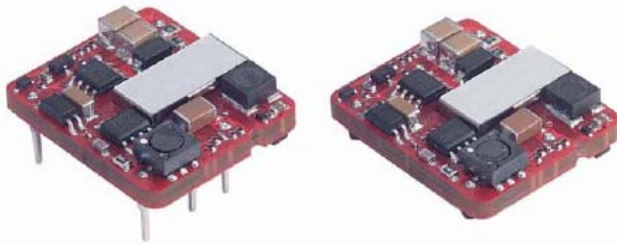


Wall Industries, Inc.

JF24S3.3-3500

DC/DC Converter
18-36 VDC Input
3.3 VDC Output at 3.5A



Features:

- RoHS Directive Compatible
- Low Profile: 1.10 x 0.94 x 0.335 inches
- Industry Standard Pin-Out
- 2:1 Wide Input Voltage of 18-36, 36-75VDC
- 15 Watts Output Power
- Over-Current Protection, Auto-Recovery
- Output Over Voltage Protection
- Under Voltage Lockout
- Remote On/Off Control
- Adjustable Output Voltage
- ISO 9001 Certified Manufacturing Facilities
- UL60950-1
- TUV EN60950-1
- CB
- CE Mark
- Input to Output Isolation: 2250VDC, min
- Approved for Basic Insulation

Applications:

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

Options:

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

Description:

JF 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 a wide input range, comprehensively protected against over-current, over-voltage, and input under-voltage protection conditions, and trimmable output voltage. The JF Series converters are especially suited to Network, Data processing, Wireless and Enterprise equipment and microprocessor, intermediate bus voltage power application.



Wall Industries, Inc.

TECHNICAL DATASHEET

JF24S3.3-3500

Technical Specifications		Model No. JF24S3.3-3500			
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	-	270	-	kHz
INPUT (Vin)					
Operating Voltage Range		18	24	36	Vdc
UVLO Turn-on Threshold			17		Vdc
UVLO Turn-off Threshold			14.5		Vdc
Input Surge Voltage (100ms max)		-0.3		50	Vdc
Input Voltage Variation	Complies with EST300 132 part 4.4			5	V/ms
Input Current	Full Load			602	mA
Reflected Ripple Current	Please see the Test Setup section (pg 9)		30		mA _{pk-pk}
EFFICIENCY	Test at nominal Vin and full load (please see the Test Setup section – pg 9)		85		%
OUTPUT (Vo)					
Operating Output Range		3.267 -1%	3.3	3.333 +1%	Vdc
Voltage Adjustment	Please see the External Trim Adjustment section (pg 6)	2.97 -10%	3.3	3.63 +10%	Vdc
Load Regulation	0% to 100% Full Load			0.2	%
Line Regulation	LL to HL at Full Load			0.2	%
Output Ripple & Noise	1uF Ceramic & 10uF Tantalum at 20MHz bandwidth (please see the Test Setup section - pg 9)			75	mV _{pk-pk}
Transient Response	50% to 75% to 50% load change, ΔIo / Δt = 0.1A/μs		300		μs
Output Current		0		3.5	A
Output Voltage Overshoot				3	%
Output Capacitor Load				1000	μF
Over Current Protection		3.85	4.375	4.9	A
Over Voltage Protection	Control Voltage Clamp	3.7		5.4	Vdc
REMOTE ON/OFF	Please see the Remote ON/OFF Control section (pg 5)				
Negative Logic	DC-DC ON (Short)	-0.7		1.2	Vdc
	DC-DC OFF (Open)	3		15	Vdc
Positive Logic	DC-DC ON (Open)	3		15	Vdc
	DC-DC OFF (Short)	-0.7		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			MΩ
Isolation Capacitance			1000		pF
ENVIRONMENTAL					
Operating Ambient Temperature		-40		85	°C
Storage Temperature		-55		125	°C
Temperature Coefficient		-0.02		+0.02	% / °C
MTBF	Please see the MTBF and Reliability section (pg 14)		2,200,000		hours
MECHANICAL					
			See Figure 1		
Weight			10.5		grams
Dimensions			1.10 x 0.94 x 0.335		inches

Figure 1: Mechanical Dimensions

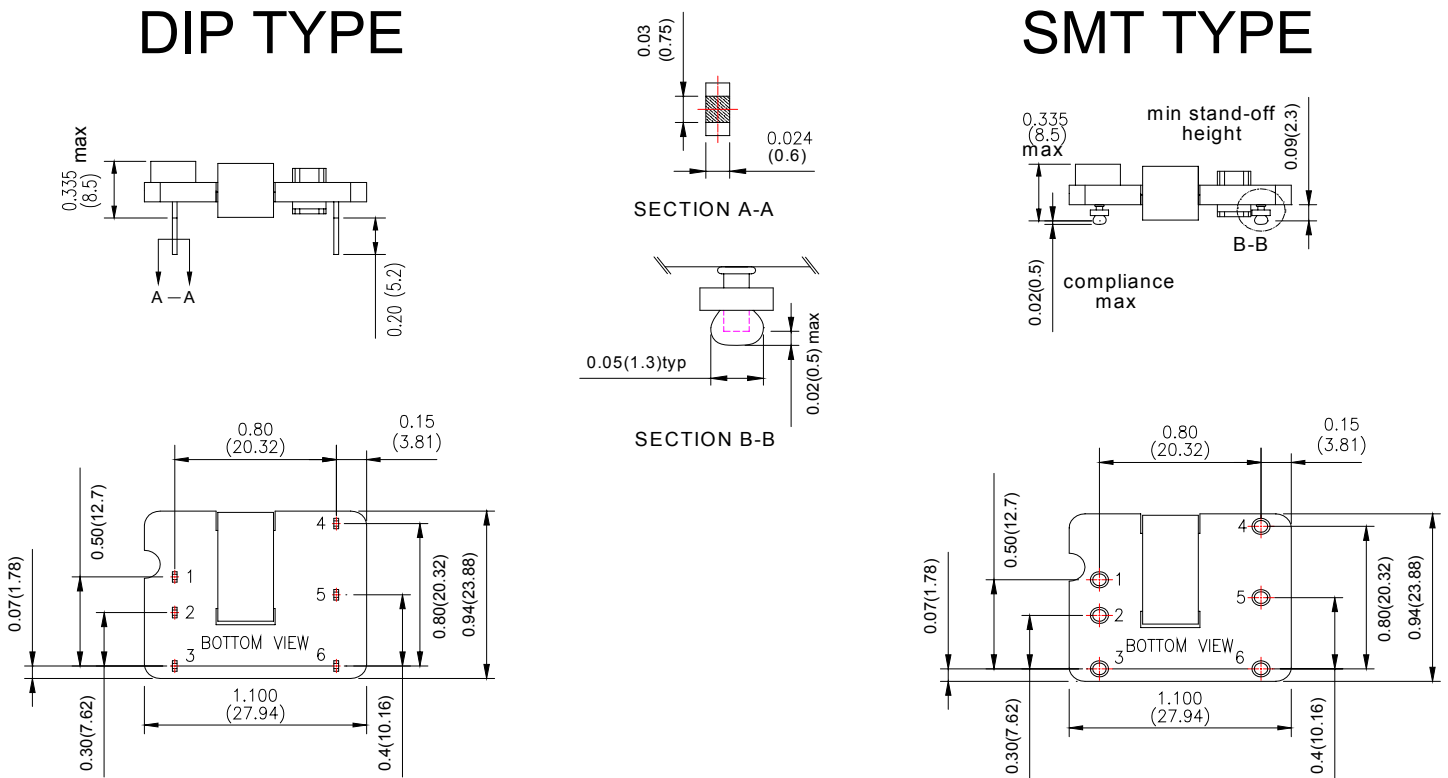


Table 1

PIN CONNECTION	
PIN	JF24S3.3-3500
1	+ INPUT
2	- INPUT
3	ON/OFF
4	+VOUT
5	TRIM
6	-VOUT

Figure 2

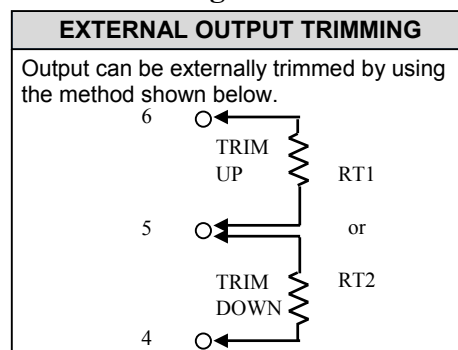


Table 2

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:

- All dimensions in inches (mm)
- Tolerance: $x.xx \pm 0.02$ ($x.x \pm 0.5$)
 $x.xxx \pm 0.010$ ($x.xx \pm 0.25$)
- 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 110~140% of rated current for the JF 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. There are other ways of protecting the power supply when it is over-loaded, such as the maximum current limiting or current foldback methods.

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.

The operation of hiccup is as follows. When the current sense circuit sees an over-current event, the controller shuts off the power supply for a given time and then tries to start up the power supply again. If the over-load condition has been removed, the power supply will start up and operate normally; otherwise, the controller will see another over-current event and shut off the power supply again, repeating the previous cycle. Hiccup operation has none of the drawbacks of the other two protection methods, although its circuit is more complicated because it requires a timing circuit. The excess heat due to overload lasts for only a short duration in the hiccup cycle, hence the junction temperature of the power devices is much lower.

The hiccup operation can be done in various ways. For example, one can start hiccup operation any time an over-current event is detected; or prohibit hiccup during a designated start-up is usually larger than during normal operation and it is easier for an over-current event is detected; or prohibit hiccup during a designated start-up interval (usually a few milliseconds). The reason for the latter operation is that during start-up, the power supply needs to provide extra current to charge up the output capacitor. Thus the current demand during start-up is usually larger than during normal operation and it is easier for an over-current event to occur. If the power supply starts to hiccup once there is an over-current, it might never start up successfully. Hiccup mode protection will give the best protection for a power supply against over current situations, since it will limit the average current to the load at a low level, so reducing power dissipation and case temperature in the power devices.

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.

Remote ON/OFF

Two remote ON/OFF controls are available for the JF Series

Positive logic remote ON/OFF turns the modules on during a logic-high voltage on the remote ON/OFF pin, and off during logic low. Negative logic remote ON/OFF turns the module off during logic high and on during logic low or when the remote ON/OFF pin is shorted to the -INPUT pin.

For negative logic remote ON/OFF control add the suffix “R” for DIP type and “SR” for SMT type. For the positive logic ON/OFF control there is no suffix for DIP type and add the suffix “S” for SMT type.

Ex: JF24S3.3-3500S

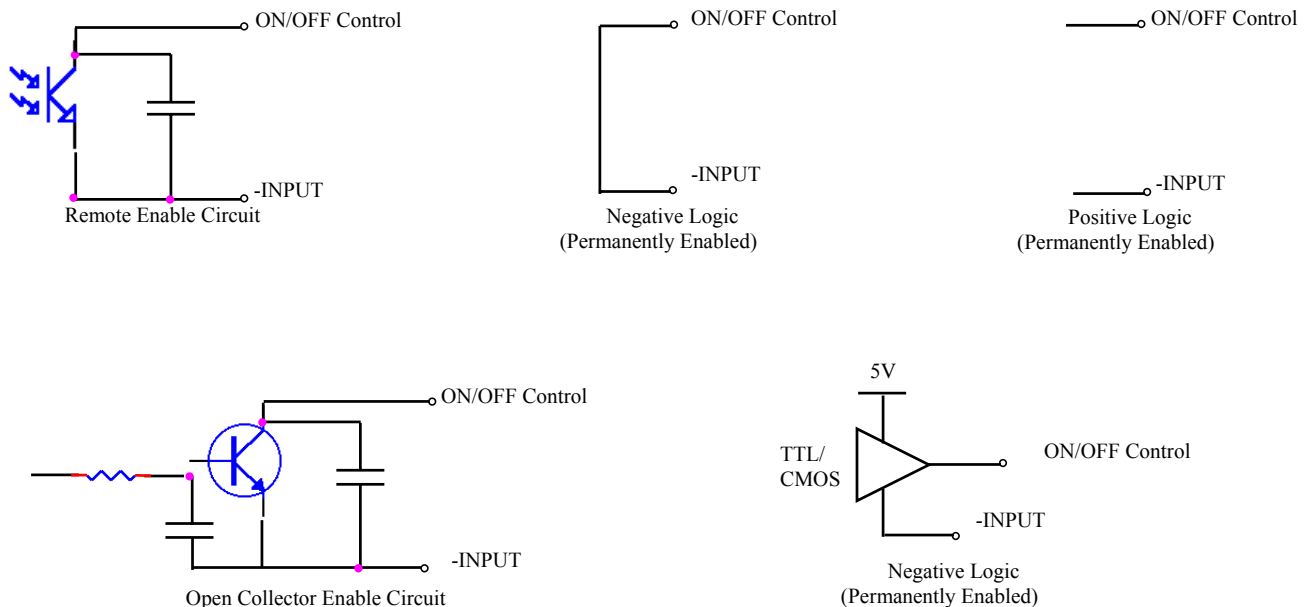
To turn the power module on and off, the user must supply a switch to control the voltage between the ON/OFF terminal ($V_{ON/OFF}$) and the -INPUT. The switch may be an open collector or equivalent (see figure). A logic low is $V_{ON/OFF} = -0.7V$ to $1.2V$. The maximum $I_{ON/OFF}$ during a logic low is 1mA. The switch should maintain a logic-low voltage while sinking 1mA.

During logic high, the maximum $V_{ON/OFF}$ generated by the power module is 15V. The maximum allowable leakage current of the switch at $V_{on/off} = 15V$ is 50uA

The module has internal capacitance to reduce noise at the ON/OFF pin. Additional capacitance is not generally needed and may degrade the start-up characteristics of the module.

The Figure below details five possible circuits for driving the ON/OFF pin.

Figure 3



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.

$$R_{up} = \frac{5110 * 2.5}{V_o^+ - 2.5 - 0.8} - 2050 \quad (\text{in } \Omega)$$

V_o^+ is the desired up output voltage

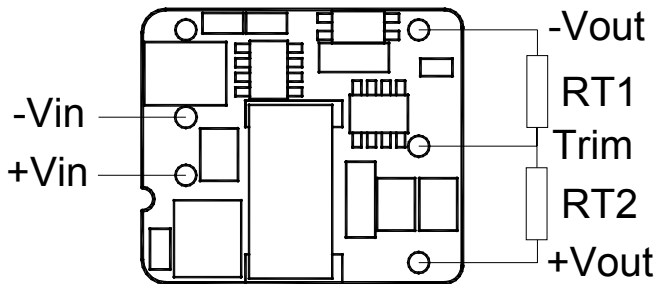
$$R_{down} = \frac{(V_o^- - 2.5) * 5110}{V_{out} - (V_o^-)} - 2050 \quad (\text{in } \Omega)$$

V_o^- is the desired down output voltage

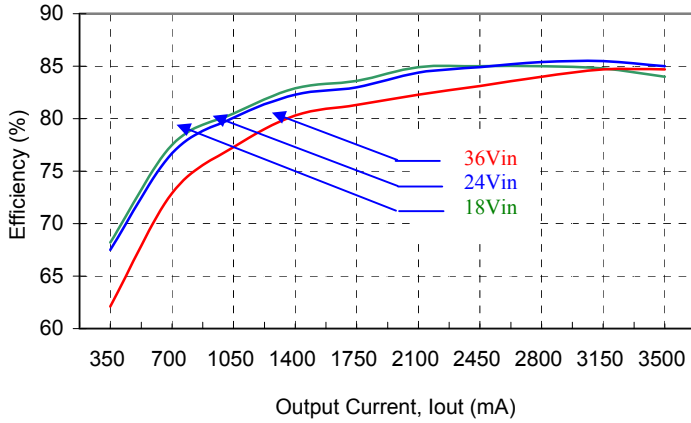
Table 3 Trim Resistor Values

Trim	V_o^+	R_{up}	V_o^-	R_{down}
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%	3.63V	36.662 kΩ	2.97V	5.228 kΩ

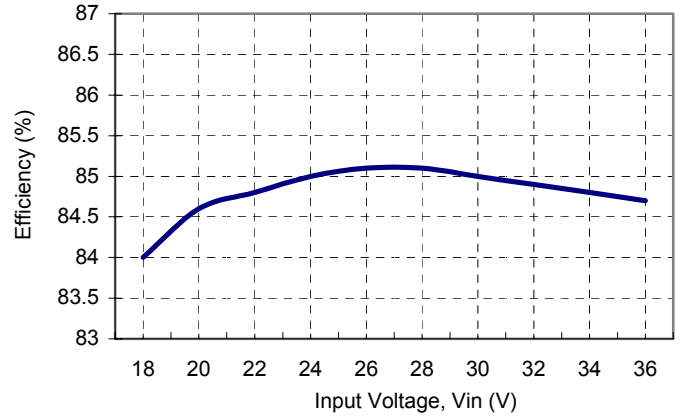
Figure 4



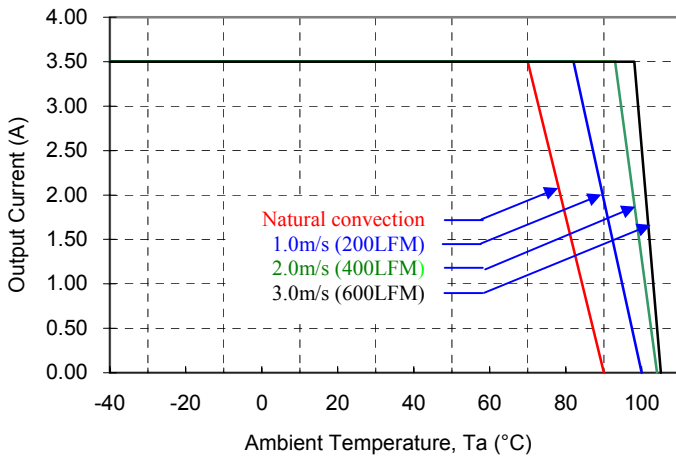
Graph 1: Efficiency vs. Output Current



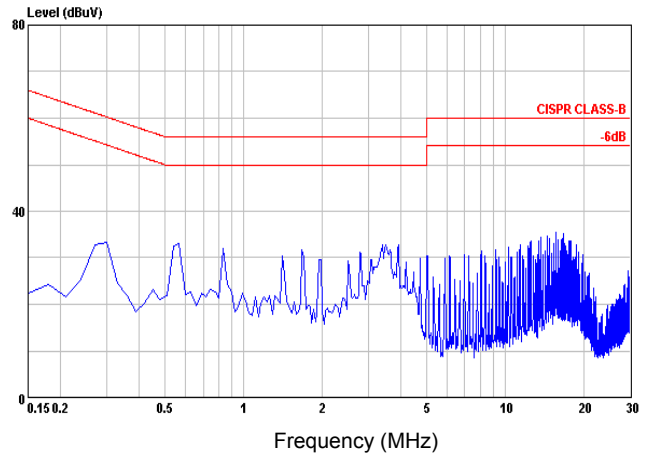
Graph 2: Efficiency vs. Input Voltage (Io=Full Load)



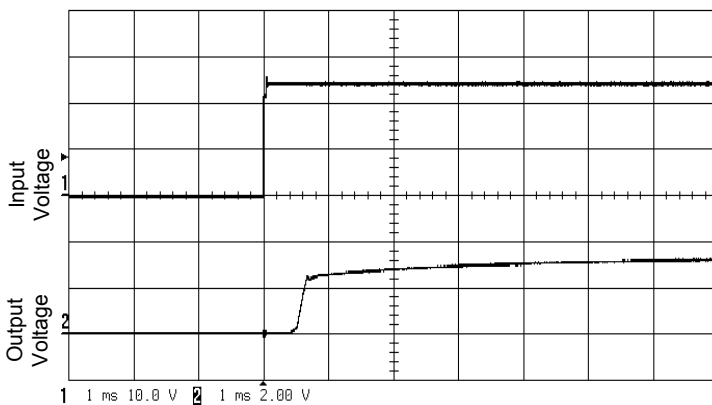
Graph 3: Output Current vs. Ambient Temperature & Airflow



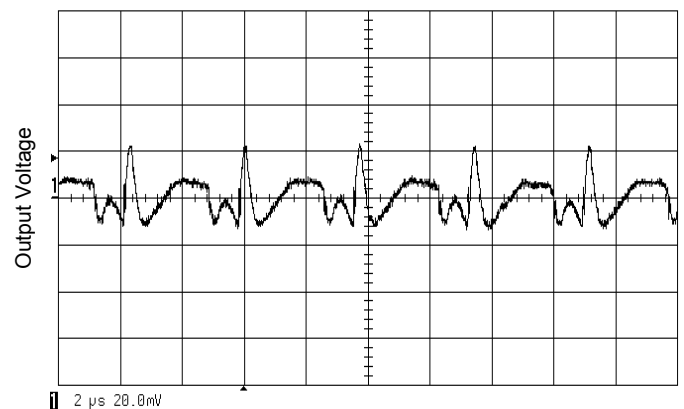
Graph 4: Conducted Emission of EN55022 Class B (Nominal Vin, Io = Full Load)



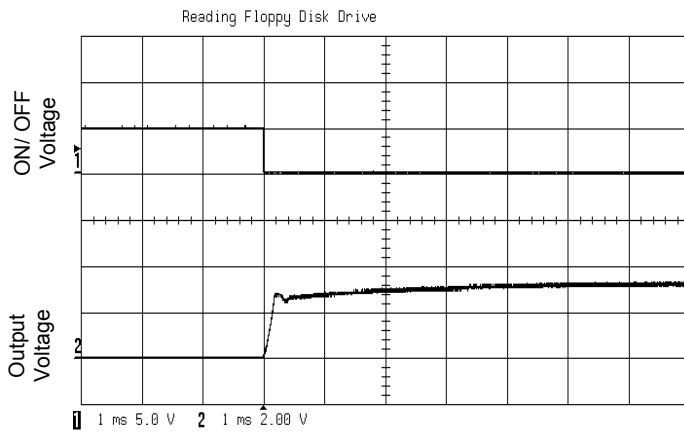
Graph 5: Typical Input Start-Up and Output Rise Characteristic



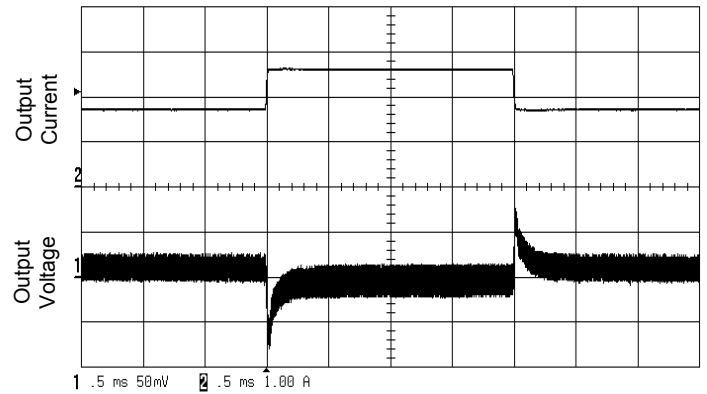
Graph 6: Typical Output Ripple and Noise (Nominal Vin, Io = Full Load)



Graph 7: Using ON/OFF Voltage Start-Up and Output Rise Characteristic



Graph 8: Transient Response to Dynamic Load Change from 70% to 50% to 75% of Full Load

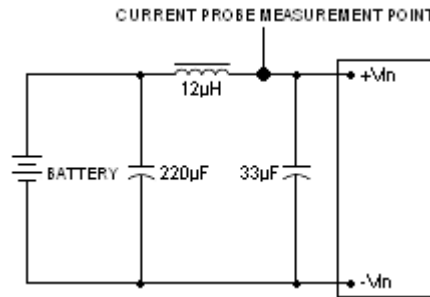


TEST SETUP:

The JF24S3.3-3500 specifications are tested with the following configurations:

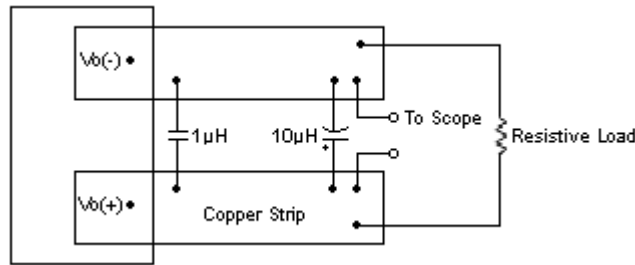
Input Reflected-Ripple Current Measurement Test Setup

Figure 5



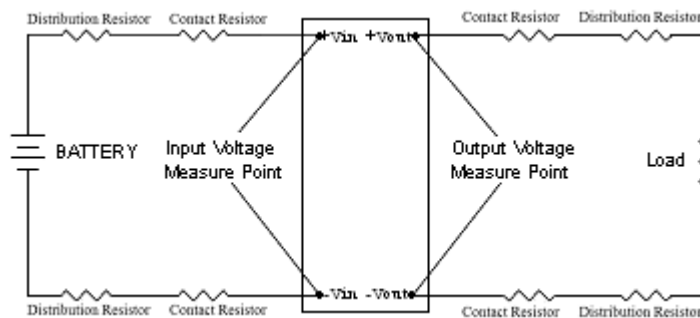
Peak-to-Peak Output Ripple & Noise Measurement Setup

Figure 6



Output Voltage and Efficiency Measurement Setup

Figure 7



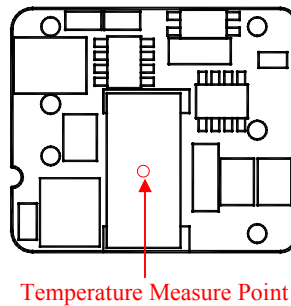
NOTE: All measurements are taken at the module terminals

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

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, convection, 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 8



EMC Considerations

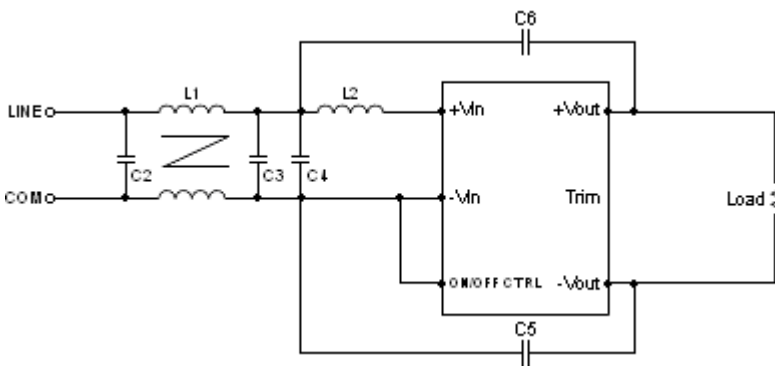


Figure 9

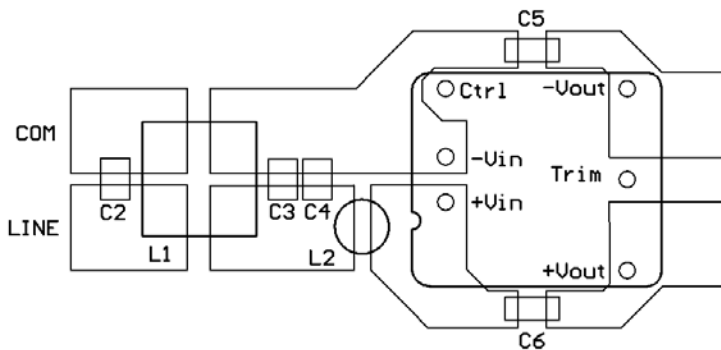


Figure 10 Recommended Layout with Input

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

C2, C3, C4: 2.2uF/100V MLCC

C5, C6: 470pF/3KV MLCC

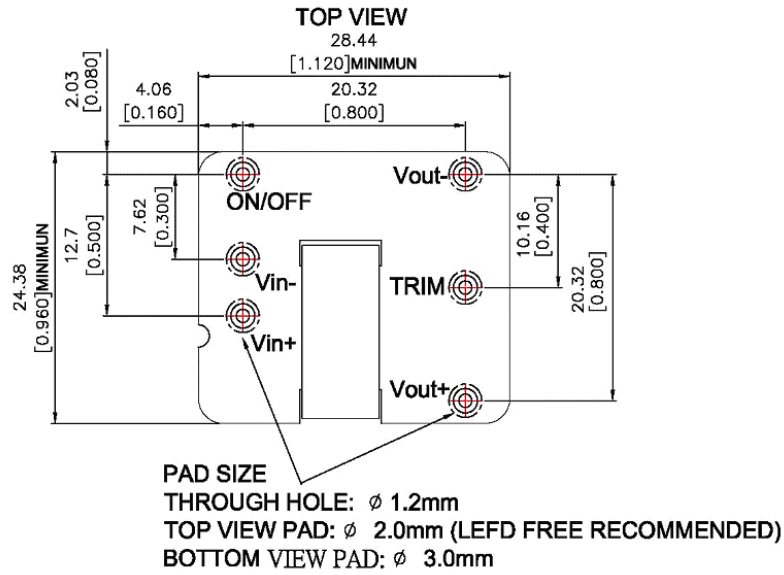
L1: Pulse Engineering type P0354, 1.17mH

L2: Inductor 10uH ϕ 0.35mm

Recommended Pad Layout for DIP Type

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

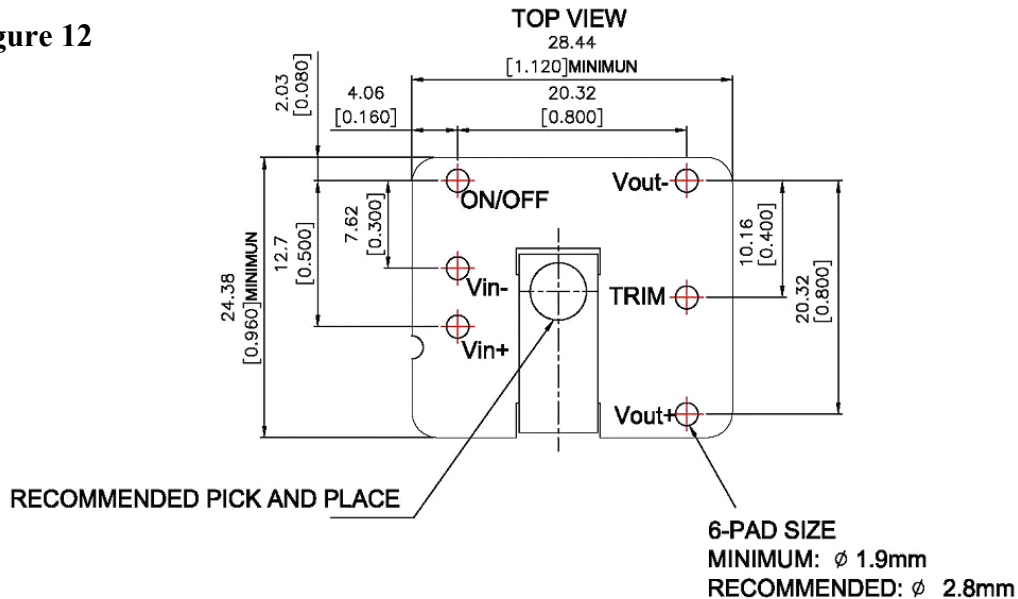
Figure 11



Recommended Pad Layout for SMT Type

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

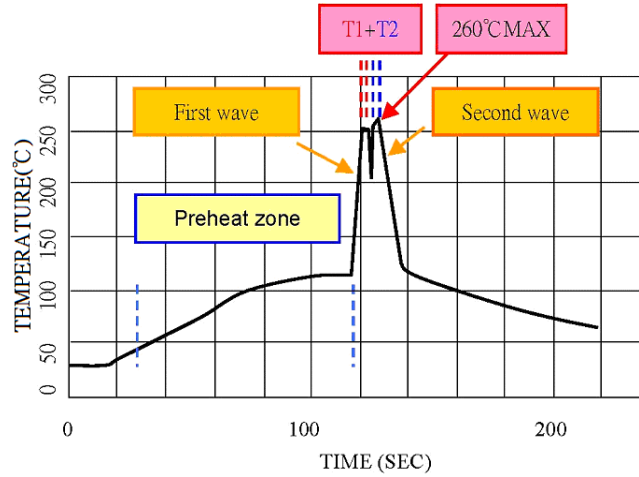
Figure 12



Soldering and Reflow Considerations:

Lead Free Wave Solder Profile for DIP Type

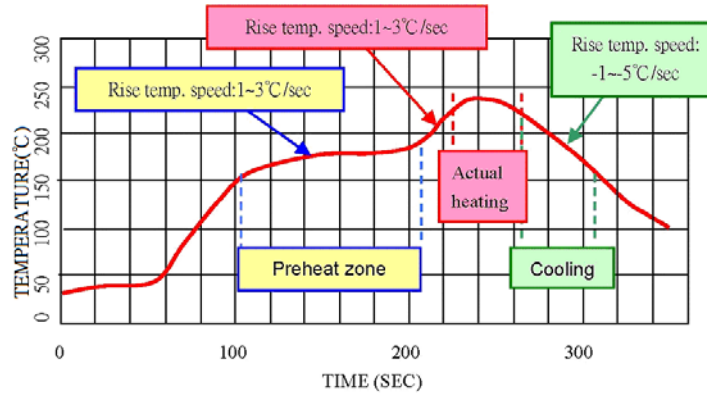
Figure 13



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 14

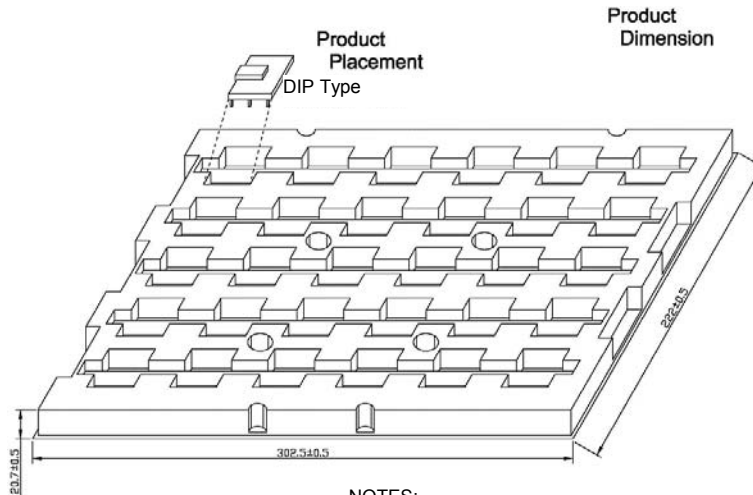


Zone	Reference Parameter
Preheat Zone	Rise temp. speed: 1~3°C/sec Preheat time: 60~90sec Preheat temp. 155~185°C
Actual Heating	Rise temp. speed: 1~3°C/sec Melting time: 20~40 sec Melting temp: 220°C Peak temp: 230~240°C Peak time: 10~20 sec
Cooling	Rise temp. speed: -1~-5°C/sec

Packaging Information:

DIP Type

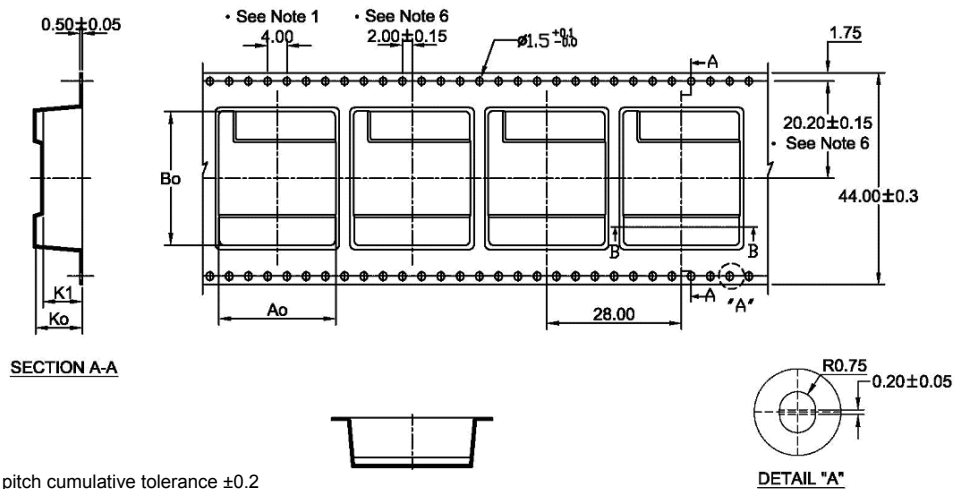
Figure 15



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

SMT Type

Figure 16



- NOTES:
1. 10 sprocket hole pitch cumulative tolerance ± 0.2
 2. Camber not to exceed 1mm in 100mm.
 3. Material: Black Advantek Polystyrene.
 4. A_o and B_o measured on a plane 0.3mm above the bottom of the pocket.
 5. K_o 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.

$A_o=24.30\text{mm}$
 $B_o=27.80\text{mm}$
 $K_o= 9.70\text{mm}$
 $K1= 8.20\text{mm}$

Safety and Installation Instruction:**Isolation Consideration**

The JF Series features 2250 Volt DC isolation from input to output. The input to output resistance is greater than 10MΩ. Nevertheless, if the system using the power module needs to receive safety agency approval, certain rules must be followed in the design of the system using the model. In particular, all of the creepage and clearance requirements of the end-use safety requirement must be observed. These documents include UL60950-1, EN60950-1 and CSA 22.2-960, although specific applications may have other or additional requirements.

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 2A. 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 JF 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 2.2×10^6 hours.

