

1000 WATT 24S12.84FXM DC/DC CONVERTER



Features

- 4:1 Input voltage range
- High power density
- Small size 2.5" x 4.7" x 0.52"
- Efficiency up to 95.4%
- Excellent thermal performance with metal case
- Over-Current and Short Circuit Protection
- Over-Temperature protection
- Auto-restart
- Monotonic startup into pre bias
- Constant frequency
- Remote ON/OFF
- Good shock and vibration damping
- RoHS Compliant

Description

The 4:1 Input Voltage 1000 Watt Single output 24S12.84FXM DC/DC converter provides a precisely regulated dc output. The output voltage is fully isolated from the input, allowing the output to be positive or negative polarity and with various ground connections. The 24S12.84FXM meets the most rigorous performance standards in an industry standard footprint and is optimized for 12V battery applications but can also be used in 24Vin process control and 28Vin military COTS applications.

The 4:1 Input Voltage 24S12.84FXM includes output current monitor (Imon) and temperature monitor (TEMP) signals. Threaded through holes are provided to allow easy mounting or addition of a heatsink for extended temperature operation.

The converters high efficiency and high power density are accomplished through use of high-efficiency synchronous rectification technology, advanced electronic circuit, packaging and thermal design thus resulting in a high reliability product. Converter operates at a fixed frequency and follows conservative component de-rating guidelines.

Product is designed and manufactured in the USA.

Model	Input Range VDC		Vout VDC	Iout ADC
	Min	Max		
24S12.84FXM (ROHS)	9	36	12	84

1. **Negative Logic ON/OFF feature available. Add "-N" to the part number when ordering.**
i.e. 24S12.84FXM-N (ROHS)

2. **Designed to meet MIL-STD-810G for functional shock and vibration. The unit must be properly secured to the interface medium (PCB/Chassis) by use of the threaded inserts of the unit.**

3. **A thermal management device, such as a heatsink, is required to ensure proper operation of this device. The thermal management medium is required to maintain baseplate < 105°C for full rated power.**

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Electrical Specifications

Conditions: TA = 25 °C, Airflow = 300 LFM (1.5 m/s), Vin = 14VDC, unless otherwise specified. Specifications are subject to change without notice.

Parameter	Notes	Min	Typ	Max	Units
Absolute Maximum Ratings					
Input Voltage	Continuous	0		40	V
	Transient (100ms)			50	V
Operating Temperature	Baseplate (100% load)	-40		105	°C
Storage Temperature		-55		125	°C
Isolation Characteristics and Safety					
Isolation Voltage	Input to Output	1500			V
	Input to Baseplate & Output to Baseplate	1500			V
Isolation Capacitance			9000		pF
Isolation Resistance		10	20		MΩ
Insulation Safety Rating			Basic		
Designed to meet UL/cUL 60950, IEC/EN60950-1					
Feature Characteristics					
Fixed Switching Frequency			200		kHz
	Input Current and Output Voltage Ripple		400		kHz
Output Current Monitor - Imon	Voltage proportional to output current		22		mV/A
	Accuracy		+/- 2		%
TEMP monitor	MCP9700A used for sensing PCB temperature of the converter. Voltage range for temperature range -40°C to 125 °C .	0.1		1.75	V
Output Overvoltage Protection	Non-latching	114	119	130	%
Overtemperature Shutdown (Baseplate)	Non-latching	108	112	120	°C
Auto-Restart Period	Applies to all protection features	1.7	2	2.3	s
Turn-On Time from Vin	Time from UVLO to Vo=90%VOUT(NOM) Resistive load	480	517	530	ms
Turn-On Time from ON/OFF Control	Time from ON to Vo=90%VOUT(NOM) Resistive load	15	22	30	ms
Rise Time	Vout from 10% to 90%	4	7.5	11	ms
ON/OFF Control – Positive Logic					
ON state	Pin open = ON or	2		12	V
Control Current	Leakage current			0.16	mA
OFF state		0		0.8	V
Control current	Sinking	0.3		0.36	mA
ON/OFF Control – Negative Logic					
ON state	Pin shorted to – ON/OFF pin or	0		0.8	V
OFF state	Pin open = OFF or	2		12	V
Thermal Characteristics					
Thermal resistance Baseplate to Ambient	Converter soldered to 5" x 3.5" x 0.07", 4 layer/2Oz copper FR4 PCB.		2.6		°C/W

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Electrical Specifications (Continued):

Conditions: $T_A = 25\text{ }^\circ\text{C}$, Airflow = 300 LFM (1.5 m/s) and 0.9" heatsink, $V_{in} = 14\text{VDC}$, unless otherwise specified. Specifications are subject to change without notice.

24S12.84FXM					
Parameter	Notes	Min	Typ	Max	Units
Input Characteristics					
Operating Input Voltage Range		9	14	36	V
Input Under Voltage Lockout	Non-latching				
Turn-on Threshold		8.2	8.5	8.8	V
Turn-off Threshold		7.7	8.0	8.3	V
Lockout Hysteresis Voltage		0.4	0.55	0.7	V
Maximum Input Current	$V_{in} = 9\text{V}$, 80% Load			89	A
	$V_{in} = 12\text{V}$, 100% Load			92	A
	$V_{in} = 14\text{V}$, Output Shorted		600		mARMS
Input Stand-by Current	Converter Disabled		2	4	mA
Input Current @ No Load	Converter Enabled	450	550	690	mA
Minimum Input Capacitance (external) ¹⁾	See Table 1				
Inrush Transient				0.19	A^2s
Input Terminal Ripple Current, i_c	25 MHz bandwidth, 100% Load (Fig. 2)		3.65		ARMS
Output Characteristics					
Output Voltage Range		11.64	12.00	12.36	V
Output Voltage Set Point Accuracy	(No load)	11.90	12.00	12.10	V
Output Regulation					
Over Line	$V_{in} = 9\text{V}$ to 36V		0.05	0.10	%
Over Load	$V_{in} = 14\text{V}$, Load 0% to 100%		0.05	0.150	%
Temperature Coefficient			0.005	0.015	%/ $^\circ\text{C}$
Overvoltage Protection		14		15.6	V
Output Ripple and Noise – 20 MHz bandwidth	100% Load, See Table 1 for external components		120		mV _{PK-PK}
			40		mV _{rms}
External Load Capacitance ¹⁾	See Table 1				
Output Current Range (See Fig. A)	$V_{in} = 12\text{V} - 36\text{V}$	0		84	A
	$V_{in} = 9\text{V}$	0		67.2	A
Current Limit Inception	$V_{in} = 12\text{V} - 36\text{V}$	92.4	100.8	109.2	A
	$9\text{V} \leq V_{in} < 12\text{V}$	73.5		109.2	A
RMS Short-Circuit Current	Non-latching, Continuous		7		Arms
Dynamic Response					
Load Change 50%-100%-50%, $di/dt = 0.5\text{A}/\mu\text{s}$	See Table 1 for external capacitors		± 500		mV
Settling Time to 1% of V_{OUT}			800		μs
Efficiency					
100% Load	$V_{in} = 14\text{V}$		93.0		%
	$V_{in} = 12\text{V}$		92.3		%
50% Load	$V_{in} = 14\text{V}$		95.4		%
	$V_{in} = 12\text{V}$		95.0		%

¹⁾ Section "Input/Output Filtering"

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Environmental and Mechanical Specifications. Specifications are subject to change without notice.

Parameter	Note	Min	Typ	Max	Units
Environmental					
Operating Humidity	Non-condensing			95	%
Storage Humidity	Non-condensing			95	%
ROHS Compliance ¹	See Calex Website http://www.calex.com/RoHS.html for the complete RoHS Compliance statement				
Shock and Vibration	Designed to meet MIL-STD-810G for functional shock and vibration.				
Water washability	Not recommended for water wash process. Contact the factory for more information.				
Mechanical					
Weight			8.55		Ounces
			242		Grams
Through Hole Pins Diameter	Pins 3, 3A, 4, 4A, 5, 6, 8 and 9	0.079	0.081	0.083	Inches
		2.006	2.057	2.108	mm
	Pins 1, 2, 10, 11 and 12	0.038	0.04	0.042	Inches
		0.965	1.016	1.667	mm
Through Hole Pins Material	Pins 3, 3A, 4, 4A, 5, 6, 8 and 9	14500 or C1100 Copper Alloy			
	Pins 1, 2, 10, 11 and 12	Brass Alloy 360, ½ Hard			
Through Hole Pin Finish	All pins	100% Matte tin over nickel			
Case Dimension		4.7 x 2.5 x 0.52			Inches
		119.38 x 63.50 x 13.21			mm
Case Material	Plastic: Vectra LCP FIT30: ½-16 EDM Finish				
Baseplate	Material	Aluminum			
	Flatness	-0.005		+0.005	Inches
		-0.125		+0.125	mm
Reliability					
MTBF	Telcordia SR-332, Method I Case 1 50% electrical stress, 40°C components		5.4		MHrs

Additional Notes:

¹ The RoHS marking is as follows

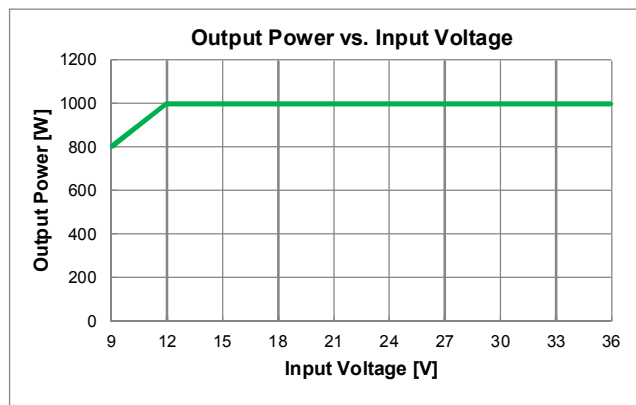


Figure A: Output Power as function of input voltage.

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Operations

Input Fusing

The FXM converters do not provide internal fusing and therefore in some applications external input fuse may be required. Use of external fuse is also recommended if there is possibility for input voltage reversal. For greatest safety, it is recommended to use fast blow fuse in the ungrounded input supply line.

Input Reverse Polarity Protection

The FXM converters do not have input reverse polarity. If input voltage polarity is reversed, internal diodes will become forward biased and draw excessive current from the power source. If the power source is not current limited or input fuse not used, the converter could be permanently damaged.

Input Undervoltage Protection

Input undervoltage lockout is standard with this converter. The FXM converter will start and regulate properly if the ramping-up input voltage exceeds Turn-on threshold of typ. 8.5V (See Specification) and remains at or above Turn-on Threshold.

The converter will turn off when the input voltage drops below the Turn-off Threshold of typical 8V (See specification) and converter enters hiccup mode and will stay off for 2 seconds. The converter will restart after 2 seconds only if the input voltage is again above the Turn-on Threshold.

The built-on hysteresis and 2 second hiccup time prevents any unstable on/off operation at the low input voltage near Turn-on Threshold.

User should take into account for IR and inductive voltage drop in the input source and input power lines and make sure that the input voltage to the converter is always above the Turn-off Threshold voltage under ALL OPERATING CONDITIONS.

Start-Up Time

The start-up time is specified under two different scenarios: a) Startup by ON/OFF remote control (with the input voltage above the Turn-on Threshold voltage) and b) Start-up by applying the input voltage (with the converter enabled via ON/OFF remote control).

The startup times are measured with maximum resistive load as: a) the interval between the point when the ramping input voltage crosses the Turn-on Threshold and the output voltage reaches 90% of its nominal value and b) the interval between the point when the converter is enabled by ON/OFF remote control and time when the output voltage reaches 90% of its nominal value.

When converter is started by applying the input voltage with ON/OFF pin active there is delay of 500msec that was intentionally provided to prevent potential startup issues especially at low input voltages

Input Source Impedance

Because of the switching nature and negative input impedance of DC/DC converters, the input of these converters must be driven from the source with both low AC impedance and DC input regulation.

The FXM converters are designed to operate without external components as long as the source voltage has very low impedance and reasonable voltage regulation. However, since this is not the case in most applications an additional input capacitor is required to provide proper operations of the FXM converter. Specified values for input capacitor are recommendation and need to be adjusted for particular application. Due to large variation between applications some experimentation may be needed.

In many applications, the inductance associated with the distribution from the power source to the input of the converter can affect the stability and in some cases, if excessive, even inhibit operation of the converter. This becomes of great consideration for input voltage at 12V or below.

The DC input regulation, associated with resistance between input power source and input of the converter, plays significant role in particular in low input voltage applications such as 12V battery systems.

Note that input voltage at the input pins of the connector must never degrade below Turn-off threshold under all load operating conditions.

Note that in applications with high pulsating loads additional input as well as output capacitors may be needed. In addition, for EMI conducted measurement, due to low input voltage it is recommended to use 5 μ H LISNs instead of typical 50 μ H LISNs.

Input/ Output Filtering

Input Capacitor

Minimum required input capacitance, mounted close to the input pins of the converter, is 1000 μ F with ESR < 0.1 Ω .

Several criteria need to be met when choosing input capacitor: a) type of capacitor, b) capacitance to provide additional energy storage, c) RMS current rating, d) ESR value that will ensure that output impedance of the input filter is lower than input impedance of the converter and its variation over the temperature.

Since inductance of the input power cables could have significant voltage drop due to rate of change of input current $di(in)/dt$ during transient load operation, an external capacitor on the output of the converter is



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required to reduce $di(in)/dt$. Another constraint is minimum rms current rating of the input capacitors which is application dependent. One component of input rms current handled by input capacitor is high frequency component at switching frequency of the converter (typ. 400kHz) and is specified under "Input terminal ripple current" i_c . Typical values at full rated load and 14 Vin are provided in Section "Characteristic Waveforms". It is recommended to use ceramic capacitors for attenuating this component for input terminal ripple current, which is also required to meet requirement for conducted EMI (See EMI Section). The second component of the input ripple current is due to pulsating load current being reflected to the input and electrolytic capacitors usually used for this purpose need to be selected accordingly. Using several electrolytic capacitors in parallel on the input is recommended.

ESR of the electrolytic capacitors, need to be carefully chosen taken into account temperature dependence.

Output Capacitor

Similar considerations apply for selecting external output capacitor. For additional high frequency noise attenuation use of ceramic capacitors is recommended while in order to provide stability of the converter during high pulsating load high value electrolytic capacitor is required. It is recommended to use several electrolytic capacitors in parallel in order to reduce effective ESR. Note that external output capacitor also reduces slew rate of the input current during pulsating load transients as discussed above.

Table 1 shows recommend external input and output capacitance for 12V battery system.

ON/OFF (Pins 1 and 2)

The ON/OFF pin is used to turn the power converter on or off remotely via a system signal and has positive logic. A typical connection for remote ON/OFF function is shown in Fig. 1.

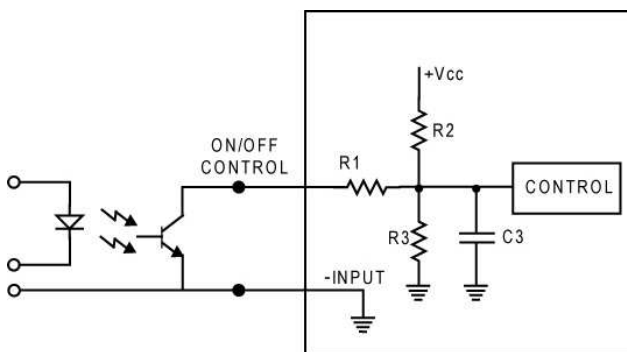


Fig. 1: Circuit configuration for ON/OFF function.

The positive logic version turns on when the ON/OFF pin is at logic high and turns off when at logic low. The

converter is on when the ON/OFF pin is either left open or external voltage greater than 2V and not more than 12V is applied between ON/OFF pin and - INPUT pin. See the Electrical Specifications for logic high/low definitions.

The negative logic version turns on when the ON/OFF pin is at logic low and turns off when at logic high. The converter is on when the ON/OFF pin is either shorted to - INPUT pin or kept below 0.8V. The converter is off when the ON/OFF pin is either left open or external voltage not more than 12V is applied between ON/OFF pin and - INPUT pin. See the Electrical Specifications for logic high/low definitions.

The ON/OFF pin is internally pulled up to typically 4.5V via resistor and connected to internal logic circuit via RC circuit in order to filter out noise that may occur on the ON/OFF pin. A properly de-bounced mechanical switch, open-collector transistor, or FET can be used to drive the input of the ON/OFF pin. The device must be capable of sinking up to 0.36mA at a low level voltage of ≤ 0.8 V. During logic high, the typical maximum voltage at ON/OFF pin (generated by the converter) is 4.5V, and the maximum allowable leakage current is 160 μ A. If not using the remote on/off feature leave the ON/OFF pin open.

TTL Logic Level - The range between 0.81V and 2V is considered the dead-band. Operation in the dead-band is not recommended.

External voltage for ON/OFF control should not be applied when there is no input power voltage applied to the converter.

Output Overcurrent Protection (OCP)

The converter is protected against overcurrent or short circuit conditions. Upon sensing an overcurrent condition, the converter will switch to constant current operation and thereby begin to reduce output voltage. When the output voltage drops below approx. 50% of the nominal value of output voltage, the converter will shut down.

Once the converter has shut down, it will attempt to restart nominally every 2 seconds. The attempted restart will continue indefinitely until the overload or short circuit conditions are removed or the output voltage rises above 50% of its nominal value.

Once the output current is brought back into its specified range, the converter automatically exits the hiccup mode and continues normal operation.

During initial startup if output voltage does not exceed typical 50% of nominal output voltage within 500 msec after the converter is enabled, the converter will be shut down and will attempt to restart after 2 seconds.

In case of startup into short circuit, internal logic detects short circuit condition and shuts down converter typical 5 msec after condition is detected. The converter will

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attempt to restart after 2 seconds until short circuit condition exists.

Output Overvoltage Protection (OVP)

The converter will shut down if the output voltage across +OUT (Pins 5 and 6) and –OUT (Pins 8 and 9) exceeds the threshold of the OVP circuitry. The OVP circuitry contains its own reference, independent of the output voltage regulation loop. Once the converter has shut down, it will attempt to restart every 2 seconds until the OVP condition is removed.

Note that OVP threshold is set for nominal output voltage and not trimmed output voltage value or remote sense voltage.

Overtemperature Protection (OTP)

The FXM converters have non-latching overtemperature protection. It will shut down and disable the output if temperature at the center of the base plate exceeds a threshold of typical 108°C for 9Vin, 112 °C for 12Vin and 115 °C for 24Vin/36Vin. Measured with FXM converter soldered to 5" x 3.5" x 0.07" 4 layers/ 2 Oz Cooper FR4 PCB.

The converter will automatically restart when the base temperature has decreased by approximately 20°C.

Safety Requirements

Basic Insulation is provided between input and the output. The converters have no internal fuse. To comply with safety agencies requirements, a fast-acting or time-delay fuse is to be provided in the unearthed lead. Recommended fuse values are:

- a) 140A for 9V<Vin<18V
- b) 90A for 18V<Vin<36V.

Electromagnetic Compatibility (EMC)

EMC requirements must be met at the end-product system level, as no specific standards dedicated to EMC characteristics of board mounted component dc-dc converters exist.

With the addition of a one stage external filter, the FXM converters will pass the requirements of MILSTD-461F CE102 Base Curve for conducted emissions. Note that 5uH LISN should be used in order to enable operation of the converter at low input voltage.

Signal GND (Pin 10)

Signal GND pin is internally shorted to –OUT (Pins 8 and 9) and should be used as a GND for Imon (Pin 12) and

TEMP (Pin 11) signals to avoid error in reading due to high output current.

TEMP (Pin 11)

The TEMP (Pin 11) is analog voltage V_{temp} proportional to the PCB temperature of the converter. Temperature of the converter T_c , is given by:

$$T_c = (V_{temp} - 0.5) * 0.01 [^{\circ}\text{C}]$$

Where,

V_{temp} is voltage at TEMP pin (pin 11) in volts.

For example, reading of 1.5V on TEMP pin corresponds to internal temperature of the converter of 100 °C while $V_{temp} = 0.5\text{V}$ corresponds to temperature of - 0 °C .

Imon (Pin 12)

The Imon (pin 12) is analog voltage proportional to output current of the converter. Output current, I_o is calculated using the following formula:

$$I_o = I_{mon} * K [A]$$

Where,

I_{mon} – voltage at pin Imon in volts

$$K = 22\text{mV/A}$$

Typical accuracy of the Imon is +/-2%.over operating temperature range.

Thermal Consideration

The FXM converter can operate in a variety of thermal environment. However, in order to ensure reliable operation of the converter, sufficient cooling should be provided. The FXM converter is encapsulated in plastic case with metal baseplate on the top. In order to improve thermal performance, power components inside the unit are thermally coupled to the baseplate. In addition, thermal design of the converter is enhanced by use of input and output pins as heat transfer elements. Heat is removed from the converter by conduction, convection and radiation.

There are several factors such as ambient temperature, airflow, converter power dissipation, converter orientation how converter is mounted as well as the need for increased reliability that need to be taken into account in order to achieve required performance. It is highly recommended to measure temperature in the middle of the baseplate in particular application to ensure that proper cooling of the converter is provided.

A reduction in the operating temperature of the converter will result in an increased reliability.



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Thermal Derating

There are two most common applications: 1) the FXM converter is thermally attached to a cold plate inside chassis without any forced internal air circulation; 2) the FXM converter is mounted in an open chassis on system board with forced airflow with or without an additional heatsink attached to the base plate of the FXM converter.

The best thermal results are achieved in application 1) since the converter is cooled entirely by conduction of heat from the top surface of the converter to a cold plate and temperature of the components is determined by the temperature of the cold plate. There is also some additional heat removal through the converter's pins to the metal layers in the system board. It is highly recommended to solder pins to the system board rather than using receptacles. Typical derating output power and current are shown in Figs. 6-7 for various baseplate temperatures up to 105°C. Note that operating converter at these limits for prolonged time will affect reliability.

Soldering Guidelines

The ROHS-compliant through-hole FXM converters use Sn/Ag/Cu Pb-free solder and ROHS-compliant component. They are designed to be processed through wave soldering machines. The pins are 100% matte tin over nickel plated and compatible with both Pb and Pb-free wave soldering processes. It is recommended to follow specifications below when installing and soldering FXM converters. Exceeding these specifications may cause damage to the FXM converter.

Wave Solder Guideline For Sn/Ag/Cu based solders	
Maximum Preheat Temperature	115 °C
Maximum Pot Temperature	270 °C
Maximum Solder Dwell Time	7 seconds
Wave Solder Guideline For Sn/Pb based solders	
Maximum Preheat Temperature	105 °C
Maximum Pot Temperature	250 °C
Maximum Solder Dwell Time	6 seconds

FXM converters are not recommended for water wash process. Contact the factory for additional information if water wash is necessary.

Test Configuration

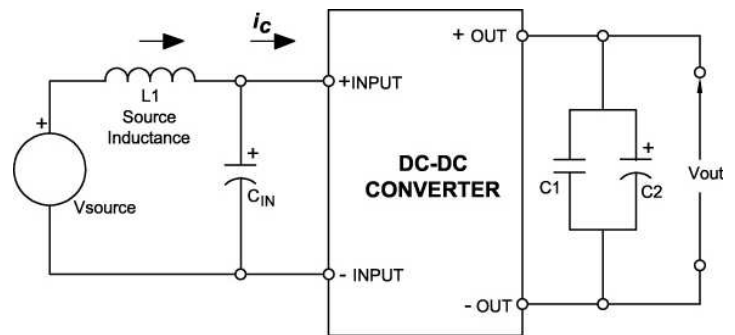


Fig. 2: Test setup for measuring input reflected ripple currents i_c .

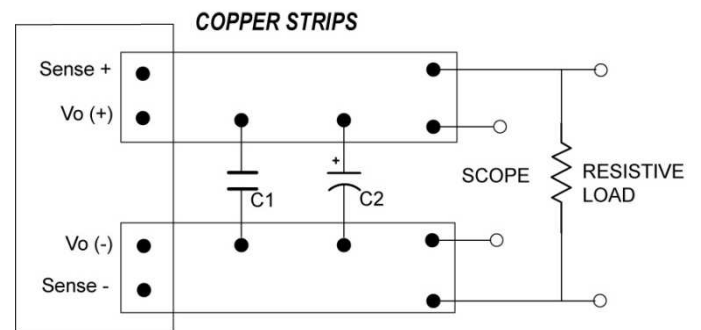


Fig. 3: Test setup for measuring output voltage ripple, startup and step load transient waveforms.

Practical Design for 12V Battery System

In this Section practical design of input and output filters for 12V battery system (14.4V) is provided. Input filter comprises inductance of 6 ft long input cables and additional input capacitors C_{IN} (Fig 2 and Table 1). The output filter comprises external capacitors C1 and C2 (Fig. 2 and Table 1). Step load transient is 50% and capacitor values are given in Table 1. Capacitor selection was made to satisfy:

1. Converter stable operation over entire temperature range and all operating condition including transient and full temperature range
2. Output voltage regulation under step load transient
3. RMS current rating for worst case step load condition

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Ref. Des.	Manufacturing p/n	24S12.84FXM
L1	N/A	6 ft. cable, AWG 4
C _{IN}	MAL214699112E3 (Vishay)	2 x 1000 μ F/50V/70m Ω (630m Ω)
	MAL214699108E3 (Vishay)	2 x 470 μ F/50V/72 m Ω (650m Ω)
C1	GRM32ER72A475KA12L (Murata)	10 μ F/1210/X7R/100v
C2	PCR1E471MCL1GS (nichicon)	4 x 470 μ F/25V/15 m Ω (30 m Ω)
	MAL214699606E3	2 x 1500 μ F/50m Ω (450m Ω)
	MAL214699608E3	2200 μ F/25V/50m Ω (450m Ω)

Table 1: Component values used in test setup from Figs. 2 and 3. Resistance in parenthesis () represents ESR value at -40C for specified capacitor.

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Characteristic Curves – Efficiency and Power Dissipation

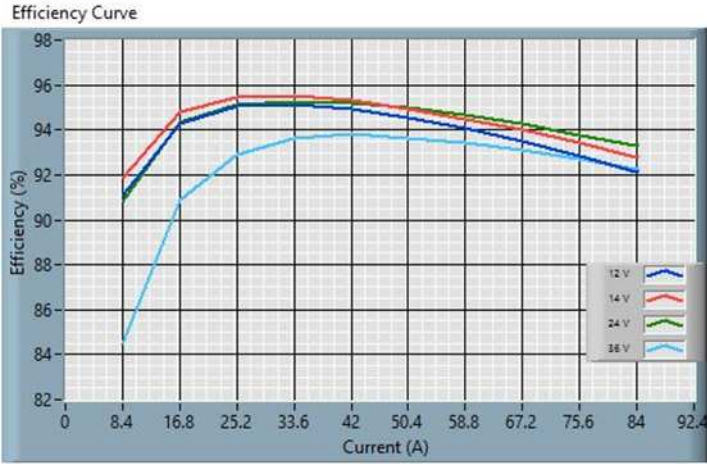


Fig. 4: 24S12.84FXM (ROHS) Efficiency Curve

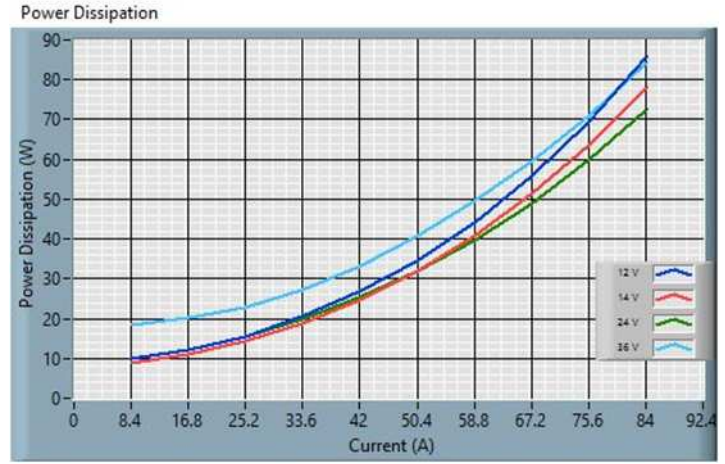


Fig. 5: 24S12.84FXM (ROHS) Power Dissipation

Characteristic Curves – Derating Curves

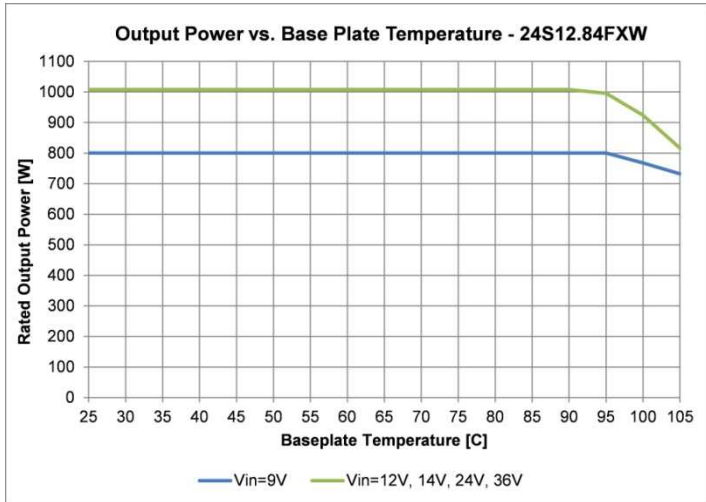


Fig. 6: 24S12.84FXM (ROHS) Derating Curve Pout vs. Base Plate Temperature

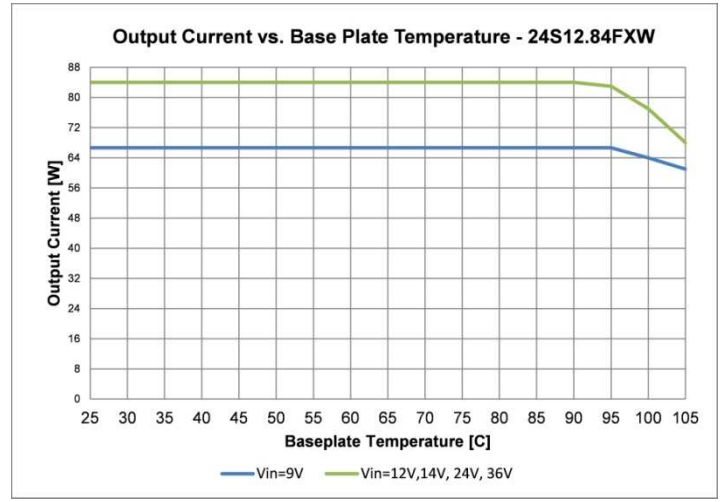


Fig. 7: 24S12.84FXM (ROHS) Derating Curve Output Current vs. Base Plate Temperature

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Characteristic Waveforms – 24S12.84FXM

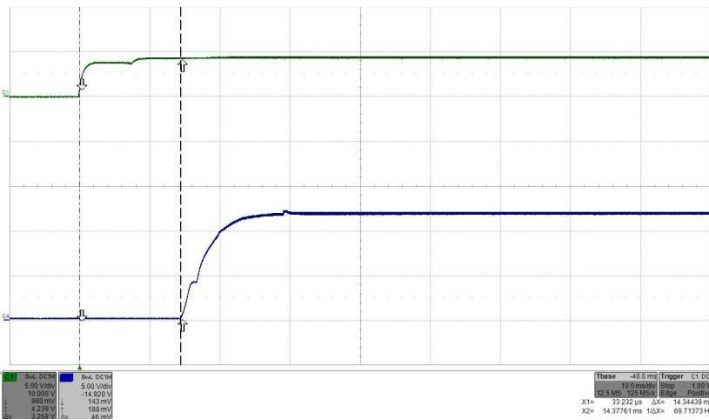


Fig. 8: Turn-on by ON/OFF transient (with V_{in} applied) at full rated load current (resistive) at $V_{in} = 14V$. Top trace (C1): ON/OFF signal (5 V/div.). Bottom trace (C4): Output voltage (5 V/div.). Time: 10 ms/div.

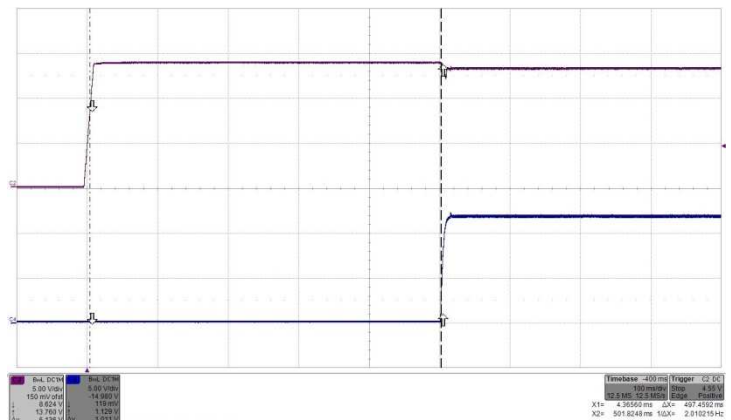


Fig. 9: Turn-on by V_{in} transient (ON/OFF high) at full rated load current (resistive) at $V_{in} = 44V$. Top trace (C2): Input voltage V_{in} (5 V/div.). Bottom trace (C4): Output voltage (5 V/div.). Time: 100 ms/div.

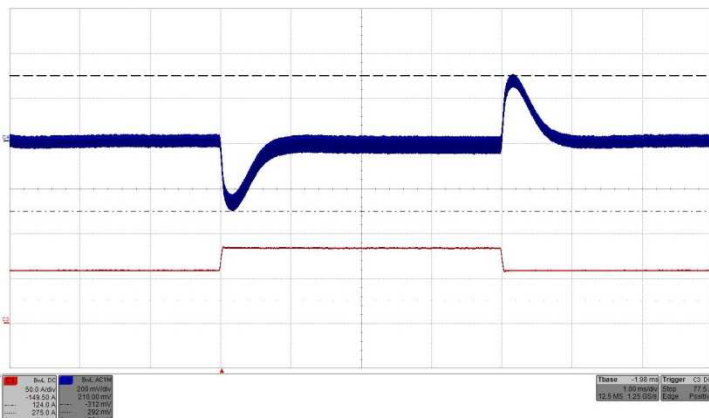


Fig. 10: Output voltage response to load current step change 70% - 100%-70% (58.5A-84A-58.8A) with $di/dt = 0.5A/\mu s$ at $V_{in} = 14V$. Top trace (C4): Output voltage (500 mV/div.). Bottom trace (C3): Load current (50A/div.). Time: 1ms/div.

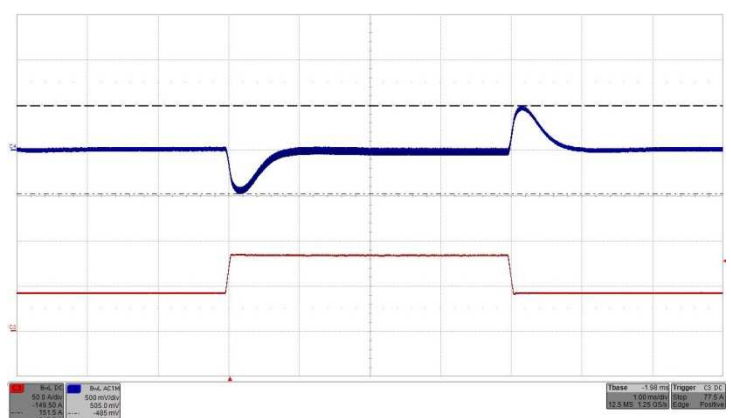


Fig. 11: Output voltage response to load current step change 50% - 100%-50% (42A-84A-42A) with $di/dt = 1A/\mu s$ at $V_{in} = 14V$. Top trace (C4): Output voltage (500 mV/div.). Bottom trace (C3): Load current (50A/div.). Time: 1ms/div.

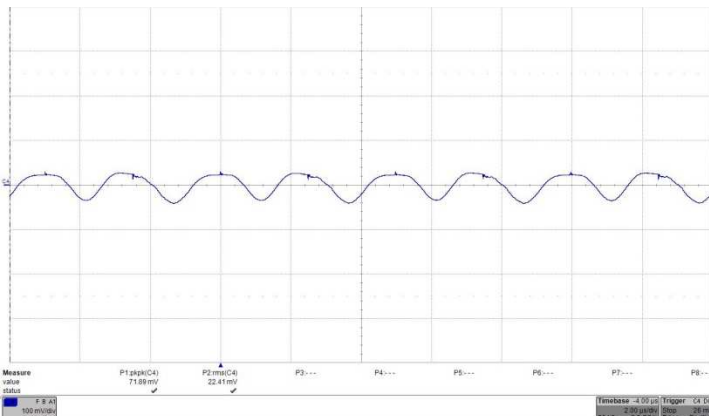


Fig. 12: Output voltage ripple (100 mV/div.) at full rated load current into a resistive load at $V_{in} = 14V$. Time: 2 μs /div.

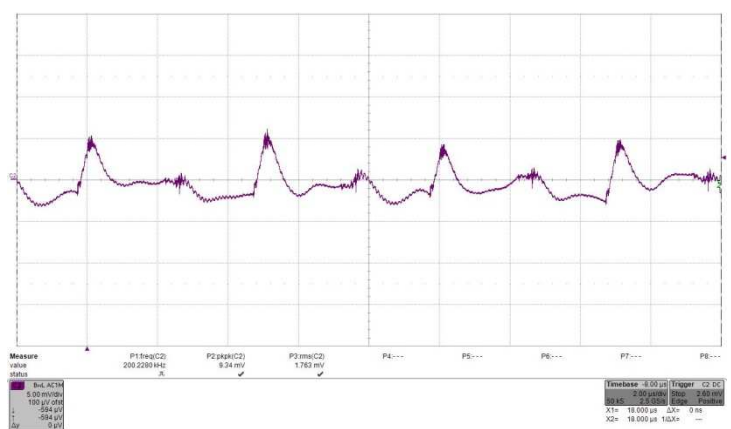


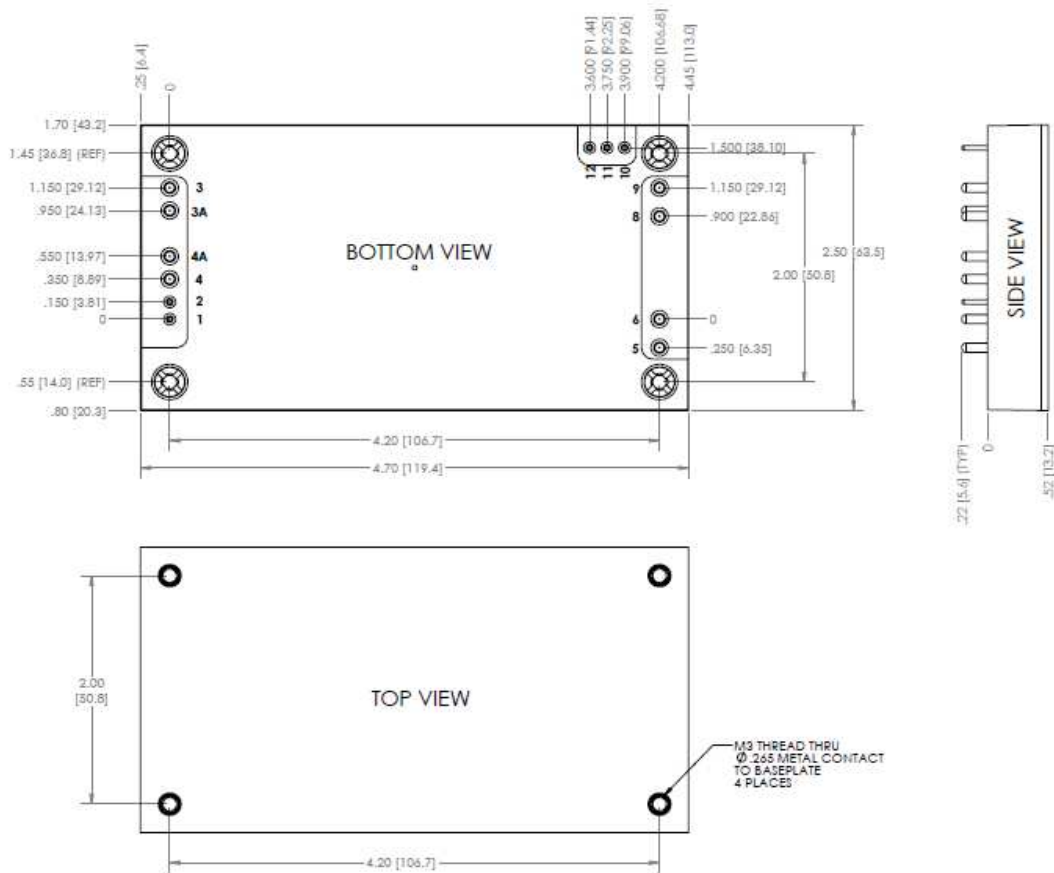
Fig. 13: Input reflected ripple current, i_c (500mA/mV), measured at input terminals at full rated load current at $V_{in} = 14V$. Refer to Fig. 2 for test setup. Time: 2 μs /div. RMS input ripple current is $1.76 \cdot 0.5A = 0.88A_{rms}$.



1000 WATT 24S12.84FXM DC/DC CONVERTER



Mechanical Specification



Input/ Output Connections

Pin	Label	Function
1	+ON/OFF	TTL input with internal pull up, referenced to — ON/OFF pin, used to turn converter on and off
2	-ON/OFF	Negative input of Remote ON/OFF
3	-INPUT	Negative Input Voltage
3A	-INPUT	Negative Input Voltage
4	+INPUT	Positive Input Voltage
4A	+INPUT	Positive Input Voltage
5	+OUT	Positive Output Voltage
6	+OUT	Positive Output Voltage
8	-OUT	Negative Output Voltage
9	-OUT	Negative Output Voltage
10	SGND	Signal Ground (for I _{mon} and TEMP)
11	TEMP	Converters Temperature (PCB)
12	I _{mon}	Output Current Monitor

Note:

- 1) Pinout as well as pin number and pin diameter are inconsistent between manufacturers of the full brick converters. Make sure to follow the pin function, not the pin number, as well as spec for pin diameter when laying out your board.

NOTES:

Unless otherwise specified:
 All dimensions are in inches [millimeter]
 Tolerances: x.xx in. ±0.02 in. [x.x mm ± 0.5mm]
 x.xxx in. ±0.010 in. [x.xx mm ± 0.25mm]

Torque fasteners into threaded mounting inserts at 10 in.lbs. or less. Greater torque may result in damage to unit and void the warranty.