	Local On/Off
20	Spare	Spare
21.	Proportional Output Current	Proportional Output Current
22	Spare	Polarity Control (TTL)
23	Spare	Set point (0-5 VDC)
24	Optional NC Phase Loss Dry Contact (0.5 Amp)	Optional NC Phase Loss Dry Contact (0.5 Amp)
25	Optional NC Phase Loss Dry Contact (0.5 Amp)	Optional NC Phase Loss Dry Contact (0.5 Amp)

4.0 SPECIFICATIONS

4.1 NON-ISOLATED OUTPUT

WARNING

The output of the power supply is not isolated from the AC input. The output of the power supply **MUST NOT** be connected to secondary referenced circuitry. Input voltage must be disconnected to prevent hazardous potentials from appearing at the output. DC control and logic circuits are isolated from the AC line and DC output.

4.2 INPUT POWER REQUIREMENTS

The Switchback 6600 power supply requires 200-240 (±5%) VAC, 3-phase, WYE, 50 or 60 Hz, and 22 A. Input 3-phase power must be in a WYE configuration.

4.3 INPUT SOURCE IMPEDANCE

Source impedance on 200-240 (±5%) VAC input must be less than or equal to 200 µH

4.4 INPUT PROTECTION

WARNING

A suitable 3-phase, 250 V, 30 amp, AC protector, such as circuit UL 489 rated circuit breaker, **SHOULD** be provided by the user to protect against failures in the regulator.

4.5 LINE FILTERING

The power supply has an integral line filter, which meets EN55011 Class A conducted emissions requirements.

4.6 SIZE AND WEIGHT

The Switchback 6600 power supply weighs 19 lbs. with dimensions of 12.75” (plus two 1” mounting flanges) x 5” x 10.5”.

4.7 MAXIMUM OUTPUT CURRENT

The output current is dipswitch adjustable by the user in ranges from 0-6.5 to 0-30A in increments of 2A. The dipswitch, located on the motherboard towards the rear under the horizontal daughter board, sets the output current range as follows:

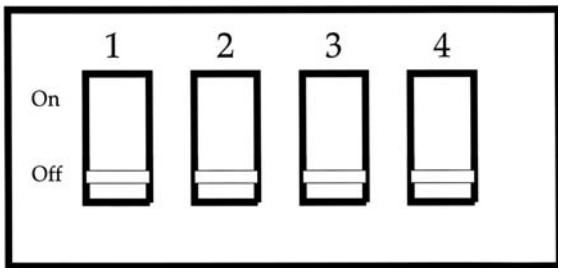


Figure 6: Sketch of 4-Position Current Dip-Switch

Table 2. Current Limit Dip-Switch Settings

Maximum Output Current (Amps)	Dip-Switch Position 1	2	3	4
6.5	OFF	OFF	OFF	OFF
8.5	ON	OFF	OFF	OFF
10.5	OFF	ON	OFF	OFF
12.5	ON	ON	OFF	OFF
14.3	OFF	OFF	ON	OFF
16.3	ON	OFF	ON	OFF
18.3	OFF	ON	ON	OFF
20.0	ON	ON	ON	OFF
22.0	ON	ON	OFF	ON
24.0	OFF	OFF	ON	ON
26.0	ON	OFF	ON	ON
28.0	OFF	ON	ON	ON
30.0	ON	ON	ON	ON

Danger: Hazardous Voltages Present!
Input power to the Switchback 6600 CE power supply must be disconnected when changing a jumper or dip-switch position.

4.8 MAXIMUM OUTPUT VOLTAGE

The maximum output is adjustable by the user via a dipswitch from 14-230 V in increments of approximately 14 V. The dipswitch, located on the horizontal daughter board towards the rear and near the heat sink, sets the maximum output current as follows:

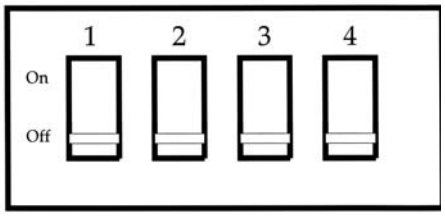


Figure 7: Sketch of 4-Position Current Dip-Switch

Table 3. Voltage Limit Dip-Switch Settings

Maximum Output Voltage (Volts)	Dip-Switch Position 1	2	3	4
14	OFF	OFF	OFF	OFF
28	OFF	OFF	OFF	ON
43	OFF	OFF	ON	OFF
57	OFF	ON	ON	OFF
71	OFF	ON	OFF	OFF
86	OFF	ON	OFF	ON
100	OFF	ON	ON	OFF
114	OFF	ON	ON	ON
130	ON	OFF	OFF	OFF
144	ON	OFF	OFF	ON
158	ON	OFF	ON	OFF
172	ON	OFF	ON	ON
186	ON	ON	OFF	OFF
200	ON	ON	OFF	ON
216	ON	ON	ON	OFF
230	ON	ON	ON	ON

Danger: Hazardous Voltages Present!
Input power to the Switchback 6600 CE power supply must be disconnected when changing a jumper or dip-switch position.

4.9 RECOMMENDED LOAD RESISTANCE

The output of the power supply will operate with I/V characteristics 0-30 A and 0-230 VDC into a resistive load over the full range of input power. To take full advantage of the current ranges available, the load resistance (R) should be:

$400\ m\Omega \leq R \leq 37\ \Omega$

Inductive loads are not recommended. The Switchback 6600 cannot operate as a current sink for a servomotor or other inductive load.

4.10 TRANSIENT RESPONSE

The output current will regulate within 10 milliseconds of a set point change or load transient of up to 50%. The product of the combined load + distribution resistance and inductance shall be less than 50 microseconds.

4.11 CONTROL BANDWIDTH

The current control loop bandwidth varies with the load resistance (R_{LOAD}) by the following relationship:

$Bandwidth = 5288/R_{LOAD}$ (Hz)

4.12 REGULATION (OUTPUT ACCURACY)

The actual output will not vary from the output current set point by more than 5% of actual output current or ± 0.5 Amps, whichever is greater.

4.13 OUTPUT RIPPLE AND NOISE

Peak to peak output ripple voltage shall not exceed 5% of the DC output voltage for output voltages greater than 50 Volts when attached to a resistive load and measured to a bandwidth up to 100 kHz. Below 50 volts of output voltage, the ripple voltage shall not exceed 2.5 volts peak to peak measured to a bandwidth up to 100 kHz.

4.14 SIGNAL ISOLATION

With the 3 phase power input and 2 power output terminals tied together, the power supply will withstand a 3000 VDC Hipot from these power leads to all signals in the signal interface and the earth ground post. The signal interface is considered earthed secondary circuitry by connecting this post.

4.15 THERMAL PROTECTION

The aluminum heat sink has a thermal protection switch attached that will shut off the power supply output should the heat sink temperature reach 70 °C. The switch will automatically reset at 53 °C, restarting the power supply. The power supply fault signal, DB-25 pin 14, will switch to TTL low when thermal shut-off occurs.

4.15 OUTPUT POWER OVERLOAD/SHORTS TO GROUND

The power supply is protected against output shorts between terminals and direct shorts to ground.

Should an output short occur, the output stage will overload and shut down. The power supply fault signal, DB-14, will switch to TTL low when the output stage overloads. If this occurs, input power to the Switchback 6600 CE must be turned off and then back on to reset the power supply.

The power supply may also shut down if the output polarity is switched at high current levels (see Section 5.5). The power supply will not be damaged, but the input power must be turned off and then back on to reset the power supply.

4.16 OPERATING TEMPERATURES

The power supply may operate in ambient temperatures from 0-40 °C. Maximum operating humidity is 80%, non-condensing.

4.17 PHASE MONITOR OPTION

The optional phase monitor shuts off the Switchback 6600 CE and triggers the bi-directional fault signal if one or more input phase falls below 180 VAC. When the voltage on the low phase increases to over 180 VAC the phase monitor will automatically restart the power supply. The phase monitor does not check phase alignment.

The phase monitor option includes 0.5 amps 250 V rated normally closed (NC) dry contact for external use (see figures 5A & 5B) for pin location).

4.18 GROUND FAULT INTERRUPT OPTION

The GFCI option shuts off the Switchback 6600 CE and triggers the bi-directional fault signal when the ground current reaches a preset limit of 30 mA.

5.0 OPERATING INSTRUCTIONS

The Switchback 6600 Power Supply is operated via control signals through the DB-25 connector. The power supply has two operating modes: remote and local. Table 4 lists the internal logic for remote or local operation via the three TTL signals, which control the operating mode (Local/Remote, Remote On/Off, Local On/Off).

Table 4: Logic for Remote and Local Operation
(Note: Remote operation not available with Governor board option)

Remote ON/OFF (Pin 18)	Local ON/Off (Pin 19)	Local Remote (Pin 20)	Output Status and Control
Low	Low	Low	On/Remote
Low	Low	High	On/Local
Low	High	Low	Off
Low	High	High	Off
High	Low	Low	Off
High	Low	High	On/Local
High	High	Low	Off
High	High	High	Off

The recommended method for pulling down one of the above signals from high to low are via a contact closure between the signal pin above and one of the signal grounds (pins 3–9). A transistor, relay, or switch may be used to effect the contact closure.

5.1 LOCAL/REMOTE SELECTOR SIGNAL INPUT

DB-25 pin# 20 selects the output current of the power supply to be set by the LOCAL input or the REMOTE input. A TTL high or open circuit on this pin causes the power supply to regulate to the LOCAL input. A TTL low on this pin causes the power supply to regulate to the REMOTE input.

5.2 REMOTE ON/OFF

DB-25 pin# 18 will cause the output to be OFF when a TTL high (or open circuit) is applied or on when a TTL low is applied. In the OFF state, leakage current from the power supply will be no greater than 50 milliamps.

5.3 LOCAL ON/OFF

DB-25 pin# 19 will cause the output to be OFF when a TTL high (or open circuit) is applied or ON when a TTL low is applied. Note that a local OFF signal turns the power supply OFF in remote operation. In the OFF state, leakage current from the power supply output will be no greater than 50 milliamps.

Note: In the OFF state, leakage current from the power supply output will be no greater than 50 milliamps, but hazardous potentials of approximately 145 VDC to ground will exist on both output terminals.

5.4 OUTPUT CURRENT SETTING

The output current of the power supply is set by one of two (LOCAL and REMOTE) 0-5 VDC analog signals that are input to the power supply.

5.4.1 LOCAL SET POINT INPUT

DB-25 pin# 23 sets the output current of the power supply to I_{max}/5 amp per volt on the control input signal when the power supply is operating in local mode.

5.4.2 REMOTE SET POINT INPUT

DB-25 pin# 16 sets the output current of the power supply to I_{max}/5 amp per volt output current when the power supply is operating in remote mode.

WARNING!
If the power supply is turned on as per Table 4, but the set point signal being used (pin 23 or 16) is disconnected, the set point signal can float up to 5V on its own, causing maximum DC output. To avoid this:
1) Never disconnect the local or remote set point signal being used.
2) If using only remote set point, tie the local set point to signal ground.

5.5 BI-DIRECTIONAL OUTPUT (POLARITY REVERSAL)

The output terminals are able to reverse polarity under control of a local or remote polarity signal, as described below. Incidental polarity reversal of the power supply while in the on state shall not damage the power supply.

IMPORTANT
Reversal at high power levels may cause the power supply output to shut off. The power supply fault signal, DB-25 pin 14, will switch to TTL low when this occurs. Should this occur, the power supply must be reset by momentarily turning off the input power. To ensure that the power supply never shuts off during polarity reversal, set output power to zero for 50 milliseconds prior to reversing polarity.

The power supply polarity is normal (as labeled on the Output Power terminal block) when a TTL high is applied and switches polarity when a TTL low is applied. When connected to a Solid State Cooling Systems' thermoelectric heat exchanger, normal polarity cools the process.

5.5.1 LOCAL POLARITY CONTROL

If the power supply is set to regulate to a local set point, DB-25 pin# 22 controls polarity of the output voltage. When this signal is TTL high (or open circuit), the output polarity matches Figure 3. When this signal is TTL low, the output polarity is opposite of Figure 3.

5.5.2 REMOTE POLARITY CONTROL

If the power supply is set to regulate to a remote set point, DB-25 pin# 17 controls polarity of the output voltage. When this signal is TTL high (or open circuit), the output polarity matches Figure 3. When this signal is TTL low, the output polarity is opposite of Figure 3.

5.6 PROPORTIONAL CURRENT OUTPUT SIGNAL

DB-25 pin# 21 provides an output voltage signal that is proportional to the actual output current at a ratio of (I_{max}/5 amp)/volt, where I_{max} is the maximum output current set by the user (see Section 4.6). This signal shall be accurate to 5% of actual output current or ± 0.5 amps, whichever is greater. This signal has a 1000-Ohm resister in series with the output and is charged at a maximum of 5.1 VDC.

5.7 +12 VOLT SUPPLY

DB-25 pin 15 provides +12 Volts DC power for use in external circuitry. This is an unregulated supply. The maximum recommended current is 125 milliamps. Drawing more than 150 milliamps may cause an auto-reset fuse to shut down the 12 V supply.

5.8 +5 VOLT SUPPLY

DB-25 pin 10 provides +5 Volts DC power for use in external circuitry. The maximum current available is 20 milliamps. Drawing more than 20 milliamps may cause an auto-reset fuse to shut down the 5V supply.

5.9 BI-DIRECTIONAL FAULT SIGNAL

DB-25 pin 14 provides a TTL fault signal to notify the user of thermal shut down or output power stage overload. Under normal operating conditions this signal will be +5 V (through a 3.3 kW resistor). Under fault conditions this signal will go LOW.

The signal is bi-directional. If the user pulls the signal down below 0.4 Volts (TTL low) the power supply output H-bridge will shut off. (This requires sinking up to 5 mA of current.) Note: leakage current through the H-bridge IGBT's may still cause hazardous potentials to be present on the output terminals if no load is present.

CAUTION

Note: This signal can only supply 0.9mA of current before shutting down the Switchback 6600 output. It may be used to drive an emitter-follower circuit, but it has insufficient current to drive a relay, whether optical or mechanical.

5.10 GOVERNOR BOARD OPTION

The governor board option limits the rate of change of the Switchback 6600CE power supply output current to a maximum of 3% per second. The governor board accepts either the standard 0-5 VDC set-point/digital polarity signal or two 4-20 mA signals like the interface board (see figure 5B). A jumper labeled 4-20/5 V selects the type of input accepted; when this jumper is removed the power supply accepts two 4-20 mA inputs. When this jumper is inserted it accepts the standard 0-5 VDC/digital polarity signals.

The governor board also includes an option to limit the maximum reverse polarity (Heating) current to 50% of the maximum current set point. This allows matching heating and cooling capacities in thermoelectric systems. A jumper labeled 50% HEAT selects this option; when this jumper is inserted the power supply divides the reverse (heating) input signal by 2 to limit the maximum current output to 50%. When this jumper is removed the reverse (Heating) current output is proportioned normally.

DANGER

Danger: Hazardous Voltages Present!
Input power to the Switchback 6600 CE power supply must be disconnected when changing a jumper or dip-switch position.

5.11 PHASE MONITOR OPTION

The phase monitor shuts off the Switchback 6600 CE if one or more input phase falls below 180 VAC. The phase monitor board has a normally closed 0.5 amp 250 VAC dry contact available on the output signal connector for external use (pins 1 and 2 on standard supplies, pins 24 and 25 when used with the Interface Board -IB or Governor Board -GB options). When the voltage on the low phase increases to over 180 VAC the phase monitor will automatically restart the power supply.

Note: Since phase alignment is not important to the Switchback 6600 CE power supply, the phase monitor does not check phase alignment.

5.12 GROUND FAULT CIRCUIT INTERRUPT

WARNING

This feature adds a preset 30 mA ground fault interrupt circuit that shuts off the power supply in the event of a ground fault.
Note: *The 30 mA trip level does not meet UL requirements for personal protection* .

The GFCI option also adds an additional over voltage shut down circuit should the output voltage of the Switchback 6600 CE exceed 250 VDC. Power to the supply must be cycled to restart after either fault.

6.0 SWITCHBACK 6600 TC TROUBLESHOOTING TABLE

The Switchback 6600 has three output signals that can be used for trouble shooting:

1. The Switchback fault signal
2. The phase loss signal
3. The attached thermoelectric system's thermostat signal

Table 5 shows how to use these signals to trouble shoot the root cause for the failure.

Table 5 Switchback Troubleshooting

25-pin dsub Signal Measurement			Failure Mode
Fault Signal	**Phase Lost**	**Thermostat**	
Pins 14-6 (volts)	**Pins 24-25 (ohms)**	**Pins 19-6 (volts)**	
5 VDC	Short Circuit	0 VDC	Normal operation.
0.0 VDC	Open circuit (contact open)	0 VDC	The voltage of one or more AC phases has fallen below 170 VAC, the Phase Monitor board has failed or the Switchback has failed.[1]
0.0 VDC	Short Circuit (Contact Closed)	0 VDC	The Switchback has over-heated from blocked airflow, fan failure, or an excessively high ambient temperature (>50°C)
0.1 – 0.5VDC	Any	Any	The Switchback has shut down due to a short across its output terminals or distortions in the 200-240 VAC sine-wave that trip the phase monitor every 50-60 Hz cycle. Check the DC power cable connectors for shorts.
0.7 VDC	Short Circuit (Contact Closed)	0 VDC	Ground Fault in the thermoelectric system or DC power cable powered by the Switchback power supply.[2]
0.7 VDC	Any	5 VDC	With the governor board option: A thermostat has tripped on the thermoelectric system powered by the Switchback. Typically this means insufficient PCW (plant cooling water flow). Less likely is a loss of process flow.
1.5-4 VDC	Any	Any	The Switchback Voltage Limit board has failed.
5 VDC	Short Circuit (Contact Closed)	0 VDC	The DC current input signal, (0-5VDC or 4-20ma) is not being received by the Switchback, the Switchback's current control circuit has failed, a TE module has failed on the thermoelectric system power powered by the Switchback without shorting to ground, or the Switchback's governor board has failed.
5 VDC	Short Circuit (Contact Closed)	5 VDC	Without the governor board option: A thermostat has tripped on the thermoelectric system powered by the Switchback. Typically this means insufficient PCW (plant cooling water flow). Less likely is a loss of process flow. With the governor board option: the governor board has failed.

Notes:

1) Unplug the 25-pin dsub connector and measure the voltage across pins 10-6. If you measure 5 VDC, then the TE power supply is ok and the phase monitor has tripped because one or more phases has dropped below 170 VAC. If this measures 0 VDC, then the Switchback's internal housekeeping supply has failed.
2) Disconnect AC power from the Switchback 6600 power supply, then disconnect the 14 AWG Red (+) and Black (-) DC output power wires from the Switchback's DC output terminals. (Leave the 22 AWG white and blue thermostat wires connected through the 25-pin dsub connector.) Troubleshoot as follows:
    a. Using a digital multi-meter, measure the resistance between the Red and Black wires. If this reads 0 ohms, there is a short in the DC power cable, most likely in one of the connectors.
    b. If there is no short in the DC power cable connectors, re-connect AC power to the Switchback 6600 power supply. If the voltage across pins 14-6 is 5 VDC, then the attached thermoelectric system has a short to ground (TE module failure).

WARRANTY POLICY

The Switchback 6600 is covered under a two-year parts and labor warranty. The length of a warranty is product-specific, depending on the type and planned usage of the product, but will be specified in the quotation upon which a purchase order is made. Prototypes are not covered under warrantee, but will be repaired/adjusted after original shipment until they meet the agreed-upon specifications.
Malfunctioning products should be returned to Solid State Cooling Systems by the method described below. Solid State Cooling Systems will provide a Failure Analysis Report to the customer and will determine if the problem is covered under the warranty.

Warranty Coverage:

Products with defects in components or manufacturing which are reported to Solid State Cooling Systems before the end of the warranty period will be repaired or replaced at no cost (see below for reporting requirements). The warranty period begins on the date the product was initially shipped from Solid State Cooling System's factory.

Excluded from Warranty:

Excluded from warranty is any damage caused to the product occurring during, but not limited to, such events as shipment, installation, storage, or usage occurring during a situation specifically cautioned against or noted in the product manual.

Specific situations, which invalidate the warranty, include (but are not limited to):

- Removing the serial number label.
- Subjecting any product to temperature, voltage, current, or pressure (internal or external) greater than that specified in the product manual.
- Operating the Switchback power supply in a corrosive environment.
- Operation of the Switchback power supply with a non-original enclosure or any replacement components. As well as voiding the warranty, these actions will also void the CE Mark (Switchback 6600 CE model power supply).
- Any actions prohibited in the "Caution" section of the product manual.

Returned Goods Procedure and Reporting Requirements

Before a failed product is returned to the factory, a Returned Materials Authorization (RMA) number must be obtained from Customer Service at (845) 296-1300. The date the RMA is requested will be the reporting date noted and relevant to the warranty. Products, which have received an RMA, must be received at Solid State Cooling System's factory within 30 days or the reporting date will be moved ahead 30 days and a new 30-day waiting period will begin.

All out of warranty returned goods will require a $250 evaluation purchase order prior to receipt at SSCS. The evaluation costs will be deducted from the cost of any repairs required.