

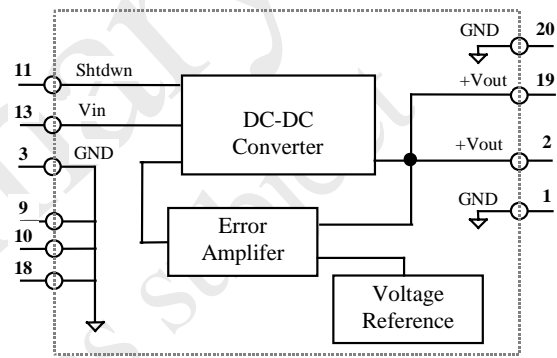
**Features:**

- High Operating Temperature (150 C)
- Compact Design (20 Pin Dip)
- High Efficiency (70-80% Typical)
- Encapsulated
- Overcurrent Protected
- Logic Level Shutdown
- Wide Input Voltage Range (6.0 to 28.0 Volts)

**Description**

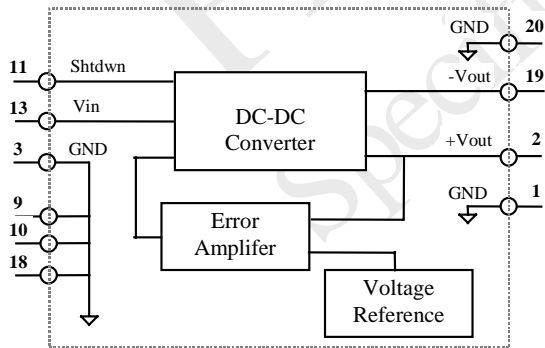
The SPA-01 series of DC-to-DC converters operate from an input of +6VDC to +28VDC and provide single or dual regulated DC outputs from +/-5 VDC to +/-15 VDC. These units are designed for rugged applications that require a regulated DC power supply capable of operating in environments of high shock, vibration and temperature.

The output voltage tolerance of the series is guaranteed to  $\pm 1\%$  at full load. The SPA-01 series provide a stable output voltage across the entire operating temperature range. Typical drift with temperature is less than 100 ppm/ $^{\circ}$ C. Output noise and ripple is small, typically less than 50mV p-p at full load.



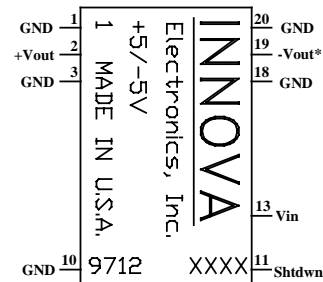
**Figure 2**  
Single Output Block Diagram

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.



**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 (shown in Figure 3).



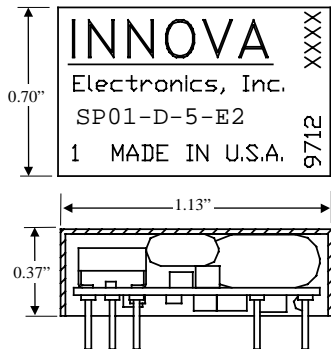
\* - +Vout for single supply

**Figure 3**  
Pin Outs

Each unit is burned-in and tested over the full operating temperature range prior to shipment and guaranteed against defects.

**Mechanical Outline**

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

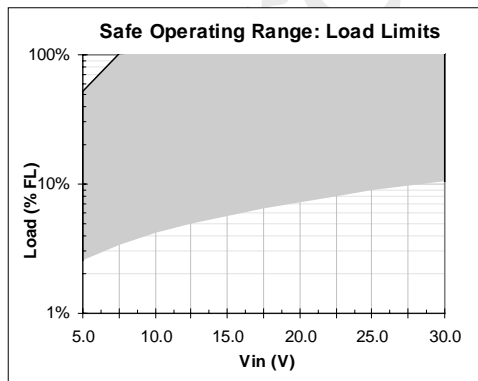


**Figure 4**

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.



**Figure 5**

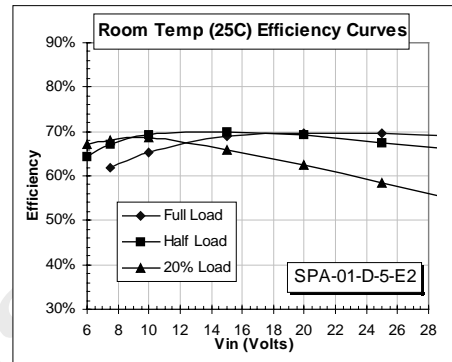
SPA-01-D/S safe operating range load limits.

Note however, for the dual output units, that mismatch of loads between the primary and auxiliary outputs, results in poor cross-regulation (on the auxiliary output - see Figure 12).

Also note that operation below 7.5 Vdc is possible for reduced load conditions. Operation above 28Vdc is not recommended.

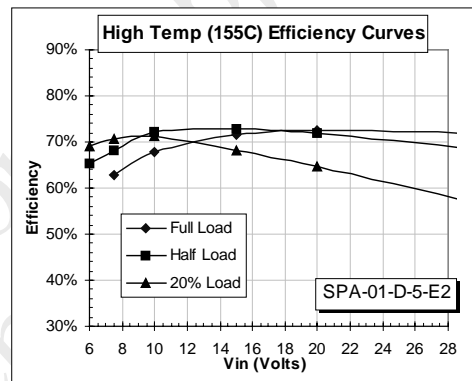
**Efficiency**

Figures 6 through 9 illustrate typical room and high temperature efficiency performance. Under full load conditions the efficiency ranges between 65% and 80%.



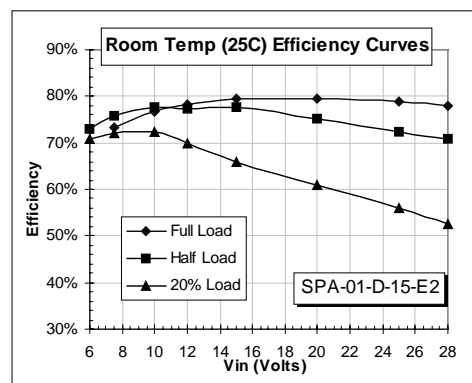
**Figure 6**

Dual +/-5V supply efficiency curves at 25C.



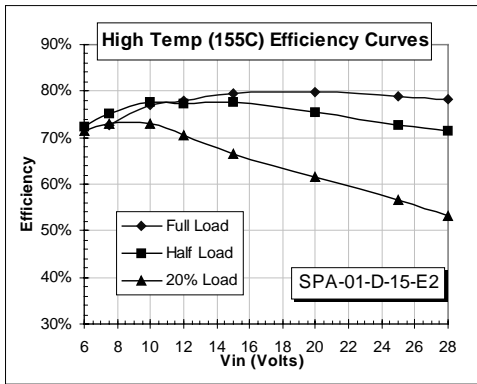
**Figure 7**

Dual +/-5V supply efficiency curves at 155C.



**Figure 8**

Dual output 15V supply efficiency curves at 25C.

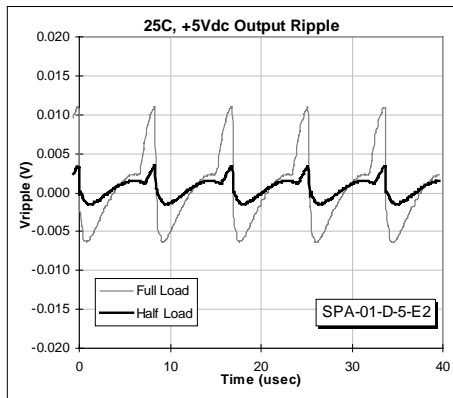


**Figure 9**

Dual +/-15V supply efficiency curves at 155C.

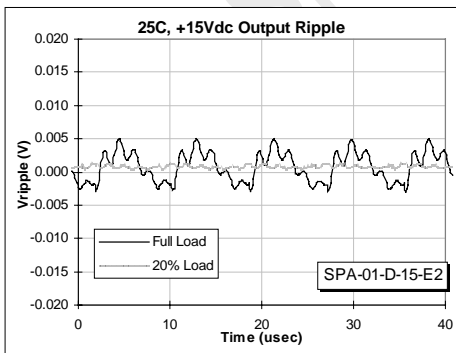
**Ripple**

Figures 10 and 11 illustrate typical output voltage ripple performance.



**Figure 10**

Typical ripple performance (at 25C) for two load conditions ( $V_{in} = 15.0Vdc$ ) for the SPA-01-D-5.



**Figure 11**

Typical ripple performance (at 25C) for two load conditions ( $V_{in} = 15.0Vdc$ ) for the SPA-01-D-15.

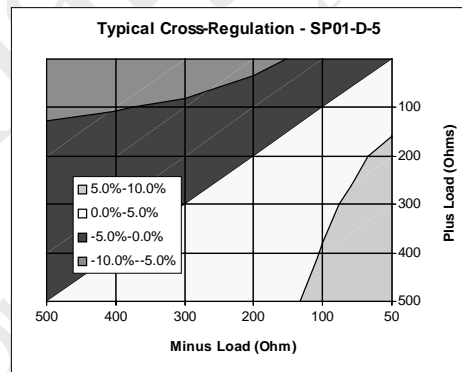
Note that, at room temperature, the full load ripple is typically less than 20mVpp for the

SPA-01-D-5 and less than 10mVpp for the SPA-01-D-15.

**Cross-regulation**

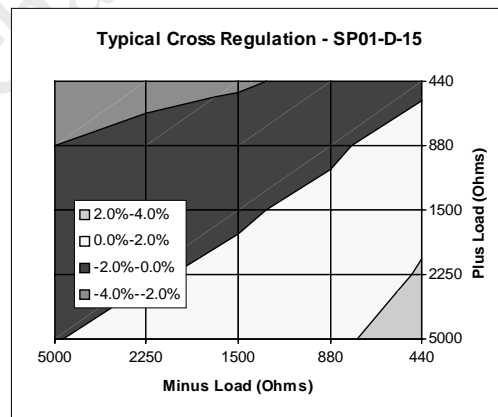
When using the auxiliary (minus) output of the dual supplies, care should be taken to understand the load conditions.

The auxiliary output will track the primary output as long as the loads are reasonably well matched. Figures 12 and 13 shows the effect of load mismatch for the SPA-01-D-5 and SPA-01-D-15. These results are typical.



**Figure 12**

Typical cross-regulation (for the SPA-01-D-5)



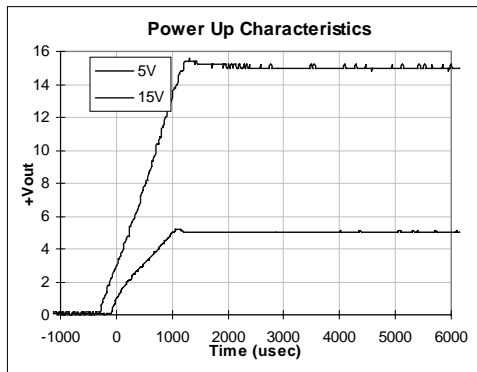
**Figure 13**

Typical cross-regulation (for the SPA-01-D-15)

Note that under sever mismatch conditions, outside the allowed operating range of Figure 5, with maximum load on the auxiliary output and close to no-load on the primary output (<10% load) can cause instability.

**Dynamic Performance**

Figure 14 illustrates the typical full-load turn-on characteristics. Time from SHUTDOWN going low to full voltage is typically 1-2 msec at full load.



**Figure 14**

Full load power-up characteristics for the SPA-01-D-5 and the SPA-01-D-15.

**Application Information**

**Additional output filtering**

The ripple voltage, as illustrated in Figure 10, is quite small and additional filtering is generally not required to obtain adequate noise performance. Distributed capacitance (i.e. decoupling capacitors) is always recommended for distributed power systems.

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 uH) 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.

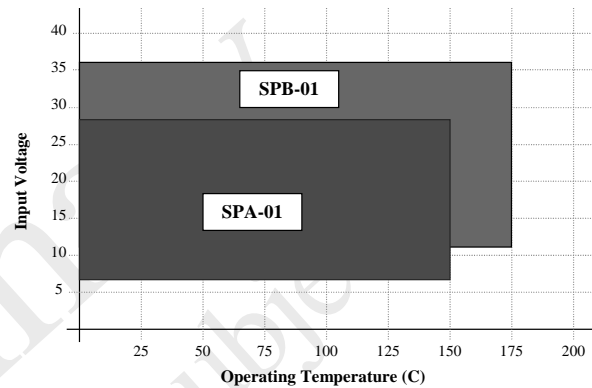
**Mounting**

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 to keep the unit on the board is not recommended.

**SPA/SPB-01 Differences**

Figure 15 shows the operating ranges for the two types of 20-pin switching power supplies currently offered by Innova Electronics.



**Figure 15**

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						
SPA-01-S/D + V <sub>out</sub>	Full Load, Vin: 7.5 to 28V	Full	4.95	5.00	5.05	volts
SPA-01-D - V <sub>out</sub>	Full Load, Vin: 7.5 to 28V	Full	-5.05	-5.00	-4.95	volts
Output Current						
SPA-01-S/D + V <sub>out</sub>	Full Load, Vin: 7.5 to 28V	Full	10/20		100/200	mAmp
SPA-01-D - V <sub>out</sub>	Full Load, Vin: 7.5 to 28V	Full	-10		-100	mAmp
Line Regulation	All Load Conditions	Full		0.0002	0.0005	V/V
Load Regulation	Vin = 15V, Full to Min load	Full		0.5	1.0	%
Cross Regulation (Note 1)						
$\Delta(-V_{out})$ , +Load = 100%	-Load 10% to 100%	Full			10.0	%
$\Delta(-V_{out})$ , +Load = 50%	-Load 10% to 100%	Full		5.0	7.5	%
Voltage Drift vs. Temp (Note 2)	Full Load	Full		±0.5	±1.0	%
Output Ripple	Vin=15.0, Full Load	25°C		20	50	mV <sub>pp</sub>
	Vin=15.0, Full Load	Full		50	100	mV <sub>pp</sub>
Efficiency	Vin=15.0V Full Load	Full	65%	70%	75%	
	Vin=15.0V 10% Load	Full	60%	65%	70%	
	Vin=7.5V Full Load	Full	60%	65%	70%	
	Vin=7.5V 10% Load	Full	60%	65%	70%	
	Vin=28.0V Full Load	Full	65%	70%	75%	
	Vin=28.0V 20% Load	Full	50%	55%	60%	
Short Circuit (Note 3)						
Survival Time	Vin=15.0V, 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)	Full Load	Full	+8.0		+28.0	V
	Half Load	Full	+6.0		+28.0	V
V <sub>SHTDWN</sub> Threshold		Full	0.5		1.5	V
"Off" Supply Current	Vin=15.0V	Full		500		μAmp

**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: SPA-01-D-12 and SPA-01-S-12**

Parameter	Test Conditions	Temp	Min	Typ	Max	Units
Output Voltage						
SPA-01-S/D + V <sub>out</sub>	Full Load, Vin: 7.5 to 28V	Full	11.9	12.0	12.1	volts
SPA-01-D - V <sub>out</sub>	Full Load, Vin: 7.5 to 28V	Full	-12.1	-120	-11.9	volts
Output Current						
SPA-01-S/D + V <sub>out</sub>	Full Load, Vin: 7.5 to 28V	Full	4/8		42/84	mAmp
SPA-01-D - V <sub>out</sub>	Full Load, Vin: 7.5 to 28V	Full	-4		-42	mAmp
Line Regulation	All Load Conditions	Full		0.0002	0.0005	V/V
Load Regulation	Vin = 15V, Full to Min load	Full		0.5	1.0	%
Cross Regulation (Note 1)						
$\Delta(-V_{out})$ , +Load = 100%	-Load 10% to 100%	Full			5.0	%
$\Delta(-V_{out})$ , +Load = 50%	-Load 10% to 100%	Full		2.5	5.0	%
Voltage Drift vs. Temp (Note 2)	Full Load	Full		±0.5	±1.0	%
Output Ripple	Vin=15.0, Full Load	25°C		10	25	mV <sub>pp</sub>
	Vin=15.0, Full Load	Full		25	50	mV <sub>pp</sub>
Efficiency	Vin=15.0V Full Load	Full	75%	80%	85%	
	Vin=15.0V 10% Load	Full	60%	65%	70%	
	Vin=7.5V Full Load	Full	70%	75%	80%	
	Vin=7.5V 10% Load	Full	65%	70%	75%	
	Vin=28.0V Full Load	Full	75%	80%	85%	
	Vin=28.0V 20% Load	Full	50%	55%	60%	
Short Circuit (Note 3)						
Survival Time	Vin=15.0V, 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)	Full Load	Full	+8.0		+28.0	V
	Half Load	Full	+6.0		+28.0	V
V <sub>SHTDWN</sub>						
Threshold		Full	0.5		1.5	V
"Off" Supply Current	Vin=15.0V	Full		500		μAmp

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

Parameter	Test Conditions	Temp	Min	Typ	Max	Units
Output Voltage						
SPA-01-S/D + V <sub>out</sub>	Full Load, Vin: 7.5 to 28V	Full	14.85	15.0	15.15	volts
SPA-01-D - V <sub>out</sub>	Full Load, Vin: 7.5 to 28V	Full	-15.15	-15.0	-14.85	volts
Output Current						
SPA-01-S/D + V <sub>out</sub>	Full Load, Vin: 7.5 to 28V	Full	3/6		34/68	mAmp
SPA-01-D - V <sub>out</sub>	Full Load, Vin: 7.5 to 28V	Full	-3		-34	mAmp
Line Regulation	All Load Conditions	Full		0.0002	0.0005	V/V
Load Regulation	Vin = 15V, Full to Min load	Full		0.5	1.0	%
Cross Regulation (Note 1)						
$\Delta(-V_{out})$ , +Load = 100%	-Load 10% to 100%	Full			5.0	%
$\Delta(-V_{out})$ , +Load = 50%	-Load 10% to 100%	Full		2.5	5.0	%
Voltage Drift vs. Temp (Note 2)	Full Load	Full		±0.5	±1.0	%
Output Ripple	Vin=15.0, Full Load	25°C		10	25	mV <sub>pp</sub>
	Vin=15.0, Full Load	Full		25	50	mV <sub>pp</sub>
Efficiency	Vin=15.0V Full Load	Full	75%	80%	85%	
	Vin=15.0V 10% Load	Full	60%	65%	70%	
	Vin=7.5V Full Load	Full	70%	75%	80%	
	Vin=7.5V 10% Load	Full	65%	70%	75%	
	Vin=28.0V Full Load	Full	75%	80%	85%	
	Vin=28.0V 20% Load	Full	50%	55%	60%	
Short Circuit (Note 3)						
Survival Time	Vin=15.0V, 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)	Full Load	Full	+8.0		+28.0	V
	Half Load	Full	+6.0		+28.0	V
V <sub>SHTDWN</sub>						
Threshold		Full	0.5		1.5	V
"Off" Supply Current	Vin=15.0V	Full		500		μAmp

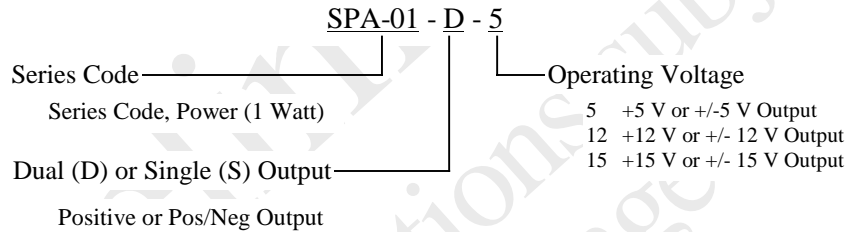
**Notes:**

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 = 8.0 to 28.0 V	-	-25		150C	°C
	Survival	Full Load, Vin = 8.0 to 28.0 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:** SPA-01-D-5 is a 1 watt, dual-output, supply with +/-5VDC outputs.

**INNOVA ELECTRONICS Inc.**  
9207 Emmott Road, Suite 105  
Houston, TX 77040

WW: www@innovaelec.com  
 EMAIL: info@innovaelec.com  
 Tel: (713) 690-9909  
 Fax: (713) 466-0210