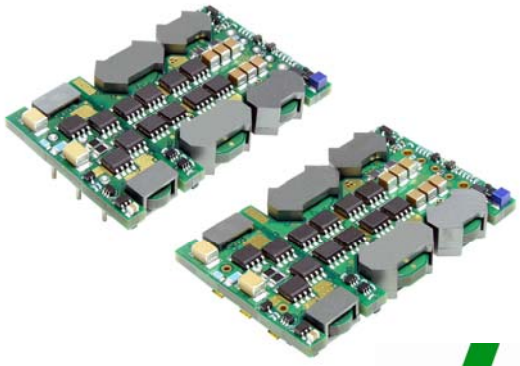


RoHS Compliant

Applications

- Telecommunications
- Data communications
- Wireless communications
- Servers, workstations

Benefits

- High efficiency – no heat sink required
- Higher current capability at 70 °C than many competitors' 12 V half-bricks

Features

- RoHS lead-free solder and lead-solder-exempted products are available
- Delivers up to 14 A (168 W)
- Industry-standard quarter-brick pinout
- Available: through-hole and surface-mount packages
- Weight: 1.1 oz [31.5 g] typical
- On-board input differential LC-filter
- Start-up into pre-biased load
- No minimum load required
- Meets Basic Insulation requirements of IEC60950
- Withstands 100 V input transient for 100 ms
- Fixed-frequency operation
- Fully protected
- Remote output sense
- Fully protected with automatic recovery
- Paralleling option available
- Positive or negative logic ON/OFF option
- Output voltage trim range: +10%/−20% with industry-standard trim equations
- High reliability: MTBF approx. 2.6 million hours, calculated per Telcordia TR-332, Method I Case 1
- Safety approved to UL60950-1, CSA60950-1, EN60950-1 and IEC60950-1.
- Designed to meet Class B conducted emissions per FCC and EN55022 when used with external filter
- All materials meet UL94, V-0 flammability rating

Description

The QM48T/S14120 converter of the QM-Series provides outstanding thermal performance in high temperature environments. This performance is accomplished through the use of patented/patent-pending circuits, packaging, and processing techniques to achieve ultra-high efficiency, excellent thermal management, and a low-body profile.

The low-body profile and the preclusion of heat sinks minimize impedance to system airflow, thus enhancing cooling for both upstream and downstream devices. The use of 100% automation for assembly, coupled with advanced electronic circuits, and thermal design results in a product with extremely high reliability.

Operating from a 36-75 V input, the QM-Series converters provide outputs that can be trimmed from –20% to +10% of the nominal output voltage, thus providing outstanding design flexibility.

The paralleling version of the QM48T/S14120-wxyP converter has the paralleling capability for use in applications requiring higher power levels than available with a single converter.

Electrical Specifications (Common for both Non-paralleling and Paralleling Options)

Conditions: T_A = 25 ºC, Airflow = 300 LFM (1.5 m/s), Vi n = 48 VDC, unless otherwise specified.

Parameter	Notes	Min	Typ	Max	Units
Absolute Maximum Ratings					
Input Voltage	Continuous	0		80	VDC
Operating Ambient Temperature		-40		85	°C
Storage Temperature		-55		125	°C
Isolation Characteristics					
I/O Isolation		2000			VDC
Isolation Capacitance			1.2		ηF
Isolation Resistance		10			MΩ
Feature Characteristics					
Switching Frequency			300		kHz
Output Voltage Trim Range[1]	Industry-standard equations	-20		+10	%
Remote Sense Compensation[1]	Percent of V_{OUT}(NOM)			+10	%
Output Overvoltage Protection	Non-latching	115	128	135	%
Overtemperature Shutdown (PCB)	Non-latching		125		°C
Auto-Restart Period	Applies to all protection features		100		ms
Turn-On Time			4		ms
ON/OFF Control (Positive Logic)					
Converter Off (logic low)		-20		0.8	VDC
Converter On (logic high)		2.4		20	VDC
ON/OFF Control (Negative Logic)					
Converter Off (logic high)		2.4		20	VDC
Converter On (logic low)		-20		0.8	VDC
Input Characteristics					
Operating Input Voltage Range		36	48	75	VDC
Input Under Voltage Lockout	Non-latching				
Turn-on Threshold		33	34	35	VDC
Turn-off Threshold		31	32	33	VDC
Input Voltage Transient	100 ms			100	VDC
Input Stand-by Current	Vin = 48 V, converter disabled		3		mADC
Input No Load Current (0 load on the output)	Vin = 48 V, converter enabled		65		mADC
Input Reflected-Ripple Current	25 MHz bandwidth		20		mA_{PK-PK}

Additional Notes:

[1] Vout can be increased up to 10% via the sense leads or up to 10% via the trim function (Vin > 40 V). However, the total output voltage trim from all sources should not exceed 10% of V_{OUT}(NOM), in order to ensure specified operation of overvoltage protection circuitry.

Electrical Specifications for Single Converter with Non-Paralleling Option

Conditions: T_A = 25 ºC, Airflow = 300 LFM (1.5 m/s), Vin = 48 VDC, unless otherwise specified.

Parameter	Notes	Min	Typ	Max	Units
Maximum Input Current	14 ADC @ 36 VDC In			5.15	ADC
Output Voltage Set Point (no load)		11.88	12.00	12.12	VDC
Output Regulation Over Line			±4	±10	mV
Output Regulation Over Load			±4	±10	mV
Output Voltage Range	Over line, load and temperature[2]	11.8		12.2	VDC
	Over line, load and temperature[3]	11.0		12.2	VDC
Output Ripple and Noise – 25 MHz bandwidth	Full load + 10 µF tantalum + 1 µF ceramic		100	140	mV_{PK-PK}
External Load Capacitance	Plus full load (resistive)			2,200	µF
Output Current Range		0		14	ADC
Current Limit Inception	Non-latching	15.0	16.0	17.0	ADC
Peak Short-Circuit Current	Non-latching, Short = 10 mΩ		19	22	A
RMS Short-Circuit Current	Non-latching			3.5	Arms
Dynamic Response					
Load Change 50%-75%-50%, di/dt = 0.1 A/µs	Co = 100 µF POS + 1 µF ceramic		240		mV
Settling Time to 1%			50		µs
Efficiency					
100% Load			92		%
50% Load			94		%

Electrical specifications for Single Converter with Paralleling Option

Conditions: T_A = 25 ºC, Airflow = 300 LFM (1.5 m/s), Vin = 48 VDC, unless otherwise specified.

Parameter	Notes	Min	Typ	Max	Units
Maximum Input Current	14 ADC @ 36 VDC In			4.75	ADC
Output Voltage Set Point (no load)		12.15	12.27	12.44	VDC
Output Regulation Over Line			±4	±10	mV
Output Regulation Over Load			0.5	0.6	V
Output Voltage Range	Over line, load and temperature[2]	11.5		12.5	VDC
	Over line, load and temperature[3]	11.0		12.5	VDC
Output Ripple and Noise – 25 MHz bandwidth	Full load + 10 µF tantalum + 1 µF ceramic		100	140	mV_{PK-PK}
External Load Capacitance	Plus full load (resistive)			2,200	µF
Output Current Range		0		14	ADC
Current Limit Inception	Non-latching	15.0	16.0	17.0	ADC
Peak Short-Circuit Current	Non-latching, Short = 10 mΩ		19	22	A
RMS Short-Circuit Current	Non-latching			3.5	Arms
Dynamic Response					
Load Change 50%-75%-50%, di/dt = 0.1 A/µs	Co = 100 µF POS + 1 µF ceramic		240		mV
Settling Time to 1%			50		µs
Efficiency					
100% Load			92		%
50% Load			94		%

Additional Notes:

[2] For Vin ≥ 40 V, I_O = 14 A, -40 °C ≤ Tamb ≤ 85 °C.
[3] For Vin ≥ 36 V, I_O = 14 A, -40 °C ≤ Tamb ≤ 85 °C.

Operations

Input and Output Impedance

These power converters have been designed to be stable with no external capacitors when used in low inductance input and output circuits.

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. The addition of a 33 µF electrolytic capacitor with an ESR < 1 Ω across the input helps to ensure stability of the converter. In many applications, the user has to use decoupling capacitance at the load. The power converter will exhibit stable operation with external load capacitance up to 2,200 µF on 12 V output.

Additionally, see the EMC section of this data sheet for discussion of other external components which may be required for control of conducted emissions.

Paralleling Option

The QM48T/S14120-wxyP is a droop parallelable version and is designed with a 600 mV output voltage droop that is proportional to output current. For any input voltage > 40 V, the converter will have an open current output voltage of 12.3 V @ Io = 0, and the nominal output voltage of 11.7 V @ Io = 14 A. The nominal output at 50% load will be 12 V.

ON/OFF (Pin 2)

The ON/OFF pin is used to turn the power converter on or off remotely via a system signal. There are two remote control options available, positive and negative logic, with both referenced to Vin(-). A typical connection is shown in Fig. A.

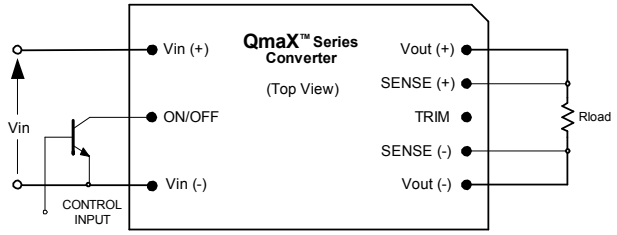


Fig. A: Circuit configuration for ON/OFF function.

The positive logic version turns on when the ON/OFF pin is at a logic high and turns off when at a logic low. The converter is on when the ON/OFF pin is left open. See the Electrical Specifications for logic high/low definitions.

The negative logic version turns on when the pin is at a logic low and turns off when the pin is at a logic high. The ON/OFF pin can be hardwired directly to Vin(-) to enable automatic power up of the converter without the need of an external control signal.

The ON/OFF pin is internally pulled up to 5 V through a resistor. A properly debounced 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 0.2 mA at a low level voltage of ≤ 0.8 V. An external voltage source (±20 V maximum) may be connected directly to the ON/OFF input, in which case it must be capable of sourcing or sinking up to 1 mA depending on the signal polarity. See the Startup Information section for system timing waveforms associated with use of the ON/OFF pin.

Remote Sense (Pins 5 and 7)

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 5) and SENSE(+) (Pin 7) pins should be connected at the load or at the point where regulation is required (see Fig. B).

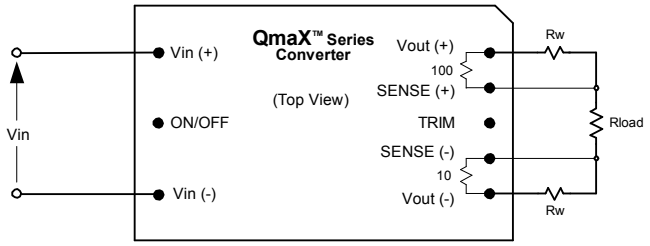


Fig. B: Remote sense circuit configuration.

CAUTION

If remote sensing is not utilized, the SENSE(-) pin must be connected to the Vout(-) pin (Pin 4), and the SENSE(+) pin must be connected to the Vout(+) pin (Pin 8) to ensure the converter will regulate at the specified output voltage. If these connections are not made, the converter will deliver an output voltage that is slightly higher than the specified data sheet value.

Because the sense leads carry minimal current, large traces on the end-user board are not required. However, sense traces should be run side by side and located close to a ground plane to minimize system noise and ensure optimum performance.

The converter's output overvoltage protection (OVP) senses the voltage across Vout(+) and Vout(-), and not across the sense lines, so the resistance (and resulting voltage drop) between the output pins of the converter and the load should be minimized to prevent unwanted triggering of the OVP.

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 by as much as 10% 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 the converter's actual output power remains at or below the maximum allowable output power.

Output Voltage Adjust /TRIM (Pin 6)

The output voltage can be adjusted up 10% (V_{IN} > 40 V) or down 20% relative to the rated output voltage by the addition of an externally connected resistor.

The TRIM pin should be left open if trimming is not being used. To minimize noise pickup, a 0.1 µF capacitor is connected internally between the TRIM and SENSE(-) pins.

To increase the output voltage, refer to Fig. C. A trim resistor, $R_{T\text{-}INCR}$, should be connected between the TRIM (Pin 6) and SENSE(+) (Pin 7), with a value of:

$$R_{T\text{-}INCR} = \frac{5.11(100+\Delta)V_{O\text{-}NOM} - 626}{1.225\Delta} - 10.22 \quad [k\Omega],$$

for non-paralleling option

$$R_{T\text{-}INCR} = 45(100+\Delta)/(\Delta * N_P) \quad [k\Omega],$$

for paralleling option

where,

$R_{T\text{-}INCR}$ = Required value of trim-up resistor [kΩ]

$V_{O\text{-}NOM}$ = Nominal value of output voltage [V]

$$\Delta = \left| \frac{(V_{O\text{-}REQ} - V_{O\text{-}NOM})}{V_{O\text{-}NOM}} \right| X\ 100 \quad [\%]$$

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

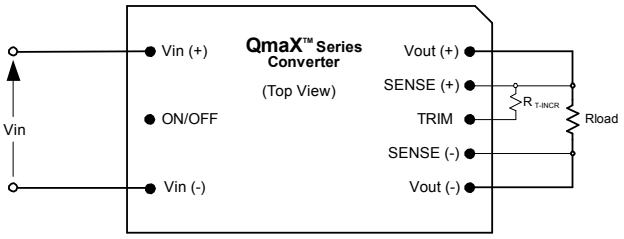


Fig. C: Configuration for increasing output voltage.

When trimming up, care must be taken not to exceed the converter's maximum allowable output power. See the previous section for a complete discussion of this requirement.

To decrease the output voltage (Fig. D), a trim resistor, $R_{T\text{-}DECR}$, should be connected between the TRIM (Pin 6) and SENSE(-) (Pin 5), with a value of:

$$R_{T\text{-}DECR} = \frac{511}{|\Delta|} - 10.22 \quad [k\Omega],$$

for non-paralleling option

$$R_{T\text{-}DECR} = (511\text{-}5.6\Delta)/(\Delta * N_P) \quad [k\Omega],$$

for paralleling option

where,

$R_{T\text{-}DECR}$ = Required value of trim-down resistor [kΩ]

and Δ is defined above.

Note:

The above equations for calculation of trim resistor values match those typically used in conventional industry-standard quarter-bricks.

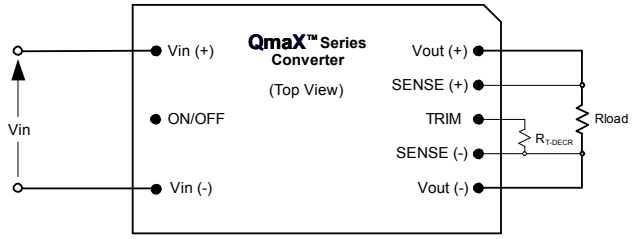


Fig. D: Configuration for decreasing output voltage.

TRIM/SENSE Function Notes:

1. Trim/Sense Functions have limited capability for Vin < 40 V.

2. Trimming/sensing beyond 110% of the rated output voltage is not an acceptable design practice, as this condition could cause unwanted triggering of the output overvoltage protection (OVP) circuit. The designer should ensure that the difference between the voltages across the converter's output pins and its sense pins does not exceed 10% of V_{OUT}(NOM), or:

$$[V_{OUT}(+) - V_{OUT}(-)] - [V_{SENSE}(+) - V_{SENSE}(-)] \leq V_{O\text{-}NOM} \times 10\% \ [V]$$

This equation is applicable for any condition of output sensing and/or output trim.

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.

The input voltage must be typically 34 V for the converter to turn on. Once the converter has been turned on, it will shut off when the input voltage drops typically below 32 V. This feature is beneficial in preventing deep discharging of batteries used in telecom applications.

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 60% 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 100 ms with a typical 3% duty cycle. The attempted restart will continue indefinitely until the overload or short-circuit conditions are removed or the output voltage rises above 60% 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.

Output Overvoltage Protection (OVP)

The converter will shut down if the output voltage across Vout(+) (Pin 8) and Vout(-) (Pin 4) 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 100 ms until the OVP condition is removed.

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 converters meet North American and International safety regulatory requirements per UL60950-1, CSA60590-1, EN60950-1, and IEC60950-1. Basic Insulation is provided between input and output.
To comply with safety agencies' requirements, an input line fuse must be used external to the converter. A 12 A fuse is recommended for use with this product.

All QM converters are UL approved for a maximum fuse rating of 15 Amps. To protect a group of converters with a single fuse, the rating can be increased from the recommended value above.

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. However, Power-One tests its converters to several system level standards, primary of which is the more stringent EN55022, *Information technology equipment - Radio disturbance characteristics-Limits and methods of measurement.*

An effective internal LC differential filter significantly reduces input reflected ripple current, and improves EMC.

With the addition of a simple external filter, all versions of the QM-Series of converters pass the requirements of Class B conducted emissions per EN55022 and FCC requirements. Please contact Power-One Applications Engineering for details of this testing.

Startup Information (using negative ON/OFF)

Scenario #1: Initial Startup From Bulk Supply
ON/OFF function enabled, converter started via application of V_{IN}. See Figure E.

Time	Comments
t_0	ON/OFF pin is ON; system front end power is toggled on, V_{IN} to converter begins to rise.
t_1	V_{IN} crosses undervoltage Lockout protection circuit threshold; converter enabled.
t_2	Converter begins to respond to turn-on command (converter turn-on delay).
t_3	Converter V_{OUT} reaches 100% of nominal value.

For this example, the total converter startup time (t_3- t_1) is typically 4 ms.

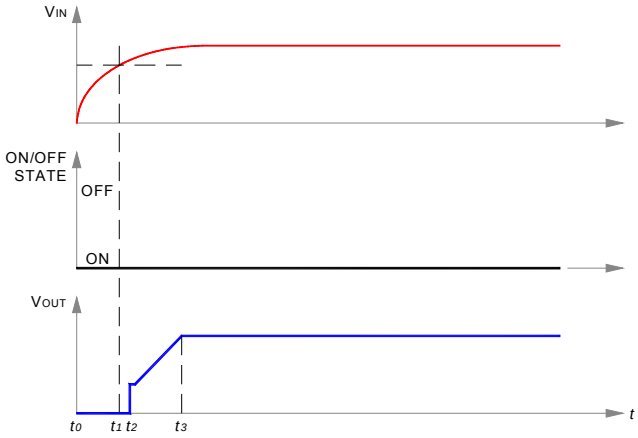


Fig. E: Startup scenario #1.

Scenario #2: Initial Startup Using ON/OFF Pin
With V_{IN} previously powered, converter started via ON/OFF pin. See Figure F.

Time	Comments
t_0	V_{INPUT} at nominal value.
t_1	Arbitrary time when ON/OFF pin is enabled (converter enabled).
t_2	End of converter turn-on delay.
t_3	Converter V_{OUT} reaches 100% of nominal value.

For this example, the total converter startup time (t_3- t_1) is typically 4 ms.

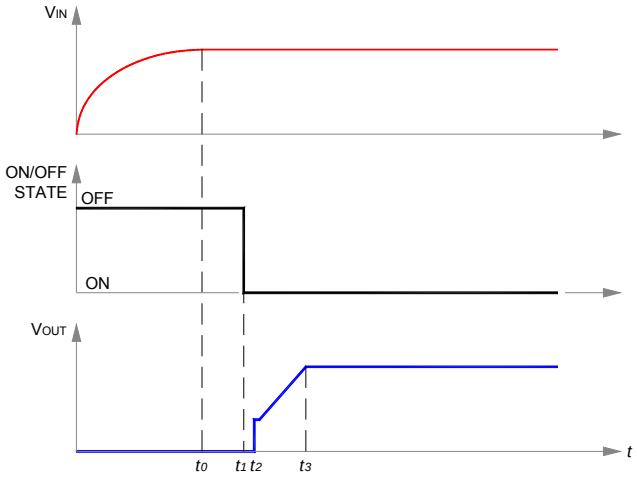


Fig. F: Startup scenario #2.

Scenario #3: Turn-off and Restart Using ON/OFF Pin
With V_{IN} previously powered, converter is disabled and then enabled via ON/OFF pin. See Figure G.

Time	Comments
t_0	V_{IN} and V_{OUT} are at nominal values; ON/OFF pin ON.
t_1	ON/OFF pin arbitrarily disabled; converter output falls to zero; turn-on inhibit delay period (200 ms typical) is initiated, and ON/OFF pin action is internally inhibited.
t_2	ON/OFF pin is externally re-enabled. **If (t_2- t_1) ≤ 100 ms**, external action of ON/OFF pin is locked out by startup inhibit timer. **If (t_2- t_1) > 100 ms**, ON/OFF pin action is internally enabled.
t_3	Turn-on inhibit delay period ends. If ON/OFF pin is ON, converter begins turn-on; if off, converter awaits ON/OFF pin ON signal; see Figure F.
t_4	End of converter turn-on delay.
t_5	Converter V_{OUT} reaches 100% of nominal value.

For the condition, **(t_2- t_1) ≤ 100 ms**, the total converter startup time (t_5- t_2) is typically 104 ms. For **(t_2- t_1) > 100 ms**, startup will be typically 4 ms after release of ON/OFF pin.

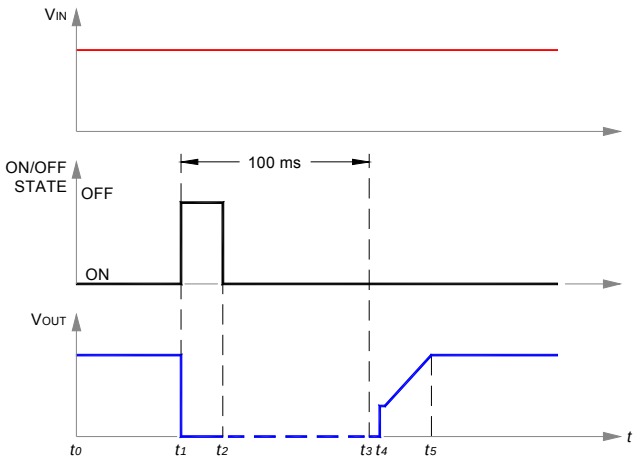


Fig. G: Startup scenario #3.

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 tunnel 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. H for the optimum measuring thermocouple locations.

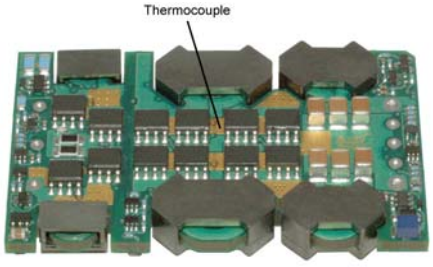


Fig. H: Locations of the thermocouple for thermal testing.

Thermal Derating

Load current vs. ambient temperature and airflow rates are given in Fig. 1 and Fig. 2 for vertical and horizontal converter mountings for through-hole version. Ambient temperature was varied between 25 °C and 85 °C, with airflow rates from 30 to 500 LFM (0.15 to 2.5 m/s).

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

(i) The output current at which any FET junction temperature does not exceed a maximum specified temperature of 120 °C as indicated by the thermographic image, or

(ii) The nominal rating of the converter (14 A).

During normal operation, derating curves with maximum FET temperature less or equal to 120 °C should not be exceeded. Temperature on the PCB at the thermocouple location shown in Fig. H should not exceed 118 °C in order to operate inside the derating curves.

Efficiency

Fig. 3 shows the efficiency vs. load current plot for ambient temperature of 25 ºC, airflow rate of 300 LFM (1.5 m/s) with vertical mounting and input voltages of 36 V, 48 V and 72 V. Also, a plot of efficiency vs. load current, as a function of ambient temperature with Vin = 48 V, airflow rate of 200 LFM (1 m/s) with vertical mounting is shown in Fig. 4.

Startup

Output voltage waveforms, during the turn-on transient using the ON/OFF pin for full rated load currents (resistive load) are shown without and with external load capacitance in Figs. 7-8, respectively.

Ripple and Noise

The output voltage ripple waveform, measured at full rated load current with a 10 µF tantalum and 1 µF ceramic capacitor across the output. Note that all output voltage waveforms are measured across a 1 µF ceramic capacitor.

The input reflected ripple current waveforms are obtained using the test setup shown in Fig I. The corresponding waveforms are shown in plot section.

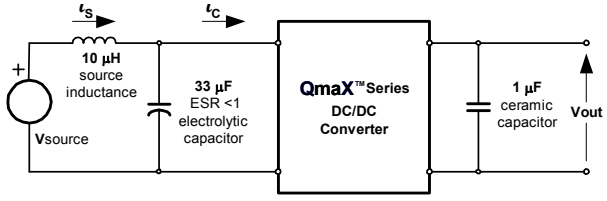


Fig. I: Test Setup for measuring input reflected-ripple currents, i_c and i_s.

QM48T/S14120-wxy0 (Non-parallelable version)

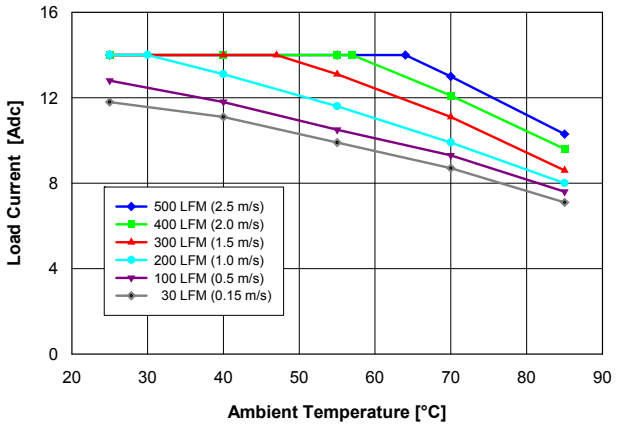


Fig. 1: Available load current vs. ambient air temperature and airflow rates for converter with B height pins mounted vertically with air flowing from pin 3 to pin 1, MOSFET temperature ≤ 120 °C, Vin = 48 V.

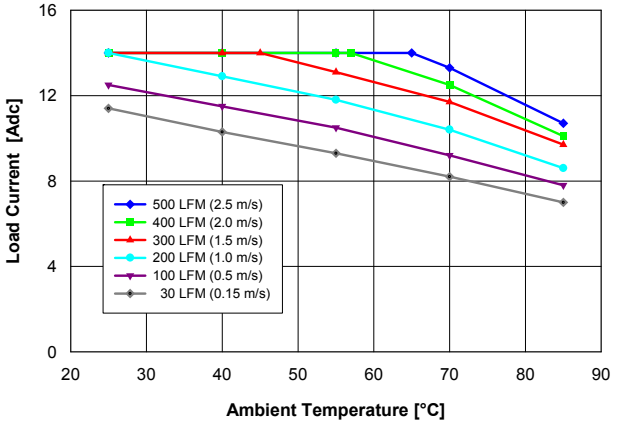


Fig. 2: Available load current vs. ambient air temperature and airflow rates for converter with B height pins mounted horizontally with air flowing from pin 3 to pin 1, MOSFET temperature ≤ 120 °C, Vin = 48 V.

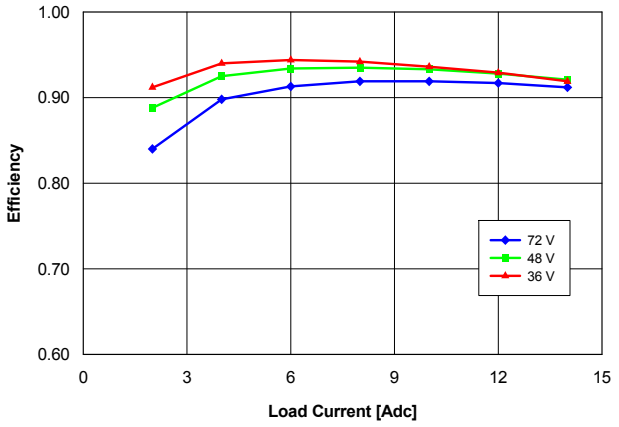


Fig. 3: Efficiency vs. load current and input voltage for converter mounted vertically with air flowing from pin 3 to pin 1 at a rate of 300 LFM (1.5 m/s) and Ta = 25 °C.

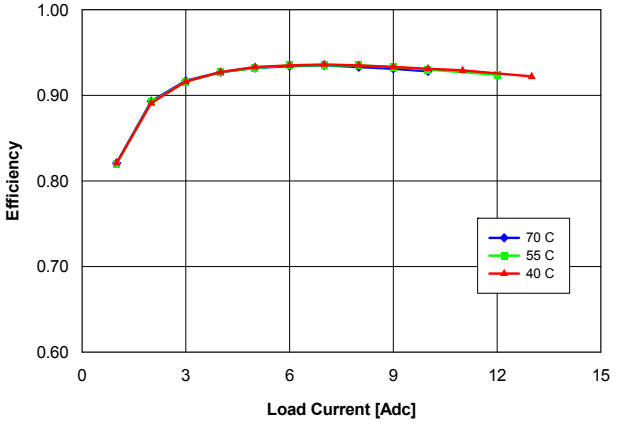


Fig. 4: Efficiency vs. load current and ambient temperature for converter mounted vertically with Vin = 48 V and air flowing from pin 3 to pin 1 at a rate of 200 LFM (1.0 m/s).

QM48T/S14120-wxy0 (Non-parallelable version)

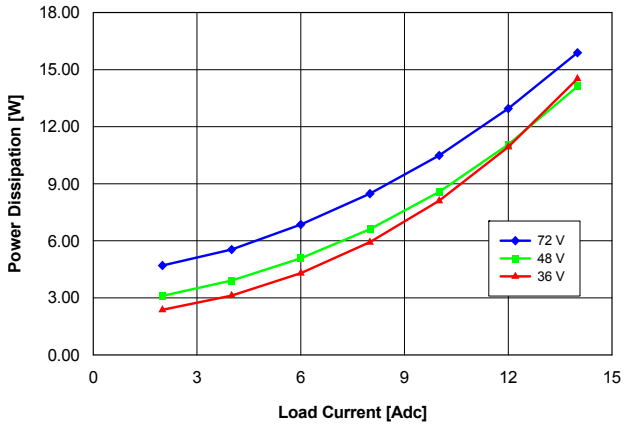


Fig. 5: Power dissipation vs. load current and input voltage for converter mounted vertically with air flowing from pin 3 to pin 1 at a rate of 300 LFM (1.5 m/s) and Ta = 25 °C.

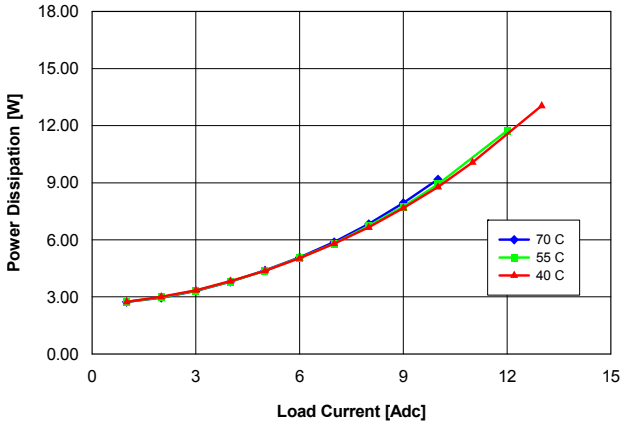


Fig. 6: Power dissipation vs. load current and ambient temperature for converter mounted vertically with Vin = 48 V and air flowing from pin 3 to pin 1 at a rate of 200 LFM (1.0 m/s).

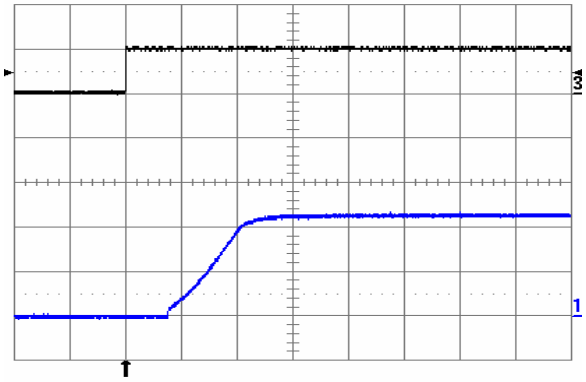


Fig. 7: Turn-on transient at full rated load current (resistive) with no output capacitor at Vin = 48 V, triggered via ON/OFF pin. Top trace: ON/OFF signal (5 V/div.). Bottom trace: output voltage (2 V/div.). Time scale: 2 ms/div.

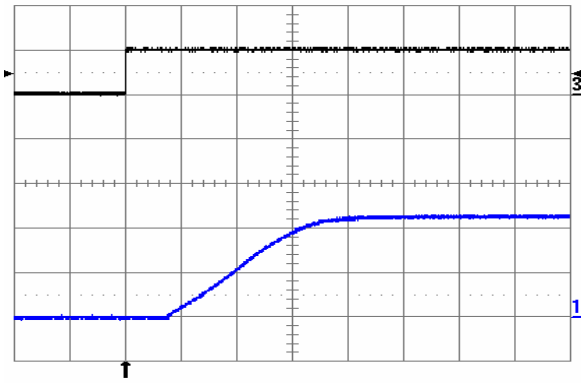


Fig. 8: Turn-on transient at full rated load current (resistive) plus 2,200 µF at Vin = 48 V, triggered via ON/OFF pin. Top trace: ON/OFF signal (5 V/div.). Bottom trace: output oltage (5 V/div.). Time scale: 2 ms/div.

QM48T/S14120-wxy0 (Non-parallelable version)

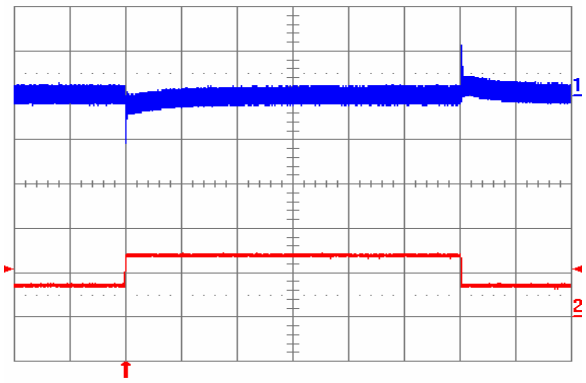


Fig. 9: Output voltage response to load current step-change (3.5 A – 7 A – 3.5 A) at Vin = 48 V. Top trace: output voltage (200 mV/div.). Bottom trace: load current (2 A/div). Bottom trace: load current (5 A/div.). Current slew rate: 5 A/µs. Co = 1 µF ceramic. Time scale: 0.2 ms/div.

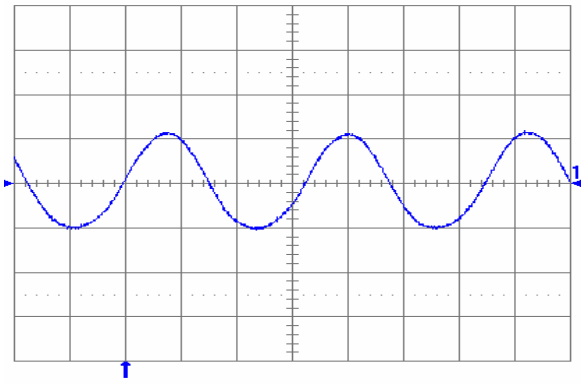


Fig. 10: Output voltage ripple (50 mV/div.) at full rated load current into a resistive load with Co = 10 µF tantalum + 1 µF ceramic and Vin = 48 V. Time scale: 1 µs/div.

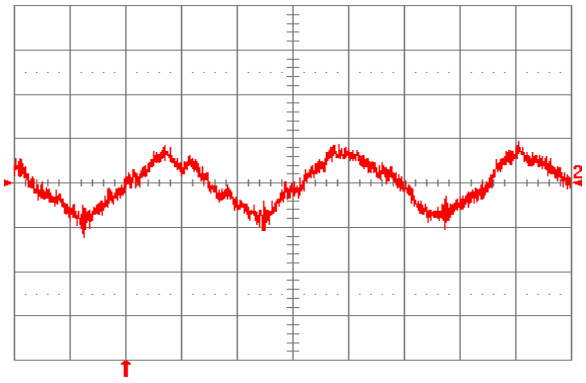


Fig. 11: Input reflected ripple current, i_s (10 mA/div), measured through 10 µH at the source at full rated load current and Vin = 48 V. Refer to Fig. 13 for test setup. Time scale: 1 µs/div.

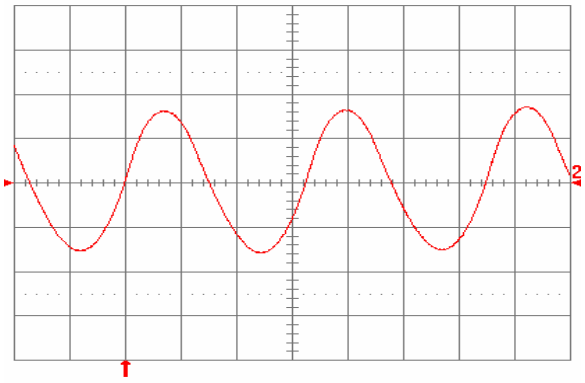


Fig. 12: Input reflected ripple current, i_c (200 mA/div), measured at input terminals at full rated load current and Vin = 48 V. Refer to Fig. 13 for test setup. Time scale: 1 µs/div.

QM48T/S14120-wxy0 (Non-parallelable version)

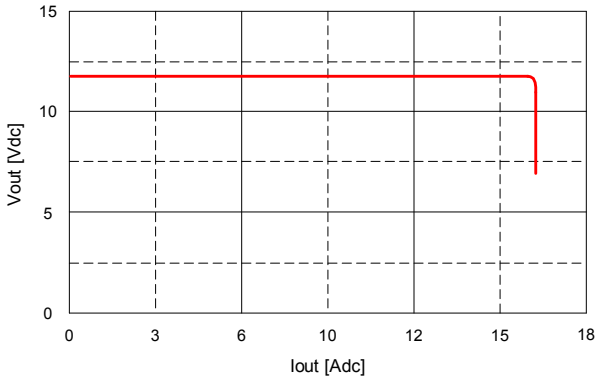


Fig. 13: Output voltage vs. load current showing current limit point and converter shutdown point. Input voltage has almost no effect on current limit characteristic.

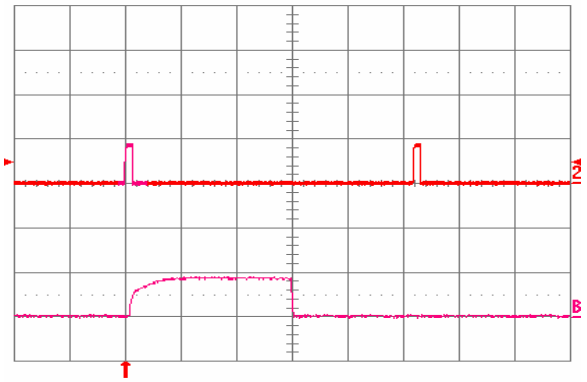


Fig. 14: Load current (top trace, 20 A/div., 20 ms/div.) into a 10 mΩ short circuit during restart, at Vin = 48 V. Bottom trace (10 A/div., 1 ms/div.) is an expansion of the on-time portion of the top trace.

QM48T/S14120-wxyP (Parallelable version)

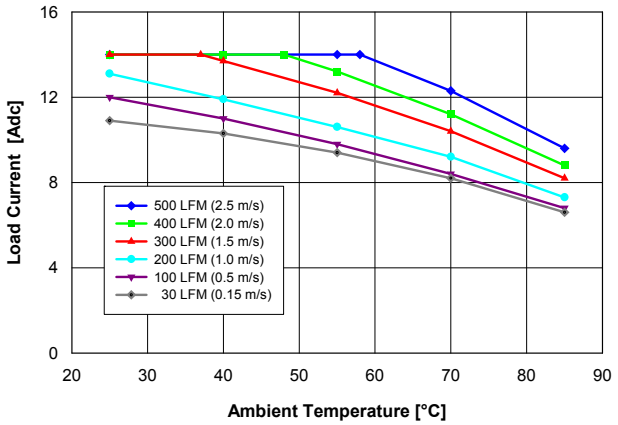


Fig. 1 : Available load current vs. ambient air temperature and airflow rates for converter with B height pins mounted vertically with air flowing from pin 3 to pin 1, MOSFET temperature ≤ 120 °C, Vin = 48 V.

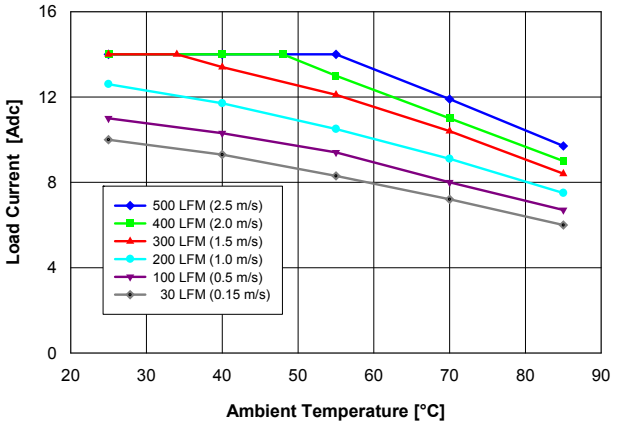


Fig. 2: Available load current vs. ambient air temperature and airflow rates for converter with B height pins mounted horizontally with air flowing from pin 3 to pin 1, MOSFET temperature ≤ 120 °C, Vin = 48 V.

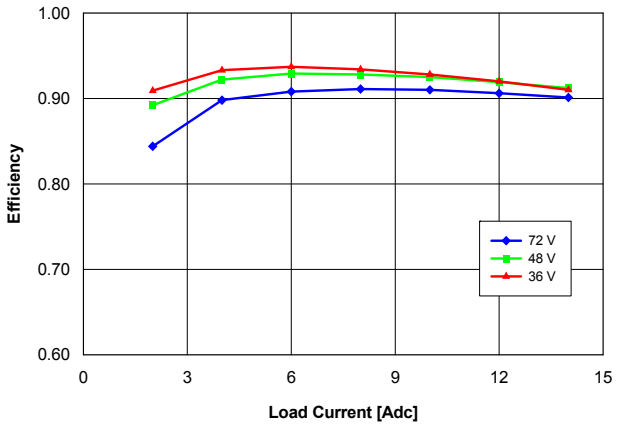


Fig. 3: Efficiency vs. load current and input voltage for converter mounted horizontally with air flowing from pin 3 to pin 1 at a rate of 300 LFM (1.5 m/s) and Ta = 25 °C.

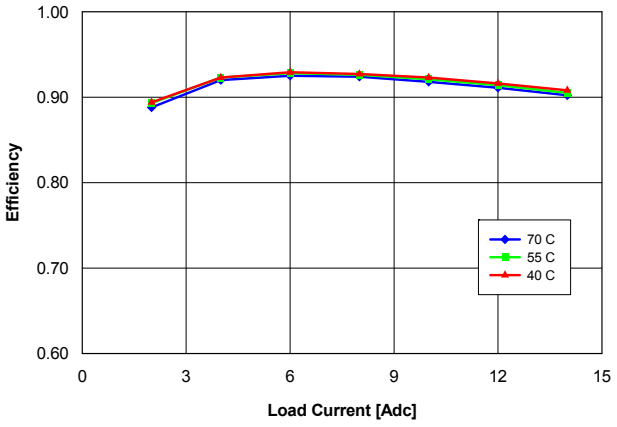


Fig. 4: Efficiency vs. load current and ambient temperature for converter mounted horizontally with Vin = 48 V and air flowing from pin 3 to pin 1 at a rate of 200 LFM (1.0 m/s).

QM48T/S14120-wxyP (Parallelable version)

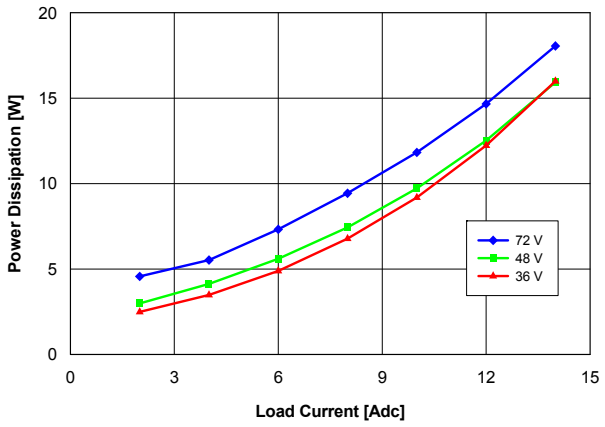


Fig. 5: Power dissipation vs. load current and input voltage for converter mounted horizontally **with air flowing from pin 3 to pin 1 at a rate of 300 LFM (1.5 m/s) and Ta = 25 °C.**

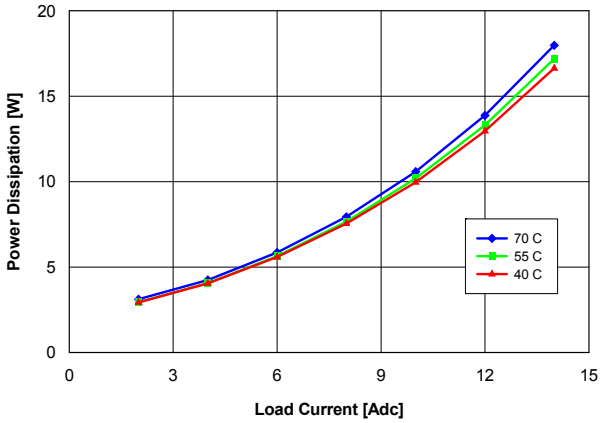


Fig. 6: Power dissipation vs. load current and ambient temperature for converter mounted horizontally **with Vin = 48 V and air flowing from pin 3 to pin 1 at a rate of 200 LFM (1.0 m/s).**

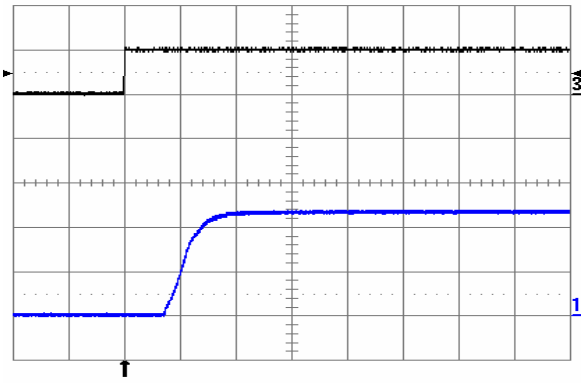


Fig. 7: Turn-on transient at full rated load current (resistive) with no output capacitor at Vin = 56 V, triggered via ON/OFF pin. Top trace: ON/OFF signal (5 V/div.). Bottom trace: output voltage (2 V/div.). Time scale: 2 ms/div.

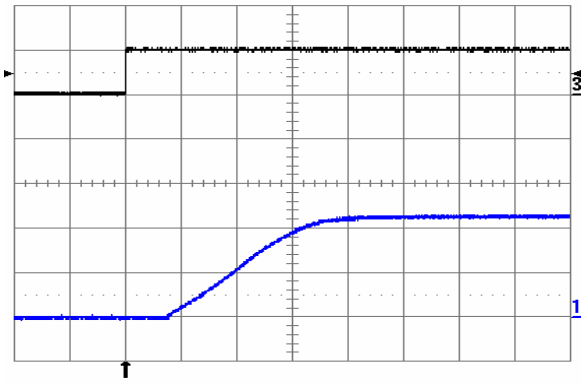


Fig. 8: Turn-on transient at full rated load current (resistive) plus 2,200 µF at Vin = 56 V, triggered via ON/OFF pin. Top trace: ON/OFF signal (5 V/div.). Bottom trace: output voltage (5 V/div.). Time scale: 2 ms/div.

QM48T/S14120-wxyP (Parallelable version)

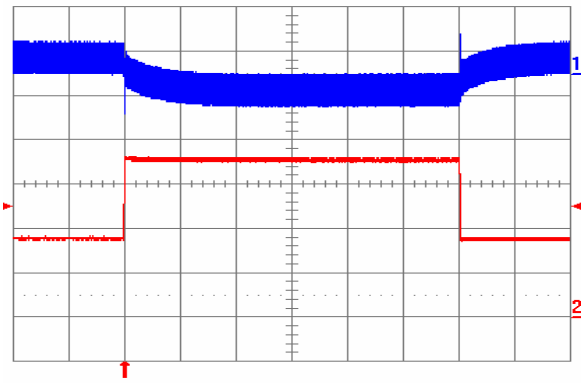


Fig. 9: Output voltage response to load current step-change (3.5 A – 7 A – 3.5 A) at Vin = 56 V. Top trace: output voltage (200 mV/div.). Bottom trace: load current (2 A/div). Bottom trace: load current (5 A/div.). Current slew rate: 5 A/µs. Co = 1 µF ceramic. Time scale: 0.5 ms/div.

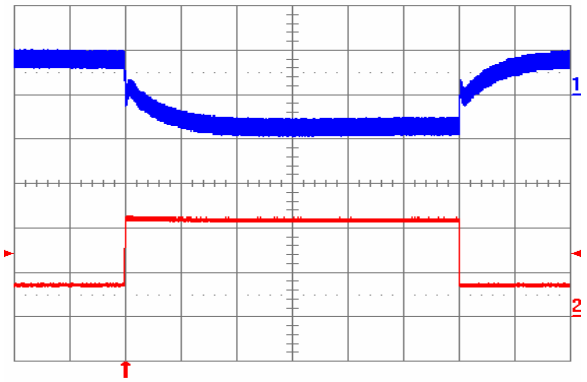


Fig. 10: Output voltage response to load current step-change (3.5 A – 11 A – 3.5 A) at Vin = 56 V. Top trace: output voltage (200 mV/div.). Bottom trace: load current (5 A/div). Current slew rate: 1 A/µs. Co = 4x150 µF tantalum + 1 µF ceramic. Time scale: 0.5 ms/div.

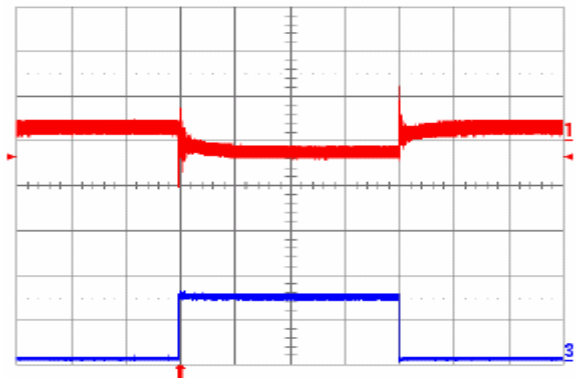


Fig. 11: Step Load response to 0% – 50% – 0% with 20 µF external ceramic capacitor and di/dt = 10 A/µs. Top trace: output voltage (500 mV/div.). Bottom trace: load current (5 A/div). Time scale: 0.5 ms/div.

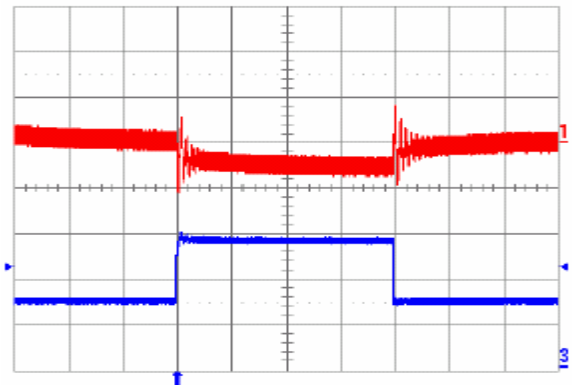


Fig. 12: Step Load response to 50% – 100% – 50% with 20 µF external ceramic capacitor and di/dt = 10 A/µs. Top trace: output voltage (500 mV/div.). Bottom trace: load current (5 A/div). Time scale: 0.2 ms/div.

QM48T/S14120-wxyP (Parallelable version)

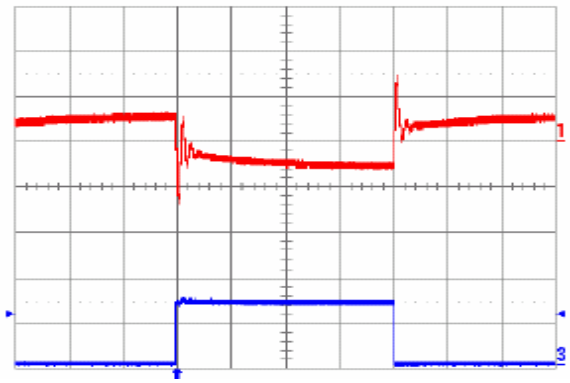


Fig. 13: Step Load response to 0% – 50% – 0% with 100 µF external ceramic capacitor and di/dt = 10 A/µs. Top trace: output voltage (500 mV/div.). Bottom trace: load current (10 A/div). Time scale: 0.2 ms/div.

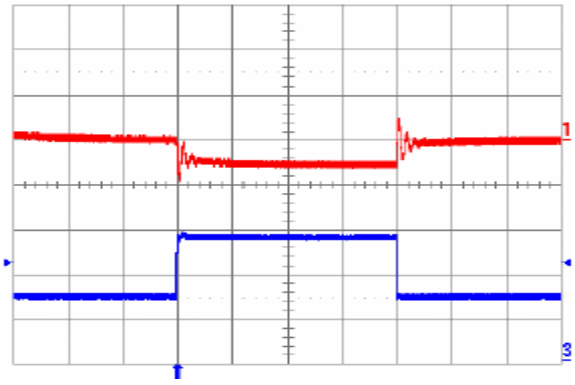


Fig. 14: Step Load response to 50% – 100% – 50% with 100 µF external ceramic capacitor and di/dt = 10 A/µs. Top trace: output voltage (500 mV/div.). Bottom trace: load current (5 A/div). Time scale: 0.2 ms/div.

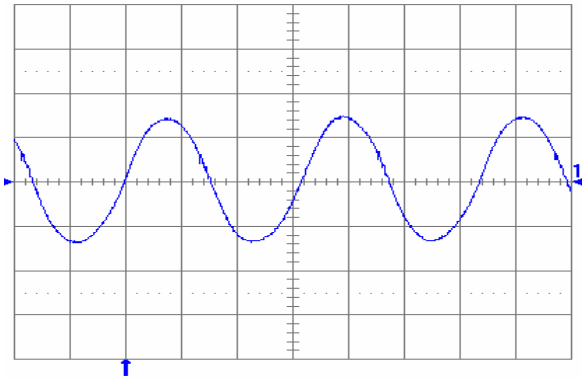


Fig. 15: Output voltage ripple (50 mV/div.) at full rated load current into a resistive load with Co = 10 µF tantalum + 1 µF ceramic and Vin = 56 V. Time scale: 1 µs/div.

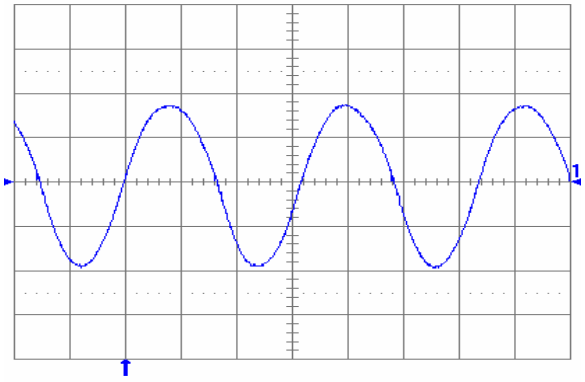


Fig. 16: Output voltage ripple (50 mV/div.) at full rated load current into a resistive load with Co = 10 µF tantalum + 1 µF ceramic and Vin = 75 V. Time scale: 1 µs/div.

QM48T/S14120-wxyP (Parallelable version)

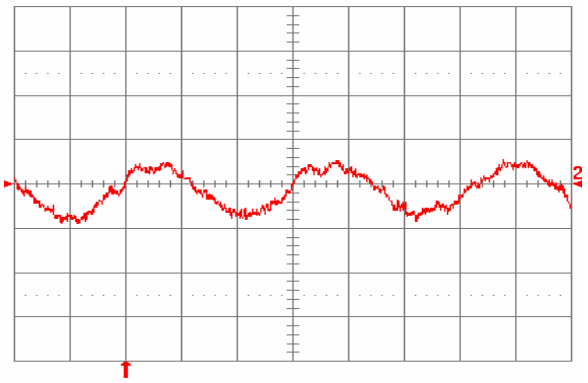


Fig. 17: Input reflected ripple current, i_s (10 mA/div), measured through 10 µH at the source at full rated load current and Vin = 56 V. Refer to Fig. I for test setup. Time scale: 1 µs/div.

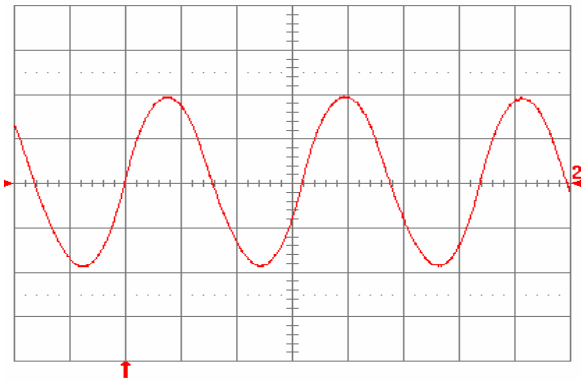


Fig. 18: Input reflected ripple current, i_c (200 mA/div), measured at input terminals at full rated load current and Vin = 56 V. Refer to Fig. I for test setup. Time scale: 1 µs/div.

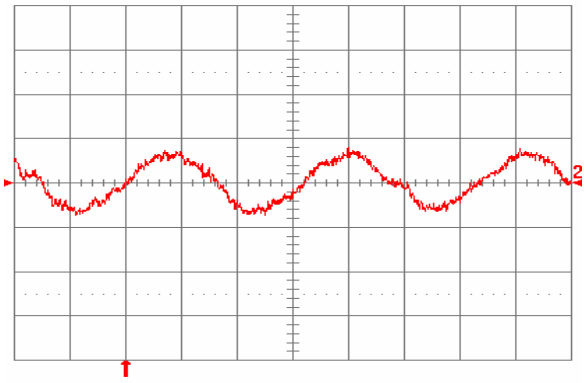


Fig. 19: Input reflected ripple current, i_s (10 mA/div), measured through 10 µH at the source at full rated load current and Vin = 75 V. Refer to Fig. I for test setup. Time scale: 1 µs/div.

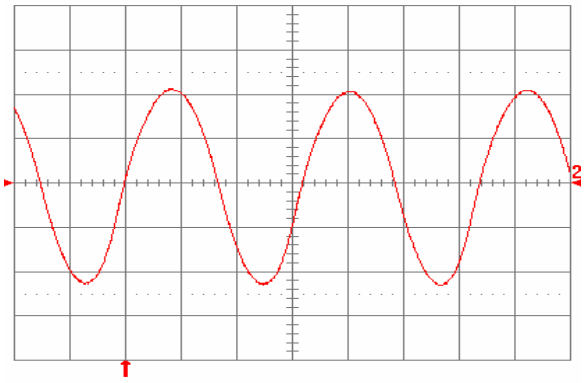


Fig. 20: Input reflected ripple current, i_c (200 mA/div), measured at input terminals at full rated load current and Vin = 75 V. Refer to Fig. I for test setup. Time scale: 1 µs/div.

QM48T/S14120-wxyP (Parallelable version)

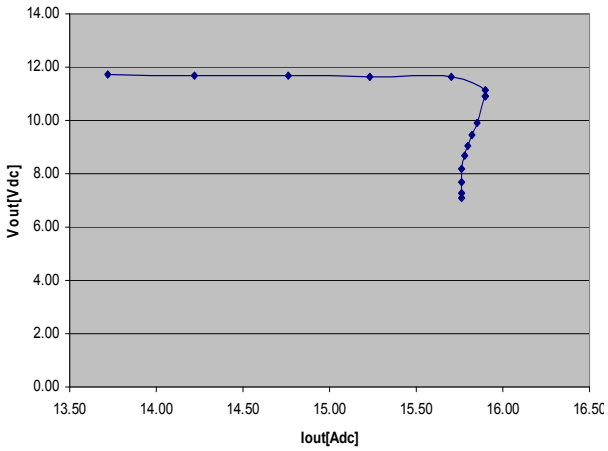


Fig. 21: Output voltage vs. load current showing current limit point and converter shutdown point. Input voltage has almost no effect on current limit characteristic.

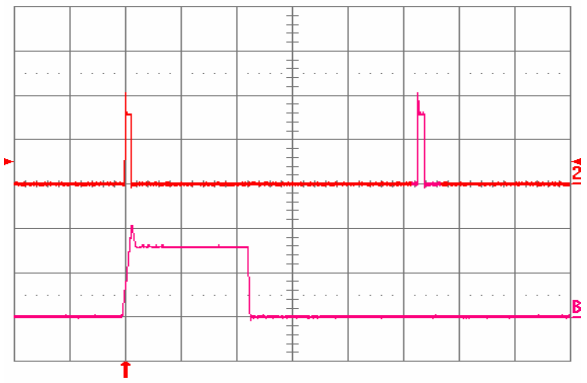
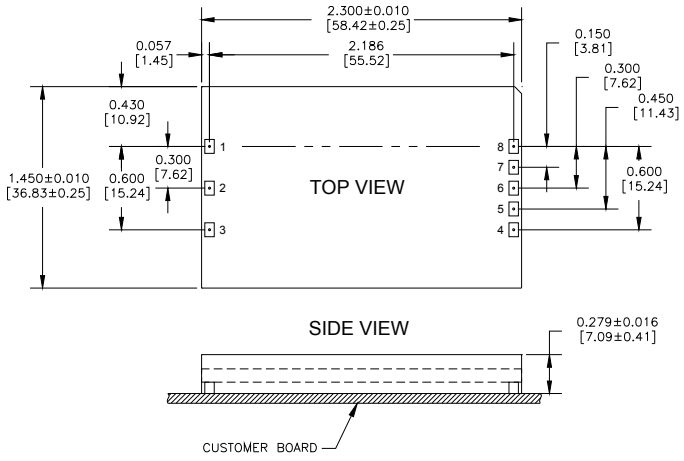


Fig. 22: Load current (top trace, 10 A/div., 20 ms/div.) into a 10 mΩ short circuit during restart, at Vin = 48 V. Bottom trace (10 A/div., 1 ms/div.) is an expansion of the on-time portion of the top trace.

Physical Information



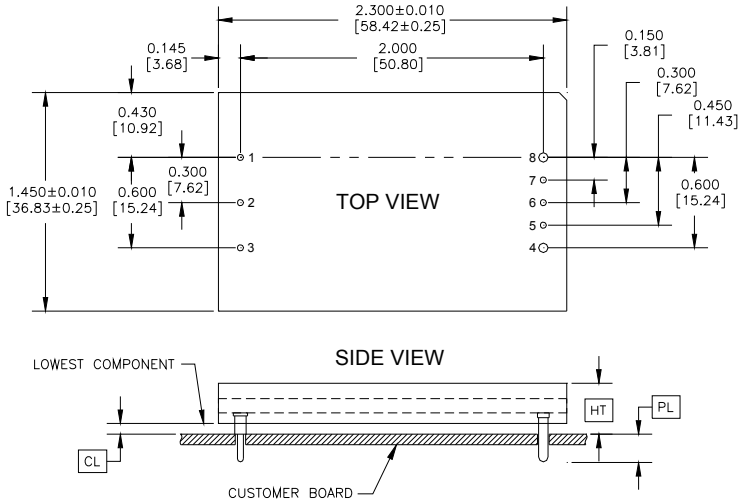
QM48S (Surface-mount)

QM48S Platform Notes

- All dimensions are in inches [mm]
- Connector Material: Copper
- Connector Finish: Gold over Nickel
- Converter Weight: 1.1 oz [31.5 g]
- Recommended Surface-Mount Pads:
  Min. 0.080" X 0.112" [2.03 x 2.84]
  Max. 0.092" X 0.124" [2.34 x 3.15]

QM48T/S Pinout

Pad/Pin Connections	
Pad/Pin #	**Function**
1	Vin (+)
2	ON/OFF
3	Vin (-)
4	Vout (-)
5	SENSE(-)
6	TRIM
7	SENSE(+)
8	Vout (+)



QM48T (Through-hole)

QM48T Platform Notes

- All dimensions are in inches [mm]
- Pins 1-3 and 5-7 are Ø 0.040" [1.02] with Ø 0.078" [1.98] shoulder
- Pins 4 and 8 are Ø 0.062" [1.57] without shoulder
- Pin Material & Finish: Brass with Tin/Lead over Nickel or Matte Tin over Nickel (G Version)
- Converter Weight: 1.1 oz [31.15 g]

Height Option	HT (Max. Height)	CL (Min. Clearance)
	+0.000 [+0.00] -0.038 [- 0.97]	+0.016 [+0.41] -0.000 [- 0.00]
A	0.325 [8.26]	0.030 [0.77]
B	0.358 [9.09]	0.063 [1.60]
D	0.422 [10.72]	0.127 [3.23]

Pin Option	PL Pin Length
	±0.005 [±0.13]
A	0.188 [4.77]
B	0.145 [3.68]
C	0.110 [2.79]

Converter Part Numbering/Ordering Information

Product Series	Input Voltage	Mounting Scheme	Rated Load Current	Output Voltage		ON/OFF Logic	Maximum Height [HT]	Pin Length [PL]	Special Features	Environmental
QM	**48**	**T**	**14**	**120**	**-**	**N**	**S**	**0**	**0**	
Quarter-Brick Format	36-75 V	S ⇒ Surface-mount T⇒ Through-hole	14 A	120 ⇒ 12 V		N ⇒ Negative P ⇒ Positive	Surface Mount S ⇒ 0.295” Through hole A ⇒ 0.325” B ⇒ 0.358” D ⇒ 0.422”	Surface Mount 0 ⇒ 0.00” Through hole A ⇒ 0.188” B ⇒ 0.145” C ⇒ 0.110”	0 ⇒ STD P ⇒ Droop Paralleling Option	No Suffix ⇒ RoHS lead-solder-exemption compliant G ⇒ RoHS Compliant for all six substances

The example above describes P/N QM48S14120-NS00: 36-75 V input, surface-mount, 14 A @ 12 V output, negative ON/OFF logic, a maximum height of 0.295”, standard (non-paralleling), and Eutectic Tin/Lead solder. Please consult factory for the complete list of available options.

NUCLEAR AND MEDICAL APPLICATIONS - Power-One products are not designed, intended for use in, or authorized for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems without the express written consent of the respective divisional president of Power-One, Inc.

TECHNICAL REVISIONS - The appearance of products, including safety agency certifications pictured on labels, may change depending on the date manufactured. Specifications are subject to change without notice.