

Features

- Low profile (< 8mm)
- 2000 VDC input-to-output isolation meets basic insulation
- High efficiency - to 88% at full load
- Start-up into high capacitive load
- Low conducted and radiated EMI
- Output overcurrent protection
- Output overvoltage protection
- Overtemperature protection
- Back drive protection
- Remote sense
- Set point accuracy $\pm 1\%$
- Remote on/off (primary referenced), positive or negative logic
- Output voltage trim adjust, positive, or negative
- UL 1950 Recognized, CSA 22.2 No. 950-95 certified, TUV IEC9

Applications

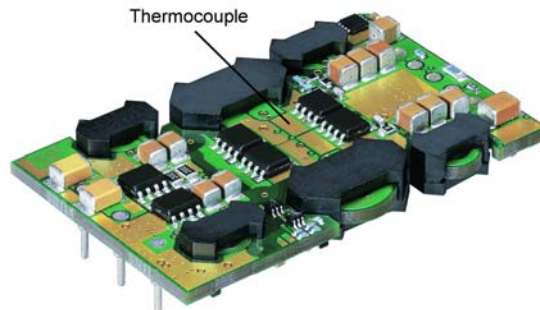
- Distributed power architectures
- Telecommunications equipment
- LAN/WAN applications
- Data processing applications

Description

The new Q2S15 series of low profile, high-density, single-output DC/DC converters convert standard telecom and datacom voltages into isolated low-voltage outputs. The Q2S's leading-edge technology provides high efficiency. The SMT mounting option eliminates the need for a separate (additional manual) process in attaching the converters to the motherboards during mass production.

Base Model Selection Chart

Model	Input voltage range, VDC	Input current, max, ADC	Output voltage, VDC	Output rated current, I rated ADC	Output Ripple / Noise, Typ, mV p-p	Efficiency @ I rated, Typical, %
Q2S15ZG	36-75	1.5	5.0	15	30	88
Q2S15YG	18-36	4.7	5.0	15	30	88



Location of the Thermocouple for Thermal Testing.



Q2S15 Series – 15A Quarter-Brick DC/DC Converter
48V, 24V Input
5.0V Output

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Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings may cause performance degradation, adversely effect long-term reliability, and cause permanent damage to the converter.

Parameter	Conditions/Description	Min	Max	Units
Input voltage	Continuous		75	VDC
	Per GR-513, tp = 10µs		100	VDC
Operating Temperature	At 100% load	-40	100	°C
Storage Temperature		-40	125	°C
ON/OFF Control Voltage	Referenced to -Vin		20	VDC

Environmental and Mechanical Specifications

All specifications apply over specified input voltage, output load and temperature range, unless otherwise noted.

Parameter	Conditions/Description	Min	Nom	Max	Units
Shock	Halfsine wave, 3 axes	50			g
Sinusoidal Vibration	GR-63-Core, Section 5.A.2	1			
Weight			1.02(28)		Oz/g
Water Washing	Standard process		Yes		
MTBF	Per Bellcore TR-NWT-000332		Consult factory		kHrs

Isolation Specifications

All specifications apply over specified input voltage, output load, and temperature range, unless otherwise noted.

Parameter	Conditions/Description	Min	Nom	Max	Units
Insulation Safety Rating			Basic		
Isolation Voltage		2000			VDC
Isolation Resistance		10			MΩ
Isolation Capacitance			230		pF

Input Specifications

All specifications apply over specified input voltage, output load and temperature range, unless otherwise noted.

Parameter	Conditions/Description	Min	Nom	Max	Units
Input Voltage	Continuous	36	48	75	VDC
		18	24	36	
Turn-On Input Voltage	Ramping Up Vin= 36-75	33		35	VDC
	Vin = 18 -36	16		17.5	
Turn-Off Input Voltage	Ramping Down Vin = 36-75	31		33	VDC
	Vin = 18-36	15		16.5	
Turn-On Time	To Output Regulation Band 100% Resistive Load		2.5		ms
Input Reflected Ripple Current	25 MHz Bandwidth		6		mA _{pk,pk}
Inrush Transient	Vin=Vin max			0.1	A ² s



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Output Specifications

All specifications apply over specified input voltage, output load, and temperature range, unless otherwise noted.

Parameter	Conditions/Description	Min	Nom	Max	Units
Output Voltage Setpoint Accuracy	Vin=Vin nom, Full Load	-1		1	%Vout
Output Current*		0		15	ADC
Line Regulation	Vin min to Vin max, Iout max		±2	±5	mV
Load Regulation	Vin=Vnom, Iout min to Iout max		±2	±5	mV
Total Output Voltage Regulation	Over all input voltage, load, and temperature conditions	4.925	5.000	5.075	Vdc
Remote Sense Headroom***				10%	%Vout
Dynamic Regulation Peak Deviation Settling Time	50-75% load step change to 1% error band		120 100		mV µS
Admissible Load Capacitance	Iout.max, Nom Vin			10,000	µF
Output Current Limit Threshold**	Vout ≤ 0.97Vout nom	16.5	18	20	Adc
Switching Frequency			435		kHz
Over voltage Protection, Non Latching	Over all input voltage and load conditions	115	122	127	%Vout
Trim Range****	Iout max, Vin=Vnom	-20		+10	%Vout

** Overcurrent protection is non-latching with auto recovery.

*** Vout can be increased up to 10% via the sense leads or up to 10% via the trim function, however total output voltage trim from all sources should not exceed 10% of Vout (Nom) in order to insure specified operation of over-voltage protection circuitry.

Feature Specifications

All specifications apply over specified input voltage, output load, and temperature range, unless otherwise noted.

Parameter	Conditions/Description	Min	Nom	Max	Units
Shutdown (ON/OFF) Negative Logic - Converter ON - Converter OFF	On/Off signal is low – converter is ON ON/OFF pin is connected to -Vin	-20 2.4		0.8 20	VDC VDC
Positive Logic - Converter ON - Converter OFF	On/Off signal is low –converter is OFF ON/OFF pin is connected to -Vin	2.4 -20		20 0.8	VDC VDC
Overtemperature Protection	PCB Temperature		118		°C

Characteristic curve

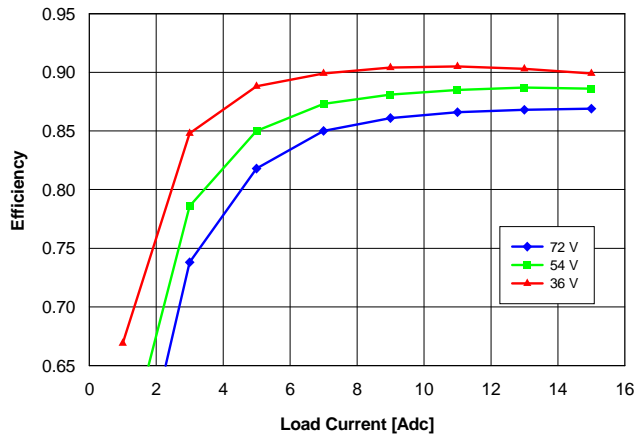


Fig. 1. Q2S15ZG (5.0V) Efficiency vs. Load

Typical Application

Figure 2 shows the recommended connections for the Q2S15 series converter.

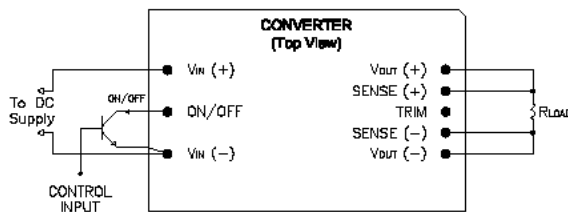


Fig. 2. Typical Application of Q2S15 Series

The Q2S15 series converters do not require any external components for proper operation. However, if the distribution of the input voltage to the converter contains significant inductance, a capacitor may be required to enhance performance of the converter. A minimum of a 100µF electrolytic capacitor with the ESR<0.7Ω is recommended for the Q2S15 series.

If magnitude of the inrush current needs to be limited, see the “Inrush Current Control Application Note” on the Power-One website at www.power-one.com.

For output decoupling we recommend using a 10µF tantalum and a 1µF ceramic capacitor connected directly across the output pins of the

converter. Note, that the capacitors do not substitute the filtering required by the load.

Shutdown Feature Description

The ON/OFF pin in the Q2S15 series converters functions as a normal soft shutdown. It is referenced to the -Vin pin (see Figure 2). With positive logic, when the ON/OFF pin is pulled low, the output is turned off and the unit goes into a very low input power mode. With negative logic, when the ON/OFF pin is pulled low, the unit is turned on.

An open collector switch is recommended to control the voltage between the ON/OFF pin and the -Vin pin of the converter. The ON/OFF pin is pulled up internally, so no external voltage source is required. The user should avoid connecting a resistor between the ON/OFF pin and the +Vin pin.

When the ON/OFF pin is used to achieve remote control, the user must take care to insure that the pin reference for the control is really the -Vin pin. The control signal must not be referenced ahead of EMI filtering or remotely from the unit. Optically coupling the information and locating the optical coupler directly at the module will solve any of these problems.

Note:

If the ON/OFF pin is not used, it can be left floating (positive logic), or connected to the -Vin pin (negative logic).

Output Voltage Trim

The trim feature allows the user to adjust the output voltage from the nominal value. This can be used to compensate distribution drops, perform margining in production, or accommodate other requirements when output voltage needs to be adjusted from the nominal.

The converter’s output voltage (at the terminals) can be adjusted up 10% or down 20% relative to the nominal output voltage by connecting the TRIM pin to sense (+) or sense (-) via a trim resistor. The Trim pin should be left open if the trimming function is not to be used.

To trim up the output voltage, a trim resistor, RT-INCR, should be connected between TRIM (Pin 6)

and SENSE(+) (Pin 7), as illustrated in Fig. 3.
 The trim-up resistor can be calculated from:

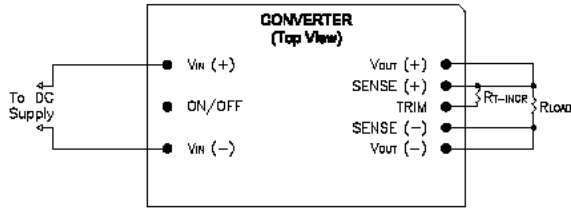


Fig. 3.

$$R_{T-INCR} = \frac{5.1(100+\Delta)V_{O-NOM} - 624.75}{1.225 \Delta} - 10.2 \quad [K\Omega]$$

where,

R_{T-INCR} = Required value of trim-up resistor
 V_{O-NOM} = Nominal value of output voltage
 insert absolute value bars

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

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

When trimming up, care must be taken not to exceed the converter's maximum allowable output power, as discussed in the previous section Remote Sense.

To trim down the output voltage, a trim resistor, R_{T-DECR} , should be connected between TRIM (Pin 6) and SENSE(-) (Pin 5), as illustrated in Fig.4.

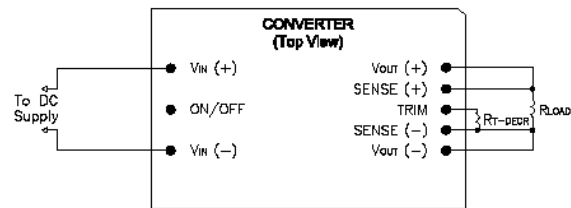


Fig. 4.

The trim-down resistor can be calculated from:

$$R_{T-DECR} = \frac{510}{\Delta} - 10.2 \quad [K\Omega]$$

where,

R_{T-DECR} = Required value of trim-down resistor
 and Δ is as defined above.

Start-up Information (using negative ON/OFF)

Scenario #1: Initial Start-up From Bulk Supply

ON/OFF function enabled, converter started via application of V_{IN} . See Figure 5.

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 Under-Voltage 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 start-up time ($t_3 - t_1$) is typically 2.5 ms.

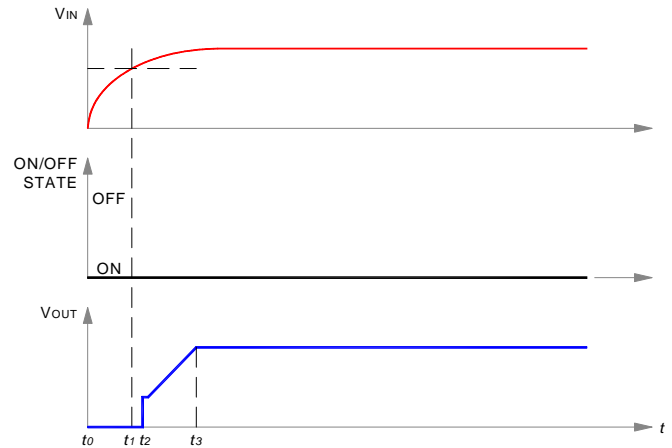


Fig.5. Start-up Scenario #1.

Scenario #2: Initial Start-up Using ON/OFF Pin

With V_{IN} previously powered, converter started via ON/OFF pin. See Figure 6.

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 start-up time ($t_3 - t_1$) is typically 2.5 ms.

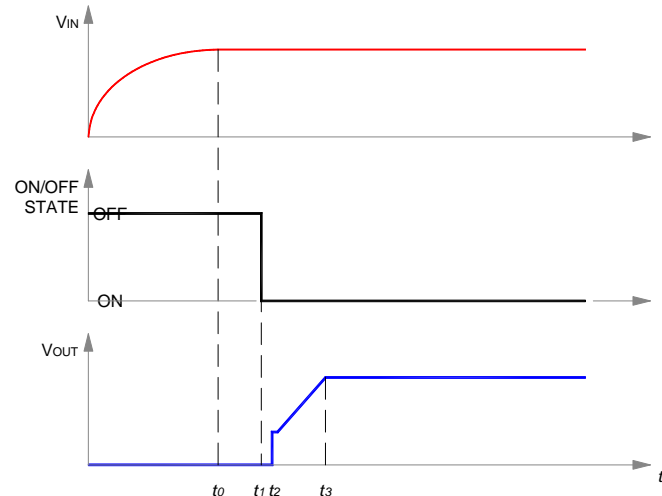


Fig. 6. Start-up Scenario #2.

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 7.

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 (100 ms typical) is initiated, and ON/OFF pin action is internally inhibited.
t_2	ON/OFF pin is externally re-enabled. If $(t_2 - t_1) \leq 100$ ms , external action of ON/OFF pin is locked out by start-up 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 8.
t_4	End of converter turn-on delay.
t_5	Converter V_{OUT} reaches 100% of nominal value.

For the condition, $(t_2 - t_1) \leq 100$ ms, the total converter start-up time ($t_5 - t_2$) is typically 102.5 ms. For $(t_2 - t_1) > 100$ ms, start-up will be typically 2.5 ms after release of ON/OFF pin.

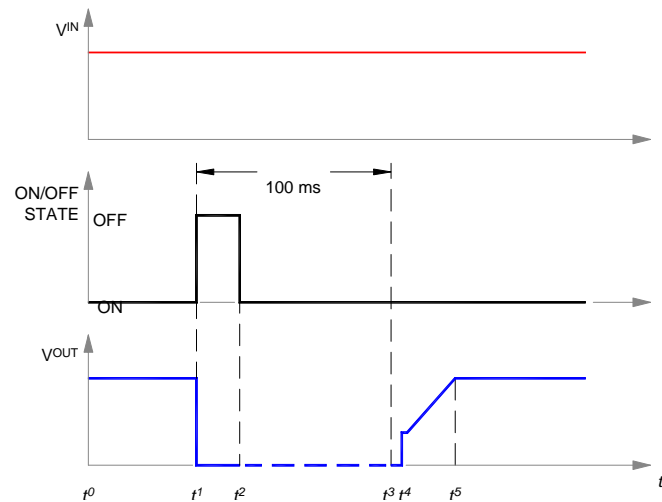


Fig. 7. Start-up Scenario #3.

Safety Considerations

The Q2S15 series converters feature 2000 Volt DC isolation from input to output. The input to output DC resistance is greater than 10MΩ. These converters are provided with Basic insulation between input and output circuits according to all IEC60950 based standards. Nevertheless, if the system using the converter needs to receive safety agency approval, certain rules must be followed in the design of the system. In particular, all of the creepage and clearance requirements of the end-use safety requirements must be observed. These documents include UL60950, CSA60950-00 and EN60950, although other additional requirements may be needed for user's specific applications.

The Q2S15 series converters have no internal fuse. An external fuse must be provided to protect the system from catastrophic failure. The fuse with a rating not greater than 10A is recommended. The user can select a lower rating fuse based upon the highest inrush transient at the maximum input voltage and the maximum input current of the converter at the minimum input voltage. Both input traces and the chassis ground trace (if applicable) must be capable of conducting a current of 1.5 times the value of the fuse without opening. The fuse must not be placed in the grounded input line, if any.

In order for the output of the Q2S15 series converter to be considered as SELV (Safety Extra Low Voltage) or TNV-1, according to all IEC60950 based standards, one of the following requirements must be met in the system design:

- If the voltage source feeding the module is SELV or TNV-2, the output of the converter may be grounded or ungrounded.
- If the voltage source feeding the module is ELV, the output of the converter may be considered SELV only if the output is grounded per the requirements of the standard.
- If the voltage source feeding the module is a Hazardous Voltage Secondary Circuit, the voltage source feeding the module must be provided with at least basic insulation between the source to the converter and any hazardous voltages. The entire system,

including the Q2S15 converter, must pass a dielectric withstand test for Reinforced insulation. Design of this type of system requires expert engineering and understanding of the overall safety requirements, and should be performed by qualified personnel.

Thermal Considerations

The Q2S15 series converters are designed for natural or forced convection cooling. The maximum allowable output power of the converters is determined by meeting the derating criteria of all electronic components used in the power supplies. An example of the derating criteria for the semiconductor junction temperature is not to exceed 120°C to provide reliable long-term operation of the converters. Note: Please contact Power-One for more derating criteria for other components.

The graph in Figure 8 shows the maximum output current of the Q2S15 series converters at different ambient temperatures under both natural and forced (longitudinal airflow direction, from pin 3 to pin 4) convection. As an example, from Figure 10, the Q2S15ZE operating at 50°C can deliver up to 15A reliably with 300LFM forced air.

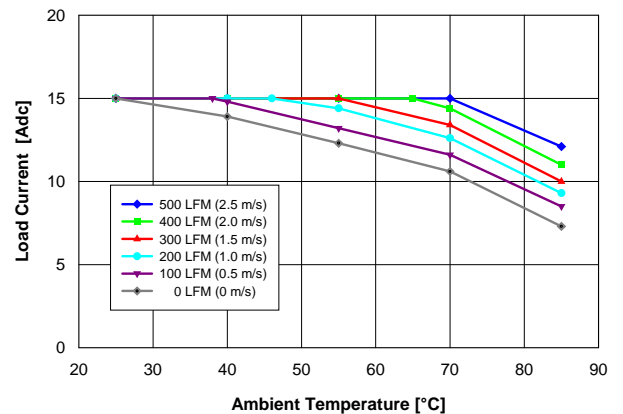
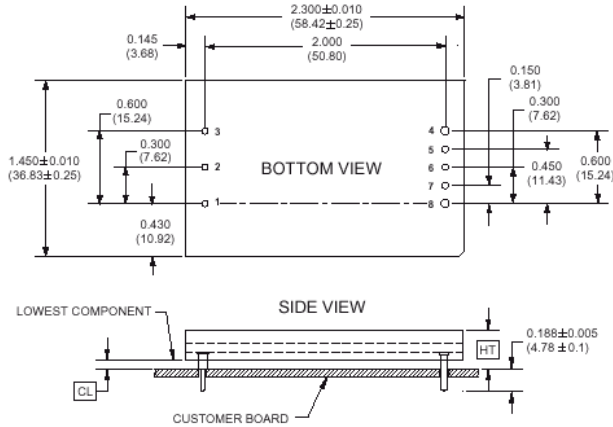
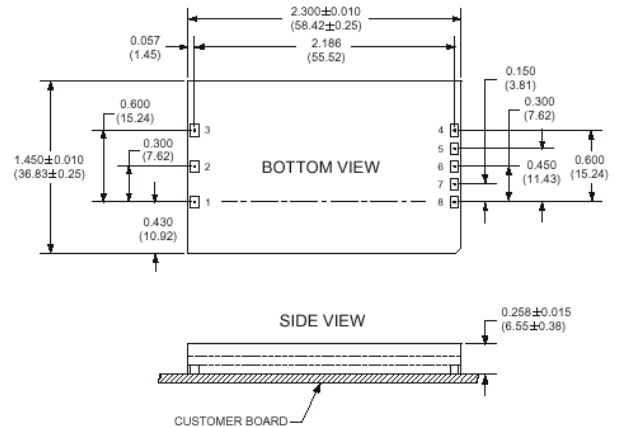


Fig. 8. Q2S15ZG (5.0V) Derating Curves

MECHANICAL DRAWING Inches (mm)



Through Hole



Surface Mount

- Pins 1-3 and 5-7 are • 0.040" (1.02) with • 0.078" (1.98) shoulder
- Pins 4 and 8 are • 0.062" (1.57) without shoulder
- Pin material: Brass
- Pin Finish: Tin/Lead over Nickel
- Module Weight: 0.95 oz (27 g)

PIN CONNECTIONS	
PIN	FUNCTION
1	Vin (+)
2	Remote ON/OFF
3	Vin (-)
4	Vout (-)
5	Sense (-)
6	Trim
7	Sense (+)
8	Vout (+)



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ORDERING INFORMATION

Product Series	Output Current	Input Voltage	Output Voltage 1		ON/OFF Logic	Surface Mount	Pin Length	Height Option
Q2S	15	Z	G	-	N	M6		C2
Single Output Quarter-Brick Format	ADC	Z = 48Vin Nom. Y = 24Vin Nom.	G = 5.0VDC		N ⇒ Negative (Blank) ⇒ Positive	M6 ⇒ Surface Mount (Blank) ⇒ Through Hole	Blank ⇒ 0.188" 7 ⇒ 0.145" 8 ⇒ 0.110"	See Chart Below Not Valid w/M6 Option

Height, Clearance and Pin Options for Through-Hole Versions

Height Option	HT (Maximum Height)		CL (Minimum Clearance)		Pin Option	PL (Pin Length)	
	+0.000 [+0.00] -0.038 [- 0.97]		+0.030 [+0.77] -0.000 [- 0.00]			±0.005 [±0.13]	
blank	0.303	[7.69]	0.030	[0.77]		0.188	[4.77]
C2	0.336	[8.53]	0.063	[1.600]	7	0.145	[3.68]
C3	0.400	[10.16]	0.127	[3.23]	8	0.110	[2.79]
C4	0.500	[12.70]	0.227	[5.77]			

Example: Q2S15ZG-NM6 indicates a 5.0V output model with Negative On/Off logic in a SMT mounting package.

Notes

1. Consult factory for the complete list of available options.
2. Power-One products are not 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.
3. 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.