DELPHI SERIES

FEATURES

- High Efficiency: 95.5% @9.6V/31A
- Standard footprint: 57.9 x 36.8 x 12.7mm (2.28”x1.45”x0.5”)
- Industry standard pin out
- Fully protected:OTP, OCP, Input OVP, UVLO
- 2250V isolation
- Basic insulation
- No minimum load required
- Current sharing
- ISO 9001, TL 9000, ISO 14001, QS 9000, OHSAS 18001 certified manufacturing facility
- UL/cUL 60950 (US & Canada), and TUV (EN60950) Certified
- CE mark meets 73/23/EEC and +3/68/EEC directives

Delphi Series Q48SB, 300W Bus Converter DC/DC Power Modules: 48V in, 9.6V/31A out

The Delphi Series Q48SB, 48V input, single output, quarter brick, 300W bus converters are the latest offering from a world leader in power systems technology and manufacturing — Delta Electronics, Inc. This product family supports intermediate bus architectures and powers multiple downstream non-isolated point-of-load (POL) converters. The Delphi Series Q48SB operates from a nominal 48V input and provides up to 300W of power or up to 31A of output current in an industry standard quarter brick footprint. The Q48SB product currently supports two input ranges: the Q48SB120 features an input voltage range of 42V to 53V and provides 4:1 unregulated output of 12V at 20A or 25A. The Q48SB108 features a wider input voltage range of 36V to 60V and provides 5:1 unregulated output of 9.6V at up to 31A. Typical efficiency for the 9.6V/31A or 10.8V/28A module is 95.5%. With optimized component placement, creative design topology, and numerous patented technologies, the Q48SB bus converter delivers outstanding electrical and thermal performance. An optional heatsink is available for harsh thermal requirements.

OPTIONS

- Positive On/Off logic
- Short pin lengths
- Heatsink available for extended operation

APPLICATIONS

- Datacom / Networking
- Wireless Networks
- Optical Network Equipment
- Server and Data Storage
- Industrial/Testing Equipment

TECHNICAL SPECIFICATIONS

(T_A=25°C, airflow rate=300 LFM, V_{in}=48Vdc, nominal Vout unless otherwise noted.)

PARAMETER	NOTES and CONDITIONS	Q48SB10828NRFA			
		Min.	Typ.	Max.	Units
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					
Continuous				63	Vdc
Operating Temperature	Refer to Figure 15 for the measuring point	-40		+124	°C
Storage Temperature		-55		+125	°C
Input/Output Isolation Voltage				2250	Vdc
INPUT CHARACTERISTICS					
Operating Input Voltage		36	48	60	Vdc
Input Under-Voltage Lockout					
Turn-On Voltage Threshold		34	35	36	Vdc
Turn-Off Voltage Threshold		32	33	34	Vdc
Lockout Hysteresis Voltage			2		Vdc
Input Over-Voltage Lockout					
Turn-Off Voltage Threshold		62	63	64	Vdc
Turn-On Voltage Threshold		60	61	62	Vdc
Lockout Hysteresis Voltage			2		Vdc
Maximum Input Current				8	A
No-Load Input Current		30		120	mA
Off Converter Input Current			5	15	mA
Inrush Current(I^2t)			0.02		A^2s
Input Reflected-Ripple Current	RMS thru 12µH inductor, 5Hz to 20MHz		10		mArms
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	Vin=48V, Io=no load, Ta=25°C		9.6		Vdc
	Vin=54V, Io=no load, Ta=25°C		10.8		Vdc
Output Voltage Regulation					
Over Load	Io=Io,min to Io,max		400	500	mV
Over Line	Vin=36V to 60V		4.8	5	V
Over Temperature	Ta=-40°C to 85°C			200	mV
Total Output Voltage Range	over sample load, line and temperature	6.6		12.1	V
Output Voltage Ripple and Noise	5Hz to 20MHz bandwidth				
Peak-to-Peak	Full Load, 1µF ceramic, 10µF tantalum		120		mV
RMS	Full Load, 1µF ceramic, 10µF tantalum		30		mV
Operating Output Current Range		0		31	A
Output DC Current-Limit Inception	Output Voltage 10% Low		40		A
DYNAMIC CHARACTERISTICS					
Output Voltage Current Transient	48V, 10µF Tan & 1µF Ceramic load cap, 0.1A/µs				
Positive Step Change in Output Current	50% Io.max to 75% Io.max		150		mV
Negative Step Change in Output Current	75% Io.max to 50% Io.max		150		mV
Settling Time (within 1% Vout nominal)			50		us
Turn-On Transient					
Start-Up Time, From On/Off Control				20	ms
Start-Up Time, From Input				20	ms
Maximum Output Capacitance				10000	µF
EFFICIENCY					
100% Load			95.5		%
60% Load			96.5		%
ISOLATION CHARACTERISTICS					
Input to Output				2250	Vdc
Isolation Resistance			10		MΩ
Isolation Capacitance			750		pF
FEATURE CHARACTERISTICS					
Switching Frequency			130		kHz
ON/OFF Control, (Logic Low-Module ON)					
Logic Low	Von/off at Ion/off=1.0mA	0		0.8	V
Logic High	Von/off at Ion/off=0.0 µA	2.4		18	V
ON/OFF Current	Ion/off at Von/off=0.0V			1	mA
GENERAL SPECIFICATIONS					
MTBF	Io=80% of Io, max; Ta=25°C		2.88		M hours
Weight			43		grams
Over-Temperature Shutdown	Refer to Figure 15 for the measuring point		127		°C

ELECTRICAL CHARACTERISTICS CURVES

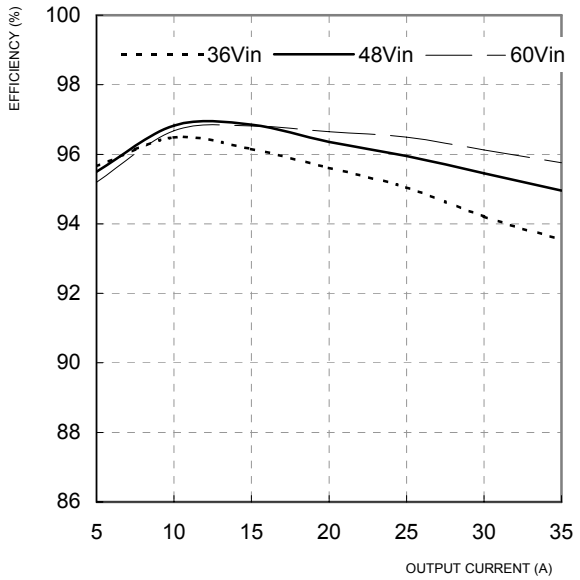


Figure 1: *Efficiency vs. load current for minimum, nominal, and maximum input voltage at 25°C*

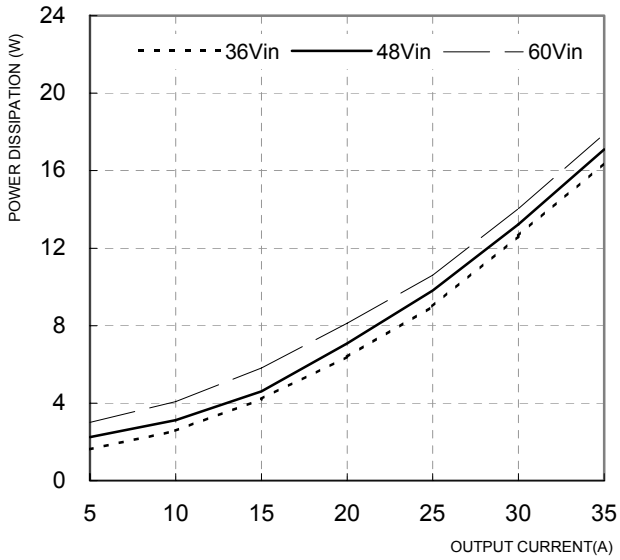


Figure 2: *Power loss vs. load current for minimum, nominal, and maximum input voltage at 25°C.*

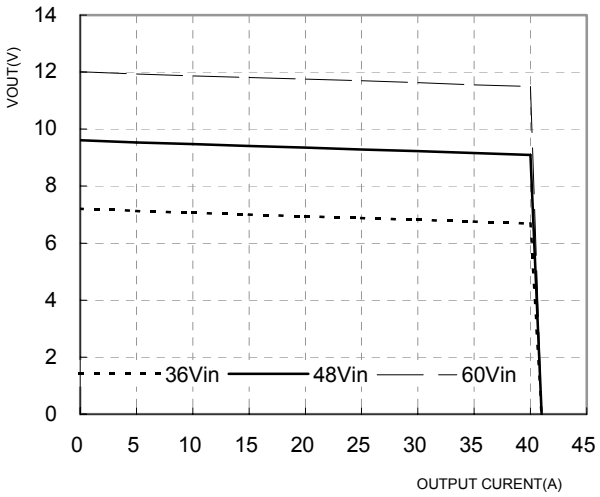


Figure 3: *Output voltage regulation vs load current showing typical current limit curves and converter shutdown points for minimum, nominal, and maximum input voltage at room temperature .*

ELECTRICAL CHARACTERISTIC CURVES

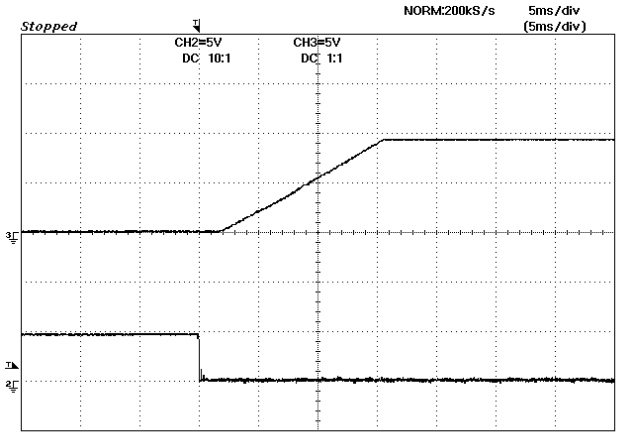


Figure 4: *Turn-on transient at full rated load current (5 ms/div). Top Trace: Vout; 5V/div; Bottom Trace: ON/OFF input: 5V/div*

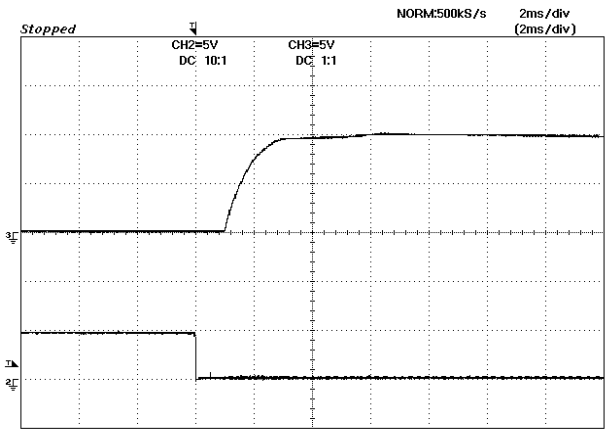


Figure 5: *Turn-on transient at zero load current (2 ms/div). Top Trace: Vout: 5V/div; Bottom Trace: ON/OFF input: 5V/div*

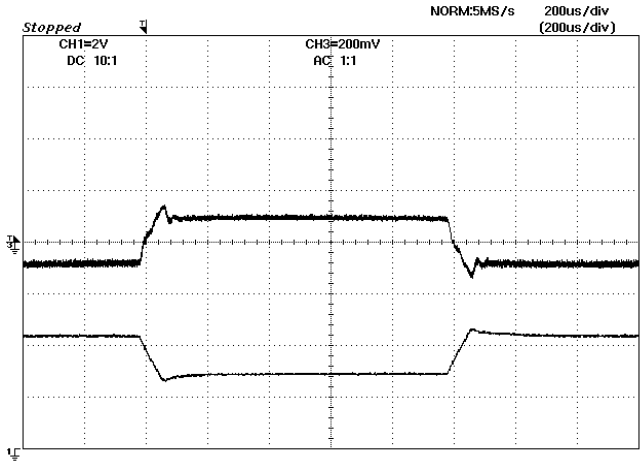


Figure 6: *Output voltage response to step-change in load current (50%-75%-50% of Io, max; di/dt = 0.1A/µs). Load cap: 10µF, tantalum capacitor and 1µF ceramic capacitor. Top Trace: Vout (200mV/div), Bottom Trace: Iout (10A/div). Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module.*

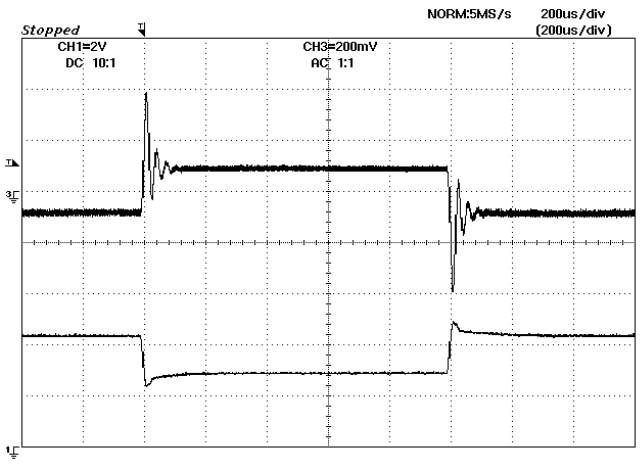


Figure 7: *Output voltage response to step-change in load current (50%-75%-50% of Io, max; di/dt = 1A/µs). Load cap:10uF,tantalum capacitor and 1µF ceramic capacitor. Top Trace: Vout (200mV/div), Bottom Trace: Iout (10A/div). Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module.*

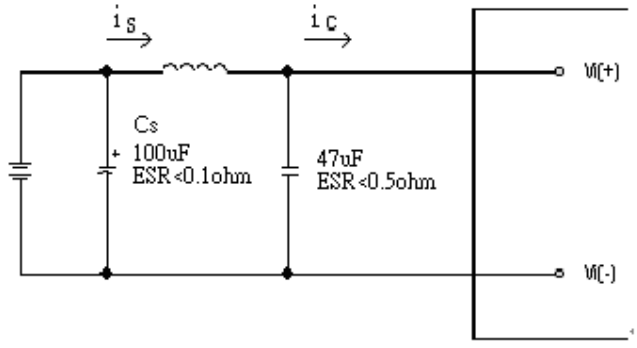


Figure 8: *Test set-up diagram showing measurement points for Input Terminal Ripple Current and Input Reflected Ripple Current.*
Note: Measured input reflected-ripple current with a simulated source Inductance (L_{TEST}) of 12 µH. Capacitor Cs offset possible battery impedance. Measure current as shown above.

ELECTRICAL CHARACTERISTIC CURVES

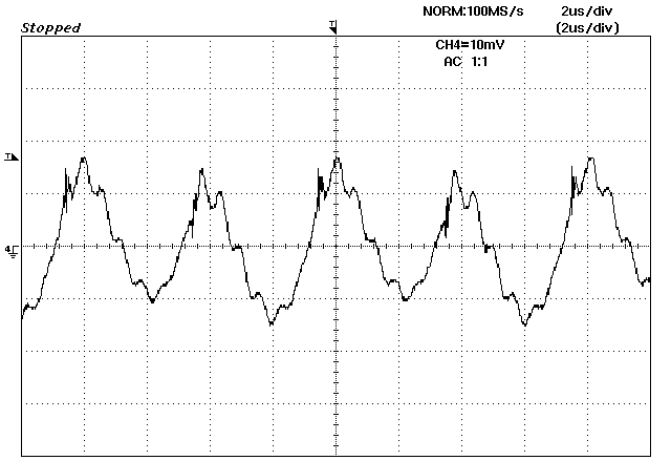


Figure 9: *Input Terminal Ripple Current, i_c, at full rated output current and nominal input voltage with 12µH source impedance and 100µF electrolytic capacitor (200 mA/div).*

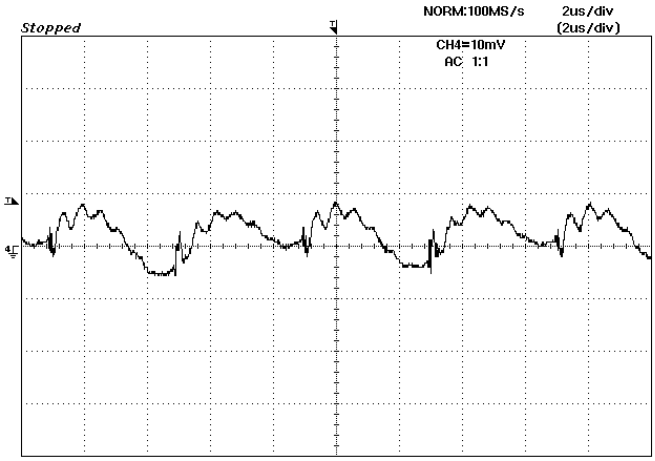


Figure 10: *Input reflected ripple current, i_s, through a 12µH source inductor at nominal input voltage and rated load current (5 mA/div).*

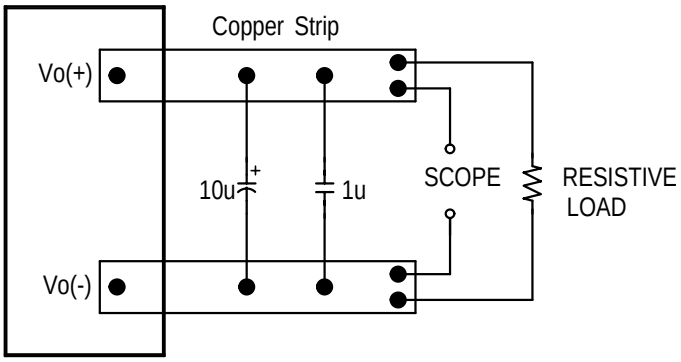


Figure 11: *Output voltage noise and ripple measurement test setup.*

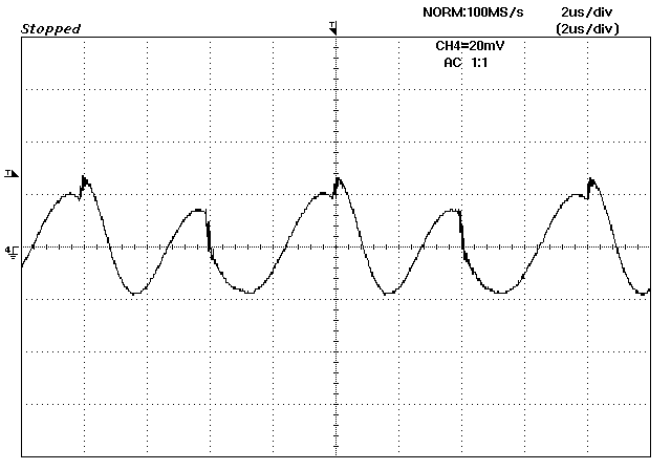


Figure 12: *Output voltage ripple at nominal input voltage and rated load current (50 mV/div). Load capacitance: 1µF ceramic capacitor and 10µF tantalum capacitor. Bandwidth: 20 MHz. Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module.*

DESIGN CONSIDERATIONS

Input Source Impedance

The impedance of the input source connecting to the DC/DC power modules will interact with the modules and affect the stability. A low ac-impedance input source is recommended. If the source inductance is more than a few μH, we advise adding a 47 to 220μF electrolytic capacitor (ESR < 0.5 Ω at 100 kHz) mounted close to the input of the module to improve the stability.

Layout and EMC Considerations

Delta's DC/DC power modules are designed to operate in a wide variety of systems and applications. For design assistance with EMC compliance and related PWB layout issues, please contact Delta's technical support team. An external input filter module is available for easier EMC compliance design. Application notes to assist designers in addressing these issues are pending release.

Soldering and Cleaning Considerations

Post solder cleaning is usually the final board assembly process before the board or system undergoes electrical testing. Inadequate cleaning and/or drying may lower the reliability of a power module and severely affect the finished circuit board assembly test. Adequate cleaning and/or drying is especially important for un-encapsulated and/or open frame type power modules. For assistance on appropriate soldering and cleaning procedures, please contact Delta's technical support team.

FEATURES DESCRIPTIONS

Over-Current Protection

The modules include an internal output over-current protection circuit, which will endure current limiting for an unlimited duration during output overload. If the output current exceeds the OCP set point, the modules will automatically shut down (hiccup mode).

The modules will try to restart after shutdown. If the overload condition still exists, the module will shut down again. This restart trial will continue until the overload condition is corrected.

Over-Temperature Protection

The over-temperature protection consists of circuitry that provides protection from thermal damage. If the temperature exceeds the over-temperature threshold the module will shut down.

The module will try to restart after shutdown. If the over-temperature condition still exists during restart, the module will shut down again. This restart trial will continue until the temperature is within specification.

Remote On/Off

The remote on/off feature on the module can be either negative or positive logic. Negative logic turns the module on during a logic low and off during a logic high. Positive logic turns the modules on during a logic high and off during a logic low.

Remote on/off can be controlled by an external switch between the on/off terminal and the Vi(-) terminal. The switch can be an open collector or open drain.

For negative logic if the remote on/off feature is not used, please short the on/off pin to Vi(-). For positive logic if the remote on/off feature is not used, please leave the on/off pin to floating.

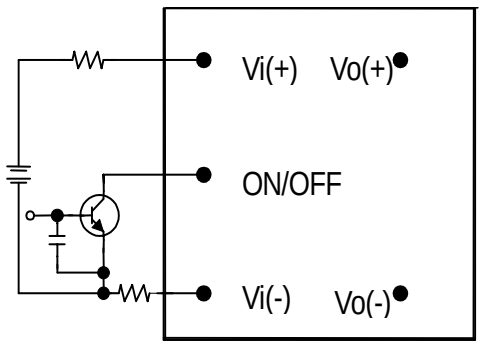


Figure 13: *Remote on/off implementation*

THERMAL CONSIDERATIONS

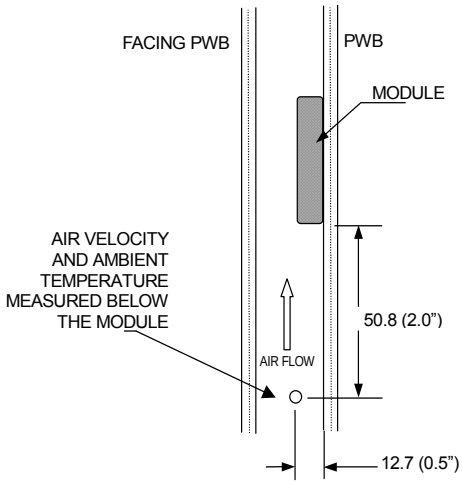
Thermal management is an important part of the system design. To ensure proper, reliable operation, sufficient cooling of the power module is needed over the entire temperature range of the module. Convection cooling is usually the dominant mode of heat transfer.

Hence, the choice of equipment to characterize the thermal performance of the power module is a wind tunnel.

Thermal Testing Setup

Delta's DC/DC power modules are characterized in heated vertical wind tunnels that simulate the thermal environments encountered in most electronics equipment. This type of equipment commonly uses vertically mounted circuit cards in cabinet racks in which the power modules are mounted.

The following figure shows the wind tunnel characterization setup. The power module is mounted on a test PWB and is vertically positioned within the wind tunnel. The space between the neighboring PWB and the top of the power module is constantly kept at 6.35mm (0.25").



Note: Wind Tunnel Test Setup Figure Dimensions are in millimeters and (Inches)

Figure 14: *Wind tunnel test setup figure*

Thermal Derating

Heat can be removed by increasing airflow over the module. The module's maximum hot spot temperature is +124°C. To enhance system reliability, the power module should always be operated below the maximum operating temperature. If the temperature exceeds the maximum module temperature, reliability of the unit may be affected.

THERMAL CURVES

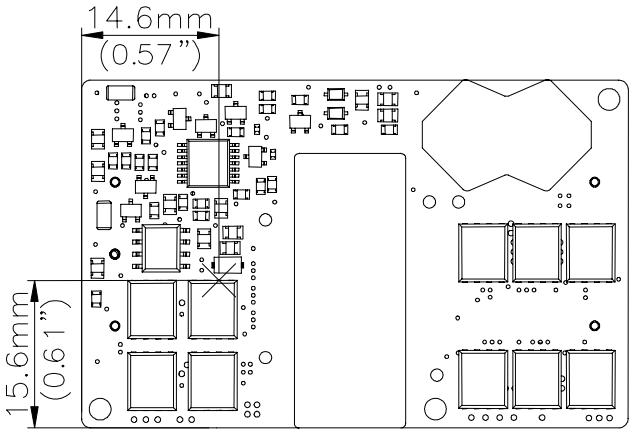


Figure 15: *Hot spot temperature measured point*
*******The allowed maximum hot spot temperature is defined at 124℃*

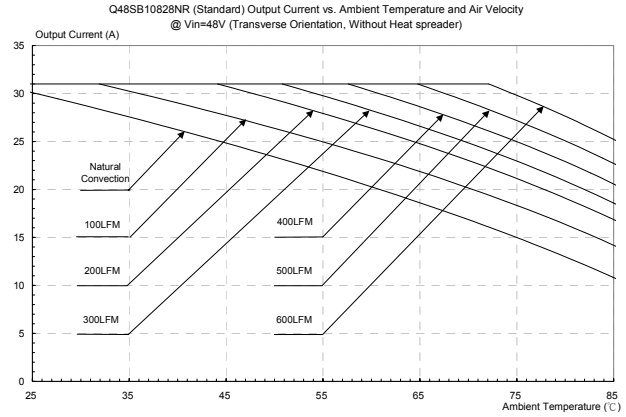


Figure 16: *Output current vs. ambient temperature and air velocity @V_{in}=48V(Transverse Orientation, without heat spreader)*

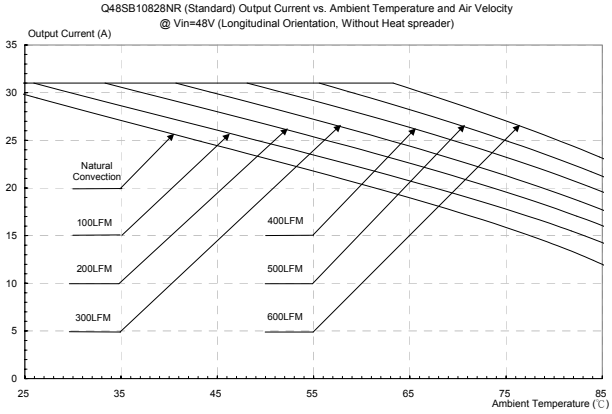


Figure 17: *Output current vs. ambient temperature and air velocity @V_{in}=48V (Longitudinal Orientation, without heatspreader)*

THERMAL CURVES

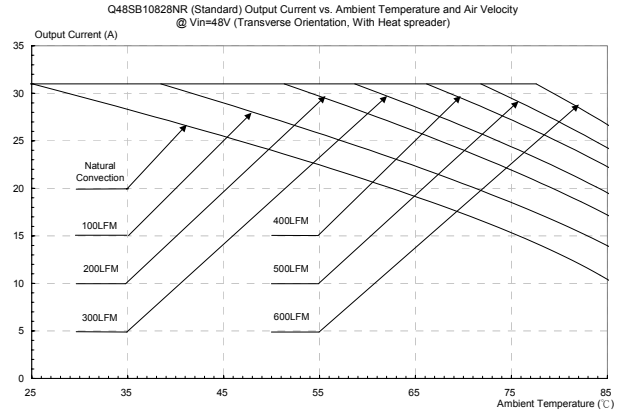


Figure 18: *Output current vs. ambient temperature and air velocity @V_{in}=48V(Transverse Orientation, with heat spreader)*

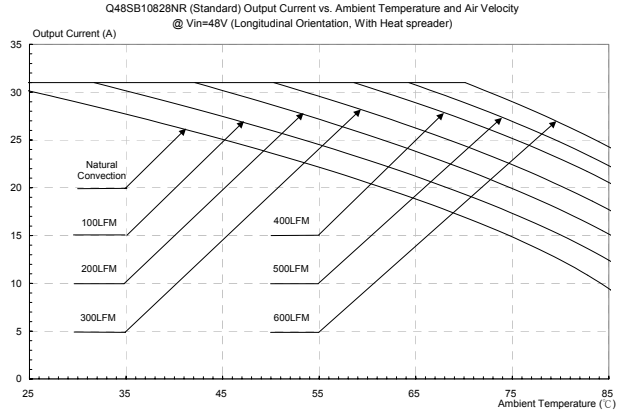
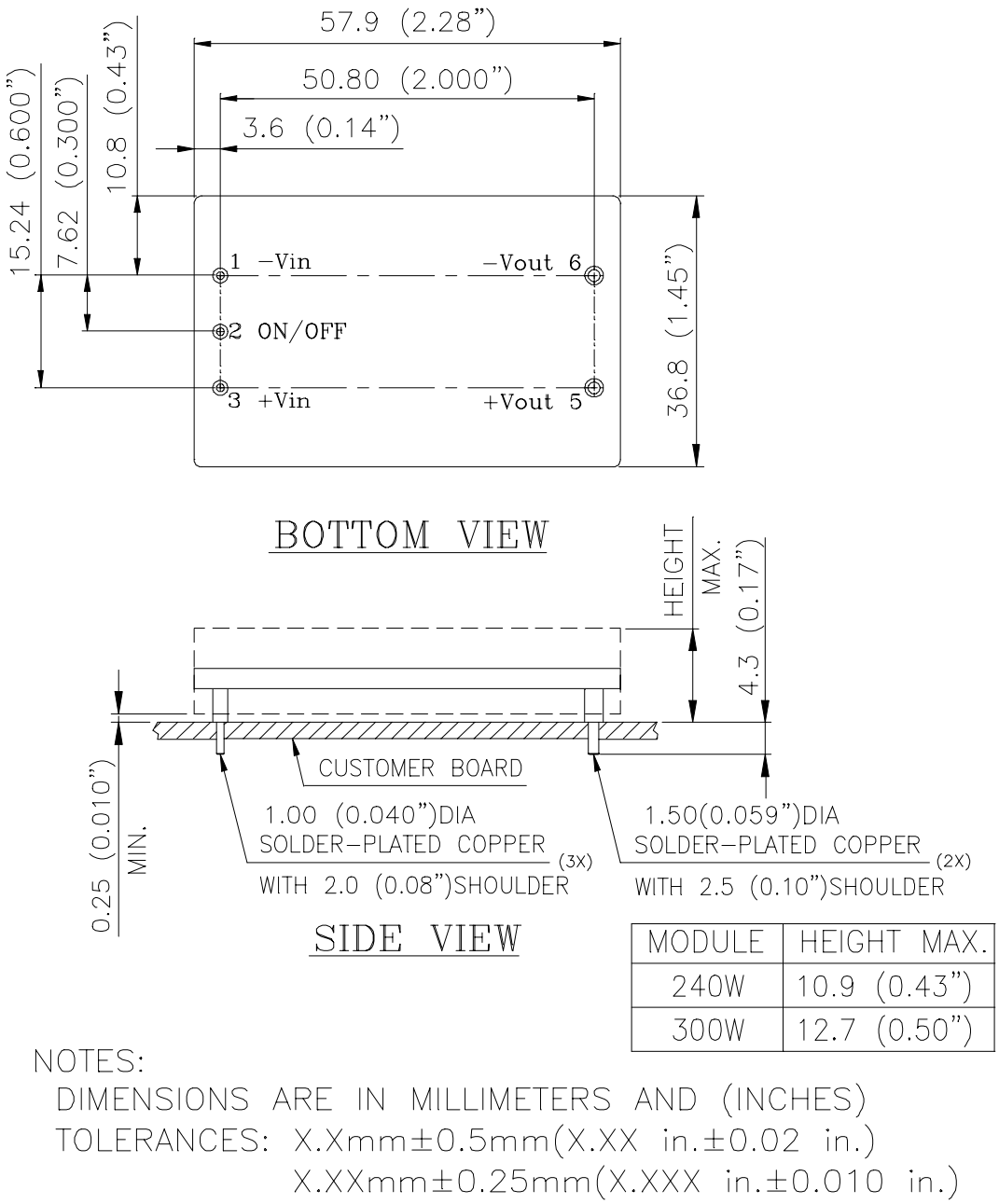


Figure 19: *Output current vs. ambient temperature and air velocity @V_{in}=48V(Longitudinal Orientation, with heat spreader)*

MECHANICAL DRAWING



MODULE	HEIGHT MAX.
240W	10.9 (0.43")
300W	12.7 (0.50")

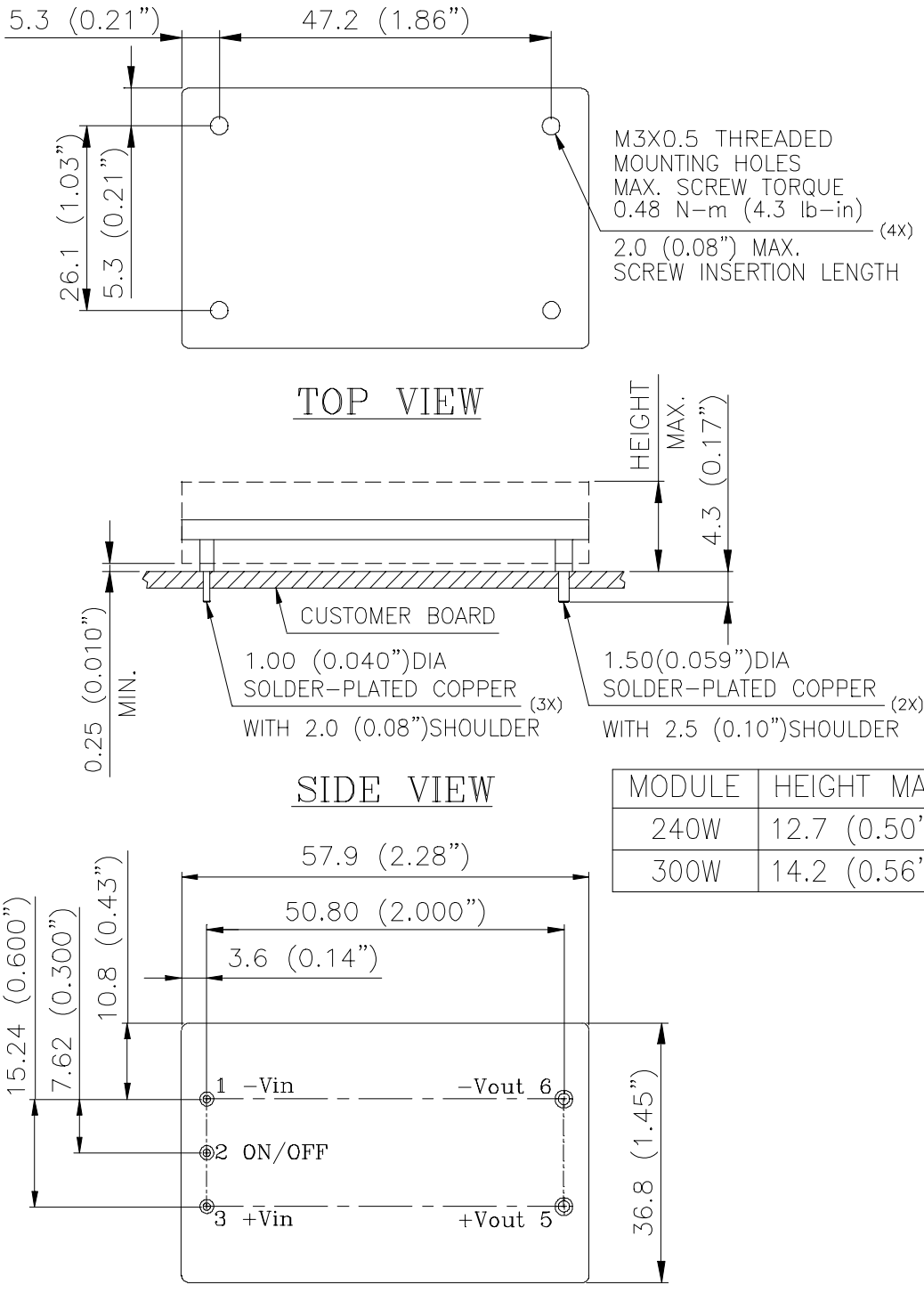
NOTES:
DIMENSIONS ARE IN MILLIMETERS AND (INCHES)
TOLERANCES: X.Xmm±0.5mm(X.XX in.±0.02 in.)
X.XXmm±0.25mm(X.XXX in.±0.010 in.)

Pin No.	Name	Function
1	-Vin	Negative input voltage
2	ON/OFF	Remote ON/OFF
3	+Vin	Positive input voltage
5	+Vout	Positive output voltage
6	-Vout	Negative output voltage

Pin Specification:

Pins 1-3 1.0mm (0.040") diameter
Pins 5-6 1.5mm (0.059") diameter
All pins are copper with Tin plating

MECHANICAL DRAWING (WITH HEAT SPREADER)



MODULE	HEIGHT MAX.
240W	12.7 (0.50")
300W	14.2 (0.56")

NOTES:
DIMENSIONS ARE IN MILLIMETERS AND (INCHES)
TOLERANCES: X.Xmm±0.5mm(X.XX in.±0.02 in.)
X.XXmm±0.25mm(X.XXX in.±0.010 in.)

PART NUMBERING SYSTEM

Q	48	S	B	108	28	N	R	F	A
Type of Product	**Input Voltage**	**Number of Outputs**	**Product Series**	**Output Voltage**	**Output Current**	**ON/OFF Logic**	**Pin Length**		**Option Code**
Q- Quarter Brick	48- 48V	S- Single	B- Bus Converter	108- 9.6V	28 - 31A	N- Negative P- Positive	R- 0.170” N- 0.145” K- 0.110”	F- RoHS 6/6 (Lead Free)	A- Standard functions H- with heat spreader

MODEL LIST

MODEL NAME	INPUT		OUTPUT		EFF @ 100% LOAD
Q48SB10828NRFA	36V~60V	6.3A	9.6V	31A	95.5%
Q48SB12020NRFA	42V~53V	5A	12V	20A	96%
Q48SB12025NRFA	42V~53V	6.25A	12V	25A	96%

Default remote on/off logic is negative and pin length is 0.170”
For different remote on/off logic and pin length, please refer to part numbering system above or contact your local sales

CONTACT: www.delta.com.tw/dcdc

USA:
Telephone:
East Coast: (888) 335 8201
West Coast: (888) 335 8208
Fax: (978) 656 3964
Email: DCDC@delta-corp.com

Europe:
Telephone: +41 31 998 53 11
Fax: +41 31 998 53 53
Email: DCDC@delta-es.tw

Asia & the rest of world:
Telephone: +886 3 4526107 x6220
Fax: +886 3 4513485
Email: DCDC@delta.com.twT

WARRANTY

Delta offers a two (2) year limited warranty. Complete warranty information is listed on our web site or is available upon request from Delta.