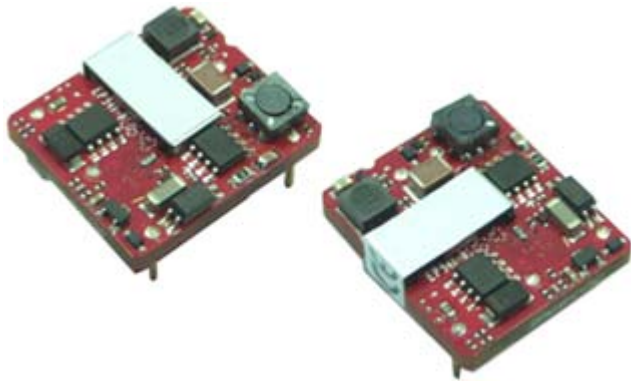


## Wall Industries, Inc.

### JFW24S3.3-4000

**9-36VDC Wide Input Voltage Range**  
**3.3VDC Output at 4A**  
**DIP and SMT Type Packages**  
**13W Open Frame DC/DC Power Converter**



#### APPLICATIONS

- Wireless Networks
- Telecom / Datacom
- Industry Control Systems
- Measurement Equipment
- Semiconductor Equipment

#### OPTIONS

- SMT Type
- Without Trim Pin
- Without ON/OFF Pin
- Negative Logic Remote ON/OFF

#### FEATURES

- 13 Watts Maximum Output Power
- 3.3VDC Single Output
- Cost Efficient Open Frame Design
- Small Size and Low Profile: 1.10" x 0.94" x 0.34"
- 85% High Efficiency
- 9-36VDC Input Voltage Range
- Fixed Switching Frequency
- Input to Output Isolation: 2250VDC
- No Minimum Load Requirement
- Output Voltage Adjustability
- Industry Standard Pin-out
- Negative or Positive Remote ON/OFF Control
- Short Circuit, Over Current, Over Voltage, and Input Under Voltage Protection
- Surface Mount and Through Hole Types Available
- SMT Package Qualified for Lead-free Reflow Solder Process According to IPC J-STD-020D
- CE Mark Meets 2006/95/EC, 93/68/EEC, and 2004/108/EC
- UL60950-1, EN60950-1, and IEC60950-1 Licensed

#### DESCRIPTION

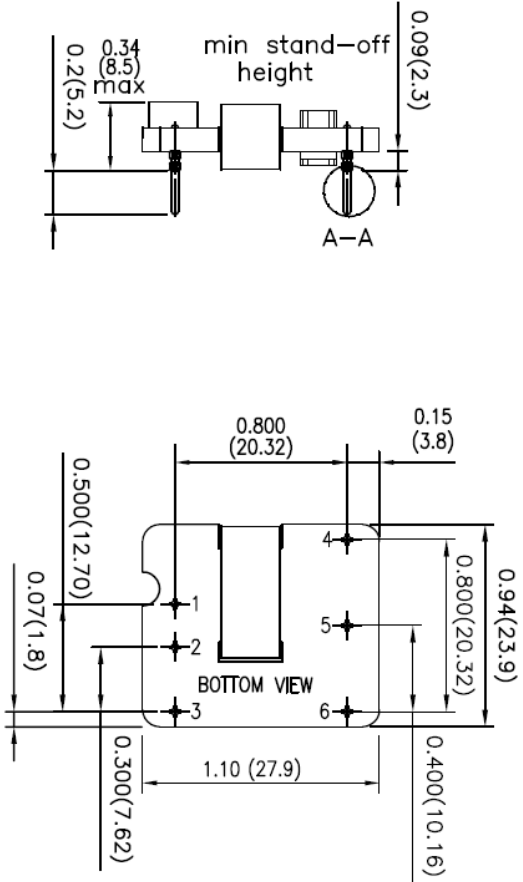
The JFW24S3.3-4000 DC/DC power converter provides 13 Watts of output power in a low profile industry standard package and footprint. This converter has a 3.3VDC single output and operate over a 4:1 input voltage range of 9-36VDC. The JFW24S3.3-4000 is also protected against short circuit, over current, over voltage, and input under voltage conditions. Some features include 85% high efficiency, adjustable output voltage, and positive or negative remote ON/OFF control. This converter is RoHS compliant and has UL60950-1, EN60950-1, and IEC60950-1 safety approvals. Both surface mount ("S" suffix) and DIP (standard) packages are available.

TECHNICAL SPECIFICATIONS		Model No. JFW24S3.3-4000			
All specifications are based on 25°C, Nominal Input Voltage, and Maximum Output Current unless otherwise noted. We reserve the right to change specifications based on technological advances.					
SPECIFICATION	TEST CONDITIONS	Min	Typ	Max	Unit
<b>INPUT SPECIFICATIONS</b>					
Input Voltage Range		9	24	36	VDC
Input Current	Nominal input and full load			680	mA
Input Standby Current	Nominal input and no load		60		mA
Input Surge Voltage (100ms)				50	VDC
UVLO Turn-On Threshold				9	VDC
UVLO Turn-Off Threshold			8		VDC
Start-Up Time	Power Up	Nominal input and constant resistive load	5	30	ms
	Remote ON/OFF		5	30	
Input Reflected Ripple Current (See Page 9)	5 to 20MHz, 12µH source impedance		30		mAp-p
<b>OUTPUT SPECIFICATIONS</b>					
Output Voltage	Nominal input, full load, and 25°C	3.267	3.3	3.333	VDC
Line Regulation	Low line to high line at full load	-0.2		+0.2	%
Load Regulation	No load to full load	-0.2		+0.2	%
Voltage Adjustability (See Page 6)		-10		+10	%
Output Power				13	W
Output Current				4000	mA
Output Capacitor Load				12000	µF
Ripple & Noise (20Hz BW) (See Page 9)	Measured with a 1µF M/C and a 10µF T/C		100	125	mVp-p
Output Voltage Overshoot	Low line to high line at full load and 25°C			3	%Vout
Minimum Load		0			%
Temperature Coefficient		-0.02		+0.02	%/°C
<b>DYNAMIC LOAD RESPONSE</b>					
Peak Deviation	75% to 100% or 100% to 75% of full load		300		mV
Setting Time (Vout < 10% peak deviation)	75% to 100% or 100% to 75% of full load		250		µs
<b>REMOTE ON/OFF (See Page 5)</b>					
Positive Logic (standard)	DC/DC ON (Open)	The ON/OFF pin is referenced to -Input	Open or 3V < Vr < 15V		
	DC/DC OFF (Short)		Short or 0V < Vr < 1.2V		
Negative Logic (optional)	DC/DC ON (Short)	The ON/OFF pin is referenced to -Input	Short or 0V < Vr < 1.2V		
	DC/DC OFF (Open)		Open or 3V < Vr < 15V		
Input Current of Remote Control Pin	Nominal Input	-0.5		1	mA
Remote Off State Input Current	Nominal Input		2.5		mA
<b>PROTECTION</b>					
Over Voltage Protection	Voltage clamped	3.7		5.4	VDC
Over Current Protection	% of FL at nominal input		150		%FL
Short Circuit Protection		Hiccup, automatic recovery			
<b>GENERAL SPECIFICATIONS</b>					
Efficiency	Nominal input and full load		85		%
Switching Frequency		315	350	385	KHz
Isolation Voltage (Input to Output)	For 1 minute	2250			VDC
Isolation Resistance		1			GΩ
Isolation Capacitance				1500	pF
<b>ENVIRONMENTAL SPECIFICATIONS</b>					
Operating Ambient Temperature	With derating	-40		+85	°C
Storage Temperature		-55		+125	°C
Relative Humidity		5		95	% RH
Thermal Shock		MIL-STD-810F			
Vibration		MIL-STD-810F			
Lead-Free Reflow Solder Process		IPC J-STD-020D			
Moisture Sensitivity Level (MSL)		IPC J-STD-033B Level 2a			
MTBF (See Page 16)	BELLCORE TR-NWT-000332, Tc=40°C	1,322,000 hours			
	MIL-HDBK-217F	514,700 hours			
<b>PHYSICAL SPECIFICATIONS</b>					
Weight		0.36oz (10.5g)			
Dimensions (L x W x H)		1.10 x 0.94 x 0.34 inches (27.9 x 23.9 x 8.5 mm)			
<b>SAFETY &amp; EMI CHARACTERISTICS</b>					
Safety Approvals		IEC60950-1, UL60950-1, EN60950-1			
EMI (See Page 10)	EN55022	Class A			
Radiated Immunity	EN61000-4-3	10 V/m	Perf. Criteria A		
Fast Transient (See Note1)	EN61000-4-4	±2KV	Perf. Criteria A		
Surge (See Note1)	EN61000-4-5	±1KV	Perf. Criteria A		
Conducted Immunity	EN61000-4-6	3 Vrms	Perf. Criteria A		

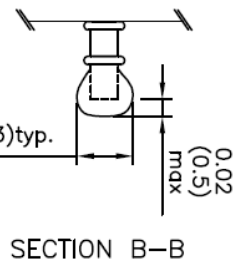
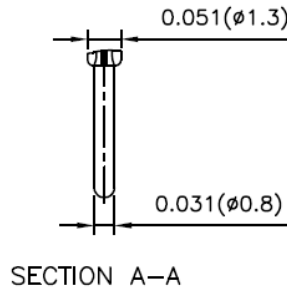
**Note1:** An external input filter capacitor is required if the module has to meet EN61000-4-4 and EN61000-4-5. The filter capacitor suggested is Nippon Chemi-con KY series 220µF/100V, ESR 48mΩ.

MECHANICAL DRAWING

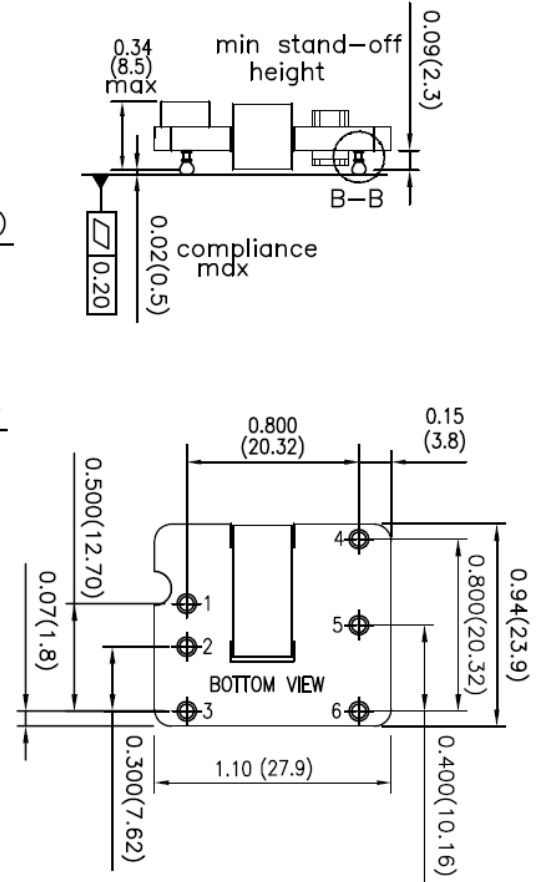
**DIP TYPE (Standard)**



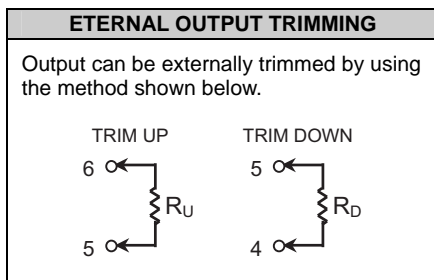
1. Unit: inches (mm)
2. Tolerance: X.XX±0.02 (X.X±0.5)  
X.XXX±0.01 (X.XX±0.25)
3. Pin pitch tolerance: ±0.01 (±0.25)
4. Pin dimension tolerance: ±0.004 (±0.1)



**SMT TYPE (Suffix "S")**



PIN CONNECTIONS	
PIN	JFW SERIES
1	+INPUT
2	-INPUT
3	CTRL
4	+OUTPUT
5	TRIM
6	-OUTPUT



PRODUCT OPTIONS	
Option	Suffix
Positive Remote ON/OFF with DIP (standard)	No Suffix
Positive remote ON/OFF with SMT	S
Negative Remote ON/OFF with DIP	R
Negative Remote ON/OFF with SMT	SR
DIP type without ON/OFF pin	D
SMT type without ON/OFF pin	SD
DIP type without ON/OFF & TRIM pin	G
SMT type without ON/OFF & TRIM pin	SG
DIP type, negative remote ON/OFF, without TRIM pin	F
SMT type, negative remote ON/OFF, without TRIM pin	SF
DIP type, positive remote ON/OFF, without TRIM pin	J
SMT type, positive remote ON/OFF, without TRIM pin	SJ

## DESIGN CONSIDERATIONS

### **Output Over Current Protection**

When excessive output currents occur in the system, circuit protection is required on all power supplies. Normally, over load current is maintained at approximately 150% of rated current for the JFW Series.

Hiccup-mode is a method of operation in a power supply whose purpose is to protect the power supply from being damaged during an over current fault condition. It also enables the power supply to restart when the fault condition is removed.

One of the problems resulting from over current is that excessive heat may be generated in the power devices; especially MOSFET and Schottky diodes and the temperature of those devices may exceed their specified limits. A protection mechanism has to be used to prevent those power devices from being damaged.

### **Output Over Voltage Protection**

The output over voltage protection consists of a Zener diode that monitors the output voltage on the feedback loop. If the voltage on the output terminals exceeds the over voltage protection threshold, then the Zener diode will send a current signal to the control IC to limit the output voltage.

### **Input Source Impedance**

The power module should be connected to a low impedance input source. Highly inductive source impedance can affect the stability of the power module. Input external C-L-C filter is recommended to minimize input reflected ripple current. The inductor is simulated source impedance of 12 $\mu$ H and capacitor is Nippon chemi-con KZE series 220 $\mu$ F/100V and 33 $\mu$ F/100V. The capacitor must be placed as close as possible to the input terminals of the power module for lower impedance.

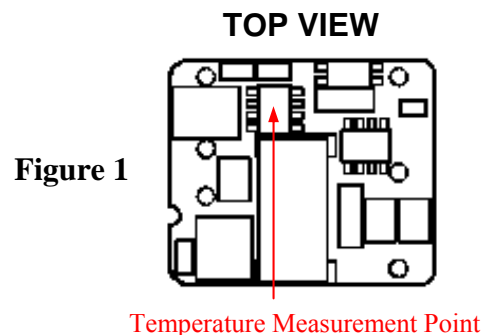
### **Short Circuit Protection**

Continuous, hiccup and auto-recovery mode.

During a short circuit the converter will shut down. The average current during this condition will be very low and the device can be handled safely in this condition.

### **Thermal Consideration**

The power module operates in a variety of thermal environments. However, sufficient cooling should be provided to help ensure reliable operation of the unit. Heat is removed by conduction, convention, and radiation to the surrounding environment. Proper cooling can be verified by measuring the point shown in the figure below. The temperature at this location should not exceed 120°C. When operating, adequate cooling must be provided to maintain the test point temperature at or below 120°C. Although the maximum point temperature of the power modules is 120°C, you can limit this temperature to a lower value for extremely high reliability.

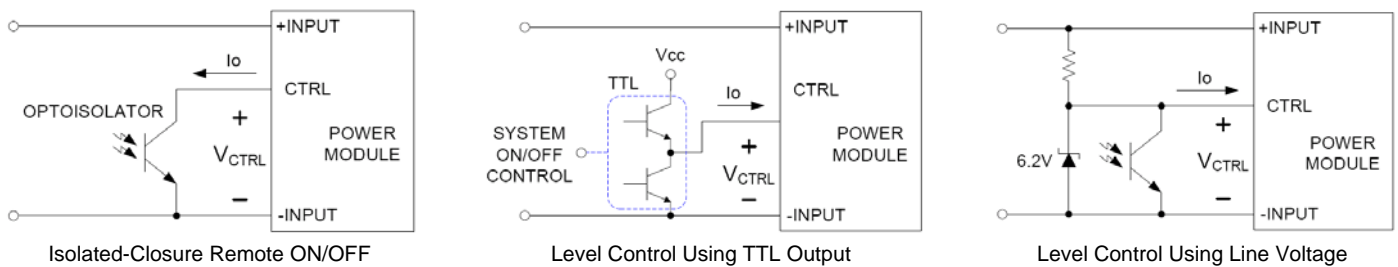


**Remote ON/OFF Control**

The remote ON/OFF pin allows the user to turn the DC/DC power module on and off from a remote switch device. The ON/OFF input can be switched by a number of switching devices. Figure 2 gives several examples of acceptable configurations. The remote ON/OFF switch is activated by the voltage difference between the ON/OFF pin and the  $-V_{in}$  pin (with  $-V_{in}$  as the reference voltage). The user-supplied switch must be capable of sinking up to 1mA of current at low-level logic voltage. The leakage current of the user-supplied switch must be 0.5mA or less at 15Vdc.

**Remote ON/OFF Implementation Circuits**

**Figure 2**



**There are two remote control options available: Positive logic and Negative logic**

- a. The positive logic structure turned the DC/DC module ON when the ON/OFF pin is at high-level logic and turned the DC/DC module OFF when the ON/OFF pin is at low-level logic.

**Figure 3**



When JFW module is turned OFF at Low-level logic

When JFW module is turned ON at High-level logic

- b. The negative logic structure turned the DC/DC module ON when the ON/OFF pin is at low-level logic and turned the DC/DC module OFF when the ON/OFF pin is at high-level logic.

**Figure 4**



When JFW module is turned ON at Low-level logic

When JFW module is turned OFF at High-level logic

**External Trim Adjustment**

Output voltage set point adjustment allows the user to increase or decrease the output voltage set point of a module. This is accomplished by connecting an external resistor between the TRIM pin and either the +Vout or -Vout pins. With an external resistor between the TRIM and +Vout pin, the output voltage set point decreases. With an external resistor between the TRIM and -Vout pin, the output voltage set point increases. The external TRIM resistor needs to be at least 1/16W.

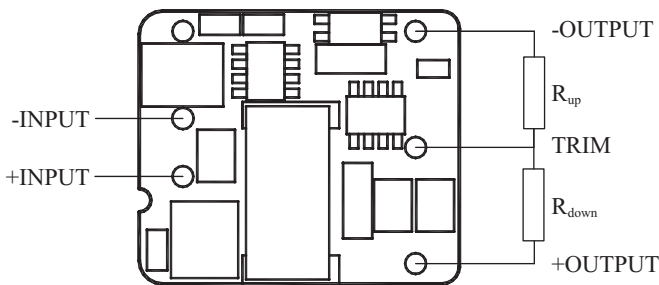
$$R_{up} = \left[ \frac{5110 * 2.5}{(V_{out,up} - 2.5 - 0.8)} - 2050 \right] \Omega$$

*V<sub>out,up</sub> is the desired up output voltage*

$$R_{down} = \left[ \frac{(V_{out,down} - 2.5) * 5110}{(V_{out} - V_{out,down})} - 2050 \right] \Omega$$

*V<sub>out,down</sub> is the desired down output voltage*

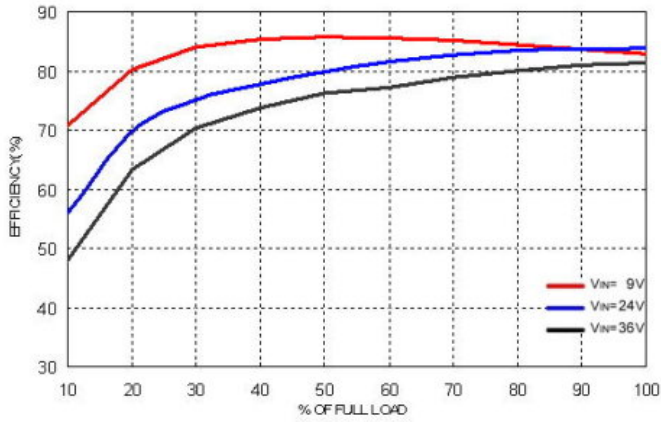
**Figure 5**



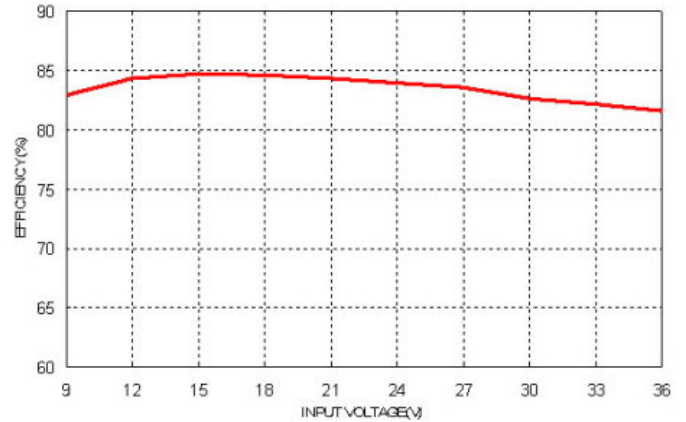
**Trim Resistor Values**

Trim	V <sub>out,up</sub>	R <sub>up</sub>	V <sub>out,down</sub>	R <sub>down</sub>
1%	3.333V	385.071 kΩ	3.267V	116.719 kΩ
2%	3.366V	191.511 kΩ	3.234V	54.779 kΩ
3%	3.399V	126.99 kΩ	3.201V	34.133 kΩ
4%	3.432V	94.73 kΩ	3.168V	23.810 kΩ
5%	3.465V	75.374 kΩ	3.135V	17.616 kΩ
6%	3.498V	62.47 kΩ	3.102V	13.486 kΩ
7%	3.531V	53.253 kΩ	3.069V	10.537 kΩ
8%	3.564V	46.34 kΩ	3.036V	8.325 kΩ
9%	3.597V	40.963 kΩ	3.003V	6.604 kΩ
10%	3.630V	36.662 kΩ	2.97V	5.228 kΩ

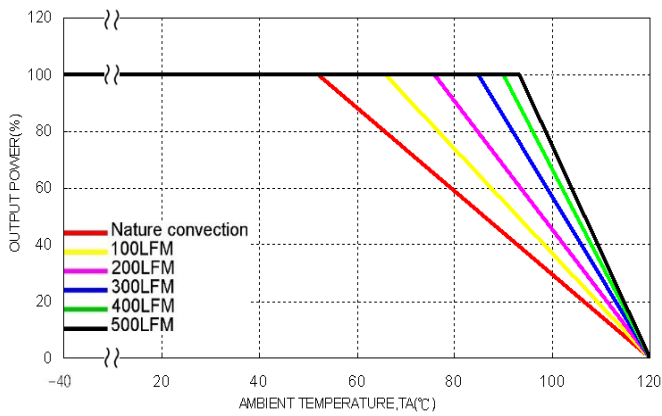
**Graph 1: Efficiency vs. Output Current**



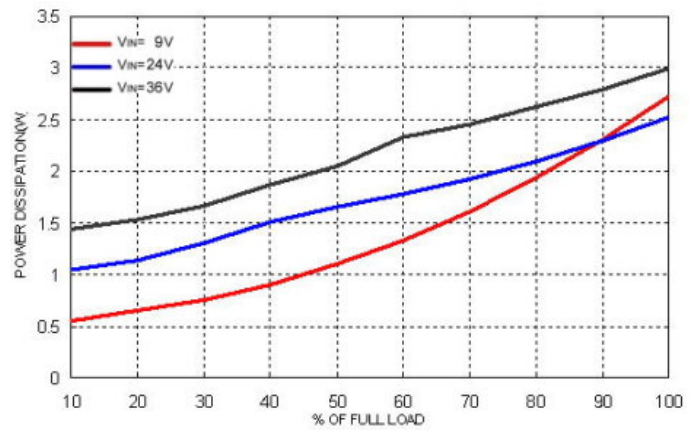
**Graph 2: Efficiency vs. Input Voltage (Full Load)**



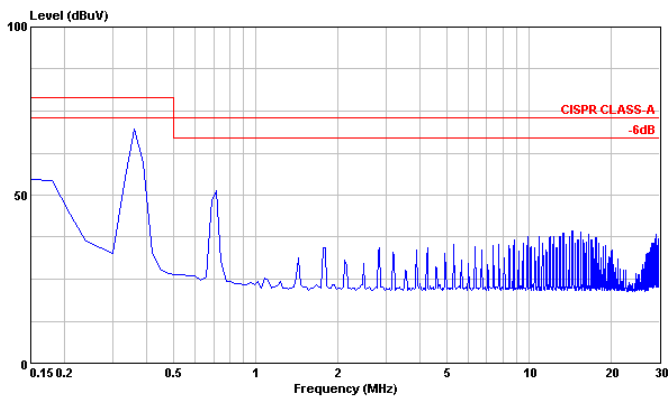
**Graph 3: Output Power vs. Ambient Temperature & Airflow (Nominal Vin)**



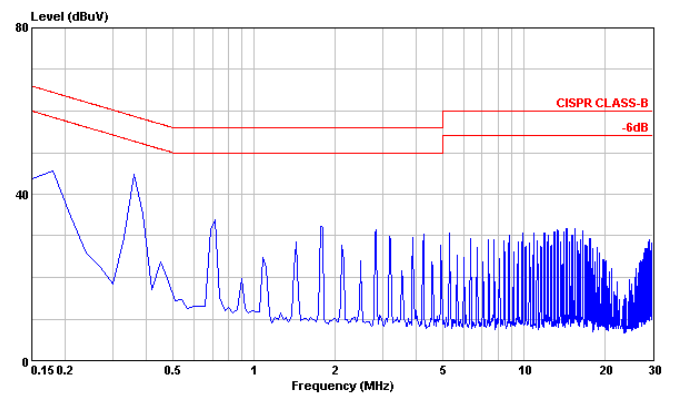
**Graph 4: Power Dissipation Vs. Output Current**



**Graph 5: Conducted Emission of EN55022 Class A (Nominal Vin and Full Load)**

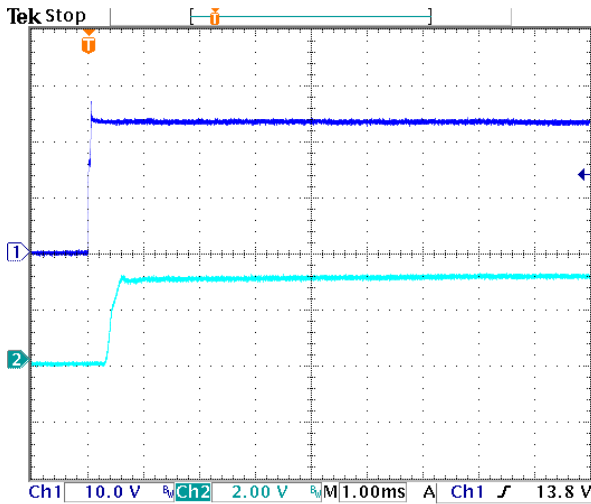


**Graph 6: Conducted Emission of EN55022 Class B (Nominal Vin and Full Load)**

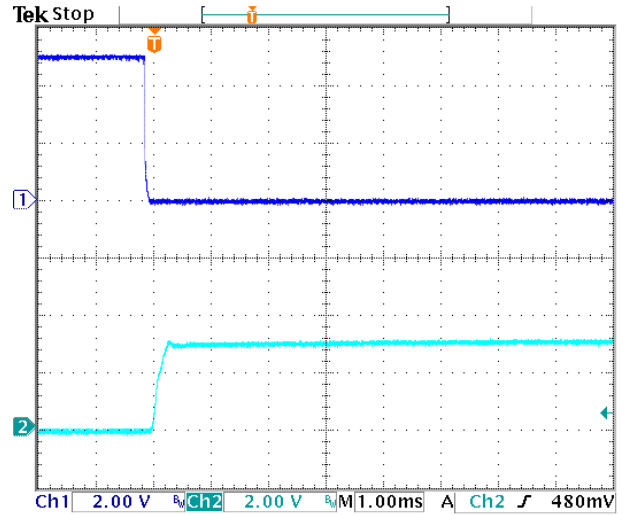




**Graph 7:** Typical Input Start-Up and Output Rise Characteristic (Nominal Vin and Full Load)



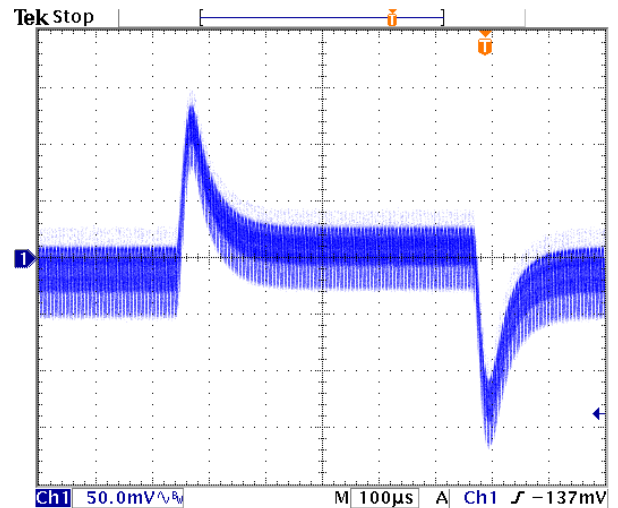
**Graph 8:** Using ON/OFF Voltage Start-Up and Vo Rise Characteristic (Nominal Vin and Full Load)



**Graph 9:** Typical Output Ripple and Noise (Nominal Vin and Full Load)



**Graph 10:** Transient Response to Dynamic Load Change from 100% to 75% to 100% of Full Load at Nominal Vin

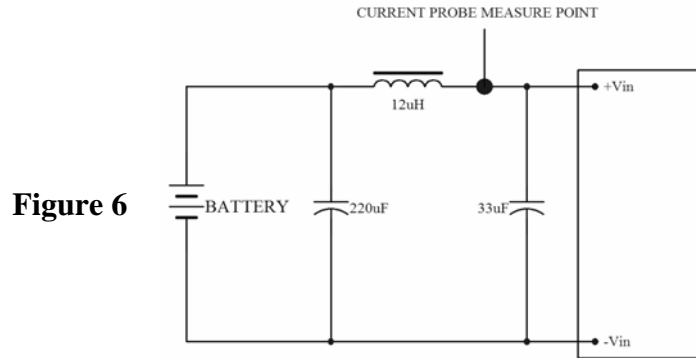




**TEST SETUP:**

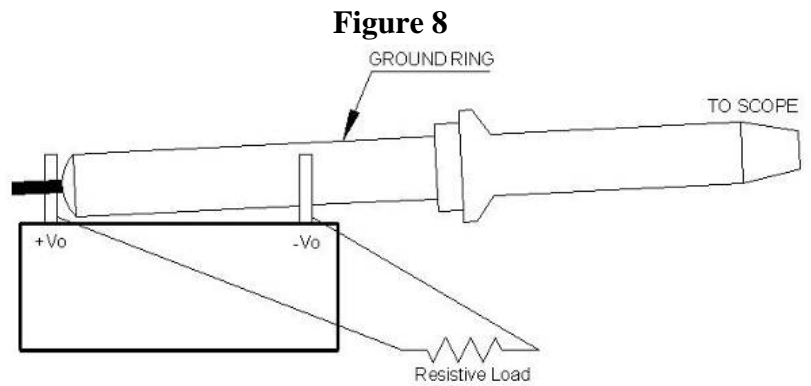
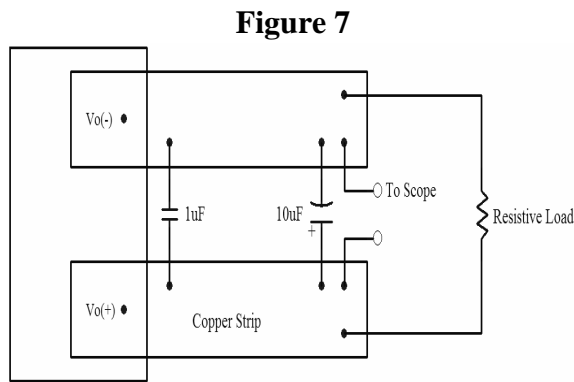
The JFW24S3.3-4000 specifications are tested with the following configurations:

**Input Reflected-Ripple Current Measurement Test Setup**



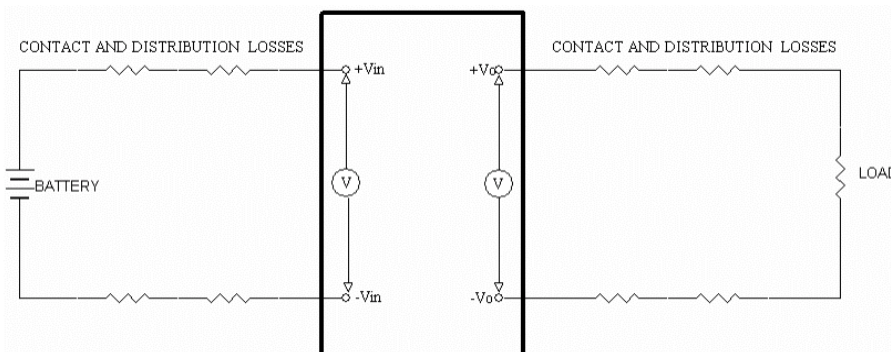
Component	Value	Voltage	Reference
L	12µH	----	----
C	220µF	100V	Aluminum Electrolytic Capacitor
C	33µF	100V	Aluminum Electrolytic Capacitor

**Peak-to-Peak Output Ripple & Noise Measurement Setup**



**Output Voltage and Efficiency Measurement Setup**

**Figure 9**

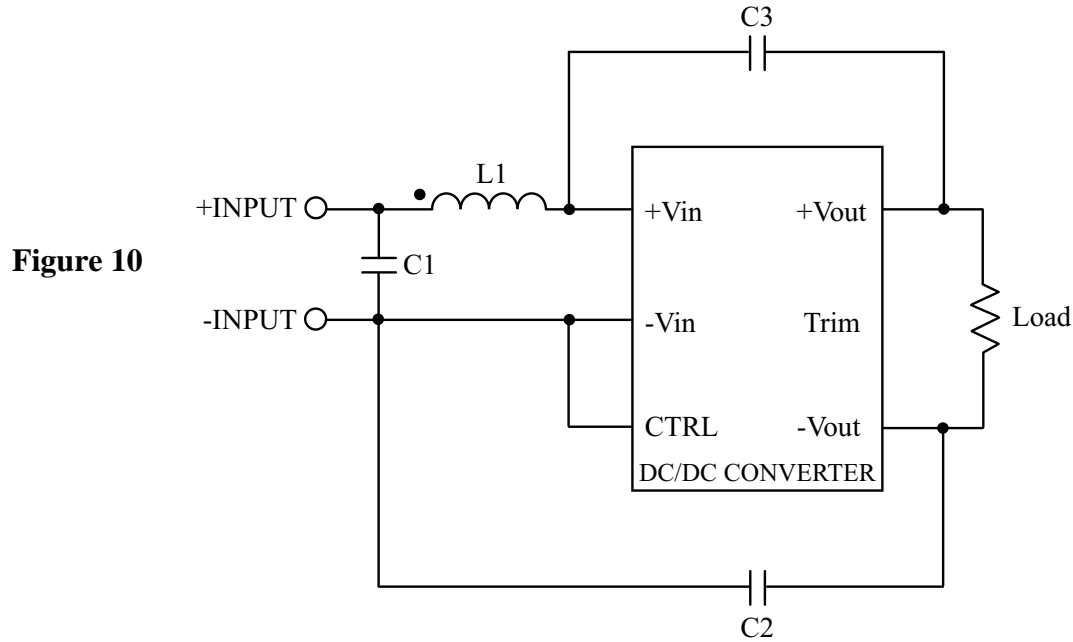


$$Efficiency = \left( \frac{V_{out} \times I_{out}}{V_{in} \times I_{in}} \right) \times 100\%$$

NOTE: All measurements are taken at the module terminals

EMI Considerations:

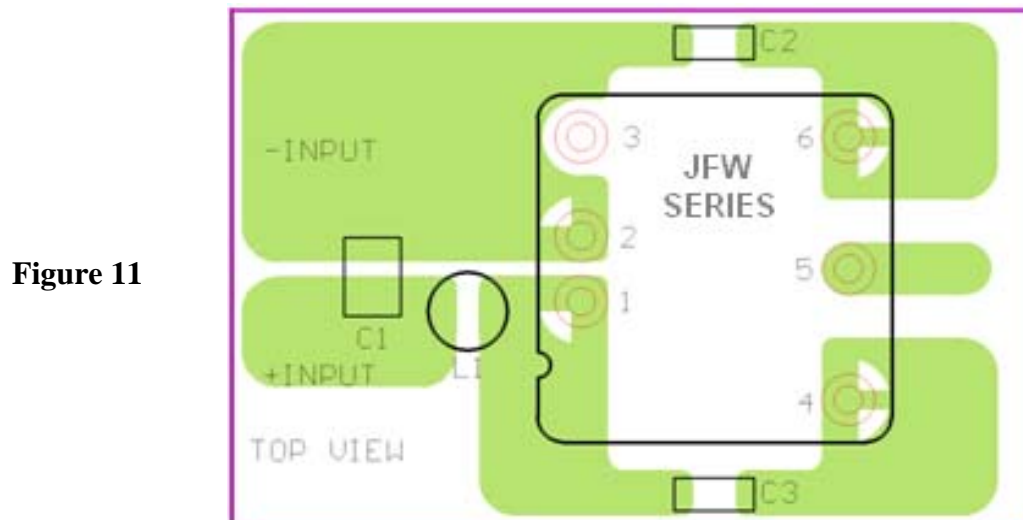
Suggested Schematic for EN55022 Conducted Emission Class A Limits



To meet conducted emissions EN55022 CLASS A the following components are needed:

JFW24S3.3-4000			
Component	Value	Voltage	Reference
L1	10 $\mu$ H	----	2.6A 0.04 $\Omega$ 0705 SMD Inductor P/N: PMT-070
C1	6.8 $\mu$ F	50V	1812 MLCC
C2, C3	470pF	3KV	1808 MLCC

Recommended Layout with Input Filter



EMI Considerations (Continued):

Suggested Schematic for EN55022 Conducted Emission Class B Limits

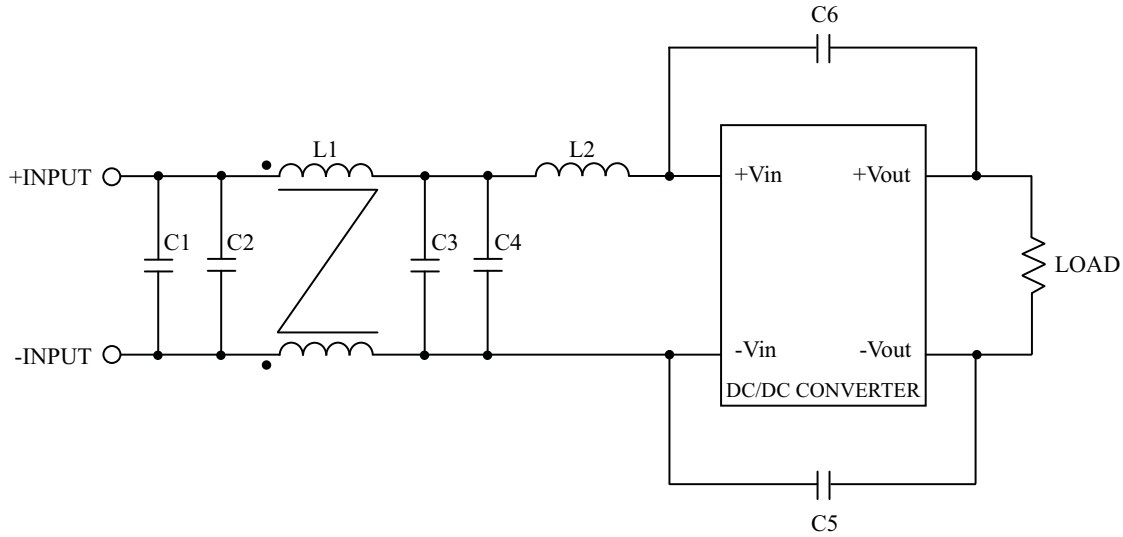


Figure 12

To meet conducted emissions EN55022 CLASS B the following components are needed:

JFW24S3.3-4000			
Component	Value	Voltage	Reference
L1	145 $\mu$ F	----	Common Choke, P/N: PMT-051
L2	10 $\mu$ F	----	2.6A 0.04 $\Omega$ 0705 SMD Inductor P/N: PMT-070
C1	----	----	----
C2, C3, C4	6.8 $\mu$ F	50V	1812 MLCC
C5, C6	470pF	3KV	1808 MLCC

Recommended Layout with Input Filter

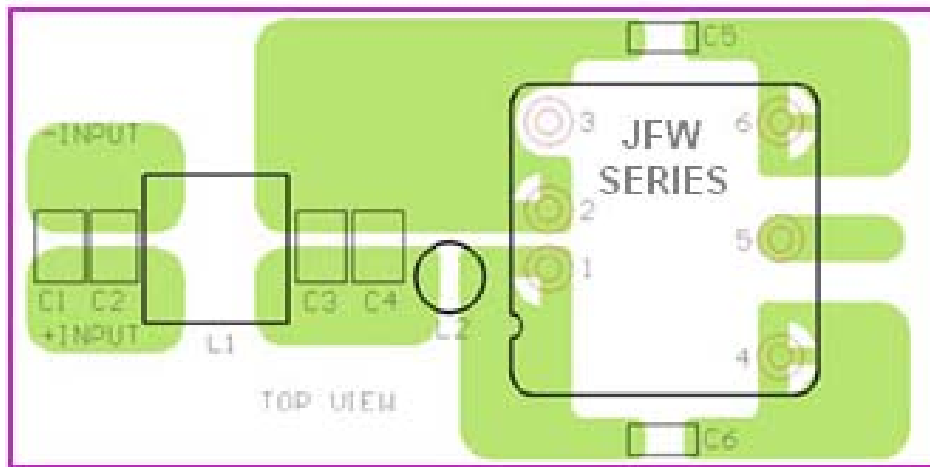
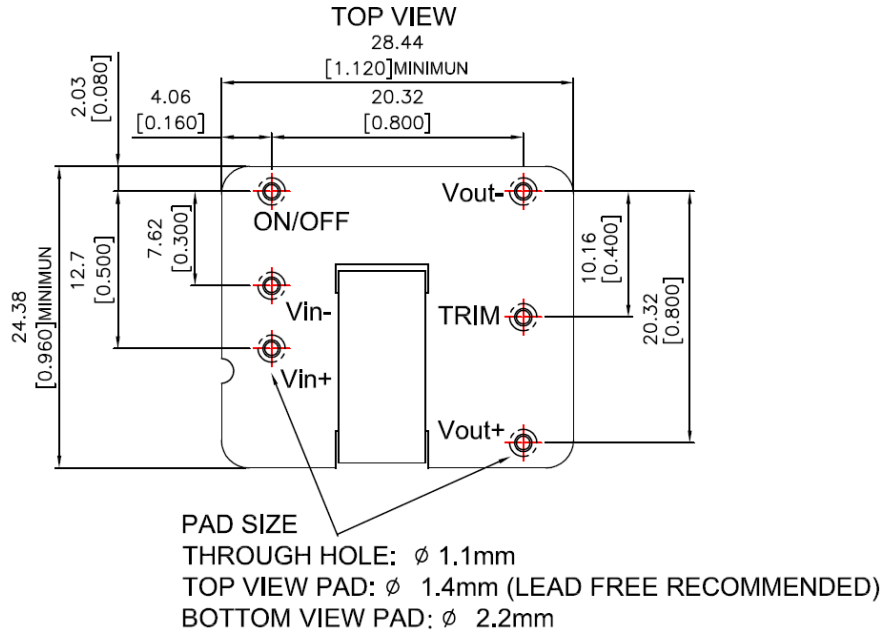


Figure 13

**Recommended Pad Layout for DIP Type**

ALL Dimensions in millimeters (inches)  
Tolerances:xx.xx mm±0.25mm (xx.xxx in ±0.010 in)

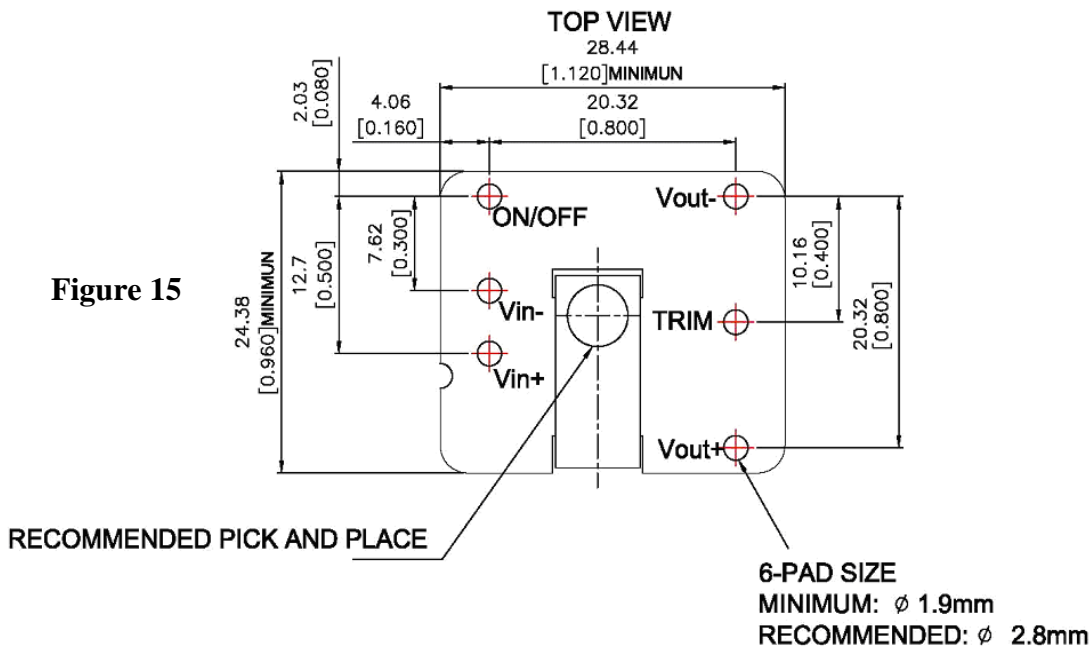
Figure 14



**Recommended Pad Layout for SMT Type**

ALL Dimensions in millimeters (inches)  
Tolerances:xx.xx mm±0.25mm (xx.xxx in ±0.010 in)

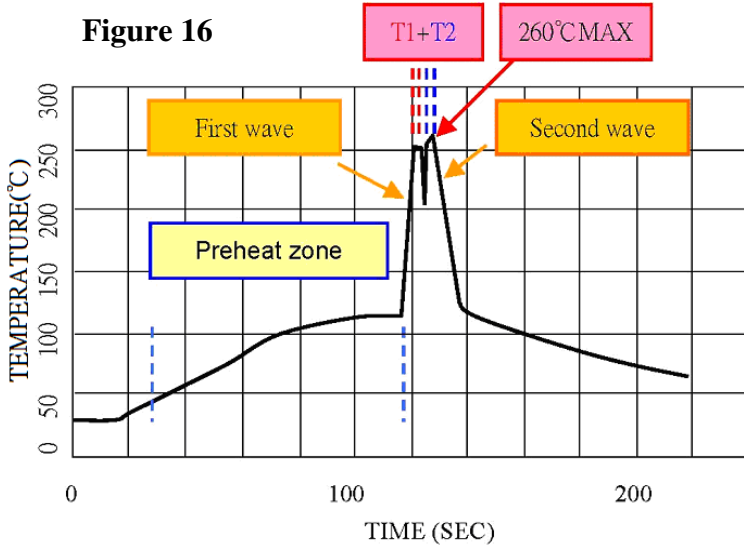
Figure 15



**Soldering and Reflow Considerations:**

**Lead Free Wave Solder Profile for DIP Type**

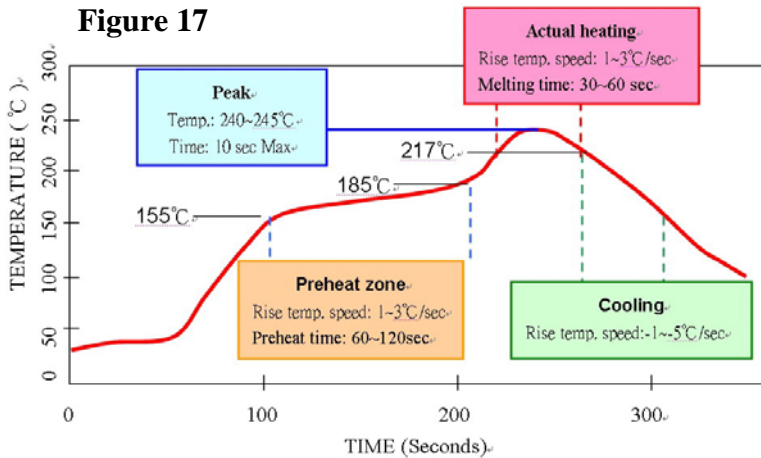
**Figure 16**



Zone	Reference Parameter
Preheat Zone	Rise temp. speed: 3°C/sec max. Preheat temp: 100~130°C
Actual Heating	Peak temp: 250~260°C Peak time (T1+T2 time): 4~6 sec

**Lead free reflow profile for SMT type**

**Figure 17**



Zone	Reference Parameter
Preheat Zone	Rise temp. speed: 1~3°C/sec Preheat time: 60~120sec Preheat temp. 155~185°C
Actual Heating	Rise temp. speed: 1~3°C/sec Melting time: 30~60 sec Melting temp: 217°C Peak temp: 240~245°C Peak time: 10 sec max
Cooling	Rise temp. speed: -1~-5°C/sec

**NOTES:**

1. Reference Solder: Sn-Ag-Cu
2. The curves define the maximum peak reflow temperature permissible to be measured on pin 1 or Vin pin of the DC/DC converter

## Cleaning & Drying Considerations:

### Cleaning

#### a. PWB Cooling Prior to Cleaning:

Power modules and their associated application PWB assemblies should not be wash-cleaned after soldering until the power modules have had an opportunity to cool to within the cleaning solution temperature. This will prevent vacuum absorption of the cleaning liquid into the module between the pins and the potting during cooling.

#### b. Cleaning Process

In aqueous cleaning, it is preferred to have an in-line cleaner system consisting of several cleaning stages (prewash, wash, rinse, final rinse, and drying). Deion-ized (DI) Water is recommended for aqueous cleaning, the minimum resistivity level is 1M $\Omega$ -cm. Tap-water quality varies per region in terms of hardness, chloride, and solid contents, therefore, the use of tap water is not recommended for aqueous cleaning. The total time of ultrasonic wave shall be less than 3 minutes.

### Drying

After cleaning, dry converters at 100°C, more than 10 minutes to assure that the moisture and other potential foreign contaminants are driven out. For open power module constructions with magnetic structures (transformers and inductors) that have unspotted windings, a baking process of 100°C for 30 min. is recommended for the assembly to ensure that the moisture and other potential foreign contaminants are driven out from the open windings.

The drying section of the cleaner system should be equipped with blowers capable of generating 1000CFM-1500CFM of air so that the amount of rinse water left to be dried off with heat is minimal. Handheld air guns are not recommended due to the variability and consistency of the operation.

### Product Post-Wash External Appearance

The marking or date-code may fade or disappear after cleaning. This is not a problem on the converter's characteristics.

Packaging Information:

DIP Type

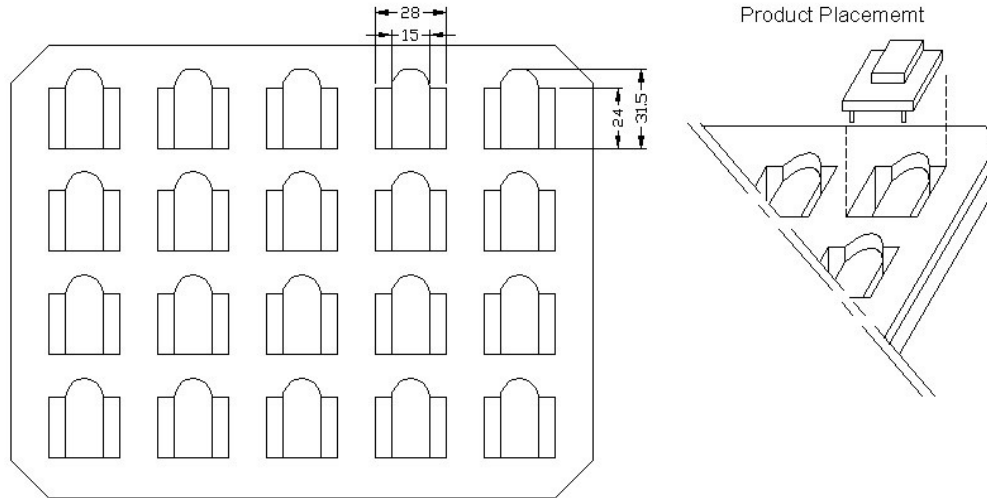


Figure 18

PS :  
1. SPEC : 230\*180\*28mm  
2. MATERIAL : LDPE

SMT Type

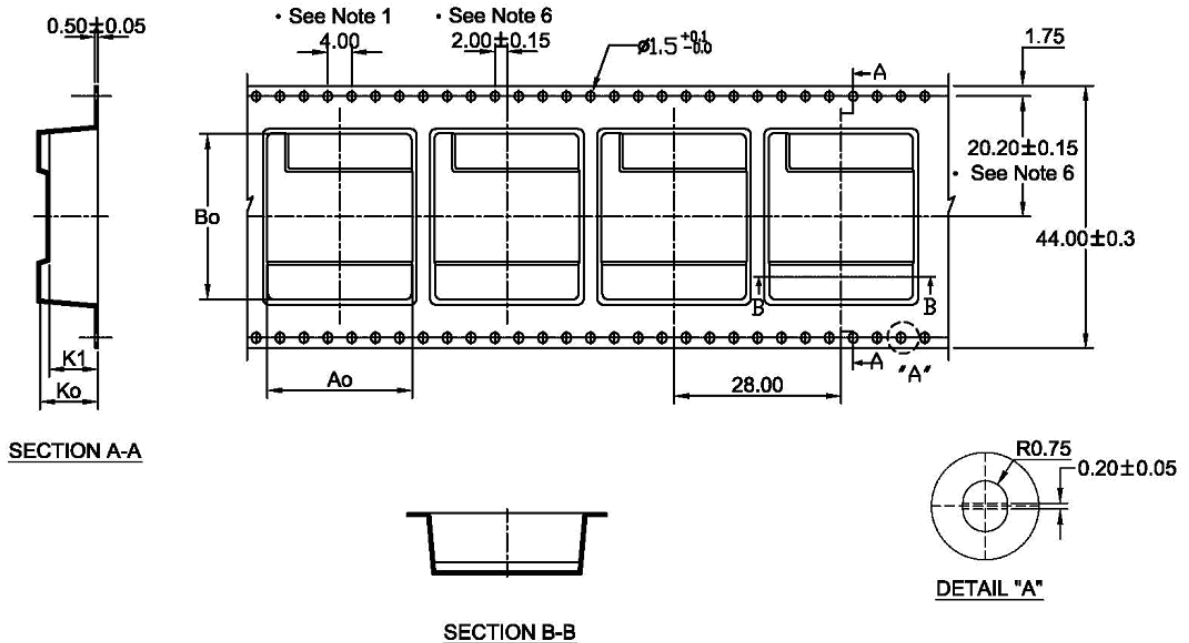


Figure 19

Notes:

1. 10 sprocket hole pitch cumulative tolerance  $\pm 0.2$
2. Camber not to exceed 1mm in 100mm.
3. Material: Black Advantek Polystyrene.
4. Ao and Bo measured on a plane 0.3mm above the bottom of the pocket.
5. Ko measured from a plane on the inside bottom of the pocket to the top surface of the carrier tape.
6. Pocket position relative to sprocket hole measured as true position of pocket, not pocket hole.

Ao=24.30mm  
Bo=27.80mm  
Ko= 9.70mm  
K1= 8.20mm



**Safety and Installation Instructions:****Fusing Consideration**

Caution: This power module is not internally fused. An input line fuse must always be used.

This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture. To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse. The safety agencies require a normal-blow fuse with maximum rating of 3A for JFW24Sxx-xxxx modules and 1.5A for JFW48Sxx-xxxx modules. Based on the information provided in this data sheet on Inrush energy and maximum DC input current; the same type of fuse with lower rating can be used. Refer to the fuse manufacturer's data for further information.

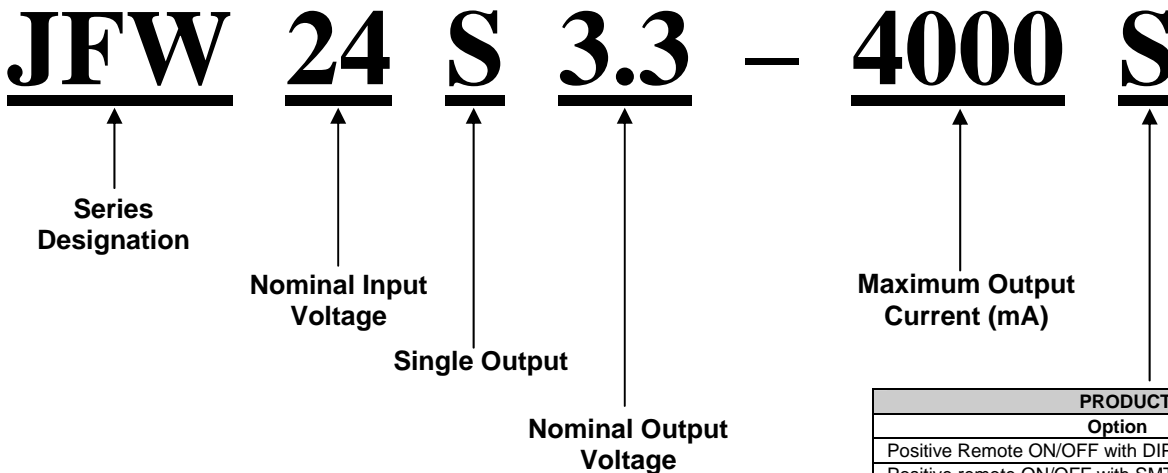
**MTBF and Reliability**

The MTBF of the JFW Series of DC/DC converters has been calculated using Bellcore TR-NWT-000332 Case I: 50% stress, Operating Temperature at 40°C (Ground fixed and controlled environment). The resulting figure for MTBF is  $1.322 \times 10^6$  hours.

MIL-HDBK 217F NOTICE2 FULL LOAD, Operating Temperature at 25°C. The resulting figure for MTBF is  $5.147 \times 10^5$  hours.

**Ordering Information**

Part Number Example:



PRODUCT OPTIONS	
Option	Suffix
Positive Remote ON/OFF with DIP (standard)	No Suffix
Positive remote ON/OFF with SMT	S
Negative Remote ON/OFF with DIP	R
Negative Remote ON/OFF with SMT	SR
DIP type without ON/OFF pin	D
SMT type without ON/OFF pin	SD
DIP type without ON/OFF & TRIM pin	G
SMT type without ON/OFF & TRIM pin	SG
DIP type, negative remote ON/OFF, without TRIM pin	F
SMT type, negative remote ON/OFF, without TRIM pin	SF
DIP type, positive remote ON/OFF, without TRIM pin	J
SMT type, positive remote ON/OFF, without TRIM pin	SJ

## Company Information

Wall Industries, Inc. has created custom and modified units for over 50 years. Our in-house research and development engineers will provide a solution that exceeds your performance requirements on-time and on budget. Our ISO9001-2008 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 its 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.

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