**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<br>Per GR-513, tp = 10µs | | 75<br>100 | VDC<br>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<br>18 | 48<br>24 | 75<br>36 | VDC |
| Turn-On Input Voltage | Ramping Up Vin= 36-75<br>Vin = 18-36 | 33<br>16 | | 35<br>17.5 | VDC |
| Turn-Off Input Voltage | Ramping Down Vin = 36-75<br>Vin = 18-36 | 31<br>15 | | 33<br>16.5 | VDC |
| Turn-On Time | To Output Regulation Band<br>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<br>Peak Deviation<br>Settling Time | 50-75% load step change<br>di/dt = 5 A/µs<br>to 1% error band | | <br>160<br>100 | | <br>mV<br>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 | 117 | 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** | On/Off signal is low – converter is ON | | | | |
| - Converter ON | Low logic range | -20 | | 0.8 | VDC |
| - Converter OFF | High logic range | 2.4 | | 20 | VDC |
| **Positive Logic** | On/Off signal is low –converter is OFF | | | | |
| - Converter ON | High logic range | 2.4 | | 20 | VDC |
| - Converter OFF | Low logic range | -20 | | 0.8 | VDC |
| Overtemperature Protection | Shut down | | 118 | | °C |

## Characteristic curves

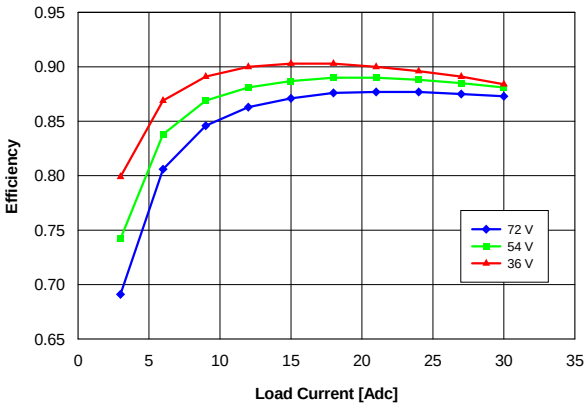



**Fig .1** Q2S30ZE (3.3V) Efficiency vs. Load

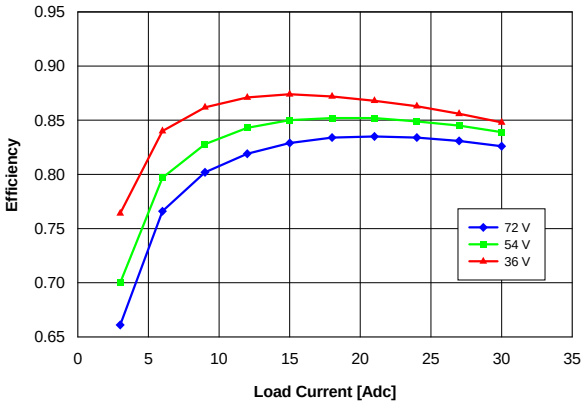



**Fig. 4** Q2S30ZB (1.8V) Efficiency vs. Load

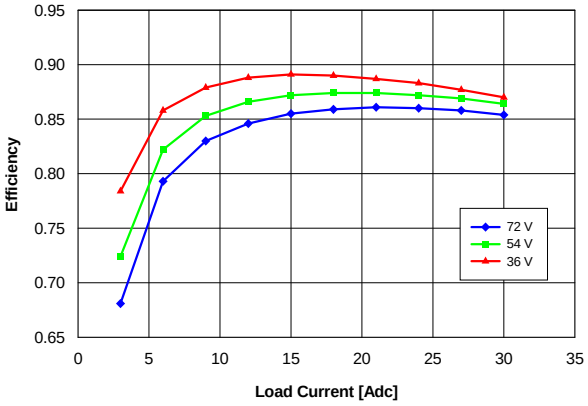



**Fig. 2** Q2S30ZD (2.5V) Efficiency vs. Load

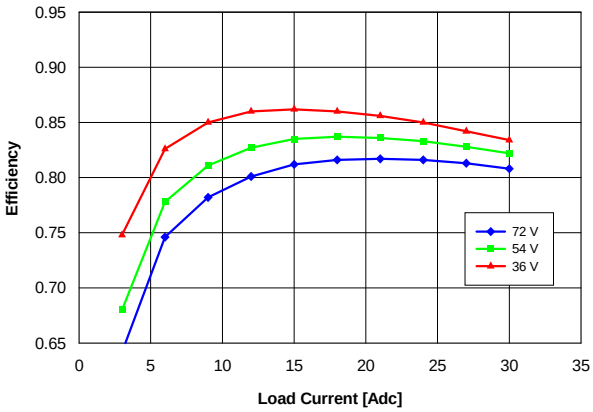



**Fig. 5** Q2S30ZA (1.5V) Efficiency vs. Load

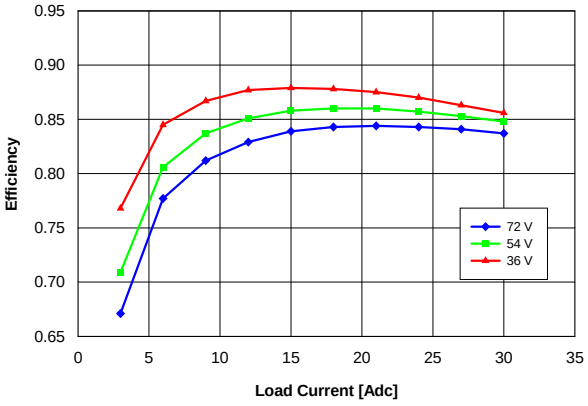



**Fig. 3** Q2S30ZC (2.0V) Efficiency vs. Load

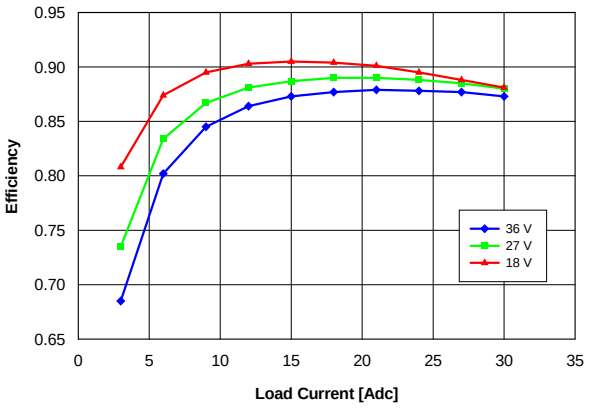



**Fig. 6** Q2S30YE (3.3V) Efficiency vs. Load

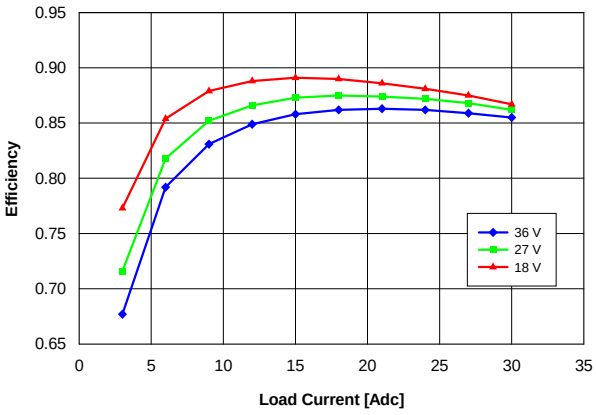



**Fig. 7** Q2S30YD (2.5V) Efficiency vs. Load

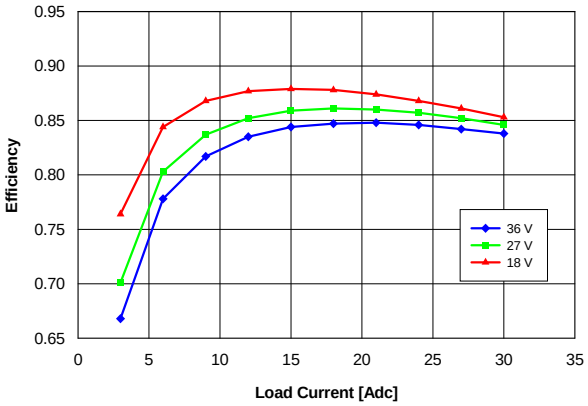



**Fig. 8** Q2S30YC (2.0V) Efficiency vs. Load

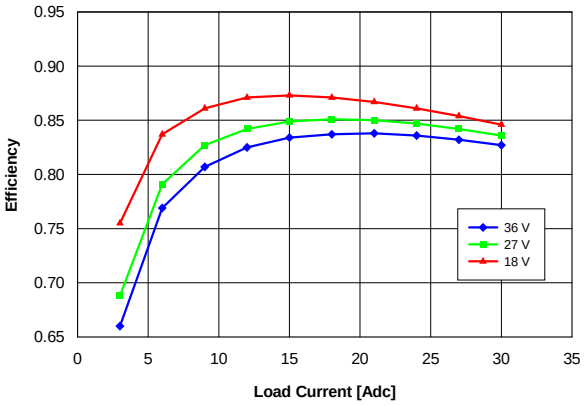



**Fig. 9** Q2S30YB (1.8V) Efficiency vs. Load

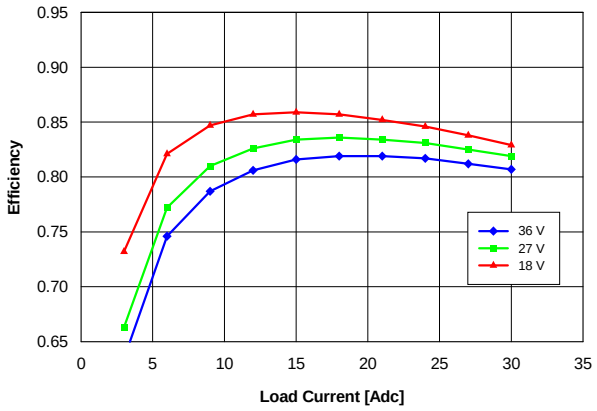



**Fig. 10** Q2S30YA (1.5V) Efficiency vs. Load

## Typical Application

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

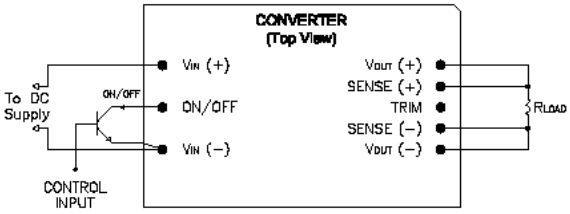



**Fig. 11** Typical Application of Q2S30 Series

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:

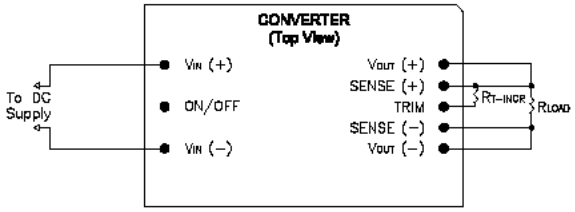



**Fig. 12** Output Voltage Trim-up

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

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.

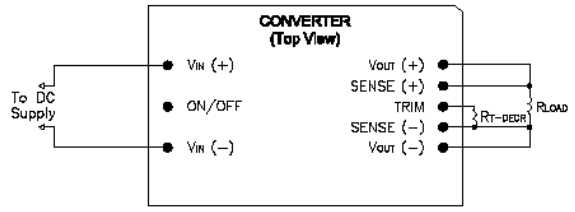



**Fig. 13** Output Voltage Trim-down

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.

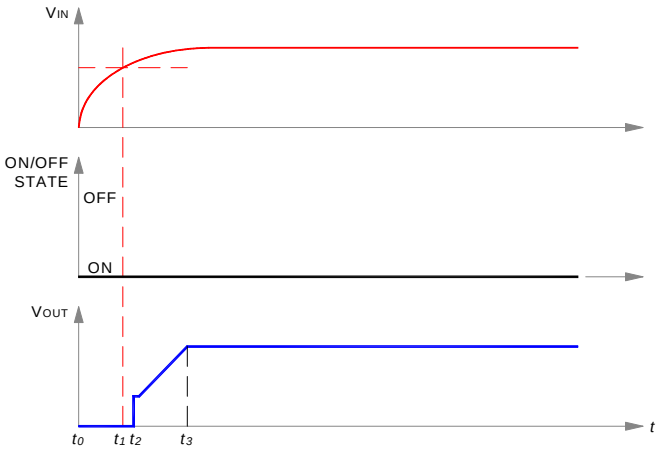



**Fig.14** Start-up Scenario #1.

**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.

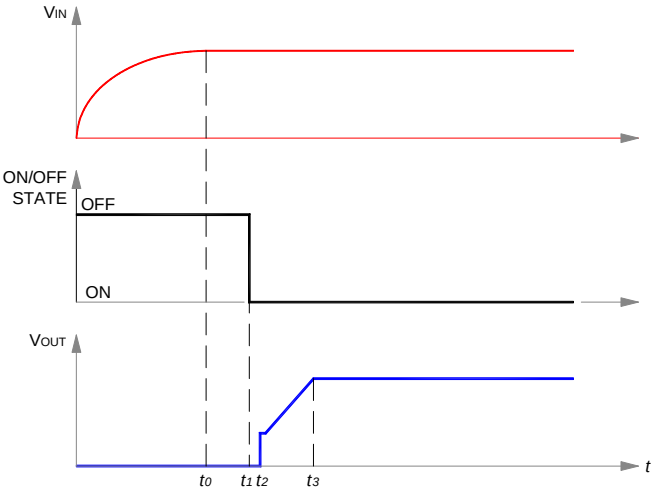



**Fig. 15** Start-up Scenario #2.

**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.<br>**If ($t_2$- $t_1$) ≤ 100 ms**, external action of ON/OFF pin is locked out by start-up inhibit timer.<br>**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

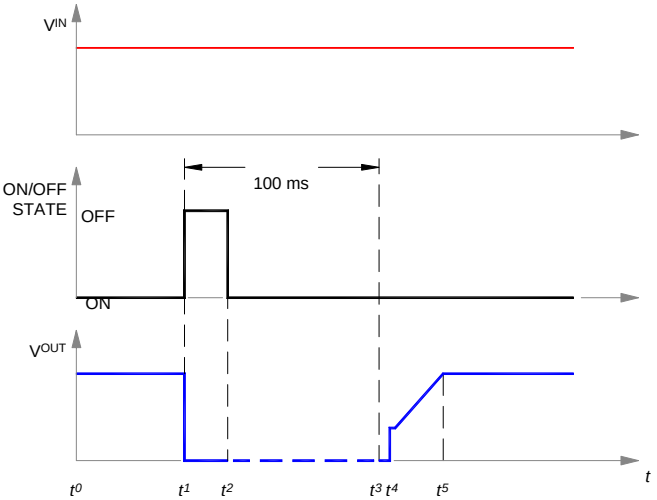



**Fig. 16** Start-up Scenario #3.

## 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 understanding 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 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 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.

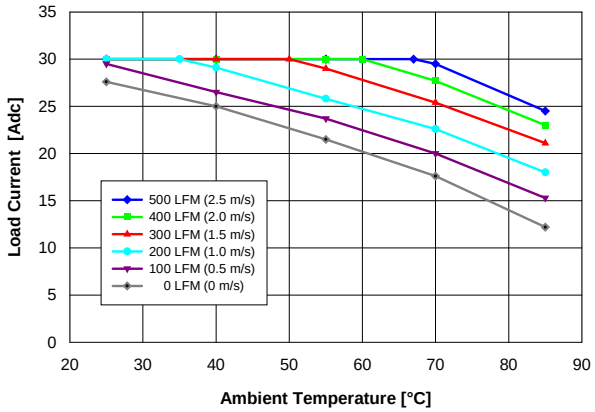



**Fig. 17** Q2S30ZE (3.3V) Derating Curves

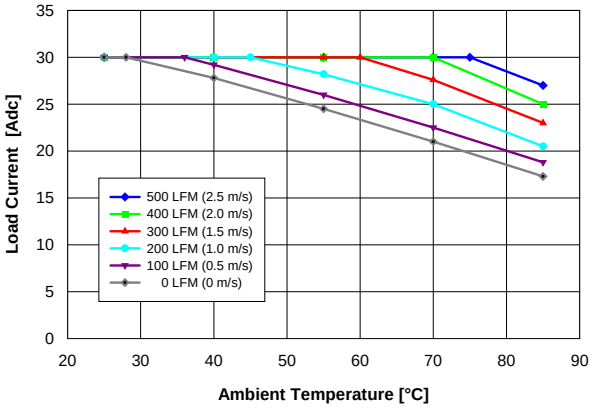



**Fig. 18** Q2S30ZD (2.5V) Derating Curves

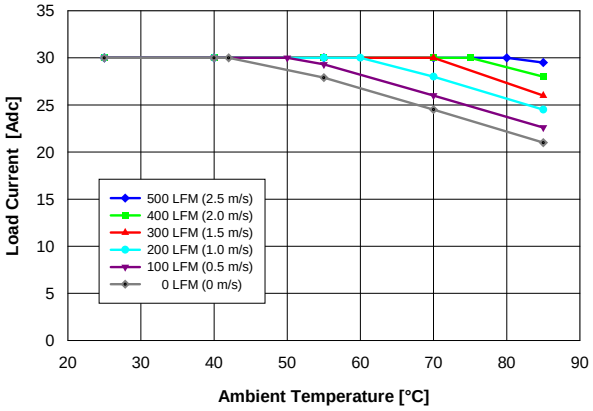



**Fig. 21** Q2S30ZA (1.5V) Derating Curves

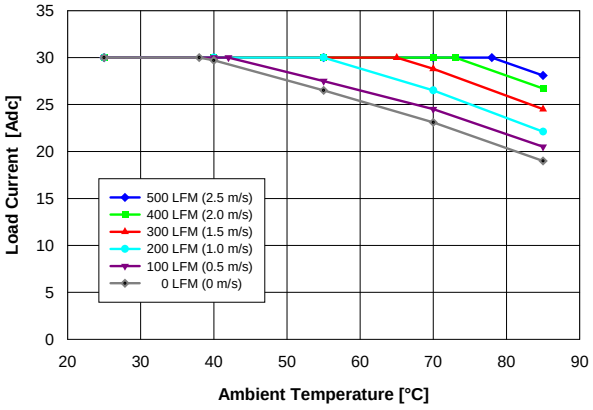



**Fig. 19** Q2S30ZC (2.0V) Derating Curves

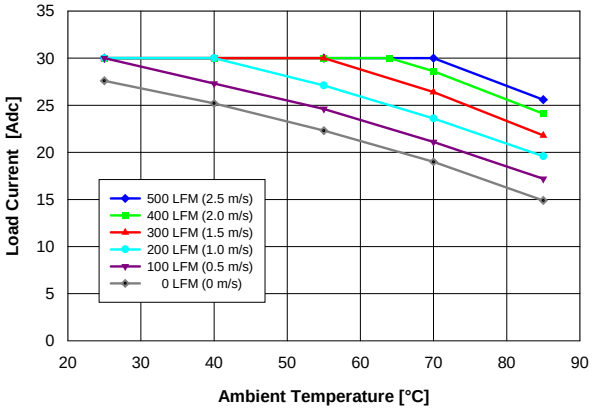



**Fig. 22** Q2S30YE (3.3V) Derating Curves

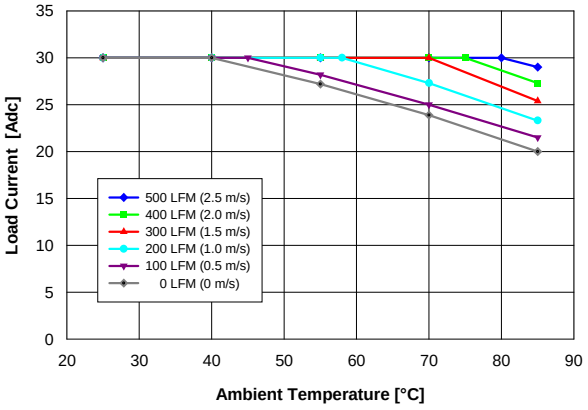



**Fig. 20** Q2S30ZB (1.8V) Derating Curves

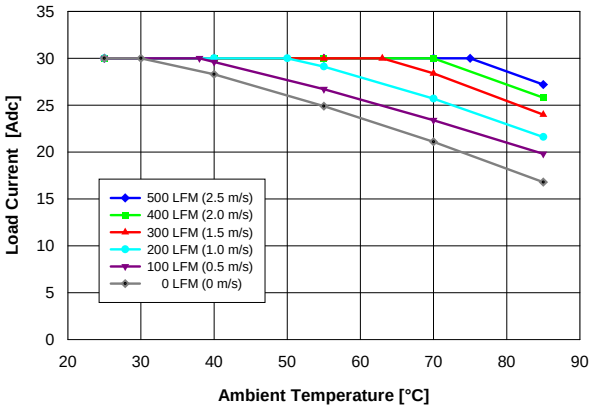



**Fig. 23** Q2S30YD (2.5V) Derating Curves

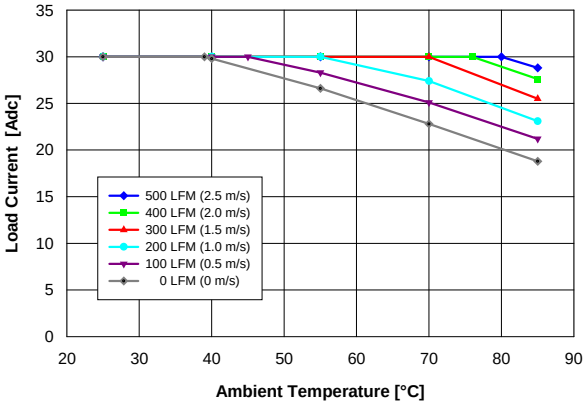



**Fig. 24** Q2S30YC (2.0V) Derating Curves

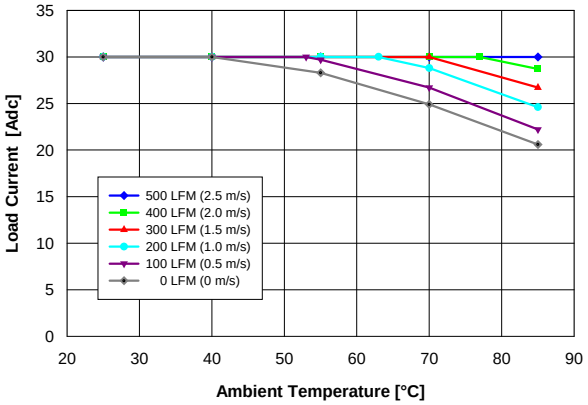



**Fig. 26** Q2S30YA (1.5V) Derating Curves

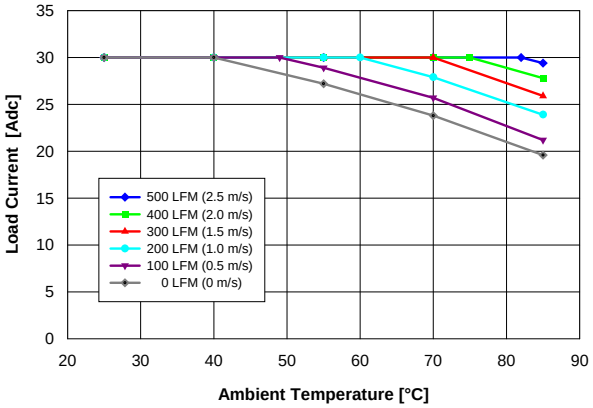
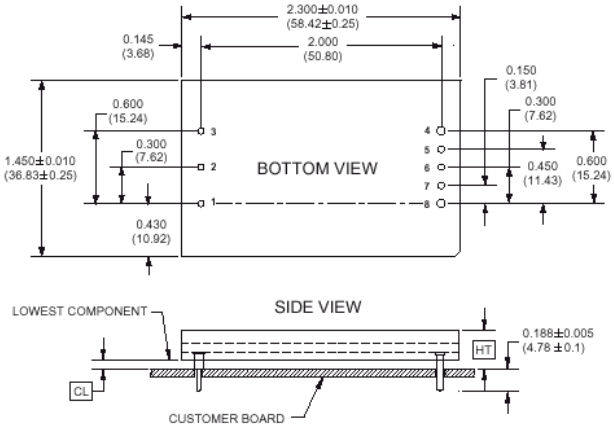
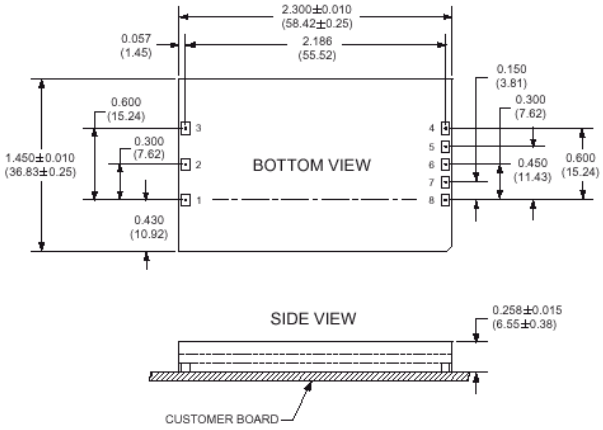



**Fig. 25** Q2S30YB (1.8V) Derating Curves

## 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] |

- 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.<br><br>Y= 24Vin Nom. | E = 3.3VDC<br>D = 2.5VDC<br>C = 2.0VDC<br>B = 1.8VDC<br>A = 1.5VDC | | N ⇒ Negative<br><br>(Blank) ⇒ Positive | M6 ⇒ Surface Mount<br><br>(Blank) ⇒ Through Hole | Blank ⇒ 0.188”<br>7 ⇒ 0.145”<br>8 ⇒ 0.110”<br><br>*Not valid w/M6 Option* | *See Chart*<br><br>*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 President of Power-One, Inc.
3. Specifications are subject to change without notice.