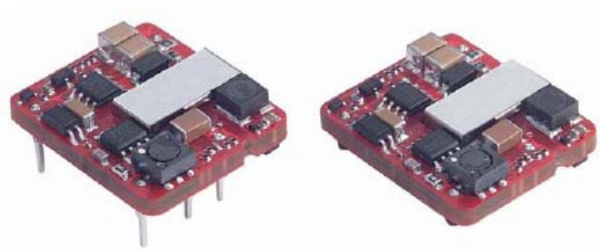
TECHNICAL DATASHEET

Wall Industries, Inc.

JFW24S15-1000

DC/DC Converter
9-36 VDC Input
15 VDC Output at 1.0A



UL
TUV
CB
CE MARK
(Pending)

Features:

- **15 Watts Output Power**
- **4:1 Ultra Wide Input Voltage of 9-36 and 18-75VDC**
- **Industry Standard Pin-Out**
- **High Efficiency Up to 87%**
- **Low Profile: 1.10 x 0.94 x 0.335 inches**
- **Fixed Switching Frequency**
- **RoHS Directive Compliant**
- **No Minimum Load**
- **Input to Output Isolation: 2250VDC, min**
- **Input Under-Voltage Protection**
- **Output Over-Voltage Protection**
- **Over-Current Protection, Auto-Recovery**
- **Output Short Circuit Protection**
- **Remote ON/OFF Control**
- **Adjustable Output Voltage**
- **Surface Mount or Through Hole**
- **Cost Efficient Open Frame Design**

Applications:

- **Distributed Power Architectures**
- **Communication Equipment**
- **Computer Equipment**
- **Test Equipment**

Options:

- **Positive Remote ON/OFF**
- **On/Off Control Function**
- **Trim Function**
- **Surface Mount**

Description:

JFW Series single output DC/DC converters provide up to 15 watts of output power in an industry standard package and footprint. These units are specifically designed to meet the power needs of low profile. All models feature with 4:1 ultra wide input voltage of 9-36VDC and 18-75VDC, comprehensively protected against over-current, over-voltage and input under-voltage protection conditions, and trimmable output voltage.

Technical Specifications	Model No. JFW24S15-1000				
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	**Related condition**	**Min**	**Nom**	**Max**	**Unit**
Switching Frequency	Test at nominal Vin and full load		400		kHz
INPUT (V_{in})					
Operating Voltage Range		9	24	36	Vdc
Input Voltage (Continuous)				36	Vdc
Input Voltage (Transient 100ms)				50	Vdc
UVLO Turn-on Threshold				9	Vdc
UVLO Turn-off Threshold			8		Vdc
Input Standby Current	Nominal Vin and No Load		15		mA
Input Voltage Variation	Complies with EST300 132 part 4.4			5	V/ms
Input Current	Nominal Vin and Full Load			772	mA
Reflected Ripple Current	5 to 20MHz, 12µH source impedance (See the Test Setup section - pg 9)		30		mA_{pk-pk}
Remote Off Input Current			2.5		mA
Input Current of Remote Control Pin		-0.5		1.0	mA
EFFICIENCY	Test at nominal Vin and full load (See the Test Setup section – pg 9)		85		%
OUTPUT (V_o)					
Operating Output Range	Nominal Vin and Full Load	14.85 -1%	15	15.15 +1%	Vdc
Voltage Adjustment	See the External Trim Adjustment section (pg 6)	13.5 -10%	15	16.5 +10%	Vdc
Load Regulation	0% to 100% Full Load	-0.2		+0.2	%
Line Regulation	LL to HL at Full Load	-0.2		+0.2	%
Output Ripple & Noise	1uF Ceramic & 10uF Tantalum at 20MHz bandwidth (See the Test Setup section - pg 9)		100		mV_{pk-pk}
Output Current		0		1.0	A
Output Voltage Overshoot	LL to HL at Full Load			3	% Vout
Over Voltage Protection	Voltage clamped	16.8		20.5	Vdc
Over Current Protection			150		% FL
Short Circuit Protection		Hiccup, automatic recovery			
DYNAMIC LOAD RESPONSE	Test at nominal Vin				
Peak Deviation	Load step change from 75 to 100% or 100 to 75 % of FL		300		mV
Setting Time (Vout < 10% peak deviation)			250		µs
REMOTE ON/OFF	The ON/OFF pin voltage is referenced to -Vin (See the Remote ON/OFF Control section - pg 5)				
Negative Logic DC-DC ON (Short)		0		1.2	Vdc
DC-DC OFF (Open)		3		12	Vdc
Positive Logic DC-DC ON (Open)		3		12	Vdc
DC-DC OFF (Short)		0		1.2	Vdc
START UP TIME	Test at nominal Vin and constant resistive load				
Power Up			30		ms
Remote ON/OFF			30		ms
ISOLATION					
Isolation Voltage (Input-Output)		2250			Vdc
Isolation Resistance		10			GΩ
Isolation Capacitance				1000	pF
ENVIRONMENTAL					
Operating Ambient Temperature (w/ derating)		-40		+85	°C
Storage Temperature		-55		+125	°C
Temperature Coefficient		-0.02		+0.02	% / °C
MTBF	See the MTBF and Reliability section (pg 15)				
Bellcore TR-NWT-000332, T_C=40°C			1,322,000		hours
MIL-STD-217F			514,700		hours
MECHANICAL			**See Figure 1**		
Weight			10.5		grams
Dimensions			1.10 x 0.94 x 0.335		inches

Figure 1: Mechanical Dimensions

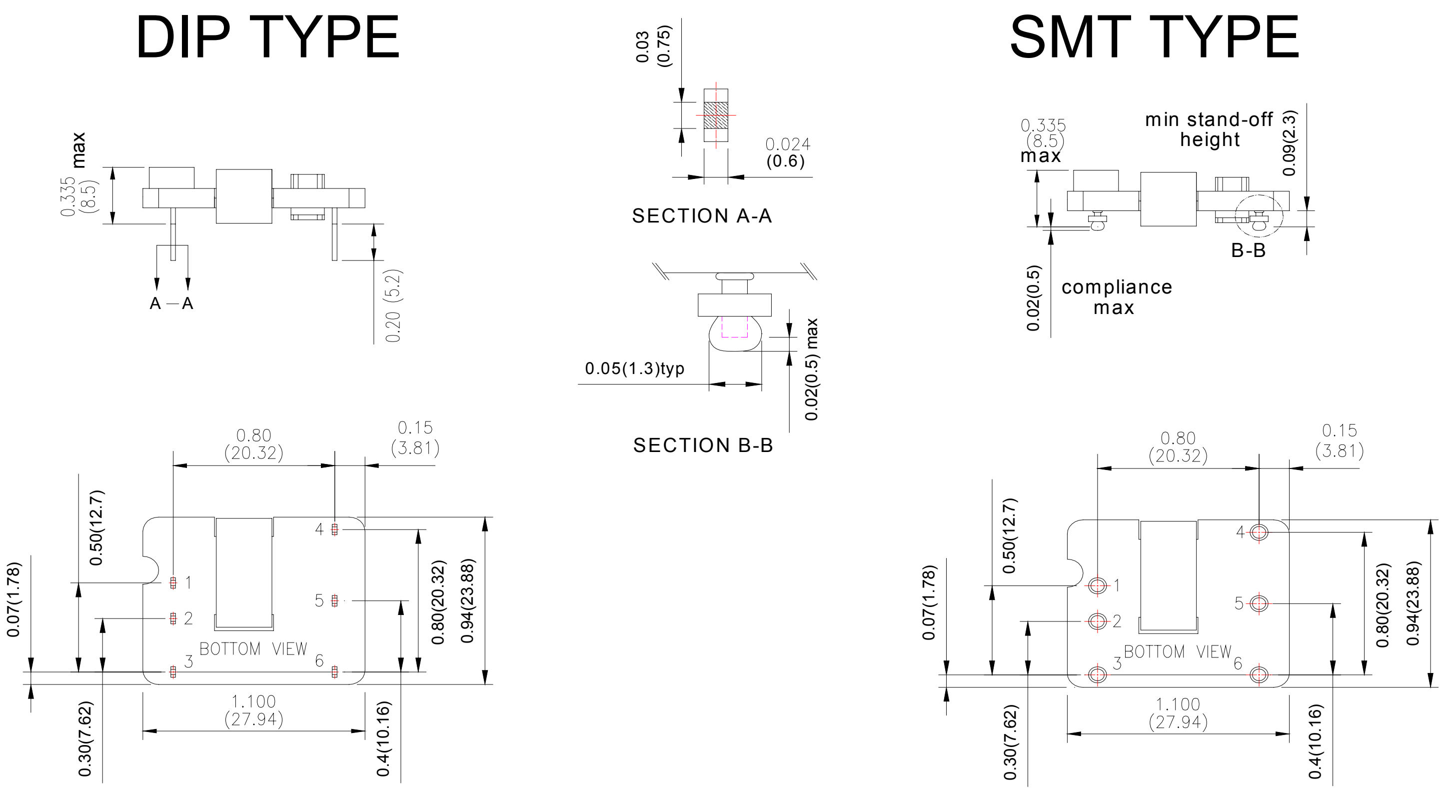


Table 1

PIN CONNECTION	
PIN	**JFW24S15-1000**
1	+ INPUT
2	- INPUT
3	ON/OFF
4	+VOUT
5	TRIM
6	-VOUT

Figure 2

EXTERNAL OUTPUT TRIMMING

Output can be externally trimmed by using the method shown below.

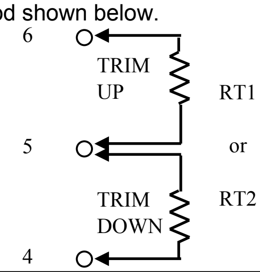


Table 2

PRODUCT STANDARD TABLE	
Option	Suffix
Negative Remote ON/OFF with DIP	R
Negative Remote ON/OFF with SMT	SR
Positive Remote ON/OFF with DIP	Blank
Positive remote ON/OFF with SMT	S
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 without TRIM pin	F
SMT type without TRIM pin	SF

NOTES:

1. All dimensions in inches (mm)
2. Tolerance: x.xx±0.02 (x.x±0.5)
   x.xxx±0.010 (x.xx±0.25)
3. Pin pitch tolerance: ±0.014 (0.35)

DESIGN CONSIDERATIONS:

Output Over Current Protection
When excessive output currents occur in the system, circuit protection is required on all power supplies. Normally, overload 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 is removed.

One of the problems resulting from over current is that excessive heat may be generated in 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 limiting the output voltage.

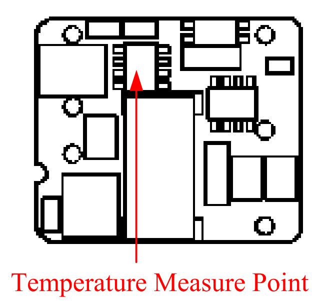
Input Source Impedance
The power module should be connected to a low impedance input source. Highly inductive source impedance can affect the stability of the power module. Input external C-L-C filter is recommended to minimize input reflected ripple current. The inductor is simulated source impedance of 12µH and capacitor is Nippon chemi-con KZE series 220µF/100V&33µF/100V. The capacitor must 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 short circuit, converter still shut down. The average current during this condition will be very low and the device can be safety 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 as 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.

Figure 3

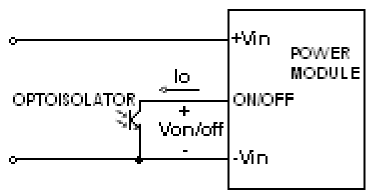


TOP VIEW

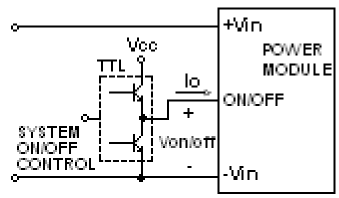
Remote ON/OFF Control
The Remote ON/OFF Pin is controlled DC/DC power module to turn on and off; the user must use a switch to control the logic voltage high or low level of the pin referenced to Vi (-). The switch can be open collector transistor, FET and Photo-Couple. The switch must be capable of sinking up to 1mA at low-level logic Voltage. High-level logic of the ON/OFF signal maximum voltage is allowable leakage current of the switch at 15V is 50uA.

Figure 4

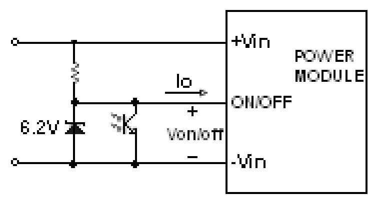
Remote ON/OFF Implementation Circuits



Isolated-Closure Remote ON/OFF



Level Control Using TTL Output

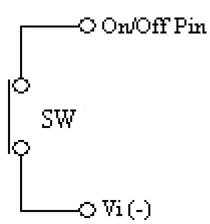


Level Control Using Line Voltage

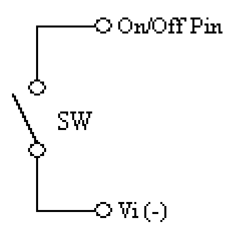
There are two remote control options available, positive logic and negative logic.

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

Figure 5



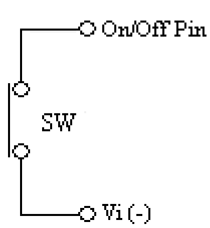
When JFW module is turned off at Low-level logic



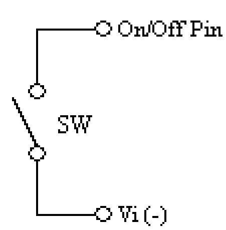
When JFW module is turned on at High-level logic

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

Figure 6



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.

$$R_{up} = \frac{1.0^4 * 2.5}{V_o^+ - 2.5 - 12.5} - 5110 \quad (\text{in } \Omega)$$

Vo^+ is the desired up output voltage

$$R_{down} = \frac{(V_o^- - 2.5) * 1.0^4}{V_{out} - (V_o^-)} - 5110 \quad (\text{in } \Omega)$$

Vo^- is the desired down output voltage

Figure 7

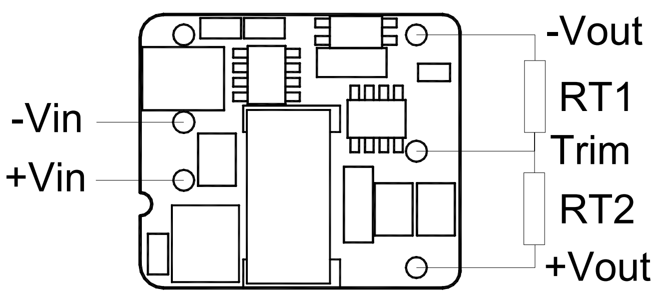
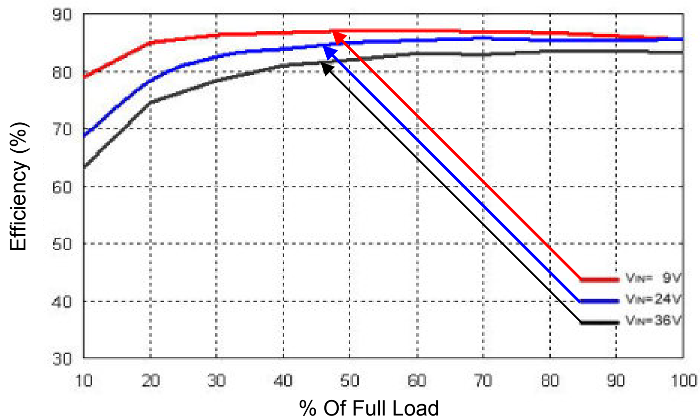


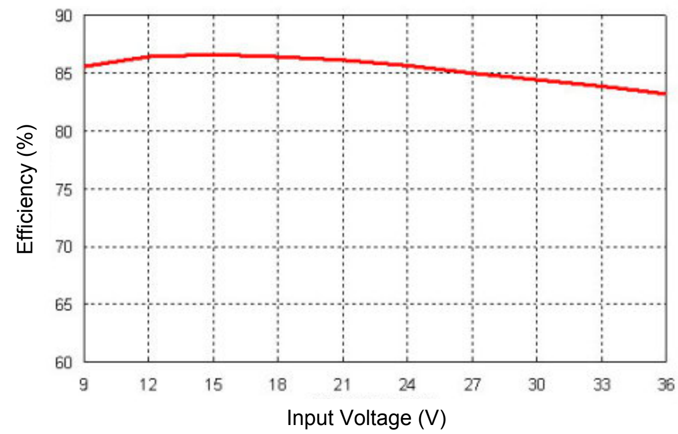
Table 3 Trim Resistor Values

Trim	Vo^+	R_{up}	Vo^-	R_{down}
1%	15.15V	161.557 kΩ	14.85V	818.223 kΩ
2%	15.3V	78.223 kΩ	14.7V	401.557 kΩ
3%	15.45V	50.446 kΩ	14.55V	262.668 kΩ
4%	15.6V	36.557 kΩ	14.4V	193.223 kΩ
5%	15.75V	28.223 kΩ	14.25V	151.557 kΩ
6%	15.9V	22.668 kΩ	14.1V	123.779 kΩ
7%	16.05V	18.7 kΩ	13.95V	103.938 kΩ
8%	16.2V	15.723 kΩ	13.8V	89.057 kΩ
9%	16.35V	13.409 kΩ	13.65V	77.483 kΩ
10%	16.5V	11.557 kΩ	13.5V	68.223 kΩ

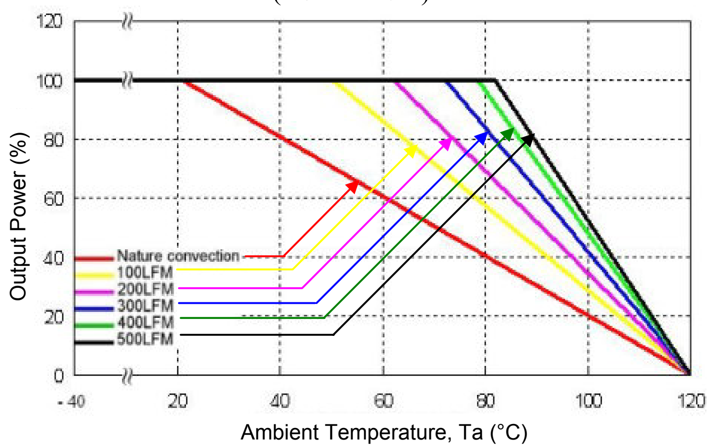
Graph 1: Efficiency vs. Output Current



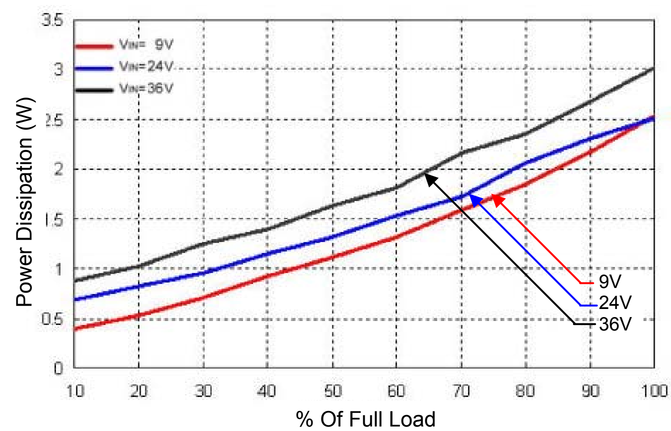
Graph 2: Efficiency vs. Input Voltage (Full Load)



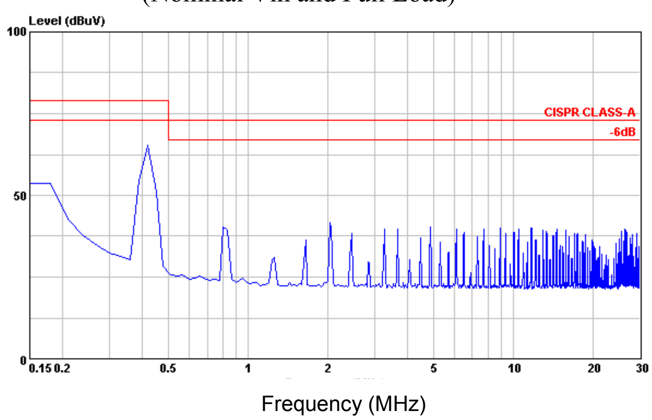
Graph 3: Output Power vs. Ambient Temperature & Airflow (Nominal Vin)



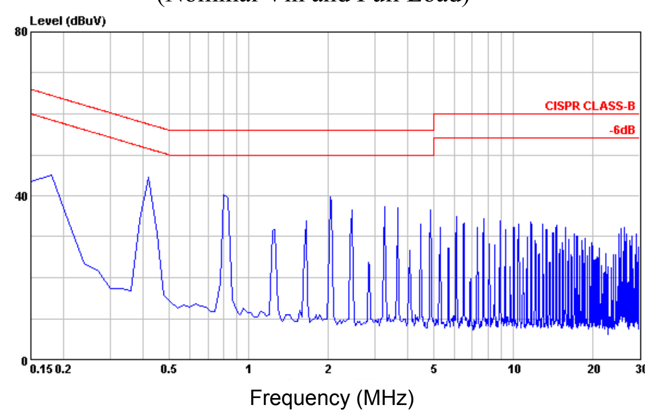
Graph 4: Power Dissipation Vs. Output Current



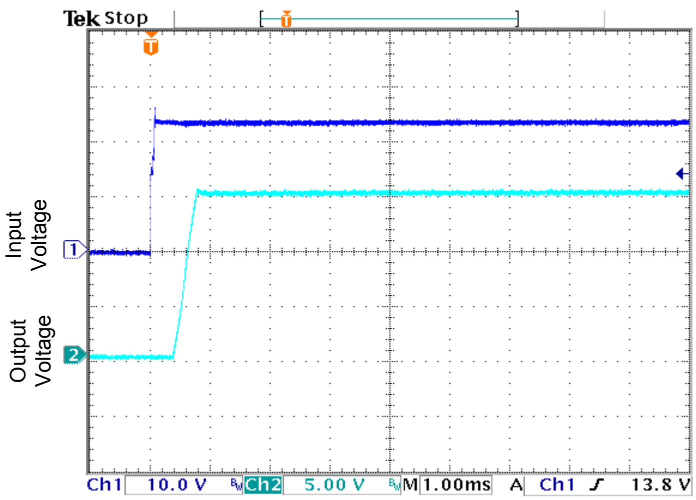
Graph 5: Conducted Emission of EN55022 Class A (Nominal Vin and Full Load)



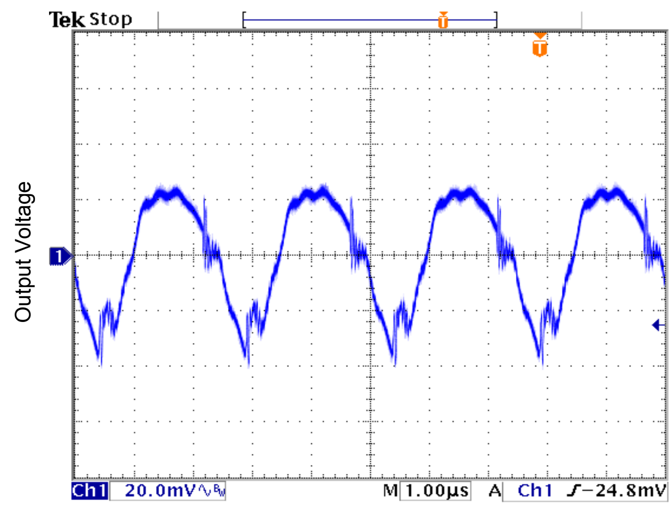
Graph 6: Conducted Emission of EN55022 Class B (Nominal Vin and Full Load)



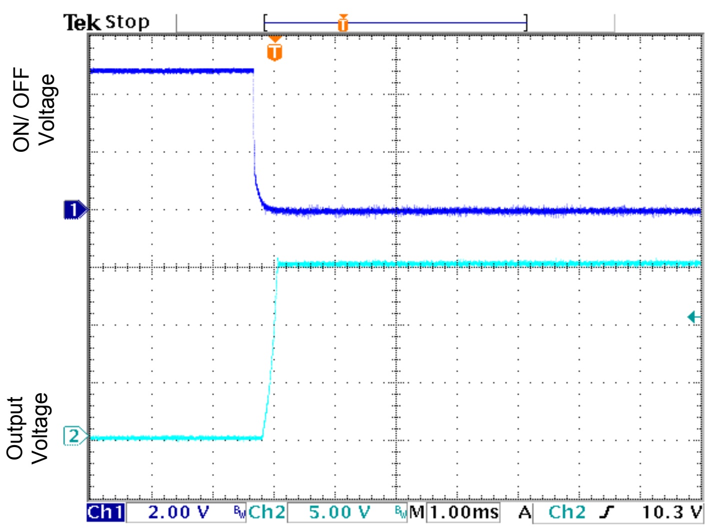
Graph 7: Typical Input Start-Up and Output Rise Characteristic (Nominal Vin and Full Load)



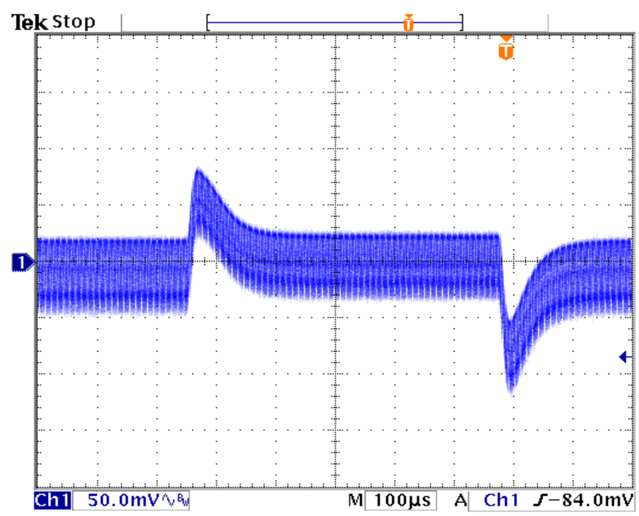
Graph 8: Typical Output Ripple and Noise (Nominal Vin and Full Load)



Graph 9: Using ON/OFF Voltage Start-Up and Vo Rise Characteristic (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

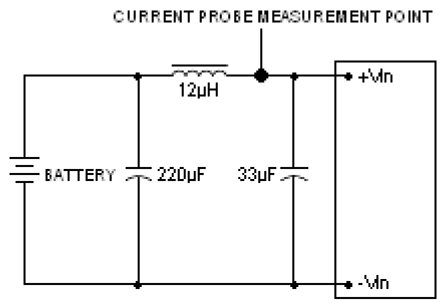


TEST SETUP:

The JFW24S15-1000 specifications are tested with the following configurations:

Input Reflected-Ripple Current Measurement Test Setup

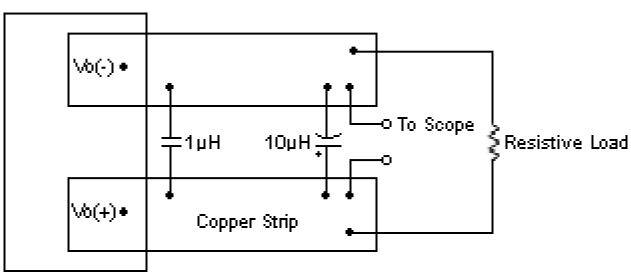
Figure 8

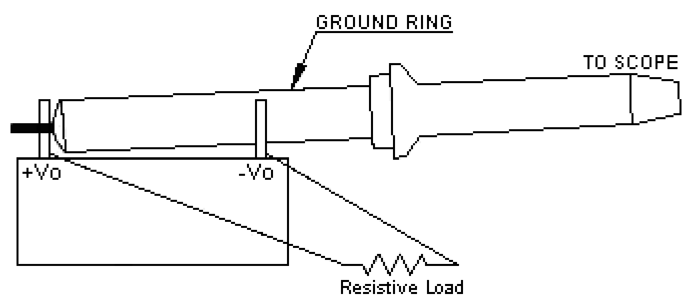


Component	Value	Voltage	Reference
L	12µH	----	----
C	220µF	100V	Aluminum Electrolytic Capacitor
C	33µF	100V	Aluminum Electrolytic Capacitor

Peak-to-Peak Output Ripple & Noise Measurement Setup

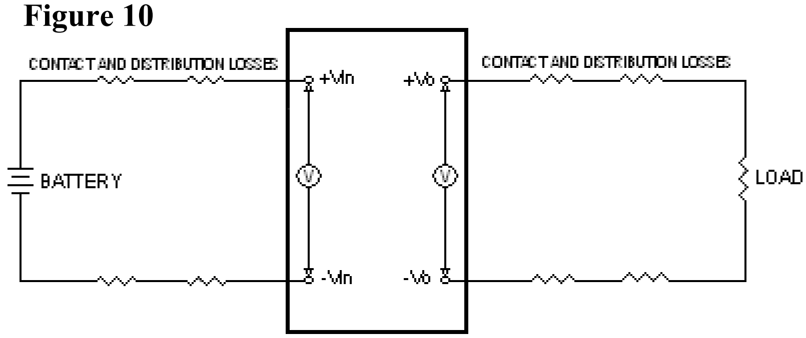
Figure 9





Output Voltage and Efficiency Measurement Setup

Figure 10



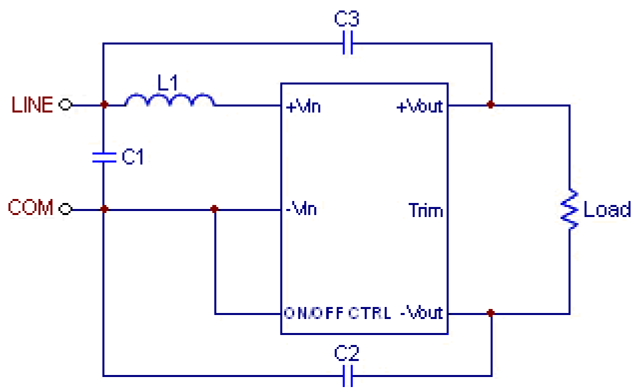
$$Efficiency = \left(\frac{Vout \times Iout}{Vin \times Iin} \right) \times 100\%$$

NOTE: All measurements are taken at the module terminals

EMC Considerations

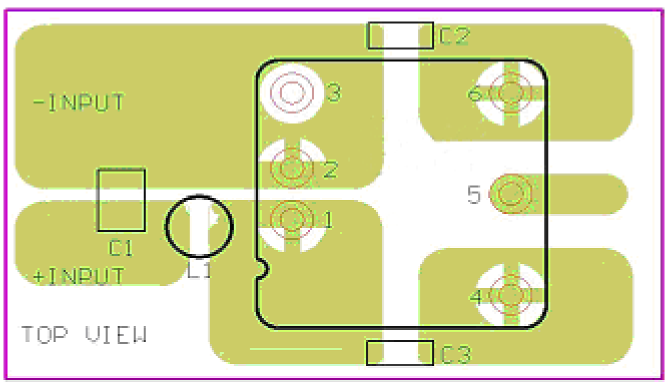
Suggested schematic for EN55022 conducted emission Class A limits

Figure 11



Recommended Layout with Input Filter

Figure 12



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

JFW24Sxx-xxxx

Component	Value	Voltage	Reference
L1	2.2uH	----	2.3A 0.025Ω 0504 SMD Inductor P/N: PMT-059
C1	2.2uF	50V	1812 MLCC
C2, C3	470pF	3KV	1808 MLCC

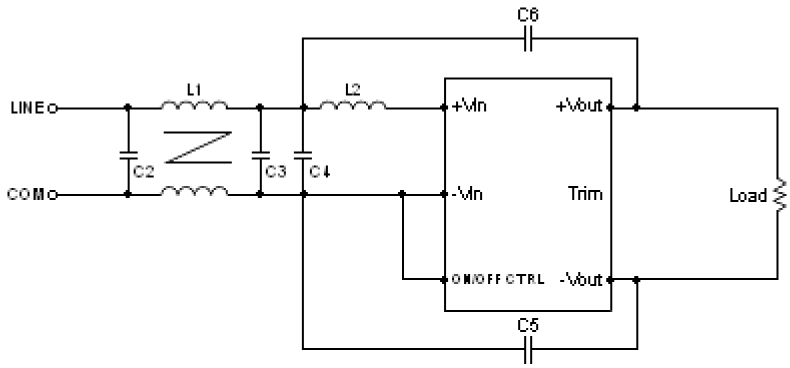
JFW48Sxx-xxxx

Component	Value	Voltage	Reference
L1	10uH	----	1.4A 0.1Ω 0504 SMD Inductor P/N: PMT-047
C1	2.2uF	100V	1812 MLCC
C2, C3	470pF	3KV	1808 MLCC

EMC Considerations (Continued)

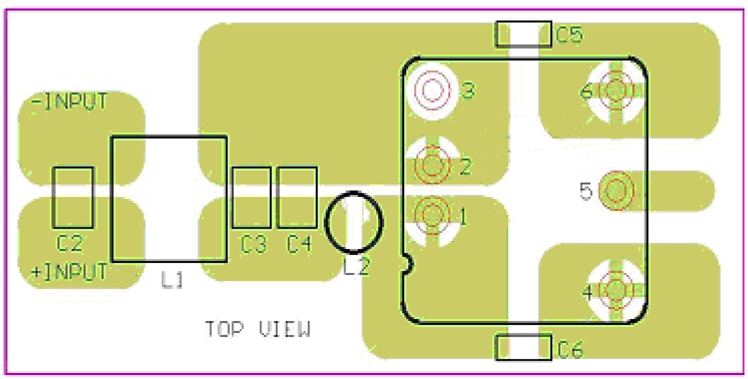
Suggested schematic for EN55022 conducted emission Class B limits

Figure 13



Recommended layout with input filter

Figure 14



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

JFW24Sxx-xxxx

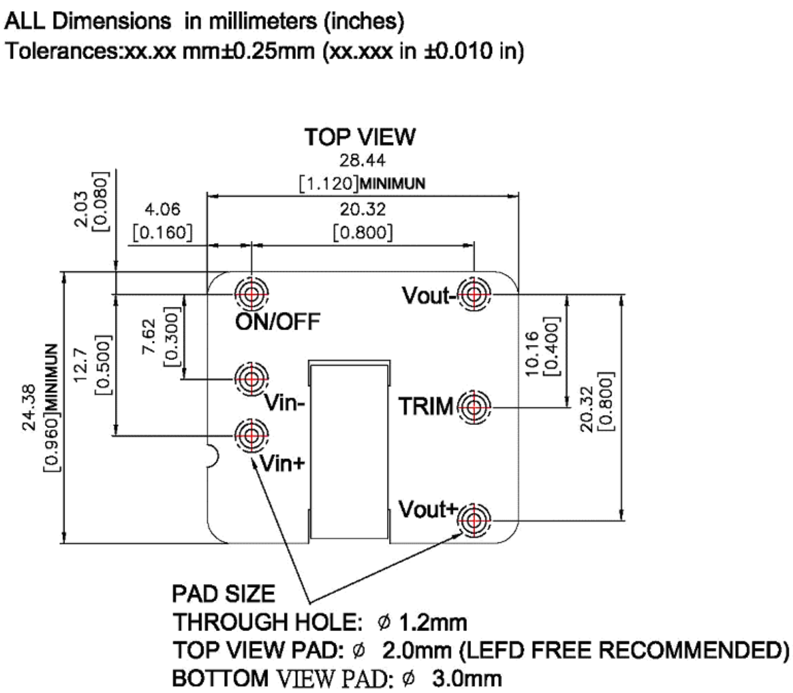
Component	Value	Voltage	Reference
C2, C3	2.2µF	50V	1812 MLCC
C4	----	----	----
C3, C4	1000pF	2KV	1808 MLCC
L1	550µH	----	Common Choke, P/N: PMT-058
L2	2.2µH	----	2.3A 0.025Ω 0504 SMD Inductor P/N: PMT-059

JFW48Sxx-xxxx

Component	Value	Voltage	Reference
C2, C3	2.2µF	100V	1812 MLCC
C4	----	----	----
C3, C4	1000pF	2KV	1808 MLCC
L1	550µH	----	Common Choke, P/N: PMT-058
L2	10µH	----	1.4A 0.1Ω 0504 SMD Inductor P/N: PMT-047

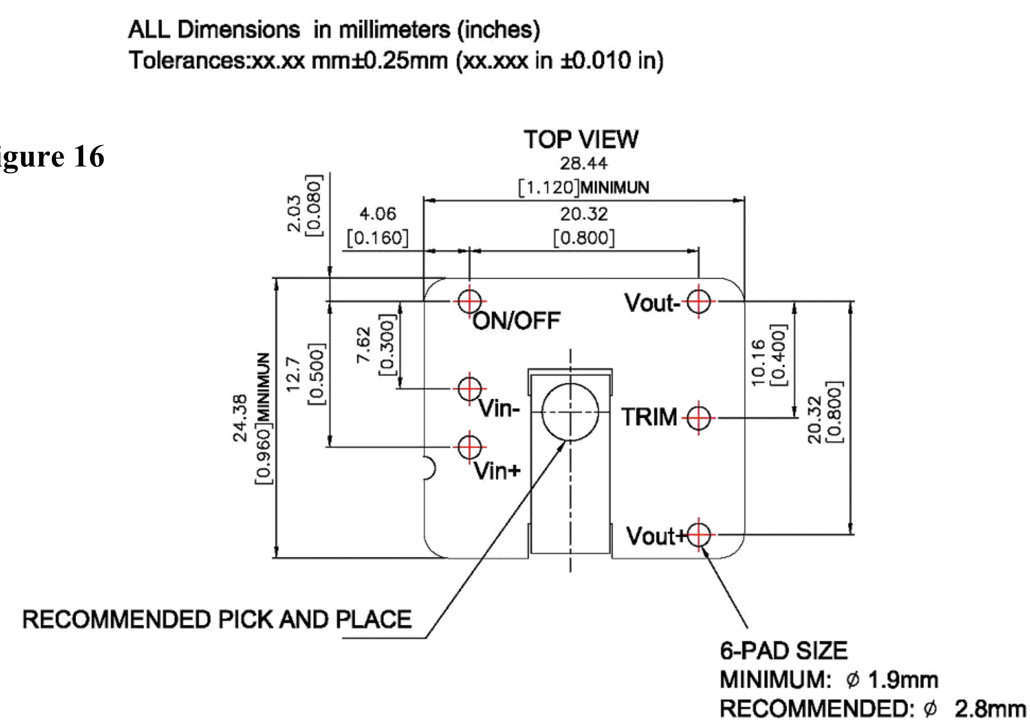
Recommended Pad Layout for DIP Type

Figure 15



Recommended Pad Layout for SMT Type

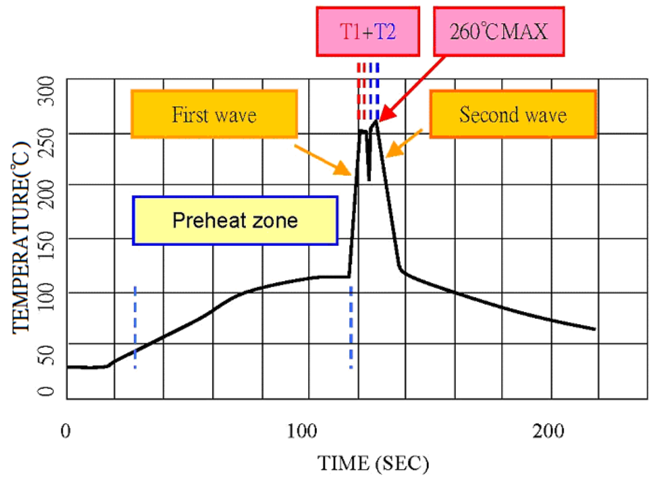
Figure 16



Soldering and Reflow Considerations:

Lead Free Wave Solder Profile for DIP Type

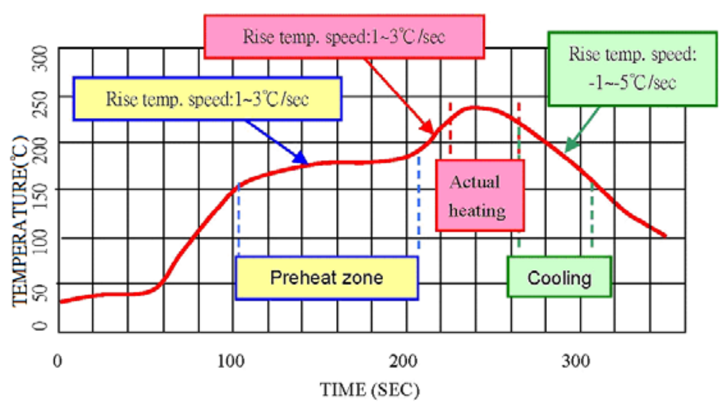
Figure 17



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

Lead free reflow profile for SMT type

Figure 18

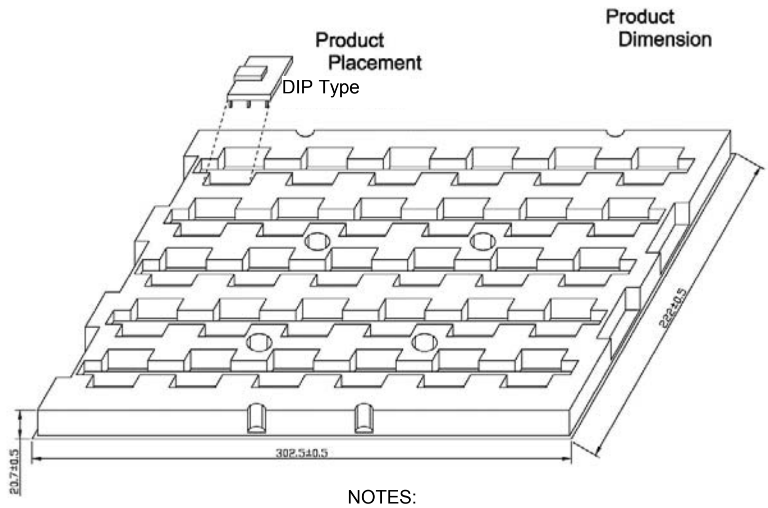


Zone	Reference Parameter
Preheat Zone	Rise temp. speed: 1~3℃/sec Preheat time: 60~90sec Preheat temp.155~185℃
Actual Heating	Rise temp. speed: 1~3℃/sec Melting time: 20~40 sec Melting temp:220℃ Peak temp: 230~240℃ Peak time: 10~20 sec
Cooling	Rise temp. speed: -1~ -5℃/sec

Packaging Information:

DIP Type

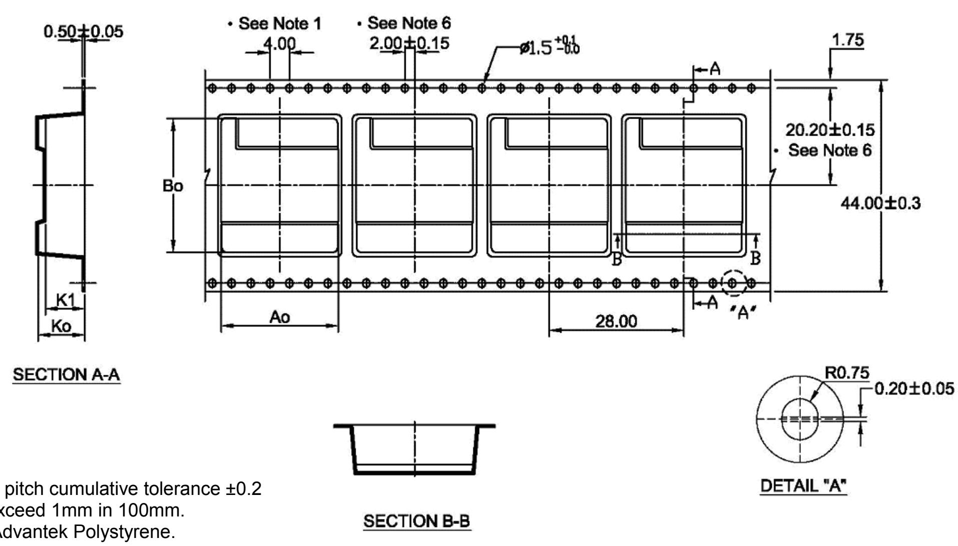
Figure 19



NOTES:
1. Material: PS (thick=1.2mm)

SMT Type

Figure 20



NOTES:
1. 10 sprocket hole pitch cumulative tolerance ±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.

Safety and Installation Instruction:

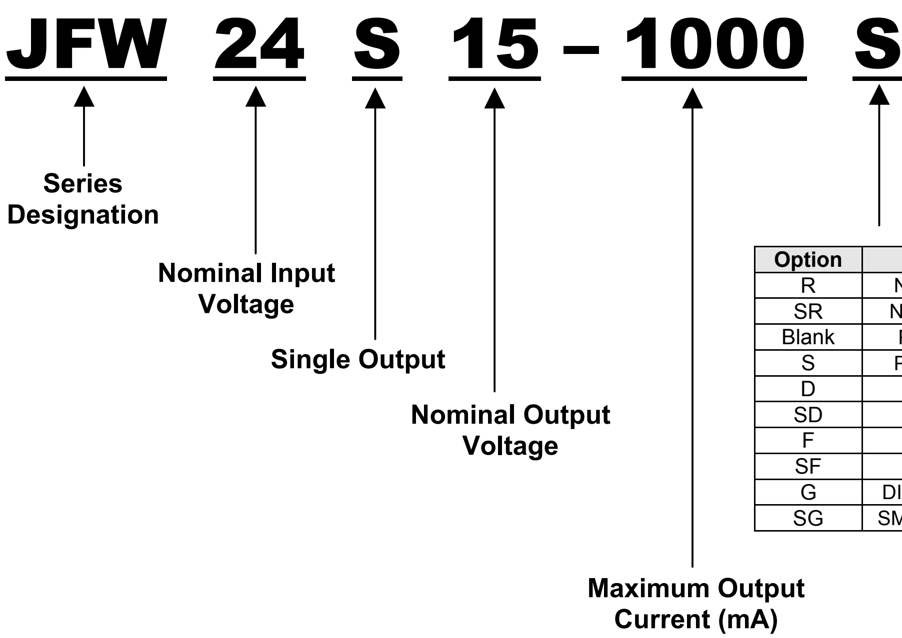
Fusing Consideration
Caution: This power module is not internally fused. An input line fuse must always be used.
This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture. To maximum 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 1.322×10^6 hours.

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

Ordering Information:

Part Number Example:



Option	Description
R	Negative Remote ON/OFF with DIP
SR	Negative Remote ON/OFF with SMT
Blank	Positive Remote ON/OFF with DIP
S	Positive Remote ON/OFF with SMT
D	DIP Type without ON/OFF pin
SD	SMT Type without ON/OFF pin
F	DIP Type without TRIM pin
SF	SMT Type without TRIM pin
G	DIP Type without ON/OFF & TRIM pin
SG	SMT Type without ON/OFF & TRIM pin

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 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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