WALL
®
INDUSTRIES, INCORPORATED

SPW48S24-100

100W DC-DC Converter
18-75 Vdc Input
24Vdc Output at 4.16A
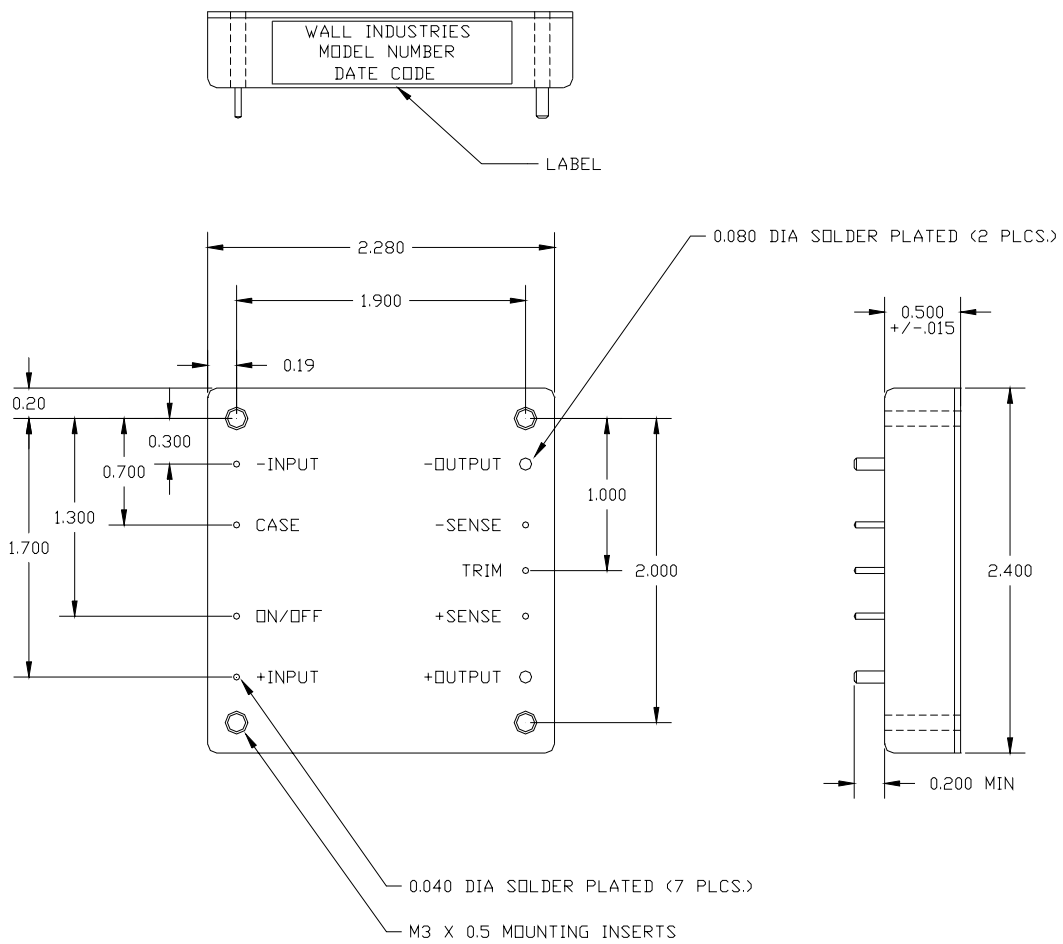## Half-Brick Package

Features:

- **84% Efficient at Full Load**
- **Fast Transient Response**
- **Operation to No Load**
- **Output Trim +/-10%**
- **Remote ON/OFF (Active High/Low)**
- **Remote Sense Compensation**
- **Delivers a Continuous 50W at 25°C with No Air**

- **Low Output Ripple**
- **Fixed Switching Frequency**
- **Output Over Current Protection**
- **Output Short Circuit Protection**
- **Over Temperature Protection**
- **1500 V Isolation**
- **100% Burn In**
- **Test Board Available**
- **UL 1950 Listed – CE Mark**

Description:

The SPW series is a high-density half brick converter that incorporates the desired features required in today's demanding applications. When performance, reliability, and low cost are needed, the SPW series delivers.

Technical Specifications	Model No. SPW48S24-100				
All specifications are based on 25ºC, Nominal Input Voltage and Maximum Output Current unless otherwise noted. We reserve the right to change specifications based on technological advances.					
SPECIFICATION	**Related condition**	**Min**	**Nom**	**Max**	**Unit**
Switching Frequency		-	350	-	KHZ
INPUT (V$_{in}$)					
Operating Voltage Range		18	48	75	Vdc
UVLO Turn On at		16.5	17	17.5	Vdc
UVLO Turn Off at		15.5	16	17	Vdc
UVLO Hysterisis		-	1	-	Vdc
Maximum Input Current *(Graph 3)*	Low Line	-	7.0	-	A
No Load Input Current *(Graph 5)*	No Load	-	0.060	-	A
Input Current under "Remote Off" *(Graph 6)*		-	1	-	mA
Reflected Ripple Current *(Photo 2, Fig. 4)*	With L-C filter as shown in Fig. 4.	-	20	-	mA
Input Surge Voltage	100 mS	-	-	100	Vdc
EFFICIENCY *(Graph 1)*	Io=4.16A	-	84	-	%
OUTPUT (V$_o$)					
Voltage Set Point	±Sense shorted to ±Vout	23.76 -1%	24.0	24.24 +1%	Vdc %
Voltage Adjustment *(Table 1)*	Max Output limited to 100W	21.6 -10%	5.0	26.4 +10%	Vdc
Load Regulation	±Sense shorted to ±Vout	-	0.05	0.1	%
Line Regulation	±Sense shorted to ±Vout	-	0.05	0.1	%
Temperature Drift		-	0.01	0.02	% / ºC
Remote Sense Compensation	Max Output limited to 100W (as measured at the converter output pins)	-	-	0.5	Vdc
Ripple *(Photo 8)*	0.1uF Ceramic & 10uF Tantalum	-	40	360	mV p-p
Spikes *(Photo 8)*	0.1uF Ceramic & 10uF Tantalum	-	40	360	mV p-p
Current		0	-	4.167	A
Current Limit	Power Limited-Dependent upon SENSE compensation and TRIM adjustment	-	5.83	-	A
Over Voltage Limit		28.5	30	31.5	Vdc
DYNAMIC RESPONSE					
Load step / Δ V *(Photo 7)*	50% to 100% Io	-	400	-	mV
Recovery Time *(Photo 7)*	Recovery to within 1% Nominal Vout	-	0.1	-	mS
Turn On Delay *(Photo 5)*	From Vin (min) to Vout (nom)	-	250	-	mS
Turn On Overshoot *(Photo 3,5)*	Full Load Resistive	-	0.0	-	%
Hold Up Time *(Photo 4,6)*	From Vin (min) to V$_{ULVO\_Turn\_Off}$	0	-	-	mS
REMOTE ON/OFF	**Active High or Active Low (Add an 'R' to the end of the PN ie: SPW48S24-100R)**				
Remote ON – Active High	Min High to Enable	2.5	-	-	Vdc
Remote OFF – Active High	Max Low to Disable	-	-	1.3	Vdc
Remote ON/OFF pin Floating – Active High	Over Operating Voltage Range	2.0	-	6.3	Vdc
I$_{ON/OFF}$ Sink to pull low – Active High	V$_{ON/OFF}$ =0V, Vin=75V	-	-	1.0	mA
Remote ON – Active Low	Max Low to Enable	-	-	0.8	Vdc
Remote OFF – Active Low	Min High to Disable	2.0	-	-	Vdc
Remote ON/OFF pin Floating – Active Low	Over Operating Voltage Range	3.0	-	5.4	
I$_{ON/OFF}$ Sink to pull low – Active Low	V$_{ON/OFF}$ =0V, Vin=75V	-	-	1	mA
I$_{ON/OFF}$ Source to drive high – Active High or Low		-	-	-	mA
Turn On Delay – *(Photo 3)*	Enabled	-	240	-	mS
Turn Off Delay – *(Photo 4)*	Disabled	-	-	10	uS
ISOLATION					
Input-Output	1 minute	1500	-	-	Vdc
Isolation Resistance		10	-	-	GΩ
Isolation Capacitance		-	2200	-	pF
THERMAL					
Ambient *(Graph 2)*	Max. Ambient limited by Derating Curves (Graph 2)	-40	25	Graph 2	ºC
Over Temperature Protection		-	110	-	ºC
Storage Temperature		-55	-	125	ºC
MTBF	Calculated Using Bellcore TR-332 Method 1 case 3		2,485,707		Hours
MECHANICAL			**See Figure 1**		
Weight		-	100	-	g

Figure 1: Mechanical Dimensions

WALL INDUSTRIES
MODEL NUMBER
DATE CODE

LABEL

0.080 DIA SOLDER PLATED (2 PLCS.)

2.280
1.900
0.19
0.20
0.300
0.700
1.300
1.700

−INPUT
CASE
ON/OFF
+INPUT

−OUTPUT
−SENSE
TRIM
+SENSE
+OUTPUT

1.000
2.000

0.500 +/−.015
2.400
0.200 MIN

0.040 DIA SOLDER PLATED (7 PLCS.)

M3 X 0.5 MOUNTING INSERTS

DESIGN CONSIDERATIONS

Under Voltage Lock Out (UVLO)
The converter output is disabled until the input voltage exceeds the UVLO turn-on limit. The converter will remain ON until the input voltage falls below the UVLO turn-off limit.

Over Current Protection
The converter is internally protected from short circuit and over current conditions. During these fault conditions, the converter output will 'hiccup'. The converter output will recover once the short or over current fault is removed.

Over Temperature Protection
The converter is protected from over temperature conditions. Upon exceeding this temperature, the converter will shut down. The converter will automatically recover once the over temperature condition is removed.

Input Filter
No additional input capacitor is needed for the power supply to operate. However, to reduce the input ripple voltage and current beyond what is seen in Photo 1, additional capacitance may be added across the input (see Photo 2). No inductor should be placed between the capacitor and the input to the converter without a termination capacitor ("Cin" Fig. 4).

Output Filter
No additional output capacitor is needed for the power supply to operate. However, to reduce the ripple and noise on the output, additional capacitance may be added. Usually, a 0.1uF X7R capacitor works best for reducing H.F.spike noise. Also, capacitance in the form of a tantalum or aluminum electrolytic capacitor may also be placed across the output in order reduce base ripple, and improve the transient peak-to-peak voltage deviation.

Remote Sense
To improve the regulation at the load, route the connections from the -Sense and the +Sense pins to the –Vout and +Vout connections AT the load. This will force the converter to regulate the voltage at the load and not at the pins of the converter (refer to Graph 9). If it is not desired to use the Remotes Sense feature, the –Sense and +Sense pins should be shorted to the -Vout and +Vout pins respectively. Shorting the Sense pins to the Vout pins will reduce the voltage drops through the converter pins.

Fusing
It is required that the input to the converter be supplied with a maximum 10 A, 250 V rated fuse.

Safety
The SPW series is CE marked and certified by the following: UL1950 ,CUL950, TUV60950 FILE 155800. The isolation provided by the SPW series is a Basic insulation in accordance with EN60950. SELV output reliability is maintained only if the input to the SPW converter is a SELV source.

Remote ON/OFF
The converter has the ability to be remotely turned ON or OFF. The SPW series may be ordered Active-High or Active-Low (place an option 'R' at the end of the part number). Active-High means that a logic high or open at the ENABLE pin will turn ON the supply. With Active-High, if the ENABLE pin is left floating, the supply will be enabled. Active-Low means that a logic low at the ENABLE pin will turn ON the supply. With Active-Low, if the ENABLE pin is left floating, the supply will be disabled. If remote On/Off is not used on an Active-Low supply, short the Enable pin to –Vin.

Figure 2. Remote (L/E)
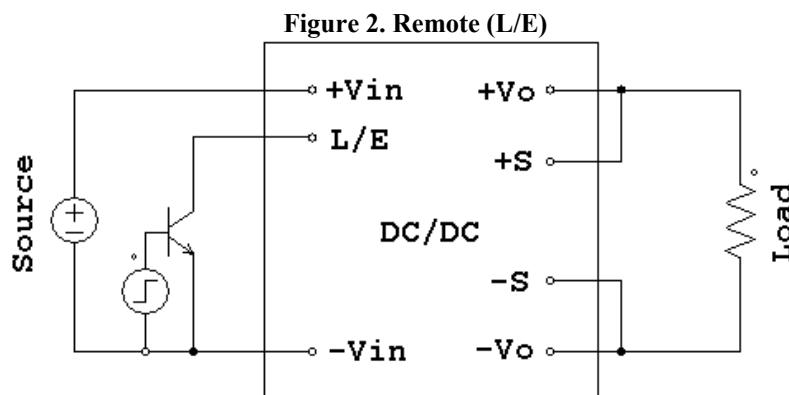
Output Voltage Trim

The following information is provided to allow quick calculation of the trim resistor value for a desired output voltage. The general procedure for calculating a trim resistor is as follows:
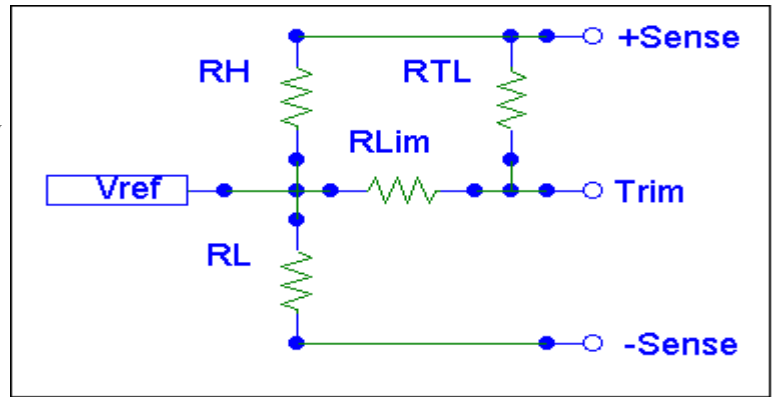
1. Determine the desired output voltage (Vo)
2. Select Equation. (Trim Low/Trim High)
3. Use the data in Table 1 to complete the equation.
4. Evaluate.

In order to trim low use Equation 1 and Table 1 to calculate resistor RTL for the desired output voltage.

Equation 1: Trim Low

$$RT_L = \left[\frac{V_o - V_{REF}}{\left(V_{REF} / R_L \right) - \left(\frac{1}{R_H} \cdot \left(V_o - V_{REF} \right) \right)} \right] - R_{LIM}$$

Vo - Desired output voltage.
All resistor values in K ohms.

Schematic 1: Trim Low

In order to trim high use Equation 2 and Table 1 to calculate resistor RTH for the desired output voltage.

Equation 2: Trim High

$$RT_H = \left[\frac{V_{REF}}{\left(\frac{V_o - V_{REF}}{R_H} \right) - \left(\frac{V_{REF}}{R_L} \right)} \right] - R_{LIM}$$

Vo - Desired output voltage.
All resistor values in K ohms.
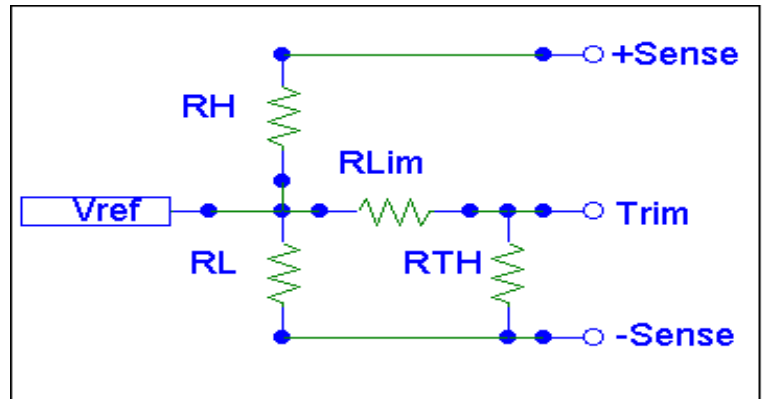
Schematic 2: Trim High

MODEL (Output Voltage)	R_H (K OHMS)	R_{LIM} (K OHMS)	R_L (K OHMS)	V_{REF} (VOLTS)
3.3V	0.750	0.499	2.32	2.495
5.0V	2.49	10.0	2.49	2.495
12.0V	9.53	13.7	2.49	2.495
15.0V	12.4	13.7	2.49	2.495
24.0V	21.5	15.4	2.49	2.495

Table 1 : Trim Low/High Data Table.

Note: Output trim +/- 10% max.

Graph 1: SPW48S24-100 Efficiency vs. Output Current
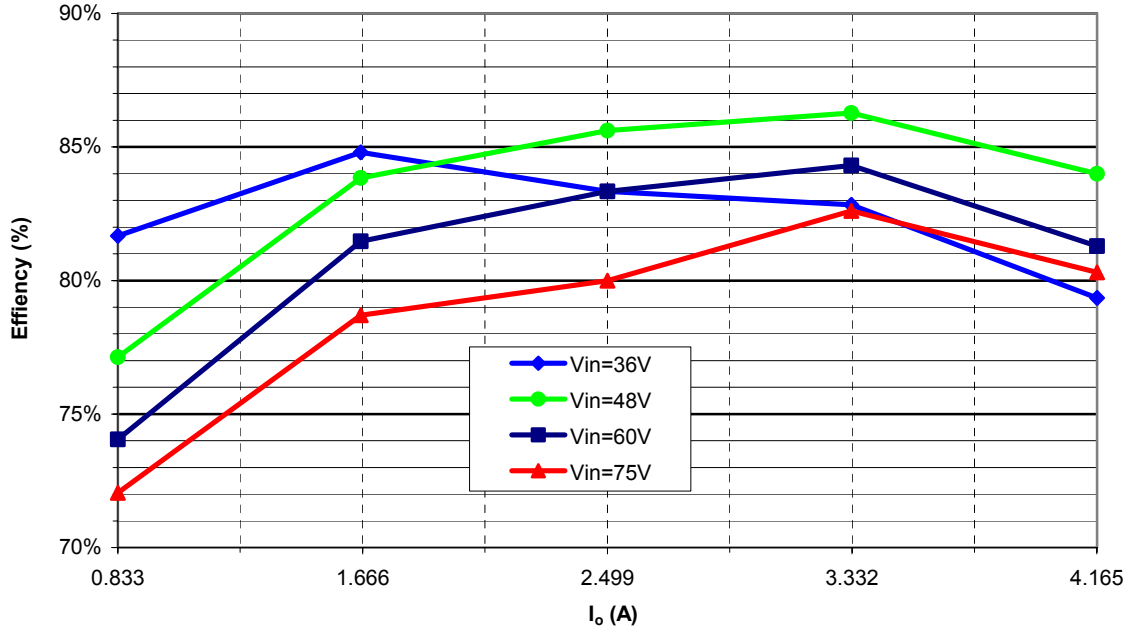

Graph 2: SPW48S24-100 Max Ambient vs. Io
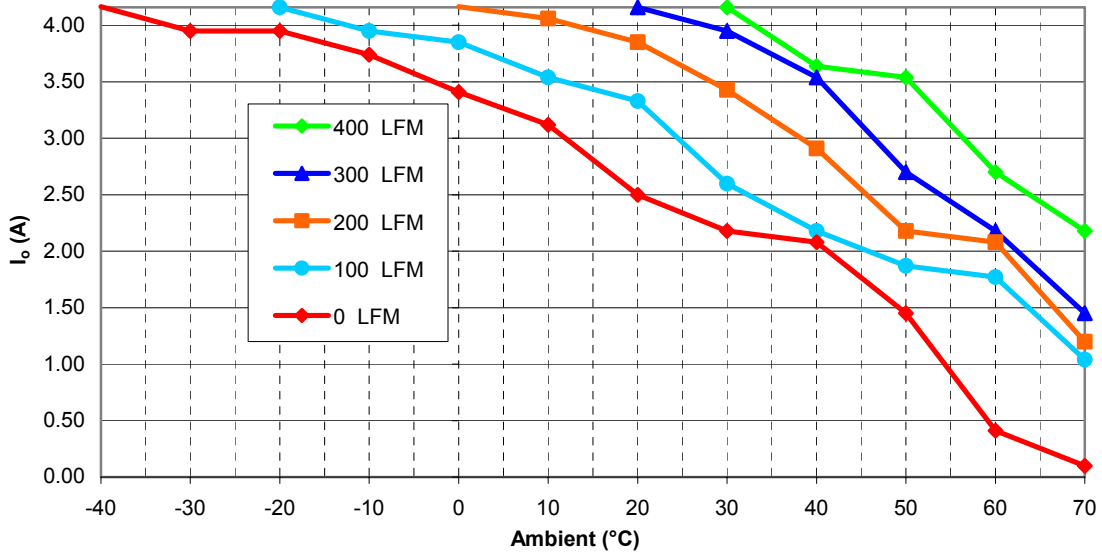
Note: When trimming the output high, I_o vs. Ambient is derated by power. ie: from Graph 2, find the maximum current at the desired ambient and airflow, and multiply this current by the nominal voltage (24V) to get the maximum power. Divide this power by the desired trimmed high voltage to get the maximum current at that ambient. When trimming low, the maximum current stays the same as shown in graph 2.

Graph 3: SPW48S24-100 Input Current vs. Input Voltage
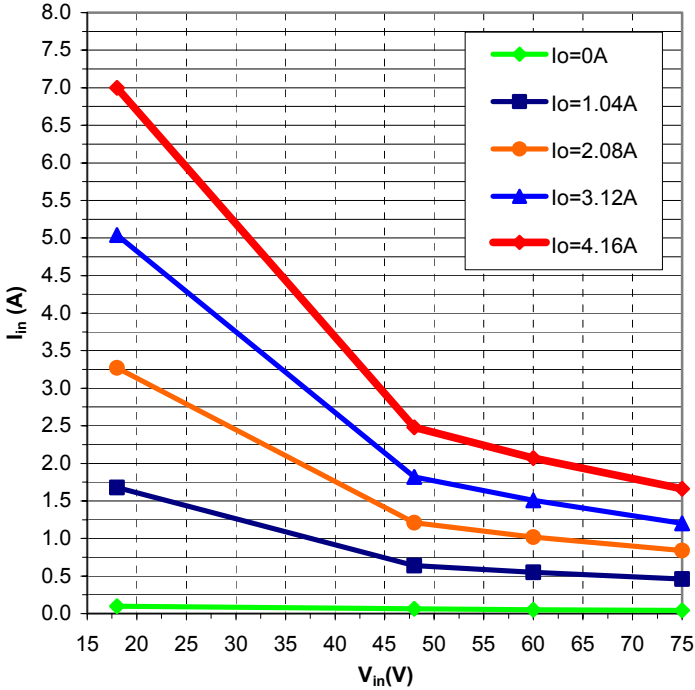
Graph 4: SPW48S24-100 Power Dissipation vs. Input Voltage
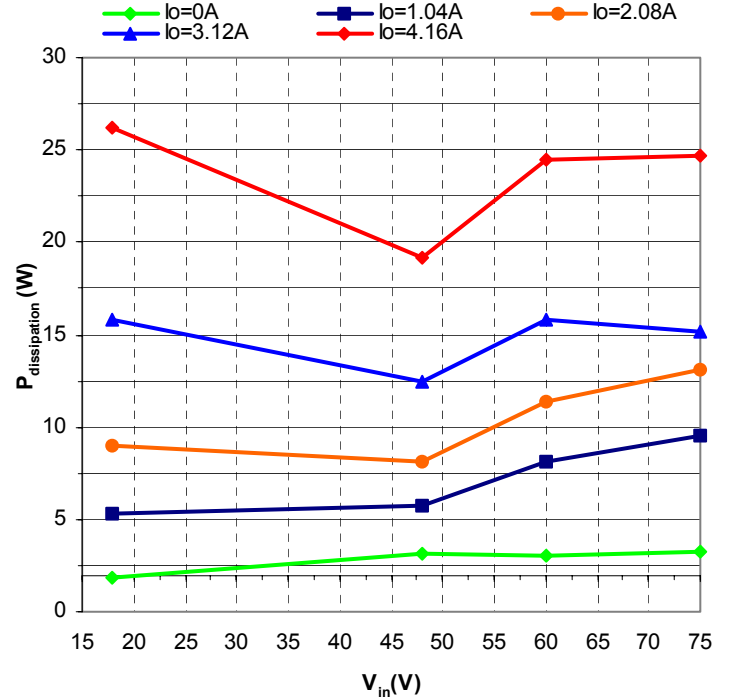
Graph 5: SPW48S14-100 No Load Input Current and Power Dissipation vs. Input Voltage
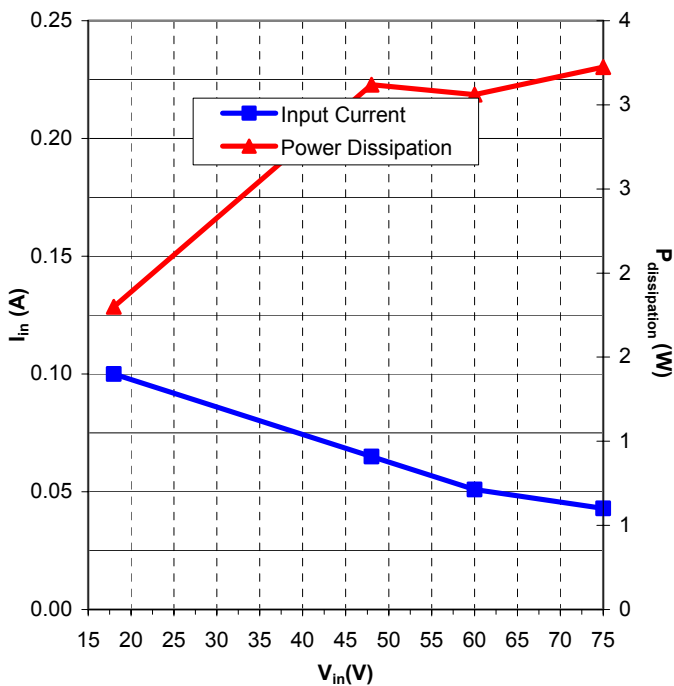
Graph 6: SPW48S24-100 "Remote Off" Input Current and Power Dissipation vs. Input Voltage
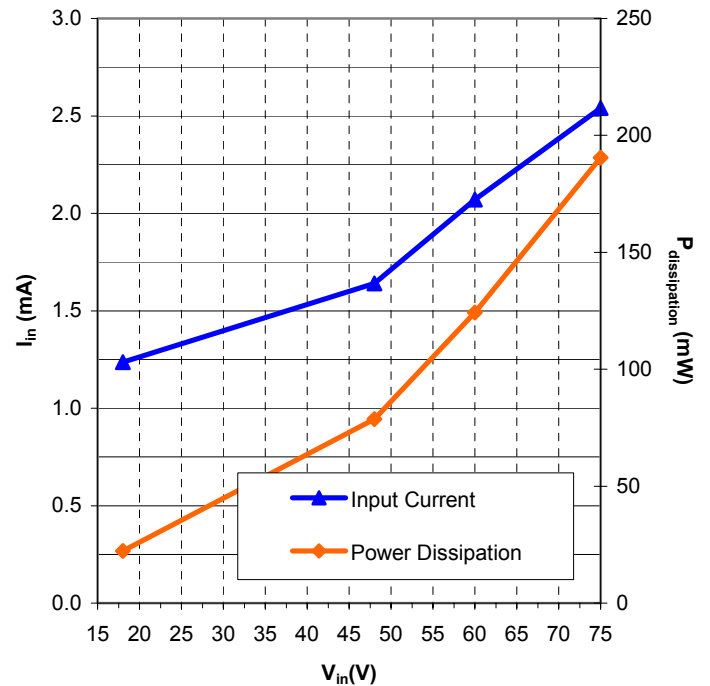
Note: Voltage measurements taken where the output pins are soldered into test board.
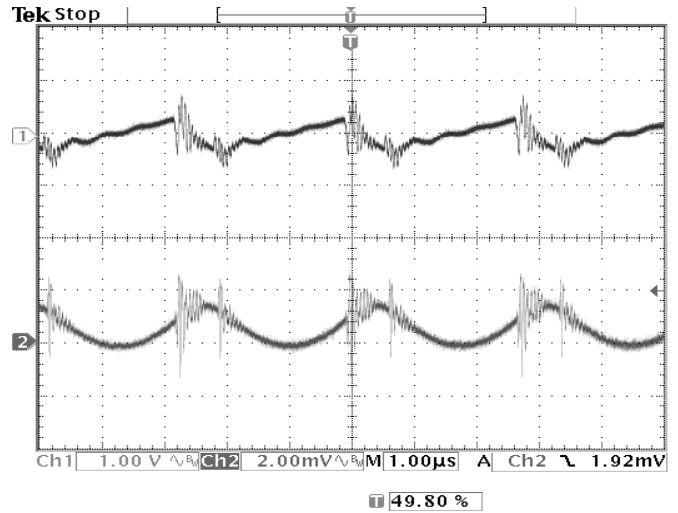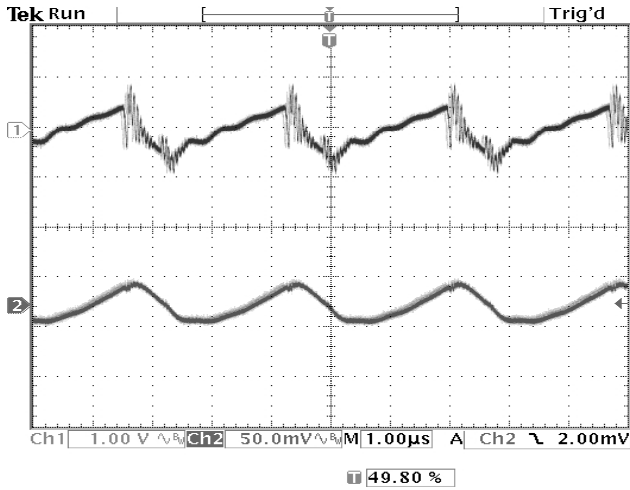
Photo 1: Input Ripple Voltage(1) and Current-500mA/Div.(2).
Vin=48V, Iout = 4.16A

Photo 2: Input Ripple Voltage(1) and Current-20mA/Div. (2).
Vin=48V, Iout = 4.16A
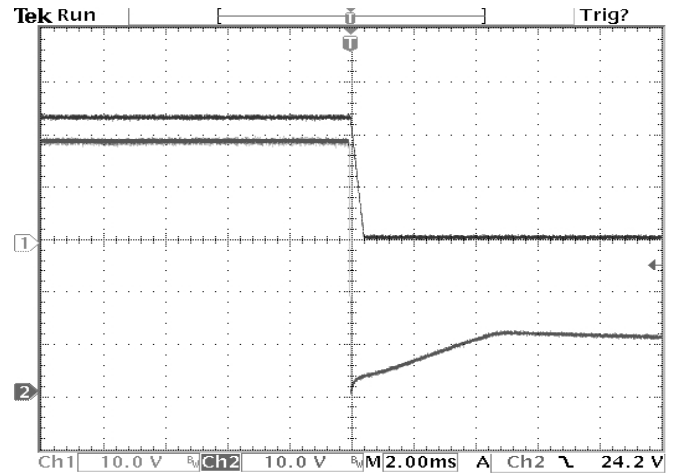With an L-C filter across the Input (Fig. 4)
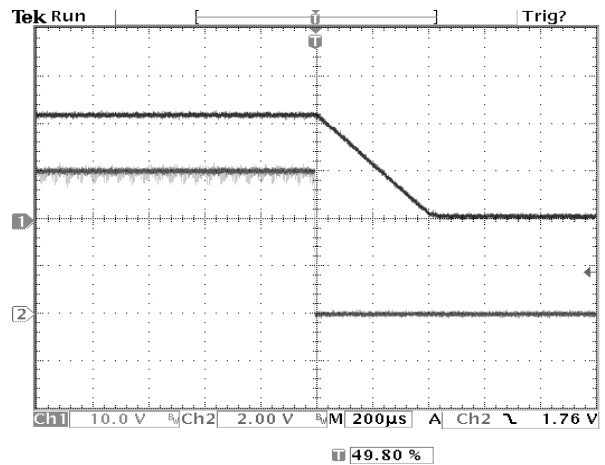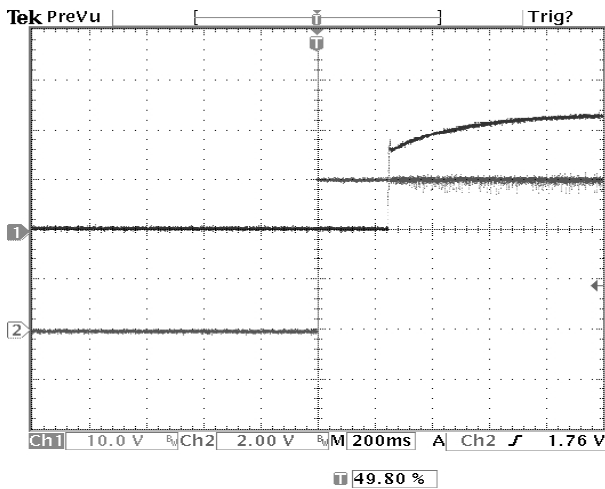
Photo 3: Remote Turn ON (Chan 1=Enable, Chan 2=Vout)
Vin=48V, Iout = 4.16A

Photo 4: Remote Turn OFF (Chan 1=Enable, Chan 2=Vout)
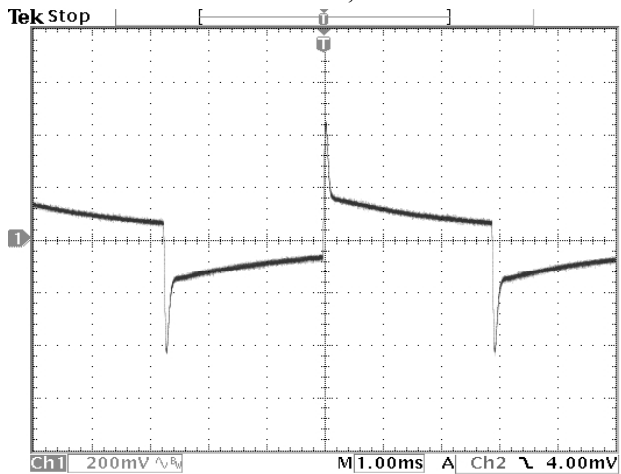Vin=48V, Iout = 4.16A
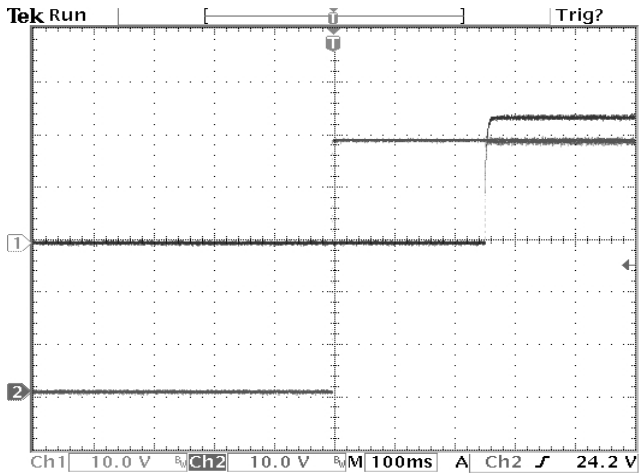
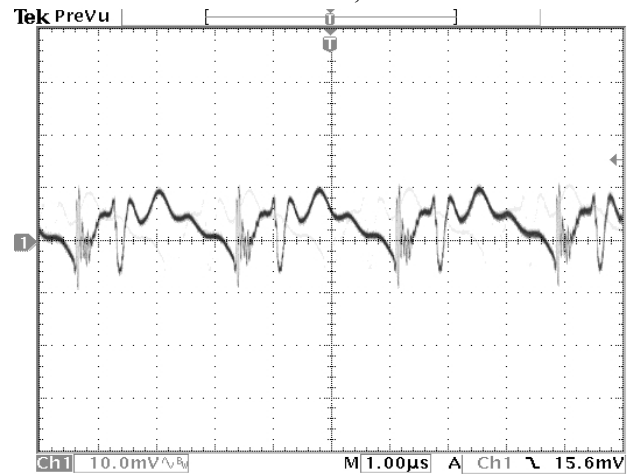**Photo 5:** Normal Turn ON (Chan 1=Vin, Chan 2=Vout)
Vin=48V, Iout = 4.167A

Photo 6: Normal Turn OFF (Chan 1=Vin, Chan 2=Vout)
Vin=48V, Iout = 4.167A

Photo 7: Transient Response 50% to 100%
Vin=48V, Iout = 4.167A to 2.08A
Cout=0.1uF Ceramic + 10uF Tantalum

Photo 8: Output Voltage Ripple (20 MHz BW)
Vin=48V, Iout= 4.16A
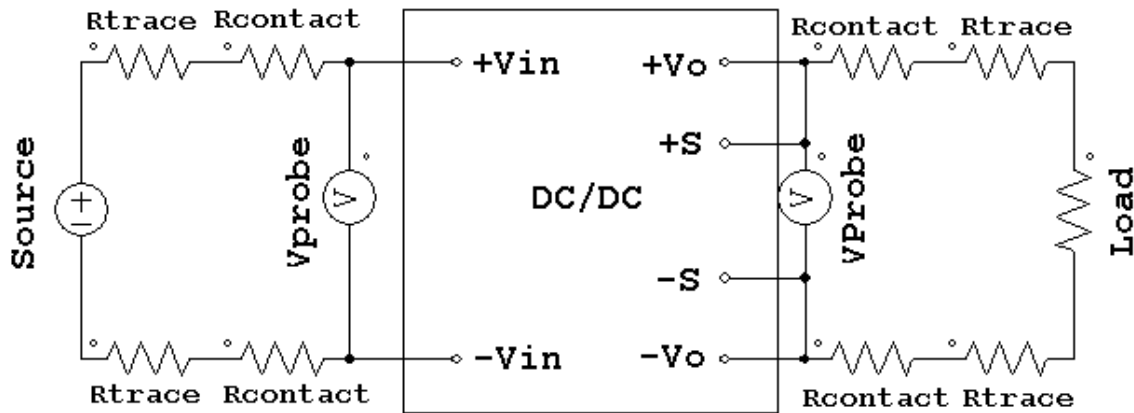Cout=0.1uF Ceramic + 10uF Tantalum

TEST SETUP:
The SPW48S24-100 specifications are tested with the following configurations:

Regulation and Efficiency Setup
To ensure that accurate measurement are taken, the voltage measurements are taken directly at the terminals of the module. This minimizes errors due to contact and trace lengths between the load and the output of the supply. The following diagram is of the test setup.
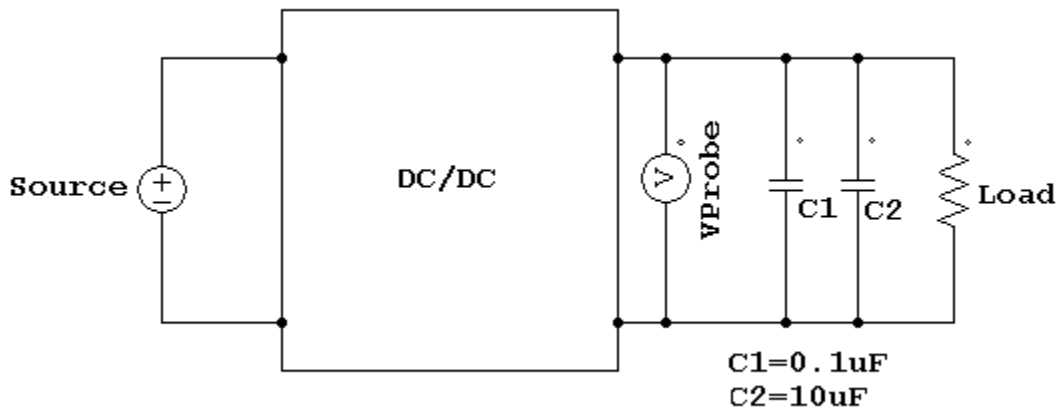
Figure 2: Regulation and Efficiency Probe Setup

Output Ripple Voltage Setup
The module is tested with a 0.1uF ceramic capacitor in parallel with a 10uF tantalum capacitor across the output terminals. Unless otherwise specified, bandwidth is limited to 20MHZ.

Figure 3: Ripple Voltage Probe Setup

Input Reflected Ripple Current and Input Ripple Voltage Setup

The module is tested for input reflected ripple current (Irrc). The input ripple voltage is also measured at the pins with and without an additional 33uF electrolytic capacitor. To reduce either the input ripple current or voltage additional capacitors and/or an inductor may be added to the input of the converter.

Figure 4: Ripple Current Setup

Cin = 33uF
Lin = 12uH
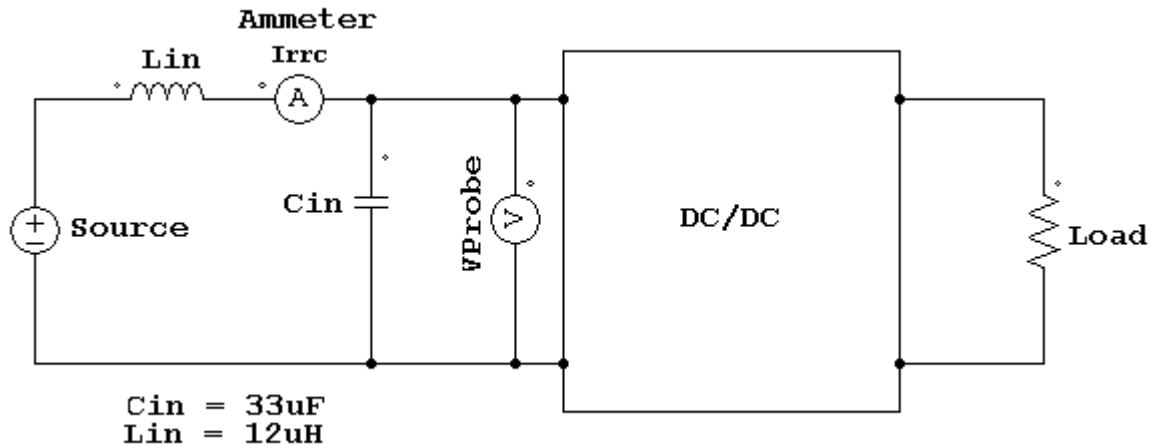
Converter Thermal Consideration

The converter is designed to operate without convective cooling if the de-rating curves are followed. The converter can operate at higher temperatures and higher output currents if airflow and or a heatsink is applied. Airflow should be aligned lengthwise to the converter's heatsink fins for optimum heat transfer. See Graph 2 for de-rating curves or contact factory for additional thermal information.
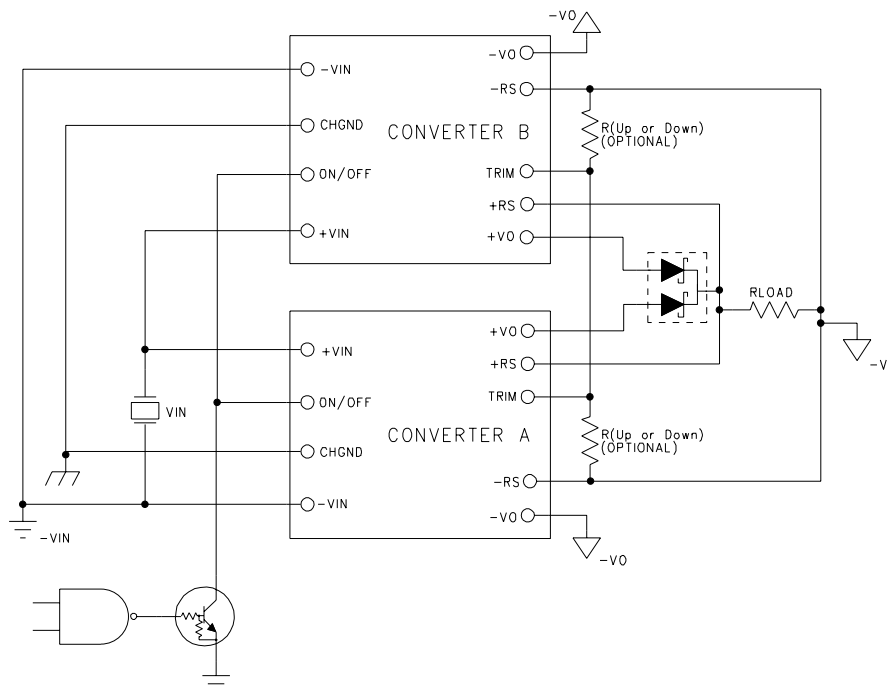
Figure 5: Airflow Orientation
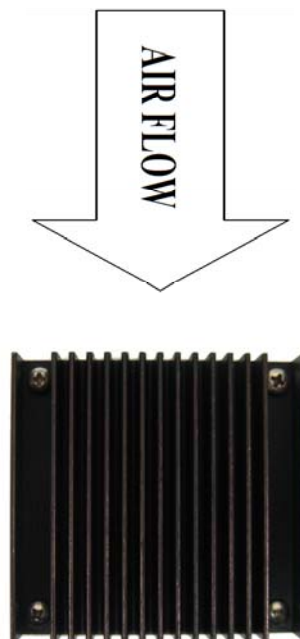
Paralleling Converters

The SPW series converters may be paralleled both for redundancy and for higher output current. However, in order to do this, a high-current, low V_f, Schottky diode must be placed at the +Vo pin of each supply as shown in Figure 6. To improve sharing, tie the two TRIM pins together. The converters may be trimmed by adding a resistor value from Table 2 from each TRIM pin to ±RS pin, or alternatively, a single resistor of half the value of Table 2 from the common TRIM pins to the common ±RS pins.
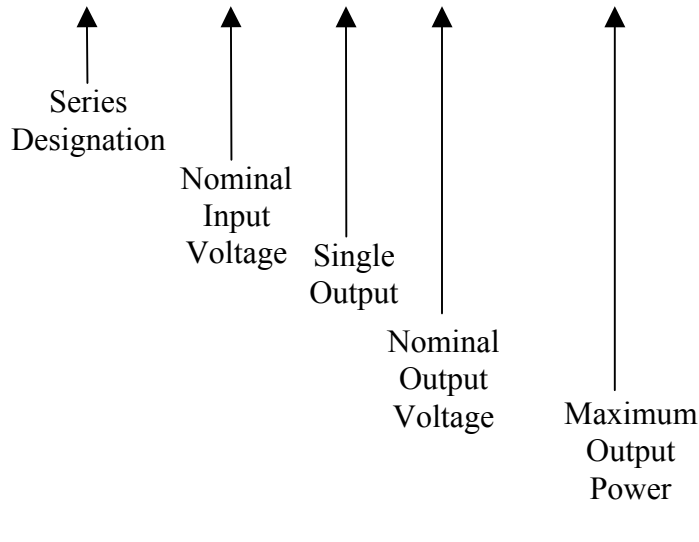
Figure 6: Paralleling Converters

Ordering Information:

Part Number Example:

SPW 48 S 24 –100 R

Series
Designation

Nominal
Input
Voltage

Single
Output

Nominal
Output
Voltage

Maximum
Output
Power

Options	
	Leave Blank for no Options
R	Active Low Enable

Company Information:

Wall Industries, Inc. has created custom and modified units for over 40 years. Our in-house research and development engineers will provide a solution that exceeds your performance requirements on time and on budget. Our ISO9001-2000 certification is just one example of our commitment to producing a high quality, well documented product for our customers.

Our past projects demonstrate our commitment to you, our customer. Wall Industries, Inc. has a reputation for working closely with it's customers to ensure each solution meets or exceeds form, fit and function requirements. We will continue to provide ongoing support for your project above and beyond the design and production phases. Give us a call today to discuss your future projects.

Contact **Wall Industries** for further information:

Phone: ☎(603)778-2300
Toll Free: ☎ (888)587-9255
Fax: ☎ (603)778-9797
E-mail: sales@wallindustries.com
Web: www.wallindustries.com
Address: 5 Watson Brook Rd.
Exeter, NH 03833