Technical Specification

S15-48-12

48Vin 12Vout 1.25A

Description

The S15 family of high efficiency, low power DC/DC converters offer power levels that exceed other bricks with similar footprints. They are targeted specifically at the telecommunication, industrial electronics, mobile telecommunication and distributed power markets. With a wide input voltage range of 36-75V they are available with output voltages of either 1. 5, 1.8, 2.5, 3.3, 5 or 12 Volts. All models feature an input filter, input undervoltage lockout, overtemperature protection, output current limiting and short circuit protection. The fully enclosed, encapsulated construction with aluminum heat spreader design achieves very efficient heat transfer with no hot spots. The use of patented design concepts facilitate maximum power delivered with the highest efficiency up to 90%. The converters combine creative design concepts with highly derated power devices to achieve very high reliability, high performance and low cost solution to systems designers requiring maximum power in small footprints.

Applications

- Telecommunications
- Data Communications
- Wireless Communications
- Networking Gear
- Servers, Switches and Data Storage
- Semiconductor Test Equipment
- Distributed Power Architecture

Features

- Delivers up to 15W in 1" x 1.6" format
- High power density up to 28.5W/inch^3
- Synchronous rectification topology
- No airflow or heat sink required
- No minumum load required
- Low profile of only 0.35 inch
- High output current in small footprint
- 1.5V, 1.8V, 2.5V, 3.3V, 5V, 12V or +/-12V models
- Wide input operating range 36-75V
- -40°C to +100°C ambient operation
- Input undervoltage lockout
- Output current limit and short circuit protection
- On/Off pin
- Output adjustment +/-10% range
- 1500V, 10M input-to-output isolation
- Enclosed construction with heat spreader for low temperature rise
- Enclosed six-sided metal shield construction for low EMI/RFI
- UL 60950 recognized, TUV EN60950 and CSA C22.2 No. 60950-00 Certified
- Meets conducted limits of FCC Class B and CEI IEC61204-3 Class B with external filter
- MTBF of 850,000 hours @ 50°C (MIL-HDBK-217F)

CONVERTER SELECTION

Typical @ T_a=+25°C under nominal line voltage and full load conditions.

Model	Input				Output		Efficiency 75% Load
	Voltage (Volts)		Current (A)		Voltage	Current	
	Nominal	Range	No load	Full load	(Volts)	(Amps)	(%)
S15-48-12	48	36-75	0.025	0.36	12.0	1.25	89

Consult factory for other output voltage configurations.

Outline Information and Summary Specifications

Pin Connection (Function)		
Pin#	**Single Output**	**Dual Output**
1	On/Off	On/Off
2	Vin -	Vin -
3	Vin +	Vin +
4	Vout +	Vout +
5	Trim	Common
6	Vout -	Vout -

All dimensions are in inches [mm]

All pins are dia. 0.040 [1.02]

Pin material: Brass

Pin finish: Gold plated

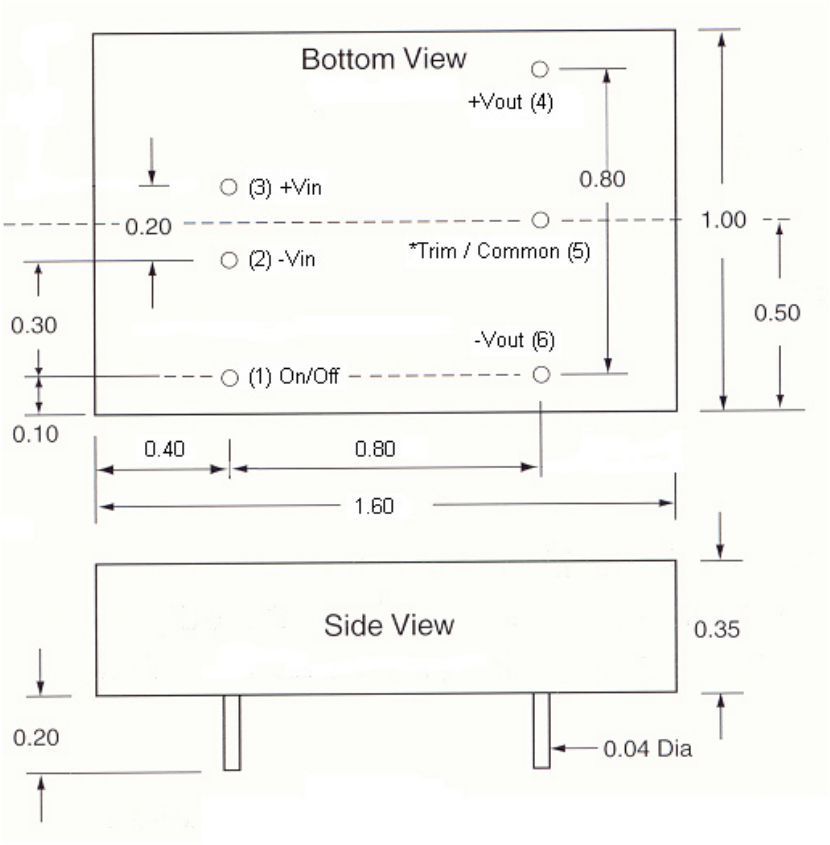
Insulator pad around pins: Silicone rubber

Case: Aluminum material with anodized finish

Weight: 25.2g (0.9oz)

Tolerance			
Inches		Millimeters	
•XX	± 0.020	•X	± 0.5
•XXX	± 0.010	•XX	± 0.25
Pin:	± 0.002	± 0.05	

Note: Pin 5 is NC.



Thermal derating for vertical orientation, Vin=54V

Output Voltage (Volts)	Output Current at 40°C (Amps)			Output Current at 60°C (Amps)			Output Current at 80°C (Amps)		
	Free Air	200 LFM	300 LFM	Free Air	200 LFM	300 LFM	Free Air	200 LFM	300 LFM
12.0	1.25	1.25	1.25	1.25	1.25	1.25	0.6	1.0	1.25

The information and specifications contained in the specification are believed to be accurate and reliable at the time of publication. Specifications are subject to change without notice.

Electrical Specifications

Ta=25°C, Vin=48V unless otherwise noted.

PARAMETER	NOTES	MIN	TYP	MAX	UNIT
Absolute maximum rating					
Input voltage		0		80	V
Operating case temperature		-40		100	°C
Storage temperature		-55		125	°C
Humidity				95	%
Input characteristics					
Operating input voltage range		36	48	75	V
Turn on voltage threshold			35		V
Turn off voltage threshold				34	V
Transient withstand	Transient duration: 100ms			100	V
Maximum input current	100% load , 36Vin			0.5	A
Off converter input current	48Vin			31	mA
Output characteristics					
Output voltage set point		11.7	12	12.3	V
Output voltage line regulation	36~75 Vin			±0.3	%
Output voltage load regulation	10%-100%Load			±0.5	%
Output voltage total regulation			±1	±2	%
Output voltage overall drift rate			±2	±3	%
Output voltage ripple and noise	20Mz bandwidth, 100% Load, 48Vin		50	100	mV(pk-pk)
Output over power protection		100	120	140	%
Over-voltage protection			N/A		
Over-temperature protection			N/A		
Temperature coefficient				±0.04	%/°C
Capacitive Load		0		10,000	µF
Output dynamic characteristics					
Startup time	5% to 95% of the output voltage		50	100	ms
Transient recovery time	25% load change			800	µs
Transient peak deviation	25% load change			2	%Vo
Efficiency (see efficiency curve)					
100% load efficiency	48 Vin		89		%
Isolation characteristics					
Isolation voltage (primary to secondary)	1minute		2000		VDC
Isolation voltage (primary to case)	1minute		1100		VDC
Isolation voltage (secondary to case)	1minute		1100		VDC
Isolation resistance	500VDC, Primary to secondary	10			MΩ
Isolation capacitance	Primary to secondary			1000	pF
Feature Characteristics					
Switching frequency		225	250	275	KHz
ON/OFF control (Positive logic) Converter On Converter Off	S15-48-12	 3 -1		 7 1.2	 V V
ON/OFF control (Negative logic) Converter On Converter Off	S15-48-12N	 -1 3		 1.2 7	 V V
Output voltage trim range	Percentage of normal output	-8		+10	%
Calculated MTBF	Bellcore @ 50°C	1,100,000			Hrs
Weight			20.7(0.7)		g(oz)

Basic Operation And Functions

S15-48-12/S15-48-12N is a high efficiency, isolated DC/DC converter. Neither heat sink nor airflow is required when the unit operates at ambient temperature of 25°C. The unit has basic control, output adjustment and protection functions.

Input (Pin 2, Pin 3)

Input power Vin(+) must be connected to Positive input pin 3; Input power Vin(-) must be connected to Negative input pin2.

Output (Pin 4, Pin 6)

Output power Vout(+) must be connected to Positive output pin 4; Output power Vout(-) must be connected to Negative output pin6.

ON/OFF (Pin 1)

Permits the user to maintain unit On/Off, in order to properly sequence different power supplies and reduce power consumption during the standby condition. There are two ON/OFF control options: positive logic (S15-48-12) and negative logic (S15-48-12N). Both are referenced to Vin-.

Pin 1 is the "Enable" pin, connecting a TTL compatible pin. A TTL control signal to this pin, according to the specification, turns the unit on or off.

The positive logic unit turns on when the pin is at logic high or open, and turns off at logic low.
The negative logic unit turns on when the pin is at logic low, and turns off at logic high state.
Typical ON/OFF connection is shown in Fig 1.

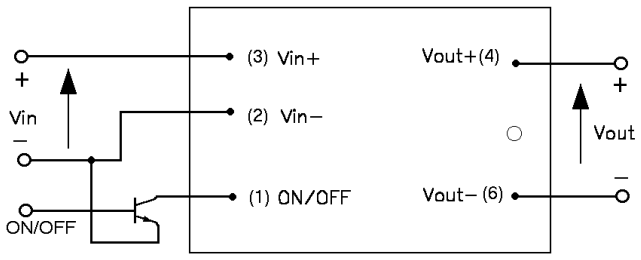


Fig 1. Recommended ON/OFF circuit configuration

Remote Sense

The unit does NOT have remote sense pins.

Trim Pin

S15-48-12 Brick does not have Trim pin.

S15-48-12N Brick has Trim pin.

Output Trim (Pin 5)

Permits the user to adjust the output voltage up or down to achieve the custom voltage or to make the output voltage margining.

The unit's output voltage can be adjusted up 10% or down 8% relative to the rated output voltage by adding an external resistor between pin 5 and one of the output pins (pin 4 and 6).

To increase the output voltage, a trim resistor should be connected between pin 5(Trim) and pin 6 (Vout-), as shown in Fig 2.

To decrease the output voltage, a trim resistor should be connected between pin 5 (Trim) and pin 4 (Vout+), as shown in Fig 3.

The recommended trim resistor values can be found in the trim table (Table 1) and charts (Fig 4 and 5).

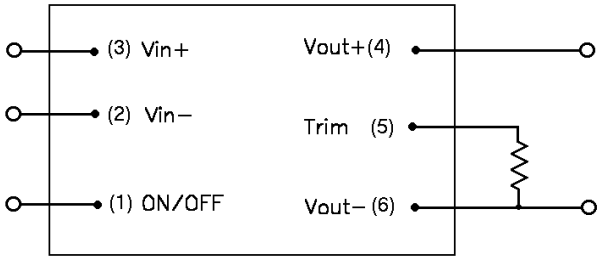


Fig 2. Configuration for increasing the output voltage

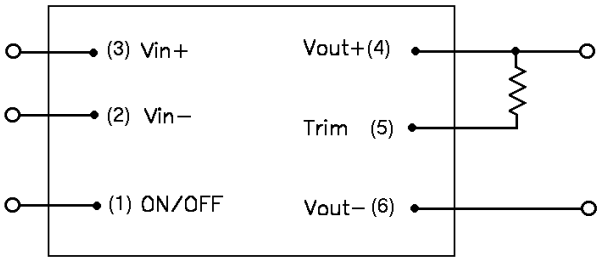


Fig 3. Configuration for decreasing the output voltage

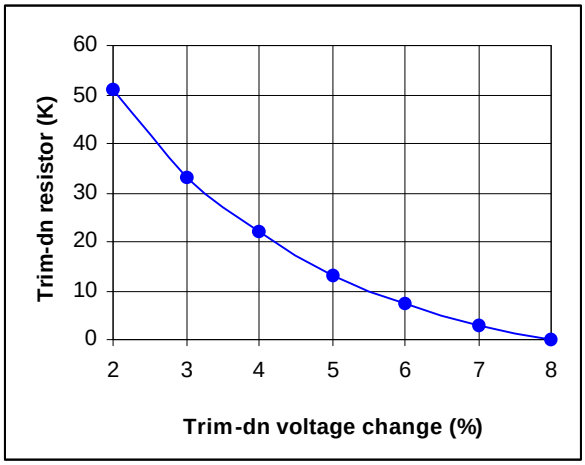


Fig 5 Trim-down output vs. trim resistance

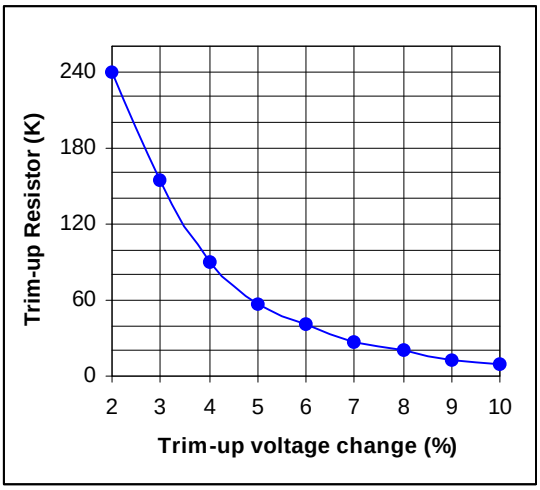


Fig 4 Trim-up output vs. trim resistance

Trim-up volt.	Trim-up resistor	Trim-dn volt.	Trim-dn resistor
+2%	240	-2%	51
+3%	154	-3%	33
+4%	90	-4%	22
+5%	56	-5%	13
+6%	41	-6%	7.5
+7%	27	-7%	3
+8%	21	-8%	0.1
+9%	13		
+10%	10		

Table 1 Output voltage trim vs. trim resistor value

Protection Features

Input under voltage lockout (UVL)

The input voltage must be at least 35V for the unit to turn on. Once the unit has been turned on, it will shut off when the input voltage drops below 34V.

Output Over-Current Protection (OCP)

The unit is protected against over current or short circuit on the output. When sensing an over current condition, the unit will enter constant current operation and reduce the output voltage. Upon short-circuit condition, the unit will shut down.

After over-current or short circuit condition is removed, the unit will resume normal operation automatically.

Output Over Voltage Protection (OVP)

This unit does NOT have OVP function.

Over Temperature Protection (OTP)

This unit does NOT have OTP function.

Application Considerations

Input source Impedance

The unit has been designed to be stable with no external capacitor when used in a low inductance input and output circuit.

However in many applications, the inductance with the distribution from the power source to the input of the unit can affect the stability of the unit. An external capacitor will improve the stability of the unit. Also in many applications, the user has to use decoupling capacitors at the output load, to ensure the hold up time for the load.

Safety Requirements (SR)

The unit meets UL/CSA/TUV safety requirements per UL60950, TUV EN60950 and CSA C22.2 No.60950-00. Basic insulation is provided between input and output.

Caution:
The unit does NOT have a fuse inside. The safety agencies require an external normal-blow fuse to be used at the input side to achieve maximum safety. The recommended fuse rating is 2A/100V.

If the input source is non-SELV (ELV or a hazardous voltage greater than 60 Vdc and less than or equal to 75 Vdc), for the unit output to be considered meeting the requirements of safety extra low voltage (SELV), all of the following must be met:

- The input source is to be provided with reinforced insulation from any hazardous voltage, including the ac main.
- The input pins of the unit are not operator accessible.
- For the whole system, for safety agencies requirements, and for the combination of the unit input side (primary side) and the output side (secondary side), verify that under a single fault, hazardous voltages do not appear at the unit output side (secondary side).
- Never ground either of the input pins of the unit without grounding one of the output pins. This may allow a non-SELV voltage to appear between the output pin and ground.

Electromagnetic Compatibility (EMC)

The unit's conducted emission meets the requirement of EN55022 Class B Specifications, so no external input filter is needed unless a stricter conducted EMI/EMC limitation is required to satisfy or user has its own requirement on the input.

Fig 6 shows the measured conducted EMC. Six-sided metal shields for zero radiated emission.

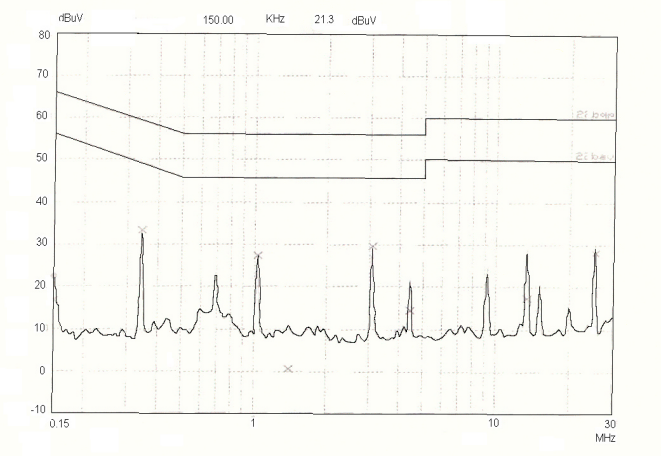


Fig 6. Conducted EMC (150KHz-30MHz) test result, the upper trace is the limit of EN55022 Class B specification

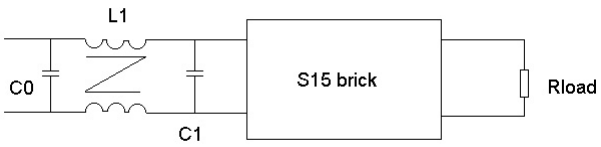


Fig 6A. The external filter circuit

C0 = 1.0 uF 250Vdc film capacitor
C1 = 1.0 uF 100Vdc ceramic capacitor
L1 = 2.2 mH Common mode choke

Input Transient Withstand (ITW)

The unit can withstand input transient voltage with 100V/100ms pulse and never be damaged.

Characterization

General information

This unit has many operational characterized aspects including thermal derating, efficiency, start up and overshoot, output ripple & noise, dynamic response, over current protection curve and etc.

The following pages contain specific plots or waveforms associated with the unit. Additional comments for specific data are provided below.

Test Conditions

All data presented were taken with the unit soldered to a test board, which is a 0.060" thick printed circuit board. No heat sink was used during all measurements. No airflow was used except in de-rating rest.

For the input line, a 1μF /100V ceramic has been used during the test. On the output side, a 10μF tantalum capacitor with Esr < 0.12Ω and 1μF ceramic capacitor have been used. Both input and output capacitors were put close to the unit.

NOTE:
It is important to make sure that the components on the unit do not exceed their rating.

Start up

The startup scenarios are explained in Fig 7 and 8.

The measured waveforms showing the turn on transient are given in Fig 9, for positive logic control units.

Efficiency

Efficiency vs. load current curve at different inputs of 36V, 48V and 75V is given in Fig 10. The ambient temperature is 25°C.
Efficiency with nominal input (48V) at different ambient temperatures (25°C, 40°C and 55°C) is also given in Fig 11.

Dynamic Response

The dynamic response of the unit at load step is shown in Fig 12. The output load current change from 50% to 75% and return to 50% at the slew of 0.1A/μs. The input is 48V and a filter of 10μF tantalum capacitor and 1μF ceramic capacitor is used parallel to the output.

Ripple and Noise

The output voltage waveform has been measured at full load condition, with 10μF tantalum capacitor plus 1μF Ceramic capacitor closely parallel to the unit's output. Fig 13 shows the output ripple and noise waveform.

Thermal De-rating

For thermal de-rating, output current vs. ambient temperature and airflow rates has been tested, and the test results are given in Fig 14.
Ambient temperature varies between 55°C and 90°C with the airflow of 0, 100 and 200LFM (0, 0.5m/s and 1m/s).

Others

Other curve and waveforms presented include output voltage vs. current curve (Fig 15) and input current ripple waveform at full load condition (Fig 16).

Start up Information

Scenario #1: Initial Start up from power supply

On/Off function enabled, the unit starts via input voltage Vin, see Fig 7.

Time	Comments
t0	On/Off pin is On: system front-end power is switched on, Vin to unit begins to rise.
t1	Vin crosses Under Voltage Lockout protection circuit threshold: the unit enabled to be on
t2	The unit begins to turn on (unit turn-on delay).
t3	Unit output voltage reaches 100% of normal voltage.

For this example, the unit total start up time (t3- t1) is typically 200us.

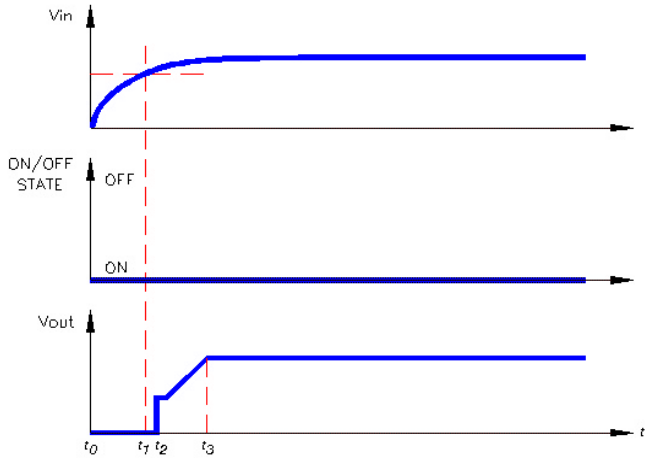


Fig 7 Start up waveform

Scenario #2: Initial Start up using On/Off Pin

With Vin previously powered, the unit starts via On/Off pin, see Fig 8.

Time	Comments
t0	Vin at nominal value.
t1	Arbitrary time when On/Off pin is enabled (Unit enabled)
t2	End of unit turn-on delay
t3	Unit Vout reaches 100% of nominal voltage.

For this example, the unit total start up time (t3- t1) is typically 300us.

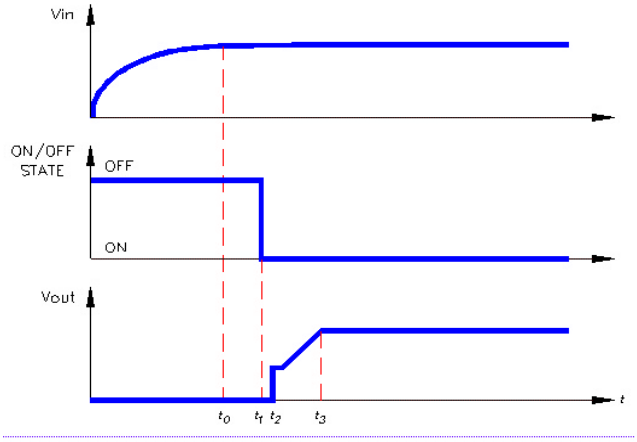


Fig 8. Start up using On/Off pin

Turn-On Transient Waveforms

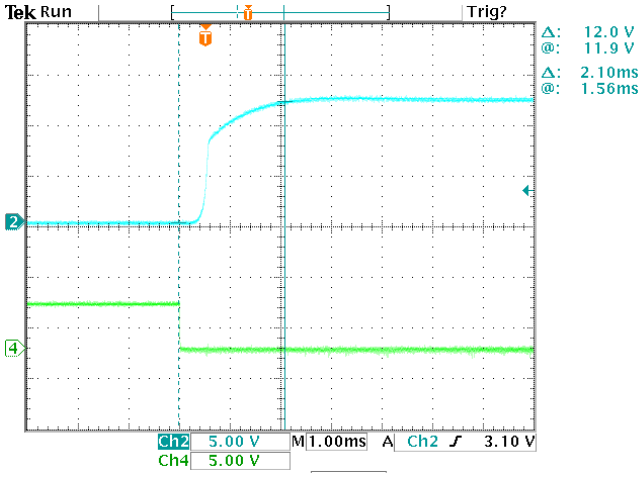


Fig 9. Startup under positive logic control at Vin=48v, Iout =3A. Ch2: ON/OFF signal (1V/div) , Ch1: Output voltage (2V/div), Co=10μF tantalum capacitor + 1μF Ceramic capacitor, time scale: 200μs/div

Efficiency Curves

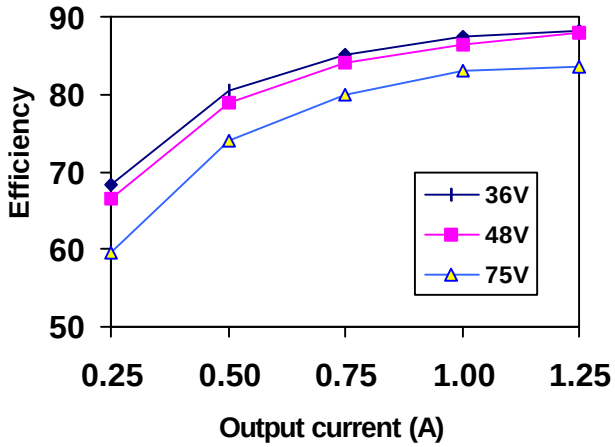


Fig 10. Efficiency vs. output current at various Input voltage. The ambient temperature is 25°C

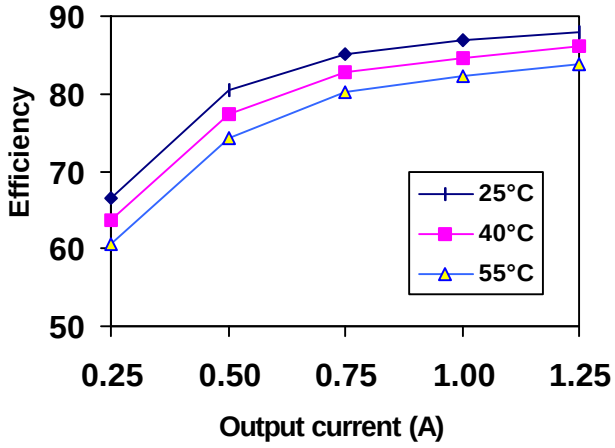


Fig 11. Efficiency at nominal input (48V) vs. load at different ambient temperatures of 25°C, 40°C, 55°C without air flow, the input voltage is 48V.

Dynamic Response Waveform

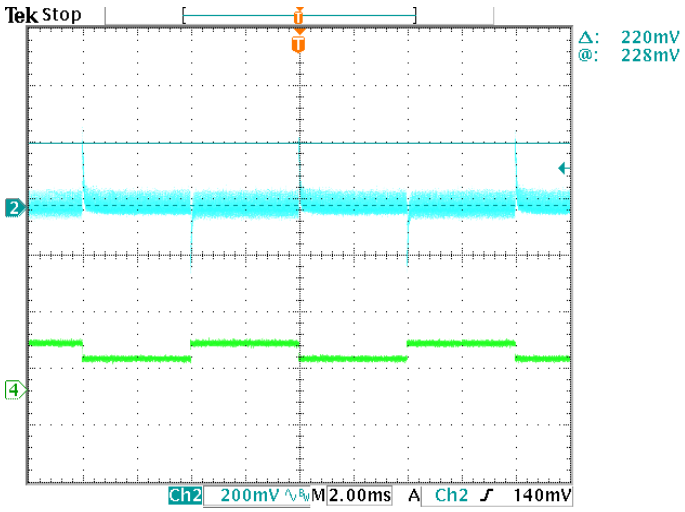


Fig 12. Dynamic response of load step at Vin=48v, Ch1: output voltage change(100mv/div), Ch2: output current step of 50%-75%-50% (0.5A/div). Current slew rate:0.1A/μs, Co=10μF tantalum capacitor + 1μF Ceramic capacitor, time scale: 1ms/div

Output Ripples and Noise Waveform

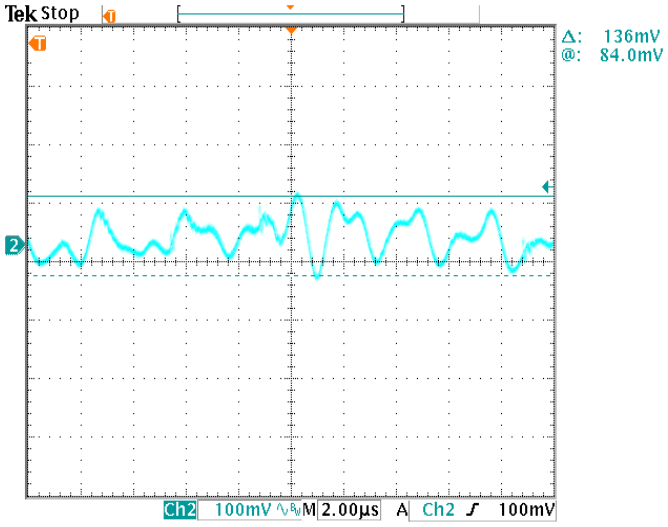


Fig13. Output voltage Ripple & Noise at Vin=48v, Iout=1.25A Co=10μF tantalum capacitor + 1μF Ceramic capacitor, ch1: 20mV/div, time scale: 1μs/div.

Thermal De-Rating Curve

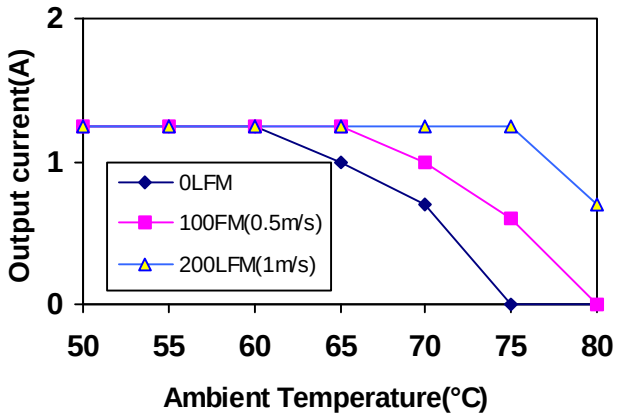


Fig 14. Maximum output current vs. temperature. Both the input and output voltages are nominal.

Over Current Protection Curve

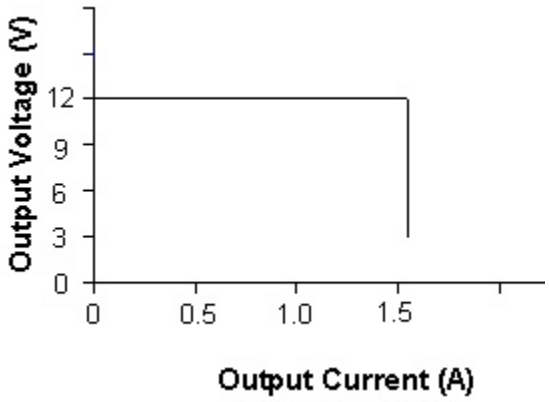


Fig 15. Output voltage vs current showing current limit point and converter shut down point

Input Current Ripple Waveform

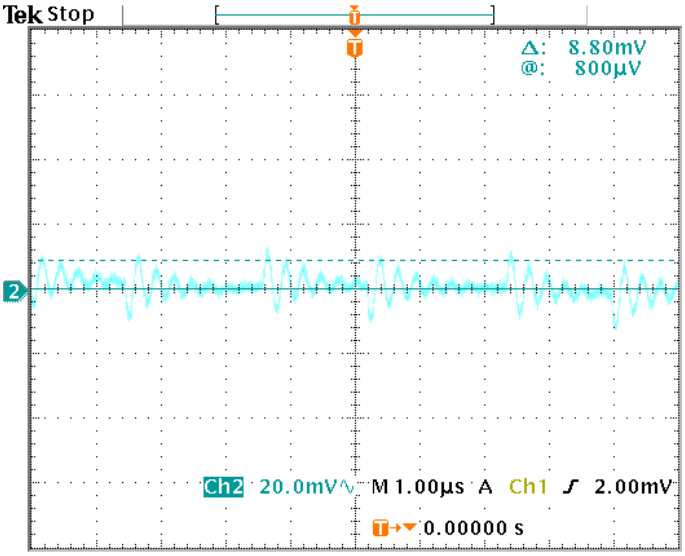


Fig 16. Input current ripple with full output load at 48V input (10mA/div), time scale: 1µs/div