

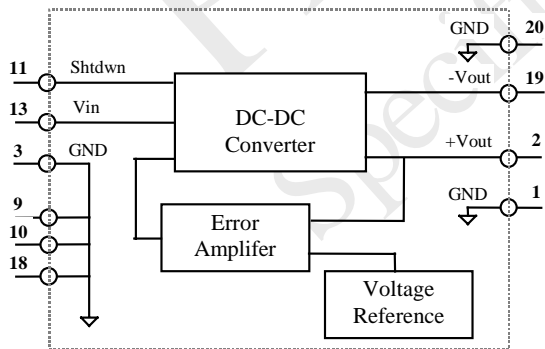
**Features:**

- High Operating Temperature (175 C)
- Compact Design (20 Pin Dip)
- High Efficiency (70-80% Typical)
- Soft Start
- Intermittent Overcurrent Protected
- Logic Level Shutdown
- Wide Input Voltage Range (12.0 to 36.0 Volts)

**Description**

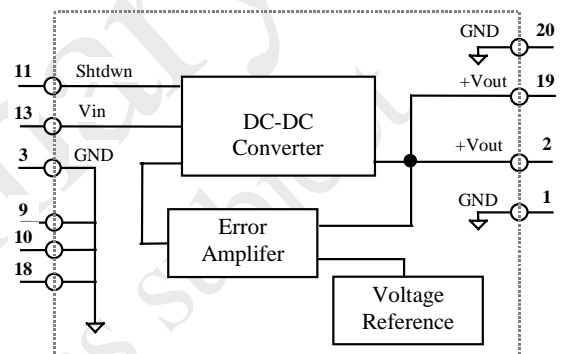
The SPB-01 series of DC-to-DC converters operate from an input of +12VDC to +36VDC and provide single or dual regulated DC outputs from +/-5 VDC to +/-15 VDC. These units are designed for rugged applications that require a regulated DC power supply capable of operating in environments of high shock, vibration and temperature.

The output voltage tolerance of the series is guaranteed to  $\pm 2\%$  and is typically  $\pm 1\%$ . The SPB-01 series provide a stable output voltage across the entire operating temperature range. Drift with temperature is typically less than 75 ppm/ $^{\circ}$ C. Output noise and ripple is small, typically less than 50mVp-p.



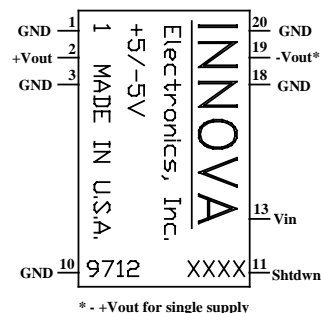
**Figure 1**  
Dual Output Block Diagram

Block diagrams for the dual and single output supplies are shown in Figures 1 and 2. The complete switching supply is housed in a package with a standard 20-pin, double-wide IC pin pattern. The pin-out pattern is shown in Figure 3.



**Figure 2**  
Single Output Block Diagram

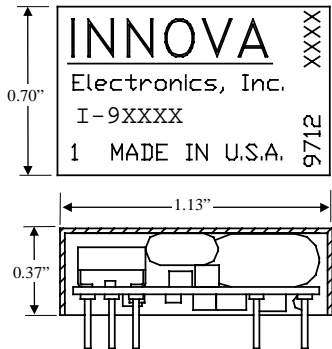
The supplies are encapsulated with high temperature potting compounds that enable them to withstand diverse environmental conditions while adding little mechanical stress to the interior components. Each unit is burned-in and tested over the full operating temperature range prior to shipment and guaranteed against defects.



**Figure 3**  
Pin Outs

**Mechanical Outline**

The supply is packaged in a 0.37" high 20-pin, double-wide IC package as shown in Figure 4.

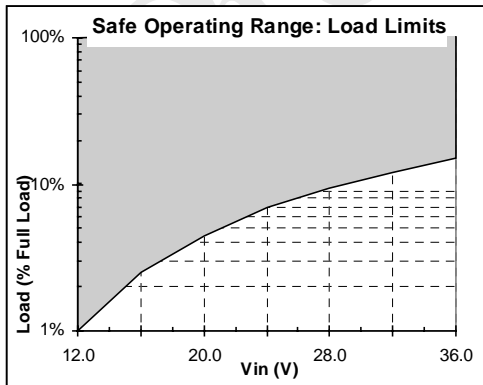


**Figure 4**

Footprint is a standard, double-wide (0.60" wide pin spacing), 20-pin dip. Pin spacing is 100 mils.

**Safe Operating Range - Loads**

Figure 5 shows the allowable operating load conditions for the SPA-01-S/D. In general, any combination of loads that stays within the constraints of maximum and minimum output power levels is allowed. Operation with lighter loads will result in higher output ripple as the unit begins to cycle skip. This is not a dangerous condition but may cause unacceptably high ripple. Operation with heavier loads may damage the supply.

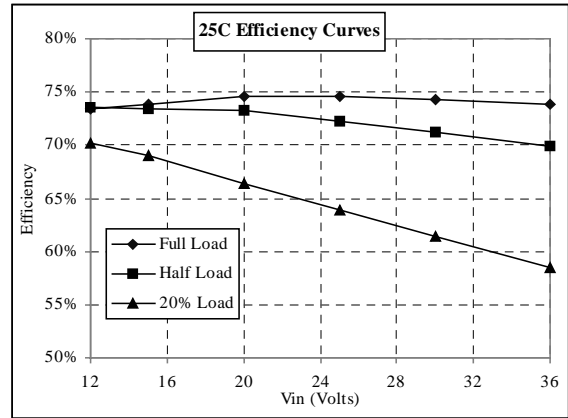


**Figure 5**

SPB-01-D and SPB-01-S safe operating range load limits. Lighter loads may cause excessive ripple.

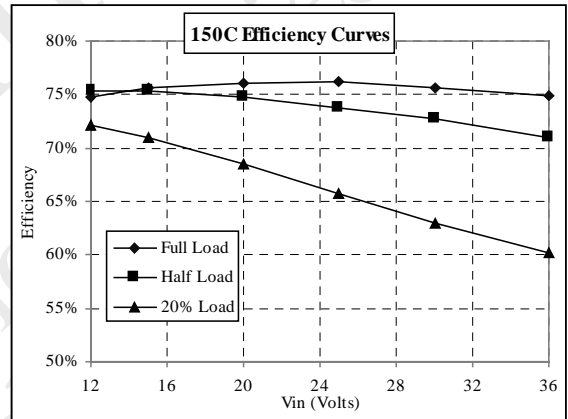
**Efficiency**

Figures 6 through 8 illustrate typical room and high temperature efficiency performance. Under full load conditions the efficiency ranges between 70% and 80%.



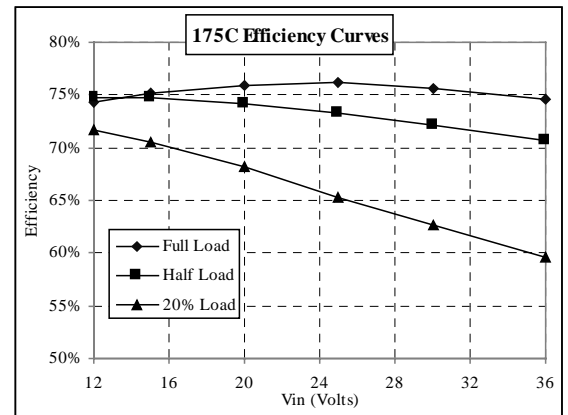
**Figure 6**

Typical dual/single +5V efficiency curves at 25C.



**Figure 7**

Typical dual/single +5V efficiency curves at 150C.

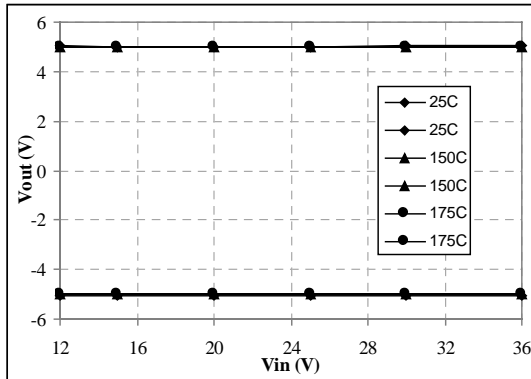


**Figure 8**

Typical dual/single +5V efficiency curves at 175C.

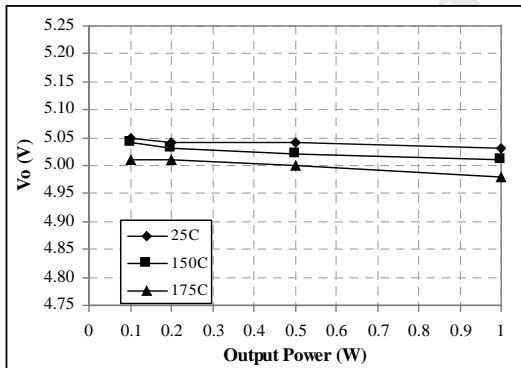
**Line/Load Regulation**

Figure 9 illustrates typical line regulation over the full temperature range. Figure 10 shows load regulation for the SPB-01-S-5 at three temperatures.



**Figure 9**

Typical line regulation, full-load, at 25, 150 and 175C.

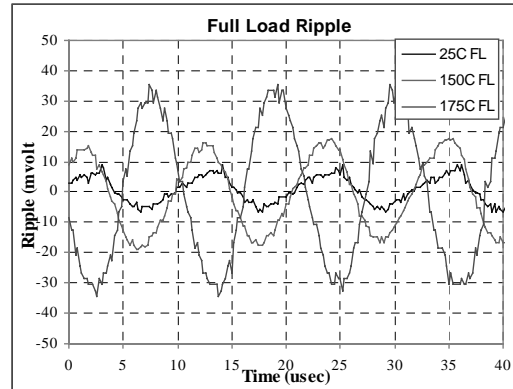


**Figure 10**

Typical load regulation for SPB-01-S-5.

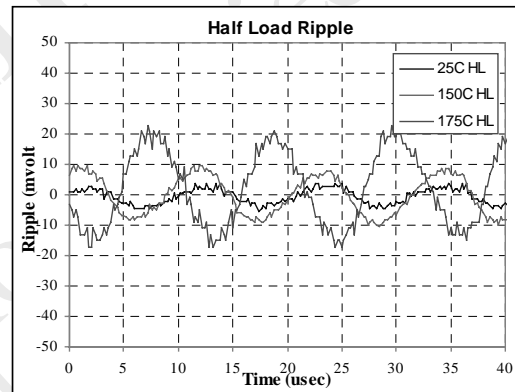
**Ripple**

Figures 11 and 12 illustrate typical output voltage ripple performance. Note that, at room temperature, the full load ripple is typically less than 20mVpp.



**Figure 11**

Typical ripple performance (at 25C, 150C and 175C) at full load. Typical 175C, full-load ripple is 70-80 mVpp.



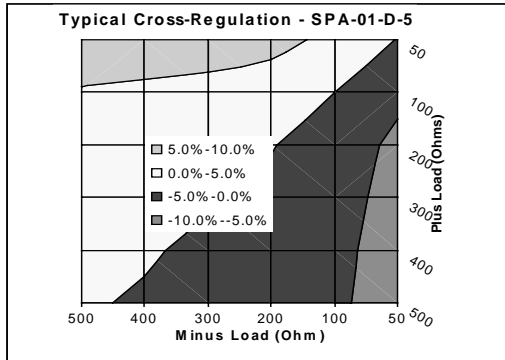
**Figure 12**

Typical ripple performance (at 25C, 150C and 175C) for half load conditions. Typical 175C, half-load ripple, is 40 mVpp.

**Cross-regulation**

The auxiliary output (minus output on dual supplies) will track the primary output as long as the loads are well matched. Figure 13 shows the effect of load mismatch for the SPB-01-D-5. These results are typical for 25C.

For example, in the case where the primary output is fully loaded (50 ohms for the SPB-01-5) and the auxiliary output is only 33% loaded (150 ohms), the -Vout will be about 5% high, or -5.25V.

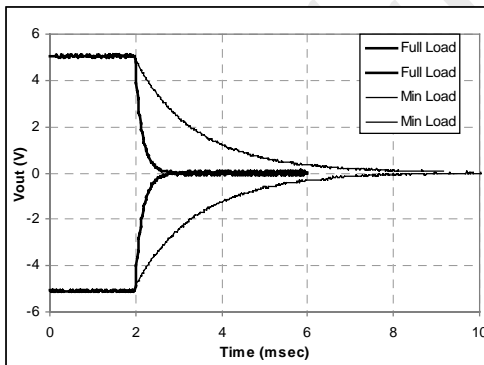


**Figure 13**

Typical cross-regulation (for the SPB-01-D-5) at 25°C.

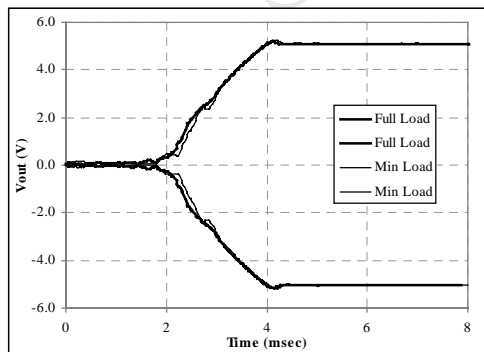
**Dynamic Performance**

Figures 14 and 15 illustrate typical full-load and minimum-load turn-on and turn-off performance (either via the shutdown pin or with applied power), illustrating the soft-start feature of the supply.



**Figure 14**

Turn-off performance at full and minimum load.



**Figure 15**

Turn-on performance at full and minimum load.

**Application Information**

**Additional output filtering**

The ripple voltage, as illustrated in Figures 11 and 12, increases significantly above 150°C. Additional filter capacitance can reduce this. An additional 1-2µF of capacitance will reduce the full load, 175°C ripple to less than 50 mVpp.

High frequency common-mode noise can be reduced by the use of common-mode chokes (a few turns of the power and return lines through an appropriate high-temperature ferrite material). Separate power and return lines for the dual supply are provided for this reason.

**Input filter**

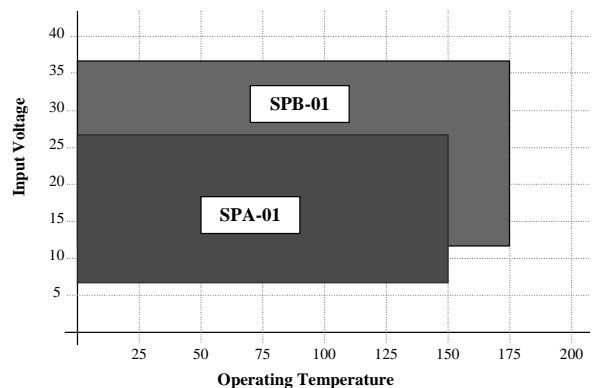
A small input inductor (10 to 50 µH) can reduce the AC input ripple current if this presents a problem. Additional capacitance at the input can also reduce the AC input ripple current.

**Mounting**

The SPA-01 weighs about 11.7 grams. This compares to about 9 grams for a standard 28-pin ceramic DIP. For high-shock and vibration environments, relying on the pins alone to keep the unit on a board is not recommended.

**SPA/SPB-01 Differences**

Figure 16 shows the operating ranges for the two types of 20-pin switching power supplies currently offered by Innova Electronics.



**Figure 16**

SPA-01/SPB-01 operating ranges.

**Specifications: SPA-01-D-5 and SPA-01-S-5**

Parameter	Test Conditions	Temp	Min	Typ	Max	Units
Output Voltage						
SPB01-S/D + V <sub>out</sub>	Full Load, Vin: 12 to 36 V	Full	4.90	5.00	5.10	volts
SPB-01-D - V <sub>out</sub>	Matched Load, Vin: 12 to 36V	Full	-4.90	-5.00	-5.10	volts
Output Current						
SPB-01-S/D + V <sub>out</sub>	Full Load, Vin: 12 to 36 V	Full	10/20		100/200	mAmp
SPB-01-D - V <sub>out</sub>	Matched Load, Vin: 12 to 36V	Full	-10		-100	mAmp
Line Regulation	All Load Conditions	Full		0.0002	0.0005	V/V
Load Regulation	Vin = 25V, Full to Min load	Full		0.5	1.0	%
Cross Regulation (Note 1)						
$\Delta(-V_{out})$ , +Load = 50%	2-Load: 10% to 100%	25		7.5	10.0	%
$\Delta(-V_{out})$ , +Load = 50%	-Load 20% to 100%	Full		10.0	15.0	%
Voltage Drift vs. Temp (Note 2)	Full Load	Full		±0.5	±1.0	%
Output Ripple	Vin=25.0, Full Load	25°C		20	50	mV <sub>pp</sub>
	Vin=25.0, Full Load	Full		150	200	mV <sub>pp</sub>
Efficiency	Vin=12.0 to 36.0V, Full Load	Full	70%	75%	80%	
	Vin=12.0 to 36.0V, 50% Load	Full	70%	75%	80%	
	Vin=12.0 to 36.0V, 20% Load	Full	60%	65%	70%	
	Vin=12.0 to 36.0V, 10% Load	Full	45%	50%	55%	
Short Circuit (Note 3)						
Survival Time	Vin=25.0V, R <sub>LOAD</sub> = 0 Ω	25C	60	∞		sec
Survival Time	Vin=15.0V, R <sub>LOAD</sub> = 0 Ω	Full	10	60		sec
Input Current	Vin=15.0V, R <sub>LOAD</sub> = 0 Ω	Full		150	200	mamp
<b>Input Requirements</b>						
Supply Voltage (Note 4)	All	Full	+12.0		+36.0	V
V <sub>SHTDWN</sub> Threshold		Full	0.5		3.5	V
"Off" Supply Current	Vin=25.0V	Full		1.2		mAmp

*Notes:*

1. Does not apply for single output supplies. See Figure 11.
2. Percent change from room temperature to maximum temperature.
3. Output shorted (either or both outputs for dual supplies)..
4. See Figure 5.

**Specifications: SPB-01-D-12 and SPB-01-S-12**

Parameter	Test Conditions	Temp	Min	Typ	Max	Units
Output Voltage						
SPB-01-S/D + V <sub>out</sub>	Full Load, Vin: 12 to 36 V	Full	11.75	12.00	12.25	volts
SPB-01-D - V <sub>out</sub>	Matched Load, Vin: 12 to 36V	Full	-11.75	-12.00	-12.25	volts
Output Current						
SPB-01-S/D + V <sub>out</sub>	Full Load, Vin: 12 to 36 V	Full	4/8		42/84	mAmp
SPB-01-D - V <sub>out</sub>	Matched Load, Vin: 12 to 36V	Full	-4		-42	mAmp
Line Regulation	All Load Conditions	Full		0.0002	0.0005	V/V
Load Regulation	Vin = 25V, Full to Min load	Full		0.5	1.0	%
Cross Regulation (Note 1)						
$\Delta(-V_{out}), +Load = 100\%$	-Load 10% to 100%	Full		TBD		%
$\Delta(-V_{out}), +Load = 50\%$	-Load 10% to 100%	Full		TBD		%
Voltage Drift vs. Temp (Note 2)	Full Load	Full				%
Output Ripple	Vin=25.0, Full Load	25°C				mV <sub>pp</sub>
	Vin=25.0, Full Load	Full				mV <sub>pp</sub>
Efficiency	Vin=12.0 to 36.0V, Full Load	Full		80%		
	Vin=12.0 to 36.0V, 50% Load	Full		80%		
	Vin=12.0 to 36.0V, 20% Load	Full		70%		
	Vin=12.0 to 36.0V, 10% Load	Full		50%		
Short Circuit (Note 3)						
Survival Time	Vin=25.0V, R <sub>LOAD</sub> = 0 Ω	25C		TBD		sec
Survival Time	Vin=25.0V, R <sub>LOAD</sub> = 0 Ω	Full		TBD		sec
Input Current	Vin=25.0V, R <sub>LOAD</sub> = 0 Ω	Full		TBD		mamp
<b>Input Requirements</b>						
Supply Voltage (Note 4)	All	Full	+12.0		+36.0	V
V <sub>SHTDWN</sub> Threshold		Full	0.5		3.5	V
"Off" Supply Current	Vin=25.0V	Full		1.2		mAmp

*Notes:*

1. Does not apply for single output supplies. See Figure 11.
2. Percent change from room temperature to maximum temperature.
3. Output shorted (either or both outputs for dual supplies)..
4. See Figure 5.

**Specifications: SPB-01-D-15 and SPB-01-S-15 (See above comments on previous specs)**

Parameter	Test Conditions	Temp	Min	Typ	Max	Units
Output Voltage						
SPB-01-S/D + V <sub>out</sub>	Full Load, Vin: 12 to 36 V	Full	14.75	15.00	15.25	volts
SPB-01-D - V <sub>out</sub>	Matched Load, Vin: 12 to 36V	Full	-14.75	-15.00	-15.25	volts
Output Current						
SPB-01-S/D + V <sub>out</sub>	Full Load, Vin: 12 to 36 V	Full	3/6		34/68	mAmp
SPB-01-D - V <sub>out</sub>	Matched Load, Vin: 12 to 36V	Full	-3		-34	mAmp
Line Regulation	All Load Conditions	Full		0.0002	0.0005	V/V
Load Regulation	Vin = 25V, Full to Min load	Full		0.5	1.0	%
Cross Regulation (Note 1)						
$\Delta(-V_{out}), +Load = 100\%$	-Load 10% to 100%	Full		TBD		%
$\Delta(-V_{out}), +Load = 50\%$	-Load 10% to 100%	Full		TBD		%
Voltage Drift vs. Temp (Note 2)	Full Load	Full				%
Output Ripple	Vin=25.0, Full Load	25°C				mV <sub>pp</sub>
	Vin=25.0, Full Load	Full				mV <sub>pp</sub>
Efficiency	Vin=12.0 to 36.0V, Full Load	Full		80%		
	Vin=12.0 to 36.0V, 50% Load	Full		80%		
	Vin=12.0 to 36.0V, 20% Load	Full		70%		
	Vin=12.0 to 36.0V, 10% Load	Full		50%		
Short Circuit (Note 3)						
Survival Time	Vin=25.0V, R <sub>LOAD</sub> = 0 Ω	25C		TBD		sec
Survival Time	Vin=25.0V, R <sub>LOAD</sub> = 0 Ω	Full		TBD		sec
Input Current	Vin=25.0V, R <sub>LOAD</sub> = 0 Ω	Full		TBD		mamp
<b>Input Requirements</b>						
Supply Voltage (Note 4)	All	Full	+12.0		+36.0	V
V <sub>SHTDWN</sub> Threshold		Full	0.5		3.5	V
"Off" Supply Current	Vin=25.0V	Full		1.2		mAmp

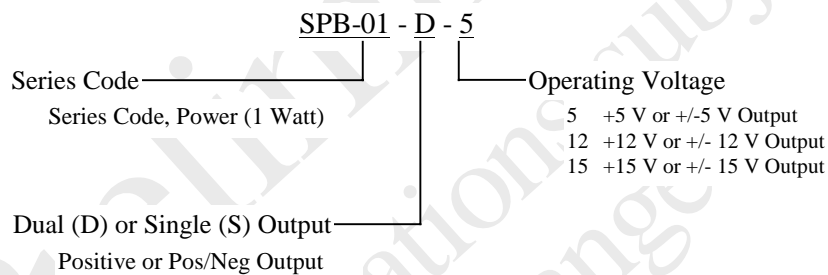
*Notes:*

1. Does not apply for single output supplies. See Figure 11.
2. Percent change from room temperature to maximum temperature.
3. Output shorted (either or both outputs for dual supplies).
4. See Figure 5.

**Mechanical/Environmental Specifications:**

Parameter		Test Conditions	Temp	Min	Typ	Max	Units
Temperature	Operating	Full Load, Vin = 12.0 to 36.0 V	-	-25		175C	°C
	Survival	Full Load, Vin = 12.0 to 36.0 V	-	-25		175C	°C
Shock (Note 6)		1/2 Sine, 5msec Duration	Full			200	G
Vibration		250 Hz Random	Full			25	G
Pressure			Full	0		500	psi
Weight				11.5	11.7	12.0	gram
Dimensions	Length				1.130	1.140	inch
	Height				0.360	0.375	inch
	Width				0.700	0.710	inch

**Ordering Information:**



**Example:** SPB-01-D-5 is a 1 watt, dual-output, supply with +/-5VDC outputs, tested and burned-in at 175C.

**INNOVA ELECTRONICS Inc.**  
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