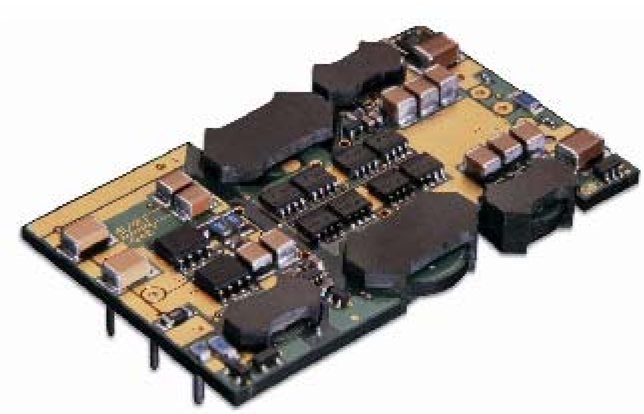
Q2S30 Series – 30A Quarter-Brick DC/DC Converter
48, 24V Input **Data Sheet**
3.3V, 2.5V, 2.0V, 1.8V, 1.5V Output



Features

- Low profile (8.5mm)
- 1500 VDC input-to-output isolation meets basic insulation
- High efficiency - to 90% 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 ± 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 IEC950

Applications

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

Description

The new Q2S30 Series of single-output DC/DC converters offer unprecedented density and performance in an industry-standard, quarter-brick footprint. Patent pending technology combined with state-of-the-art packaging techniques allows the Q2S30 to provide 30A of output current in an 8.5mm package without a heatsink. The 100% surface mount design provides consistent high quality and reliability, and the SMT mounting option eliminates the need for separate (additional manual) operations to mount the converters to the motherboards during mass production.

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, %
Q2S30ZA	36-75	1.5	1.5	30	30	83
Q2S30ZB	36-75	1.7	1.8	30	30	85
Q2S30ZC	36-75	1.9	2.0	30	30	85
Q2S30ZD	36-75	2.3	2.5	30	30	87
Q2S30ZE	36-75	3.1	3.3	30	30	88
Q2S30YA	18-36	3.1	1.5	30	30	82
Q2S30YB	18-36	3.6	1.8	30	30	83.5
Q2S30YC	18-36	4.0	2.0	30	30	84.5
Q2S30YD	18-36	4.9	2.5	30	30	86
Q2S30YE	18-36	6.3	3.3	30	30	88

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 Per GR-513, tp = 10µs		75 100	VDC 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			102(28)		Oz/g
Water Washing	Standard process		Yes		
MTBF	Telcordia TR-332, Method I Case 1		2.6		MHrs

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		1500			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 18	48 24	75 36	VDC
Turn-On Input Voltage	Ramping Up Vin= 36-75 Vin = 18-36	33 16		35 17.5	VDC
Turn-Off Input Voltage	Ramping Down Vin = 36-75 Vin = 18-36	31 15		33 16.5	VDC
Turn-On Time	To Output Regulation Band 100% Resistive Load		2.5		ms
Input Reflected Ripple Current	25 MHz Bandwidth			10	$mA_{pk.pk}$
Inrush Transient	Vin = Vin max			0.1	A^2s

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		30	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	-3		3	%Vout
Remote Sense Headroom***				10%	%Vout
Dynamic Regulation Peak Deviation Settling Time	50-75% load step change di/dt = 5 A/µs to 1% error band		 160 100		 mV µs
Admissible Load Capacitance	Iout max, Nom Vin			30,000	µF
Output Current Limit Threshold**	Vout ≤0.97Vout nom	33	36	40	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 ensure 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 **Positive Logic** - Converter ON - Converter OFF	 On/Off signal is low – converter is ON Low logic range High logic range On/Off signal is low –converter is OFF High logic range Low logic range	 -20 2.4 2.4 -20		 0.8 20 20 0.8	 VDC VDC VDC VDC
Overtemperature Protection	Shut down		118		°C

Characteristic curves

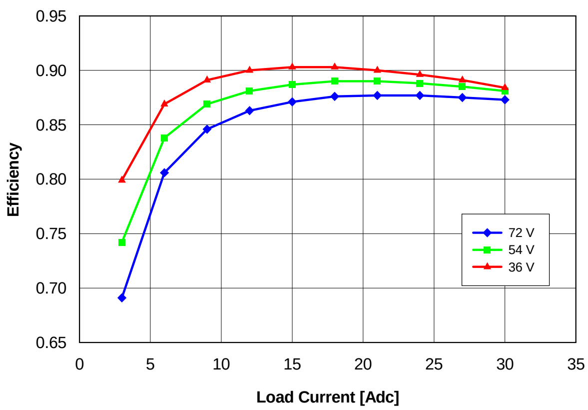


Fig .1 Q2S30ZE (3.3V) Efficiency vs. Load

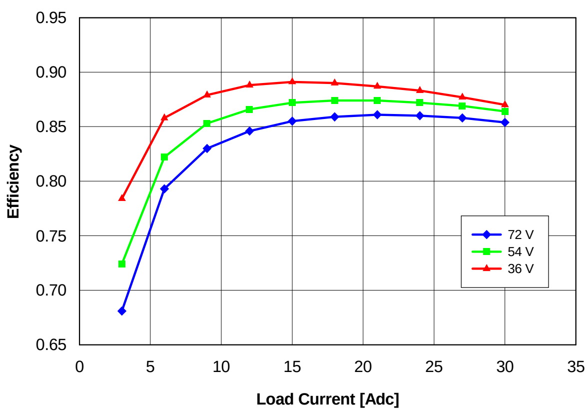


Fig. 2 Q2S30ZD (2.5V) Efficiency vs. Load

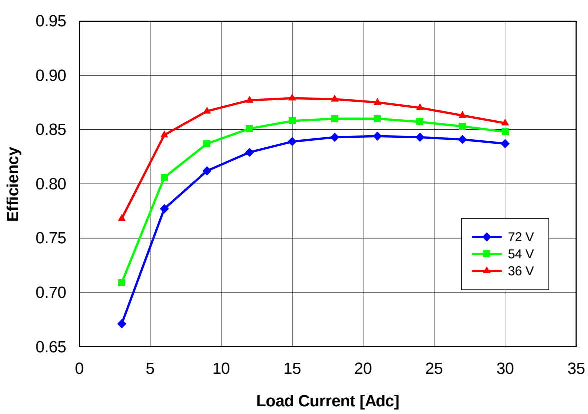


Fig. 3 Q2S30ZC (2.0V) Efficiency vs. Load

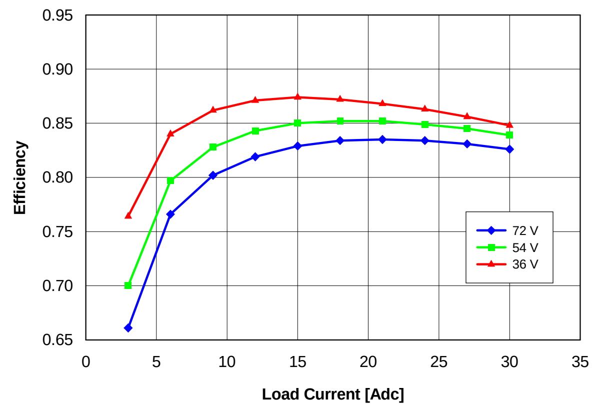


Fig. 4 Q2S30ZB (1.8V) Efficiency vs. Load

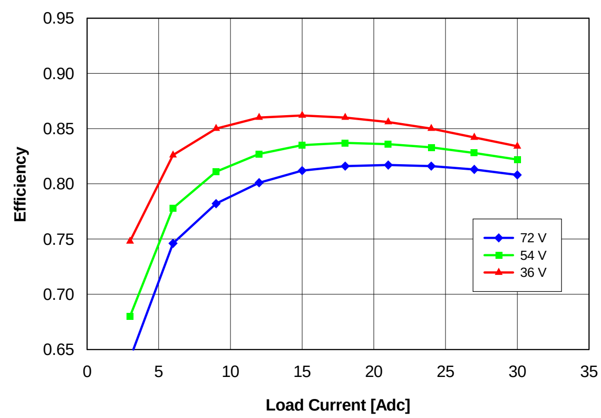


Fig. 5 Q2S30ZA (1.5V) Efficiency vs. Load

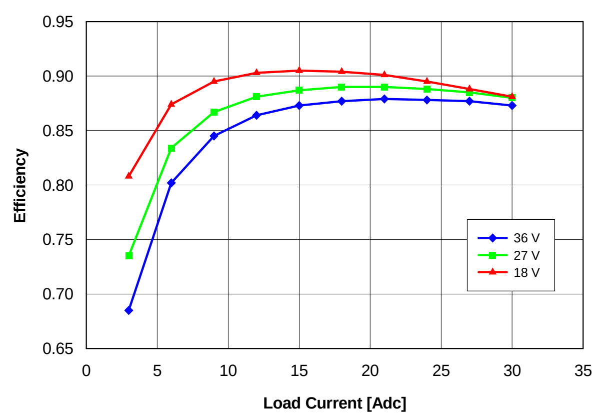


Fig. 6 Q2S30YE (3.3V) Efficiency vs. Load

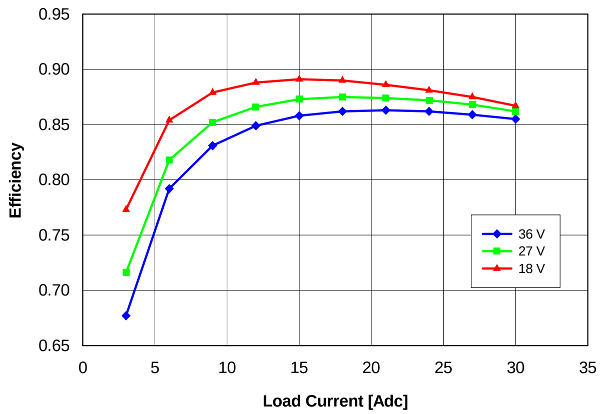


Fig. 7 Q2S30YD (2.5V) Efficiency vs. Load

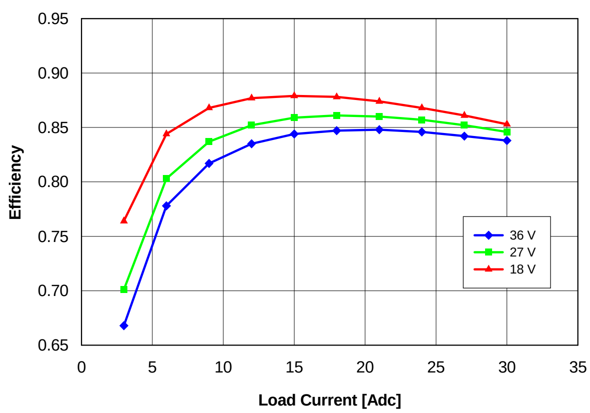


Fig. 8 Q2S30YC (2.0V) Efficiency vs. Load

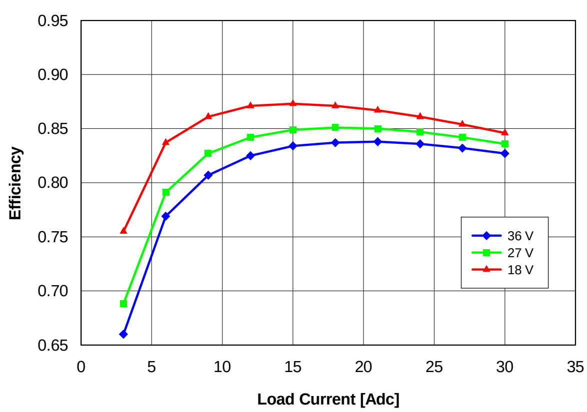


Fig. 9 Q2S30YB (1.8V) Efficiency vs. Load

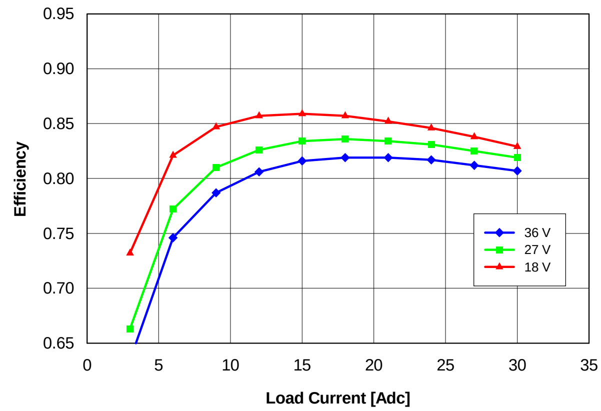


Fig. 10 Q2S30YA (1.5V) Efficiency vs. Load

Typical Application

Fig. 11 shows the recommended connections for the Q2S30 Series converter.

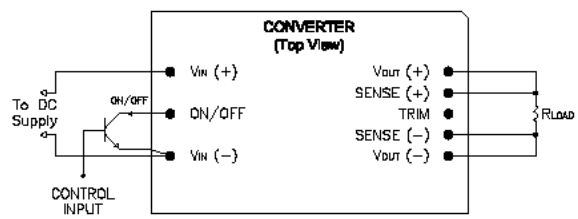


Fig. 11 Typical Application of Q2S30 Series

The Q2S30 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, an input 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 Q2S30 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 10µF tantalum and 1µF ceramic capacitors 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 of the Q2S30 Series converters functions as a normal soft shutdown. It is referenced to the –Vin pin. 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 ensure 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. 12. The trim-up resistor can be calculated from:

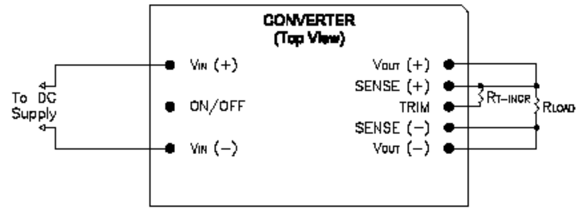


Fig. 12 Output Voltage Trim-up

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

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

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

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

When trimming up, care must be taken not to exceed the converter's maximum allowable output power.

To trim down the output voltage, a trim resistor, $R_{T\text{-}DECR}$, should be connected between TRIM (Pin 6) and SENSE(-) (Pin 5), as illustrated in Fig.13.

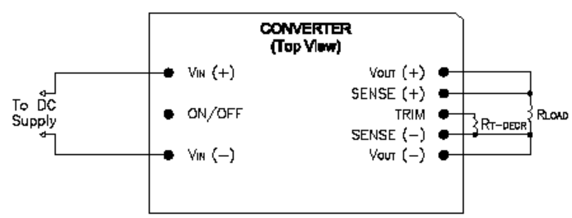


Fig. 13 Output Voltage Trim-down

The trip-down resistor can be calculated from:

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

where,
$R_{T\text{-}DECR}$ = 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 14**.

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.

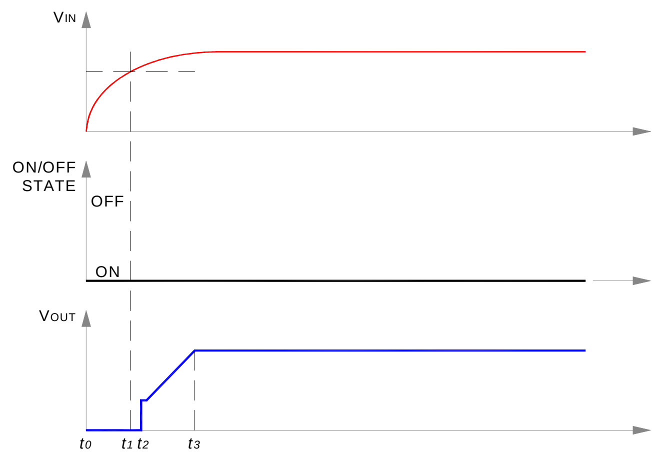


Fig.14 Start-up Scenario #1.

Scenario #2: Initial Start-up Using ON/OFF Pin
With V_{IN} previously powered, converter started via ON/OFF pin. See **Figure 15**.

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.

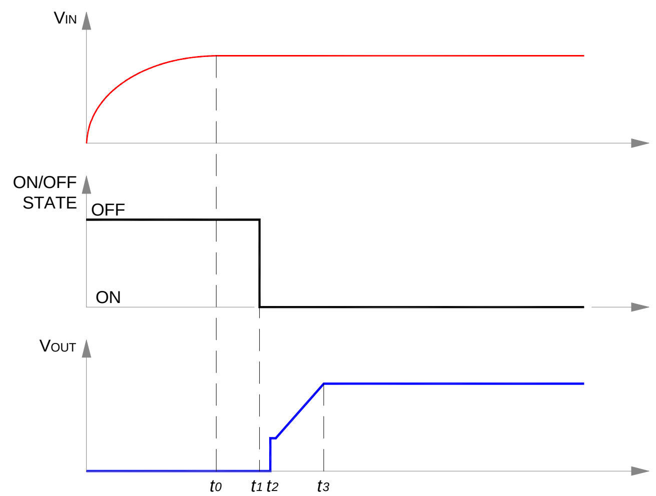


Fig. 15 Start-up Scenario #2.

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 16**.

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) ≤ 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) ≤ 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

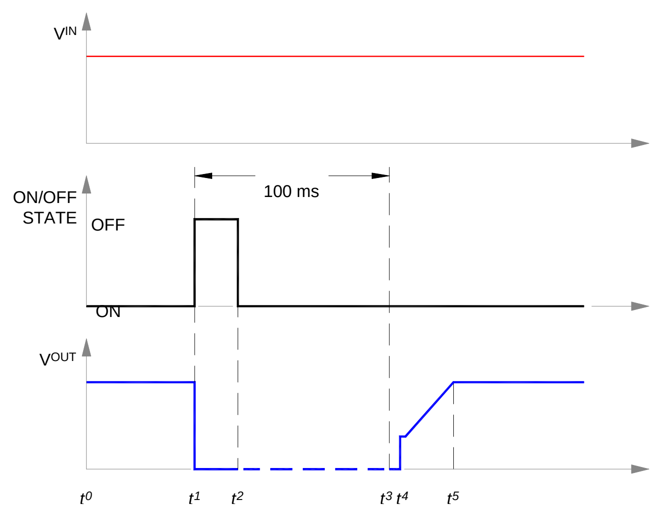


Fig. 16 Start-up Scenario #3.

Safety Considerations

The Q2S30 Series converters feature 1500 Volt DC isolation from input-to-output. The input-to-output DC resistance is greater than 10 MΩ. 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 Q2S30 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 Q2S30 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 Q2S30 converter, must pass a dielectric withstand test for Reinforced insulation. Design of this type of systems requires expert engineering and under-standing of the overall safety requirements and should be performed by qualified personnel.

Thermal Considerations

The Q2S30 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 temp-erature 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 graphs below show the maximum output current of the Q2S30 Series converters at different ambient temperatures under both natural and forced (airflow direction from pin 1 to pin 3) convection. As an example, the Q2S30ZE operating at 50 °C can deliver 30A reliably with 300LFM forced air, while up to 30A at 60 °C reliably with 400LFM forced air.

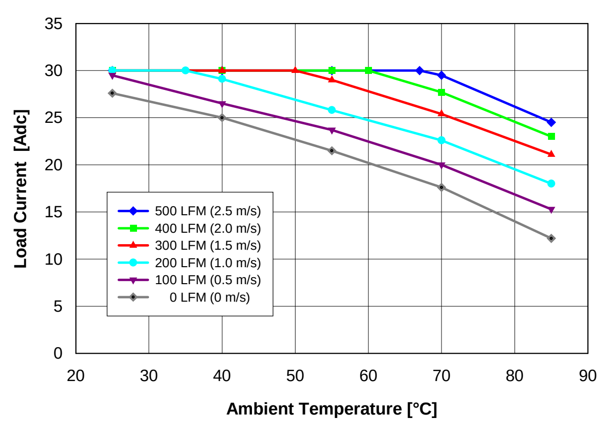


Fig. 17 Q2S30ZE (3.3V) Derating Curves

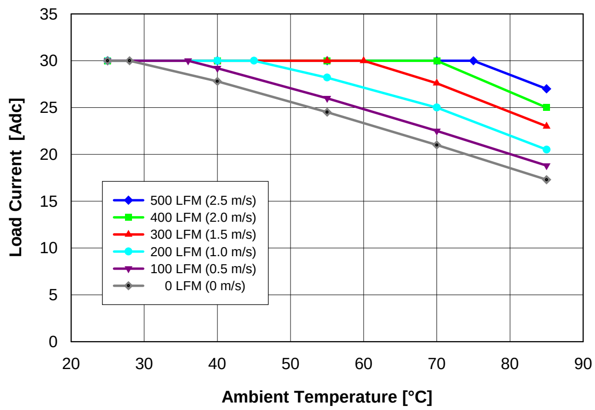


Fig. 18 Q2S30ZD (2.5V) Derating Curves

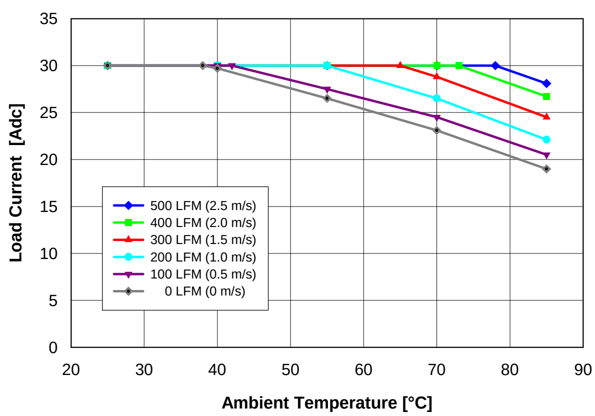


Fig. 19 Q2S30ZC (2.0V) Derating Curves

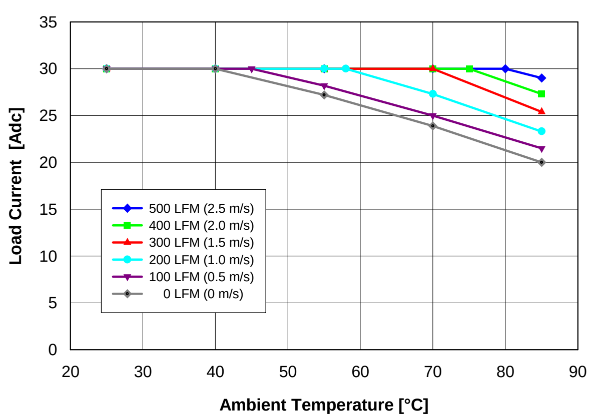


Fig. 20 Q2S30ZB (1.8V) Derating Curves

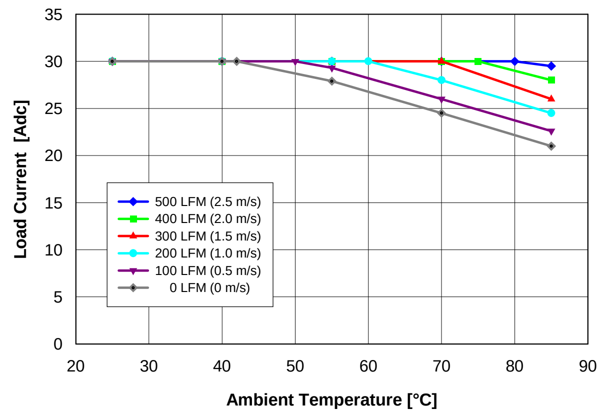


Fig. 21 Q2S30ZA (1.5V) Derating Curves

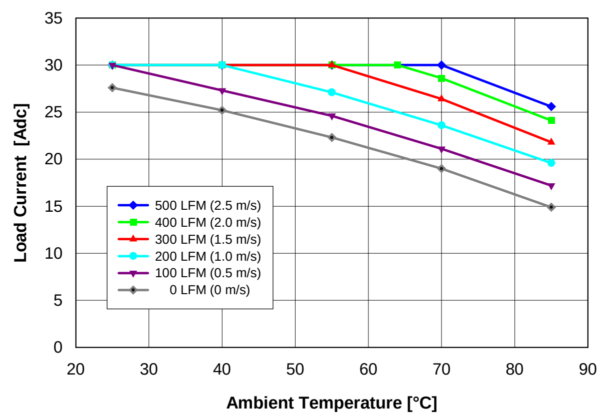


Fig. 22 Q2S30YE (3.3V) Derating Curves

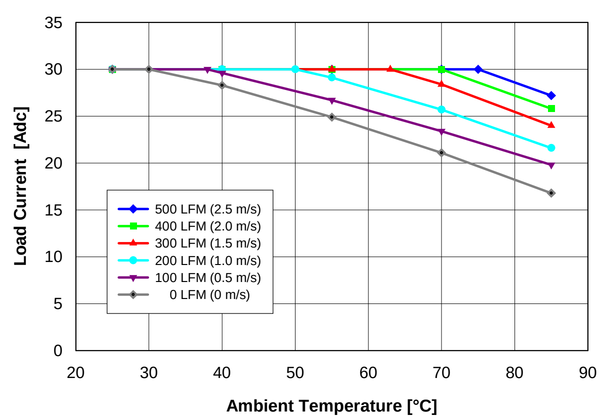


Fig. 23 Q2S30YD (2.5V) Derating Curves

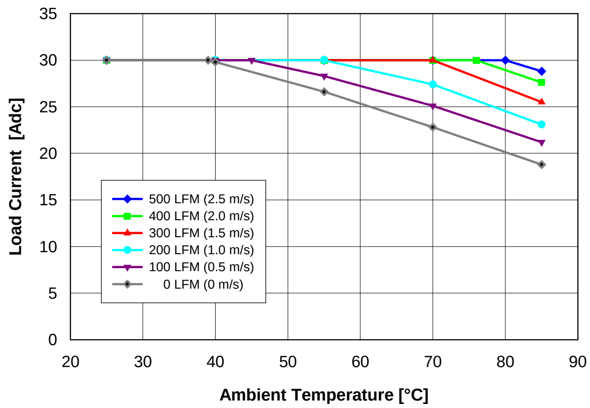


Fig. 24 Q2S30YC (2.0V) Derating Curves

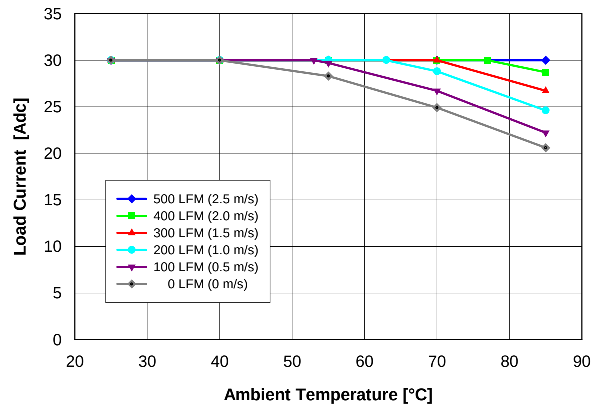


Fig. 26 Q2S30YA (1.5V) Derating Curves

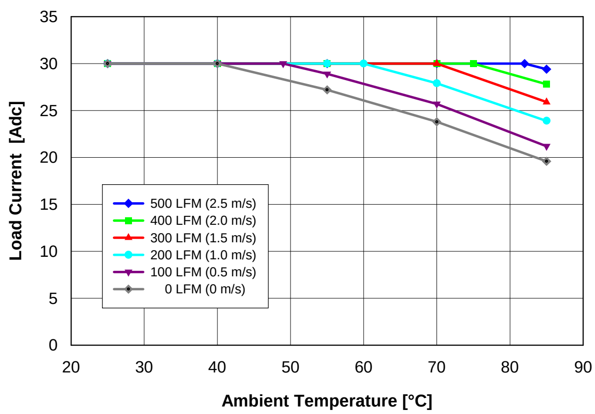
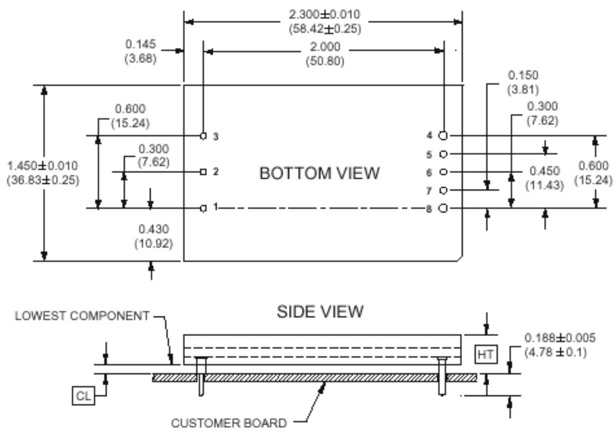
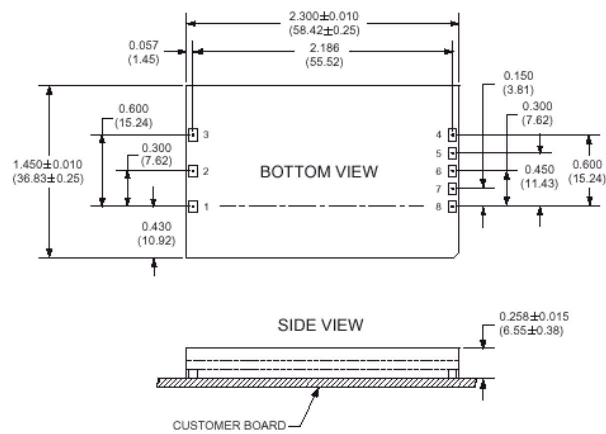


Fig. 25 Q2S30YB (1.8V) Derating Curves

MECHANICAL DRAWING Inches (mm)



Through Hole



Surface Mount

Height option	HT (Max Height)	CL (Min Clearance)
blank	0.303 [7.69]	0.030 [0.77]
C2	0.336 [8.53]	0.063 [1.600]
C3	0.400 [10.16]	0.127 [3.23]
C4	0.500 [12.70]	0.227 [5.77]

- 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 (+)

ORDERING INFORMATION

					ON/OFF			
Q2S	**30**	**Z**	**G**	**-**	**N**	**M6**		**C2**
Single Output Quarter-Brick Format	ADC	Z = 48Vin Nom. Y= 24Vin Nom.	E = 3.3VDC D = 2.5VDC C = 2.0VDC B = 1.8VDC A = 1.5VDC		N ⇒ Negative (Blank) ⇒ Positive	M6 ⇒ Surface Mount (Blank) ⇒ Through Hole	Blank ⇒ 0.188" 7 ⇒ 0.145" 8 ⇒ 0.110" *Not valid w/M6 Option*	*See Chart* *Not Valid w/M6 Option*

Example: Q2S30ZA-NM6 indicates a 1.5V 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.