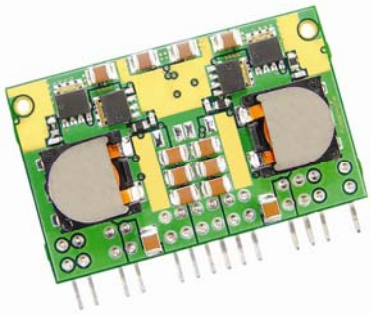
YV12T25 DC-DC Converter

10 - 14 VDC Input; 0.8 - 5.5 VDC Programmable @ 25 A

Data Sheet



RoHS Compliant

Applications

- Intermediate Bus Architectures
- Telecommunications
- Data communications
- Distributed Power Architectures
- Servers, workstations

Benefits

- High efficiency– no heat sink required
- Cost effective
- Reduces Total Solution Board Area

The maXyz Products: Y-Series

Features

- RoHS lead-free solder and lead-solder-exempted products are available
- Delivers up to 25 A
- Input range 10 - 14 V
- Small size and low profile: 1.25” x 2.00” x 0.335” (31.7 x 50.8 x 8.50 mm)
- Start-up into pre-biased output
- No minimum load required
- Operating ambient temperature: -40 °C to 85 °C
- Remote output sense
- Remote ON/OFF
- Fixed frequency operation (500 kHz)
- Auto-reset output overcurrent protection
- High reliability, MTBF = 23 Million Hours
- All materials meet UL94, V-0 flammability rating
- UL60950 recognition in U.S. & Canada, and certification per IEC/EN60950

Description

Power-One’s point-of-load converters are recommended for use with regulated bus converters in an Intermediate Bus Architecture (IBA). The YV-Series of non-isolated dc-dc converters deliver up to 25 Amps of output current in a through-hole (SIP) package. Operating from a 10 - 14 VDC input, the YV12T25 converter is an ideal choice for Intermediate Bus Architectures where Point-of-Load (POL) power delivery is a requirement. The converter provides an extremely tight regulated programmable output voltage of 0.80 V to 5.5 V.

The YV-Series of converters provide exceptional thermal performance, even in high temperature environments with minimal airflow. This performance is accomplished through the use of advanced circuitry, packaging and processing techniques to achieve a design possessing ultra-high efficiency, excellent thermal management, and a very low body profile.

The low body profile minimizes impedance to system airflow, thus enhancing cooling for both upstream and downstream devices. The use of automation for assembly, coupled with advanced power electronics and thermal design, results in a product with extremely high reliability.

Electrical Specifications

Conditions: T_A = 25 ºC, Airflow = 300 LFM (1.5 m/s), Vin = 12.0 VDC, Vout = 0.8 – 5.5 V, unless otherwise specified.

Parameters	Notes	Min	Typ	Max	Units
Absolute Maximum Ratings					
Input Voltage	Continuous	-0.3		14	VDC
Operating Ambient Temperature		- 40		85	°C
Storage Temperature		-55		125	°C
Feature Characteristics					
Switching Frequency			500		kHz
Output Voltage Trim Range[1]	By external resistor, See Trim Table 1	0.7887		5.5	VDC
Remote Sense Compensation[1]				0.5	VDC
Turn-On Delay Time[2]	Full resistive load				
With Vin = (Converter Enabled, then Vin applied)	From Vin = Vin(min) to Vo = 0.1* Vo(nom)		0.5		ms
With Enable (Vin = Vin(nom) applied, then enabled)	From enable to Vo = 0.1*Vo(nom)		1.0		ms
Rise time[2] (Full resistive load; No external output capacitors)	From 10%Vo(set) to 90%Vo(set)		2.0		ms
SEQ/ENA Control Signal[3]	Vin=Vin(on) to Vin(max); Open collector or equivalent; (Signal referenced to GND)				
Logic High (Module OFF)					
SEQ/ENA Current		0.5		2.33	mA
SEQ/ENA Voltage		3.5		14	VDC
Logic Low (Module ON)					
SEQ/ENA Current				200	µA
SEQ/ENA Voltage				0.8	VDC

Additional Notes:
1 The output voltage should not exceed 5.5 V (taking into account both the programming and remote sense compensation).
2 Note that startup time is the sum of turn-on delay time and rise time.
3 The converter is ON if the SEQ/ENA pin is left open.

Electrical Specifications (continued)

Conditions: T_A = 25 ºC, Airflow = 300 LFM (1.5 m/s), Vin = 12.0 VDC, Vout = 0.8 – 5.5 V, unless otherwise specified.

Parameter	Notes	Min	Typ	Max	Units
Input Characteristics					
Operating Input Voltage Range		10	12	14	VDC
Input Undervoltage Lockout					
Turn-on Threshold				9.9	VDC
Turn-off Threshold		8.1			VDC
Maximum Input Current	25 ADC Output @ 10VDC Input				
	V_{OUT} = 5.0 VDC			13.2	ADC
	V_{OUT} = 3.3 VDC			8.9	ADC
	V_{OUT} = 2.5 VDC			6.9	ADC
	V_{OUT} = 2.0 VDC			5.6	ADC
	V_{OUT} = 1.8 VDC			5.1	ADC
	V_{OUT} = 1.5 VDC			4.3	ADC
	V_{OUT} = 1.2 VDC			3.5	ADC
	V_{OUT} = 0.8 VDC			2.5	ADC
Input Standby Current (Converter disabled)			25		mA
Input No Load Current (Converter enabled)	V_{OUT} = 5.0 VDC		113		mA
	V_{OUT} = 3.3 VDC		94		mA
	V_{OUT} = 2.5 VDC		84		mA
	V_{OUT} = 2.0 VDC		78		mA
	V_{OUT} = 1.8 VDC		78		mA
	V_{OUT} = 1.5 VDC		77		mA
	V_{OUT} = 1.2 VDC		77		mA
	V_{OUT} = 0.8 VDC		77		mA
Input Reflected-Ripple Current - i_S	See Fig. E for setup. (BW = 20 MHz)		30		mA_{P-P}
Input Voltage Ripple Rejection	120 Hz		60		dB

Electrical Specifications (continued)

Conditions: T_A = 25 ºC, Airflow = 300 LFM (1.5 m/s), Vin = 12.0 VDC, Vout = 0.8 – 5.5 V, unless otherwise specified.

Parameter	Notes	Min	Typ	Max	Units
Output Characteristics					
Output Voltage Set Point (No Load)		- 1.2	Vout	+1.2	%Vout
Output Regulation					
Over Line	Full resistive load		0.01	0.1	%Vout
Over Load	From no load to full load		0.1	0.2	%Vout
Output Voltage Range (Over all operating input voltage, resistive load and temperature conditions until end of life)		-3.0		+3.0	%Vout
Output Ripple and Noise – 20 MHz bandwidth	Over line, load and temperature				
Peak-to-Peak	V_{OUT} = 5.0 VDC		40		mV_{P-P}
Output Overvoltage Protection (Non-Latching)	All output voltages	5.7	6.0	6.3	V
Overtemperature protection	All output voltages		125		°C
External Load Capacitance	Plus full load (resistive)				
Min ESR > 1mΩ				1,000	µF
Min ESR > 10mΩ				10,000	µF
Min ESR > 10mΩ	V_{OUT} = 5.0 VDC			6,800	µF
Output Current Range		0		25	A
Output Current Limit Inception (I_{OUT})			125	150	%Iout
Output Short-Circuit Current , RMS Value	Short = 10 mΩ, continuous		3		Arms
Dynamic Response					
Load current change from 12.5 A – 25 A, di/dt = 5 A/µs	No external output capacitance			150	mV
Settling Time (V_{OUT} < 10% peak deviation)			25		µs
Unloading current change from 25 A – 12.5 A, di/dt = -5 A/µs	No external output capacitance			150	mV
Settling Time (V_{OUT} < 10% peak deviation)			25		µs
Efficiency	Full load (25A)				
	V_{OUT} = 5.5 VDC		94.3		%
	V_{OUT} = 3.3 VDC		92.2		%
	V_{OUT} = 2.5 VDC		90.7		%
	V_{OUT} = 2.0 VDC		88.9		%
	V_{OUT} = 1.8 VDC		88.0		%
	V_{OUT} = 1.5 VDC		86.3		%
	V_{OUT} = 1.2 VDC		83.7		%
	V_{OUT} = 0.8 VDC		77.7		%

General Specifications

Parameter	Notes	Min	Typ	Max	Units
Calculated MTBF	50% Stress, Ta = 40 °C		23		Million Hours
Weight		-	19 (0.67)	-	g(oz.)

Operations

Input and Output Impedance

The YV-Series converter should be connected via a low impedance to the DC power source. In many applications, the inductance associated with the distribution from the power source to the input of the converter can affect the stability of the converter. It is recommended to use low - ESR tantalum, POS or ceramic decoupling capacitors (minimum 150 µF) placed as close as possible to the converter input pins in order to ensure stability of the converter and reduce input ripple voltage. Internally, the converter has 40 µF (low ESR ceramics) of input capacitance.

The YV12T25-0 has been designed for stable operation with or without external output capacitance.

It is important to keep low resistance and low inductance PCB traces for connecting load to the output pins of the converter in order to maintain good load regulation.

SEQ/ENA (Pin 13)

The SEQ/ENA pin is used to turn the power converter on or off remotely via a system signal. If not using the remote ON/OFF, leave the pin open (module will be on). The SEQ/ENA signal is referenced to ground. The typical connections are shown in Fig. A.

The converter is ON when the SEQ/ENA pin is at a logic low or left open, and OFF when the SEQ/ENA pin is at a logic high (3.5V min) or connected to Vin. The external resistor R1 should be chosen to maintain 3.5V minimum on the SEQ/ENA pin to insure that the unit is OFF when Q1 is turned OFF. Note that the external diode is required for proper operation.

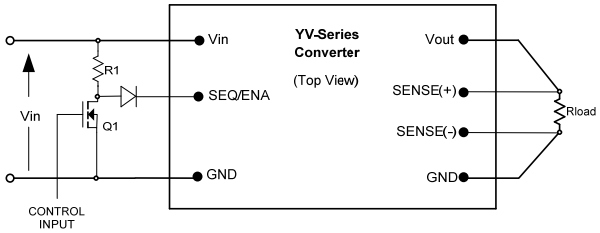


Fig. A: Circuit configuration for ON/OFF function.

Remote Sense (Pins 1 and 2)

The remote sense feature of the converter compensates for voltage drops occurring between the output pins of the converter and the load. The SENSE(-) (Pin 2) and SENSE(+) (Pin 1) pins should be connected at the load or at the point where regulation is required (see Fig. B).

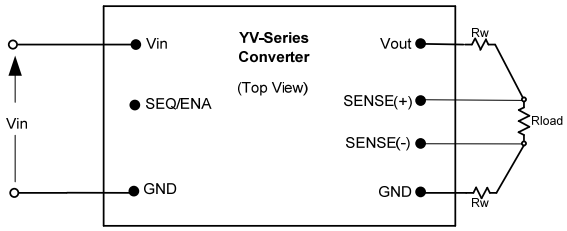


Fig. B: Remote sense circuit configuration.

Because the sense lead carries minimal current, large trace on the end-user board are not required. However, sense trace should be located close to a ground plane to minimize system noise and ensure the optimum performance.

When utilizing the remote sense feature, care must be taken not to exceed the maximum allowable output power capability of the converter, which is equal to the product of the nominal output voltage and the allowable output current for the given conditions.

When using remote sense, the output voltage at the converter can be increased up to 0.5 V above the nominal rating in order to maintain the required voltage across the load. Therefore, the designer must, if necessary, decrease the maximum current (originally obtained from the derating curves) by the same percentage to ensure output power remains at or below the maximum allowable output power.

Output Voltage Programming

The output voltage can be programmed from 0.8 V to 5.5 V by connecting an external resistor (R_{TRIM}) between SENSE(+) pin (Pin 1) and Vout pin (see Fig. C).If the R_{TRIM} is not used and SENSE(+) is shorted to Vout, the output voltage of the module will be 0.7887V. If the SENSE(+) is not connected to the Vout, the output of the module will reach overvoltage shutdown. A 1µF multilayer ceramic capacitor is required from R_{TRIM} to SENSE(-) pin to minimize noise.

A trim resistor, R_{TRIM}, for a desired output voltage can be calculated using the following equation:

$$R_{TRIM} := 775 \cdot \left(\frac{V_{O-REQ}}{0.7887} - 1 \right) \quad [\Omega]$$

where,

R_{TRIM} = Required value of trim resistor [Ω]

V_{O-REQ} = Desired (trimmed) output voltage [V]

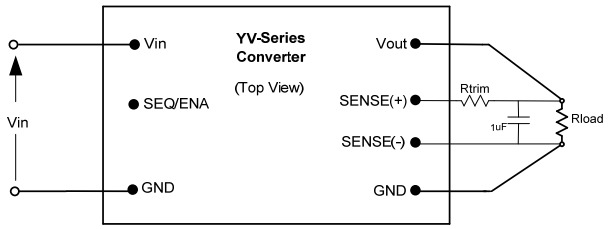


Fig. C: Configuration for programming output voltage.

Note that the tolerance of a trim resistor directly affects the output voltage tolerance. It is recommended to use standard 1% or 0.5% resistors; for tighter tolerance, two resistors in parallel are recommended rather than one standard value from Table 1.

V_{O-REG} [V]	R_{TRIM} [Ω]
0.8	11
1.0	208
1.2	404
1.5	699
1.8	994
2.0	1190
2.5	1682
3.3	2468
5.0	4138
Overvoltage Shutdown	Open

Table 1: Trim Resistor Values

Protection Features

Input Undervoltage Lockout

Input undervoltage lockout is standard with this converter. The converter will shut down when the input voltage drops below a pre-determined voltage; it will start automatically when Vin returns to a specified range. .

Output Overcurrent Protection (OCP)

The converter is protected against overcurrent and short circuit conditions. Upon sensing an overcurrent condition, the converter will enter hiccup mode. Once over-load or short circuit condition is removed, Vout will return to nominal value.

Overtemperature Protection (OTP)

The converter will shut down under an overtemperature condition to protect itself from overheating caused by operation outside the thermal derating curves, or operation in abnormal conditions such as system fan failure. After the converter has cooled to a safe operating temperature, it will automatically restart.

Safety Requirements

The converter meets North American and International safety regulatory requirements per UL60950 and EN60950. The maximum DC voltage between any two pins is Vin under all operating conditions. Therefore, the unit has ELV (extra low voltage) output; it meets SELV requirements under

the condition that all input voltages are ELV. The converter is not internally fused. To comply with safety agencies' requirements, a recognized fuse with a maximum rating of 30 Amps must be used in series with the input line.

Characterization

General Information

The converter has been characterized for many operational aspects, to include thermal derating (maximum load current as a function of ambient temperature and airflow) for vertical and horizontal mountings, efficiency, startup and shutdown parameters, output ripple and noise, transient response to load step-change, overload, and short circuit.

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

Test Conditions

All data presented were taken with the converter soldered to a test board, specifically a 0.060" thick printed wiring board (PWB) with four layers. The top and bottom layers were not metalized. The two inner layers, comprised of two-ounce copper, were used to provide traces for connectivity to the converter.

The lack of metalization on the outer layers as well as the limited thermal connection ensured that heat transfer from the converter to the PWB was minimized. This provides a worst-case but consistent scenario for thermal derating purposes.

All measurements requiring airflow were made in the vertical and horizontal wind tunnels using Infrared (IR) thermography and thermocouples for thermometry.

Ensuring components on the converter do not exceed their ratings is important to maintaining high reliability. If one anticipates operating the converter at or close to the maximum loads specified in the derating curves, it is prudent to check actual operating temperatures in the application. Thermographic imaging is preferable; if this capability is not available, then thermocouples may be used. The use of AWG #40 gauge thermocouples is recommended to ensure measurement accuracy. Careful routing of the thermocouple leads will further minimize measurement error. Refer to Fig. D for the optimum measuring thermocouple location.

Thermal Derating

Load current vs. ambient temperature and airflow rates are given in Figures 13 to 16 for maximum temperature of 110 °C. Ambient temperature was varied between 25 °C and 85 °C, with airflow rates from 30 to 400 LFM (0.15 m/s to 2.0 m/s), and vertical and horizontal converter mountings. The airflow during the testing is parallel to the long axis of the converter.

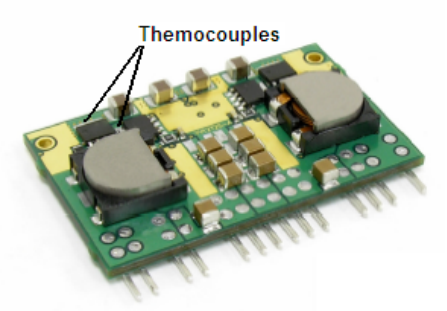


Fig. D: Location of the thermocouples for thermal testing.

For each set of conditions, the maximum load current is defined as the lowest of:

(i) The output current at which any MOSFET temperature does not exceed a maximum specified temperature (110 °C) as indicated by the thermographic image, or

(ii) The maximum current rating of the converter

During normal operation, derating curves with maximum FET temperature less than or equal to 110°C should not be exceeded. Temperature on the MOSFET at the thermocouple location shown in Fig. D should not exceed 110 °C in order to operate inside the derating curves.

Efficiency

Figures 1 to 6 shows the efficiency vs. load current plot for ambient temperature of 25 ºC and input voltages of 10.8 V, 12 V, and 13.2 V.

Ripple and Noise

The output voltage ripple waveform is measured at full rated load current. Note that all output voltage waveforms are measured across a 1 µF ceramic capacitor. The output voltage ripple and input reflected ripple current waveforms are obtained using the test setup shown in Fig. E.

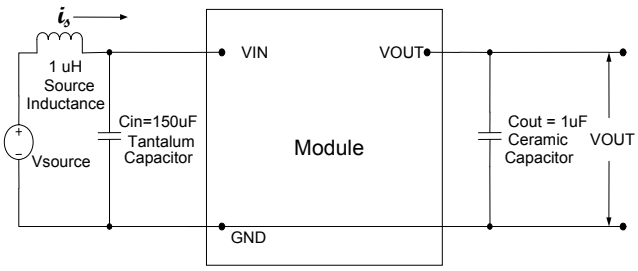


Fig. E: Test setup for measuring input reflected-ripple currents, is and output voltage ripple.

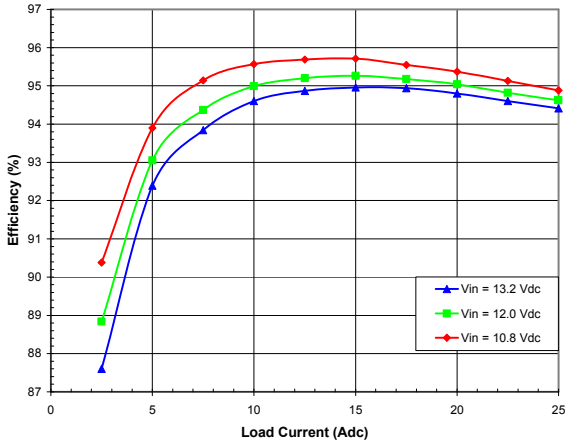


Fig. 1: Efficiency vs. load current and input voltage for Vout = 5.0 V.

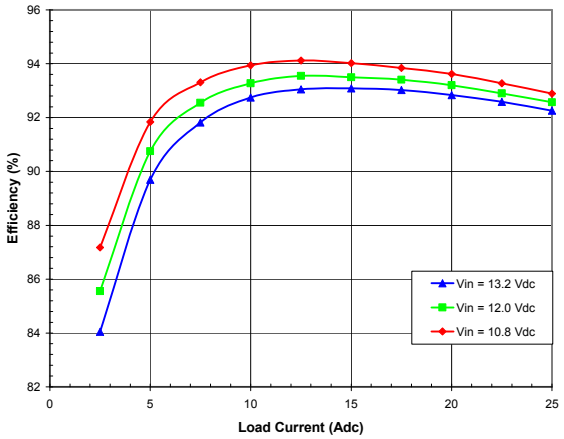


Fig. 2: Efficiency vs. load current and input voltage for Vout = 3.3 V.

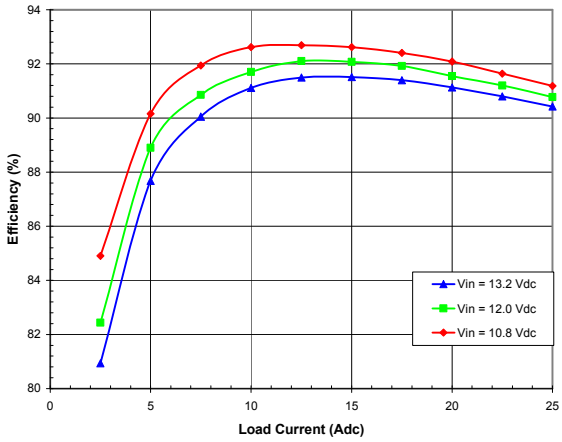


Fig. 3: Efficiency vs. load current and input voltage for Vout = 2.5 V.

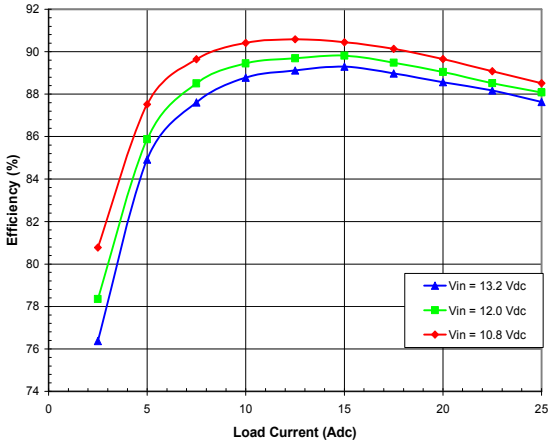


Fig. 4: Efficiency vs. load current and input voltage for Vout = 1.8 V.

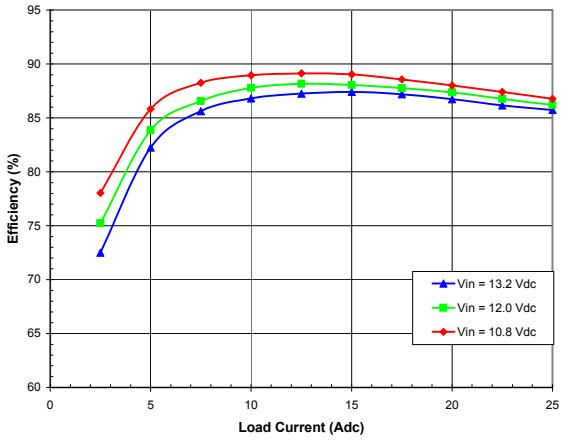


Fig. 5: Efficiency vs. load current and input voltage for Vout = 1.5 V.

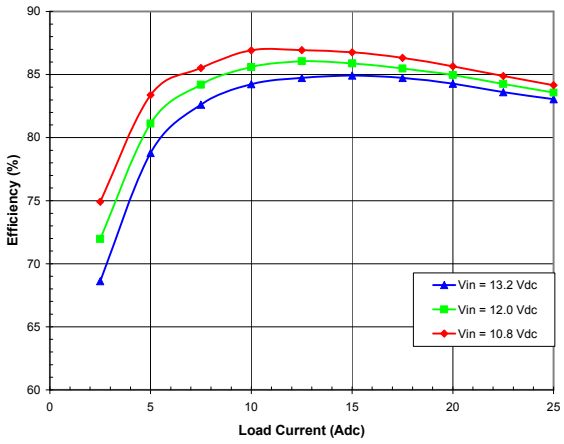


Fig. 6: Efficiency vs. load current and input voltage for Vout = 1.2 V.

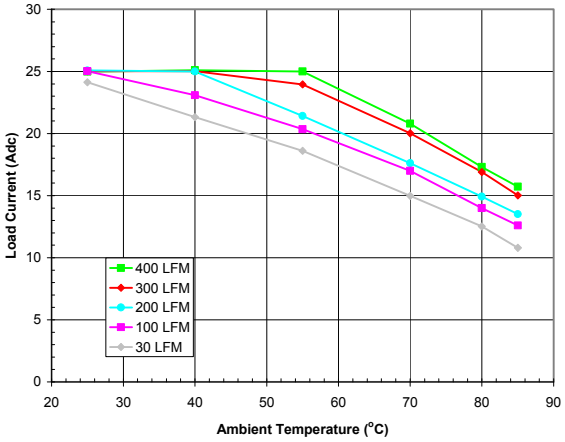


Fig. 13: Available load current vs. ambient temperature and airflow rates for Vout = 5.0 V with Vin = 12 V, and maximum MOSFET temperature ≤ 110 °C. Horizontal Orientation (Airflow from Vin pin to GND pin.)

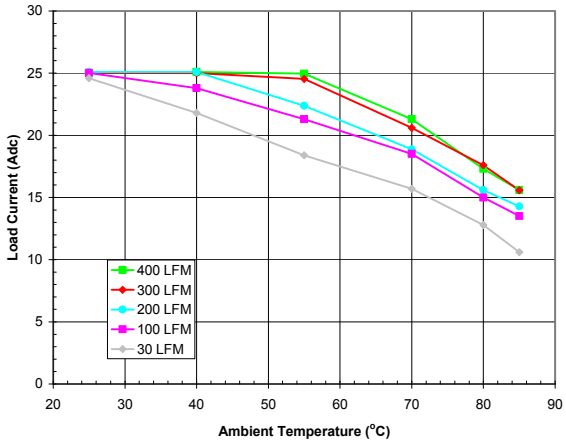


Fig. 14: Available load current vs. ambient temperature and airflow rates for Vout = 3.3 V with Vin = 12 V, and maximum MOSFET temperature ≤ 110 °C. Horizontal Orientation (Airflow from Vin pin to GND pin.)

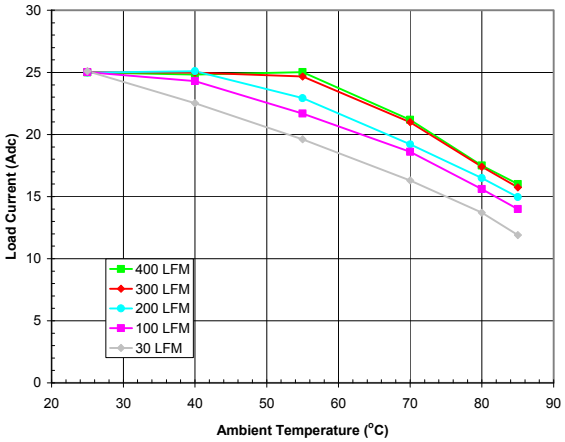


Fig. 15: Available load current vs. ambient temperature and airflow rates for Vout = 1.8 V with Vin = 12 V, and maximum MOSFET temperature ≤ 110 °C. Horizontal Orientation (Airflow from Vin pin to GND pin.)

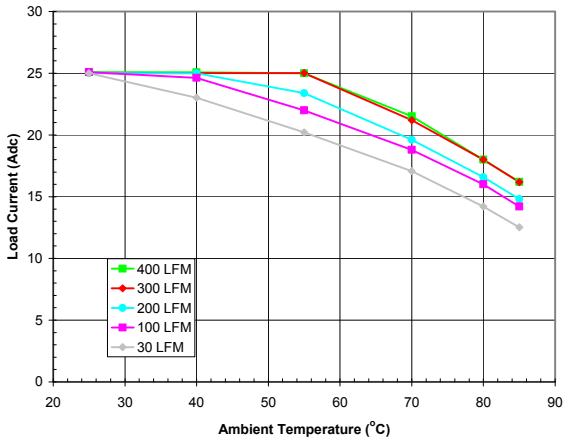


Fig. 16: Available load current vs. ambient temperature and airflow rates for Vout = 1.2 V with Vin = 12 V, and maximum MOSFET temperature ≤ 110 °C. Horizontal Orientation (Airflow from Vin pin to GND pin.)

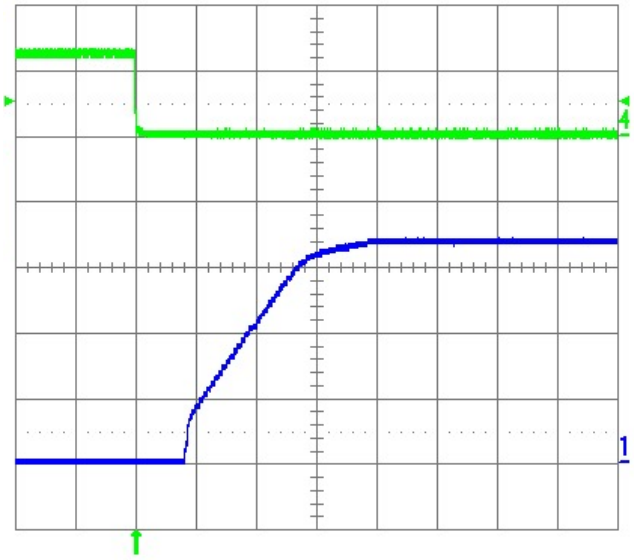


Fig. 17: Turn-on transient for Vout = 3.3 V with the application of SEQ/ENA signal at full rated load current (resistive) and 1 µF external capacitance at Vin = 12 V. Top Trace: SEQ/ENA Signal (5 V/div.); Bottom Trace: Output Voltage (1 V/div.); Time Scale: 1 ms/div.

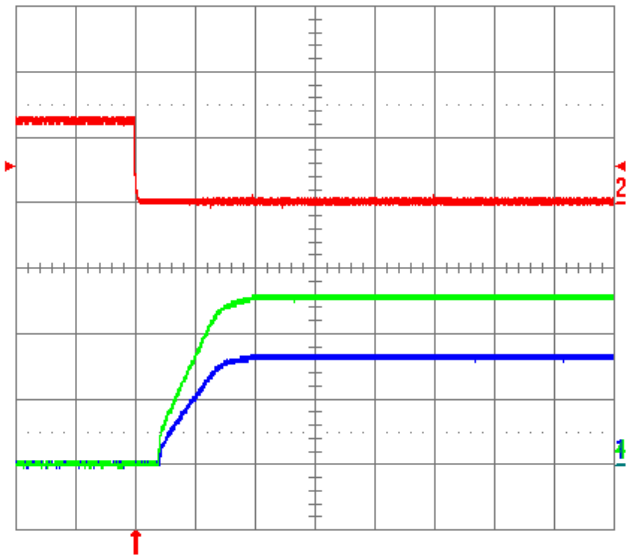


Fig. 18: Turn-on transient for Vout = 3.3 V and 5.0 V with the application of SEQ/ENA signal at full rated load current (resistive) and 1 µF external capacitance at Vin = 12 V. SEQ/ENA pins are tied together. Top Trace: SEQ/ENA Signal (5 V/div.); Middle Trace: Output Voltage of 5V POL (2V/div.); Bottom Trace: Output Voltage of 3.3V POL (2 V/div.); Time Scale: 2 ms/div.

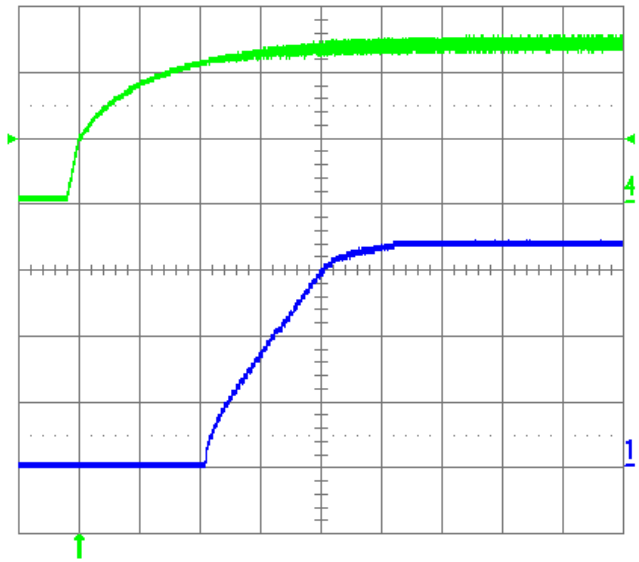


Fig. 19: Turn-on transient for Vout = 3.3 V with the application of the input voltage at full rated load current (resistive) and 1 µF external capacitance at Vin = 12 V. Top Trace: Input Voltage Signal (5 V/div.); Bottom Trace: Output Voltage (1 V/div.); Time Scale: 1 ms/div.

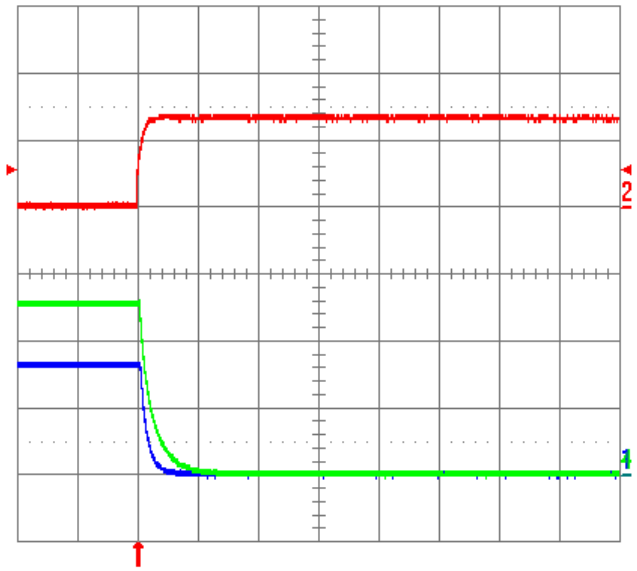


Fig. 20: Turn-off transient for Vout = 3.3 V and 5.0 V with the removal of SEQ/ENA signal at full rated load current (resistive) and 1 µF external capacitance at Vin = 12 V. SEQ/ENA pins are tied together. Top Trace: SEQ/ENA Signal (5 V/div.); Middle Trace: Output Voltage of 5V POL (2V/div.); Bottom Trace: Output Voltage of 3.3V POL (2 V/div.); Time Scale: 2 ms/div.

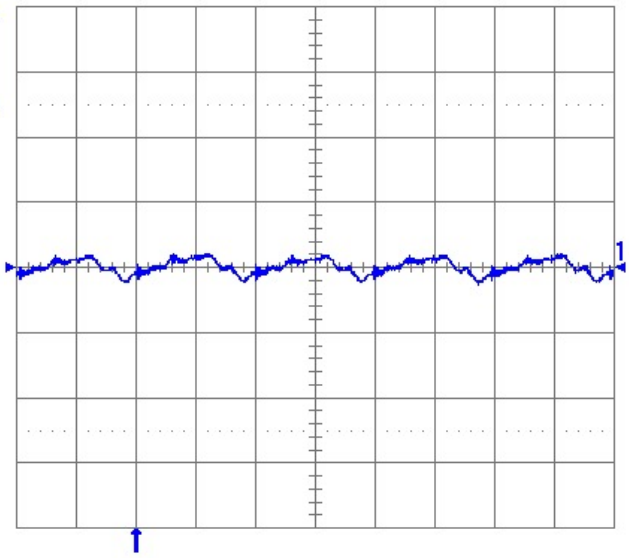


Fig. 21: Output voltage ripple (20 mV/div.) at full rated load current into a resistive load with external capacitance 1 µF ceramic and Vin = 12 V for Vout = 3.3 V.
Time Scale: 1 µs/div.

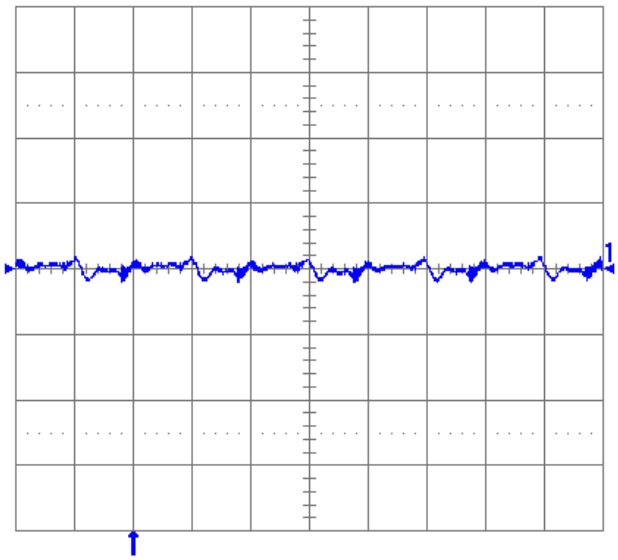


Fig. 22: Output voltage ripple (20 mV/div.) at full rated load current into a resistive load with external capacitance 1 µF ceramic and Vin = 12 V for Vout = 1.2 V.
Time Scale: 1 µs/div.

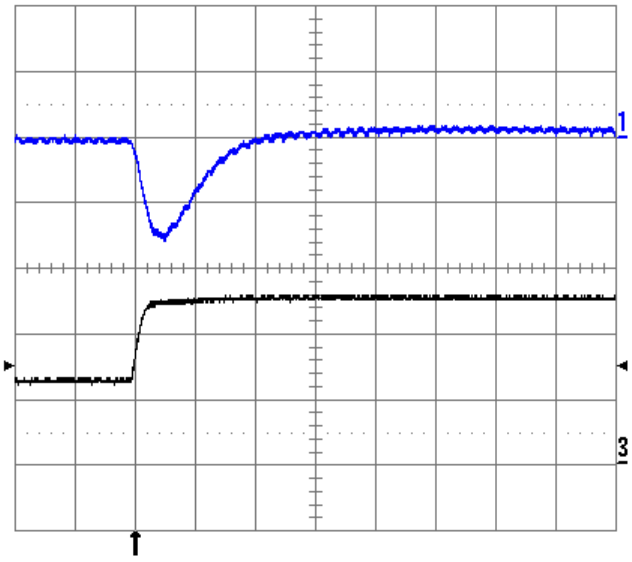


Fig. 23: Output voltage response for Vout = 3.3 V to positive load current step change from 12.5 A to 25 A with slew rate of 5 A/µs at Vin = 12 V. Top Trace: Output Voltage (100 mV/div.); Bottom Trace: Load Current (10 A/div.) Co =1 µF ceramic. Time Scale: 10 µs/div.

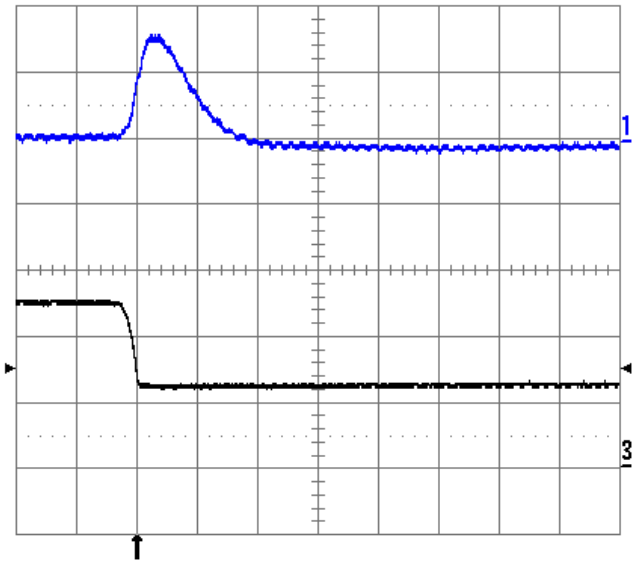
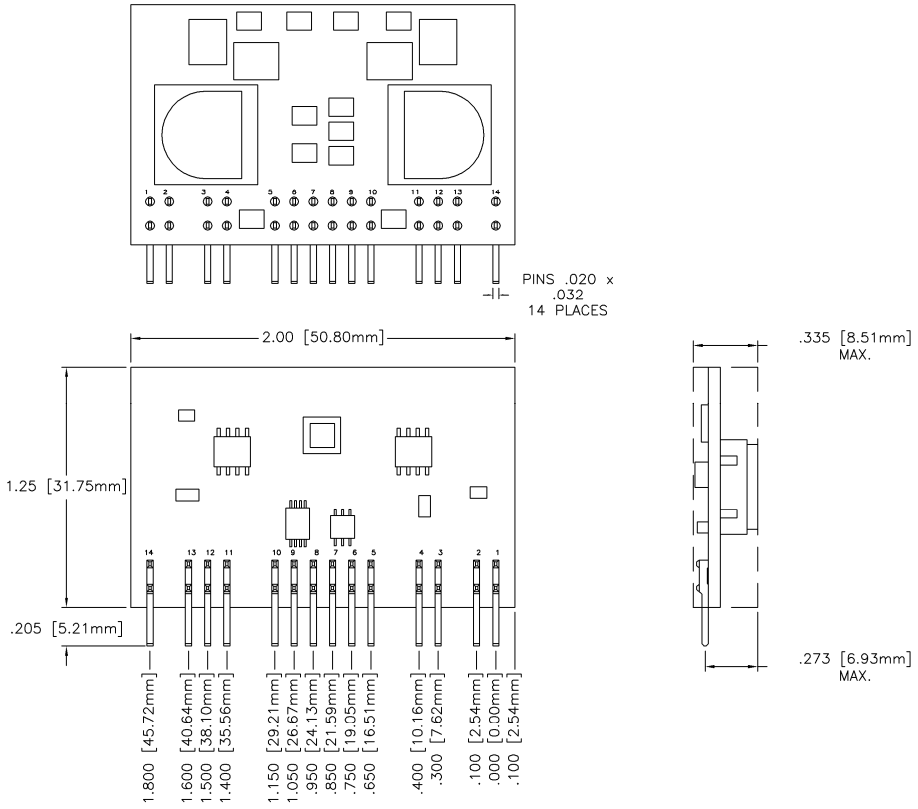


Fig. 24: Output voltage response for Vout = 3.3 V to negative load current step change from 25 A to 12.5 A with slew rate of -5 A/µs at Vin = 12 V. Top Trace: Output Voltage (100 mV/div.); Bottom Trace: Load Current (10 A/div.) Co = 1 µF ceramic. Time Scale: 10 µs/div.

Physical Information



Through-hole – SIP

Pad/Pin Connections	
Pad/Pin #	**Function**
1	SENSE+
2	SENSE-
3	Vin
4	Ground
5	Vout
6	Vout
7	Ground
8	Ground
9	Vout
10	Vout
11	GROUND
12	Vin
13	SEQ/ENA
14	SHARE

YV12T25 Platform Notes

- All dimensions are in inches [mm]
- All pins are .032 x .032
- Pin Material & Finish: Copper C11000 with Matte Tin over Nickel

Tolerances:
x.xxx in. +/- .010 [x.xx mm +/- 0.25]
x.xx in. +/- .020 [x.x mm +/- 0.5]

Converter Part Numbering Scheme

Product Series	Input Voltage	Mounting Scheme	Rated Load Current		Enable Logic	Environmental
YV	**12**	**T**	**25**	**–**	**0**	**G**
YV-Series	10 – 14 V	T ⇒ SIP Through-hole	25 A (0.8 V to 5.5 V)		0 ⇒ Standard (Negative Logic)	No Suffix ⇒ RoHS lead-solder exemption compliant G ⇒ RoHS lead-free solder compliant
The example above describes P/N YV12T25-0: 10 – 14 V input, through-hole (SIP), 25 A at 0.8 V to 5.5 V output, standard enable logic, and Eutectic Tin/Lead solder. Please consult factory for the complete list of available options.						