DELPHI SERIES

FEATURES

- High efficiency 94.5% @12V/33A
- Size:
  57.9x36.8x11.2mm (2.28"x1.45"x0.44")
  (w/o heat spreader)
  57.9x36.8x12.7mm (2.28"x1.45"x0.50")
  (with heat spreader)
- Standard footprint
- Industry standard pin out
- Fixed frequency operation
- Input UVLO, Output OCP, OVP, OTP
- 2250V isolation and basic insulation
- No minimum load required
- ISO 9001, TL 9000, ISO 14001, QS9000, OHSAS18001 certified manufacturing facility
- UL/cUL 60950-1 (US & Canada) Recognized, and TUV (EN60950-1) Certified
- CE mark meets 73/23/EEC and 93/68/EEC directives

Delphi Series Q48SH, 400W Quarter Brick Family DC/DC Power Modules: 48V in, 12V/33A out

The Delphi series Q48SH, quarter Brick, 48V input, single output, Isolated DC/DC converter is the latest offering from a world leader in power system and technology and manufacturing — Delta Electronics, Inc. This product family provides up to 400 watts of power in an industry standard footprint and pinout. With creative design technology and optimization of component placement, these converters possess outstanding electrical and thermal performances, as well as extremely high reliability under highly stressful operating conditions. All models are fully protected from abnormal input/output voltage, current, and temperature conditions. The Delphi Series converters meet all safety requirements with basic insulation.

OPTIONS

- Latched over current protection
- Positive On/Off logic
- Heat spreader available for extended operation.
- Latched over voltage protection

APPLICATIONS

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

Delta Electronics, Inc.

TECHNICAL SPECIFICATIONS

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

PARAMETER	NOTES and CONDITIONS	Q48SH12033 (Standard)			
		Min.	Typ.	Max.	Units
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					
Continuous				80	Vdc
Transient	100ms			100	Vdc
Operating Case Temperature (Without heat spreader)	Please refer to Fig.18	-40		121	°C
Operating Case Temperature (With heat spreader)	Please refer to Fig.20	-40		103	°C
Storage Temperature		-55		125	°C
Input/Output Isolation Voltage				2250	Vdc
INPUT CHARACTERISTICS					
Operating Input Voltage		36	48	75	Vdc
Input Under-Voltage Lockout					
Turn-On Voltage Threshold		31	34	36	Vdc
Turn-Off Voltage Threshold		29	31	33	Vdc
Lockout Hysteresis Voltage			3		Vdc
Maximum Input Current	100% Load, 36Vin			15	A
No-Load Input Current			110	200	mA
Off Converter Input Current			10	20	mA
Inrush Current (I^2t)				1	A^2s
Input Reflected-Ripple Current	P-P thru 12µH inductor, 5Hz to 20MHz		10		mA
Input Voltage Ripple Rejection	120 Hz		TBD		dB
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	Vin=48V, Io=50%Io.max, Tc=25°C	11.76	12.00	12.24	Vdc
Output Voltage Regulation					
Over Load	Io=Io,min to Io,max		±300	±600	mV
Over Line	Vin=36V to 75V		±50	±300	mV
Over Temperature	Tc=-40°C to 100°C			±240	mV
Total Output Voltage Range	over sample load, line and temperature	11.4		12.6	V
Output Voltage Ripple and Noise	5Hz to 20MHz bandwidth				
Peak-to-Peak	Full Load, 1µF ceramic, 10µF tantalum		100	200	mV
RMS	Full Load, 1µF ceramic, 10µF tantalum		50	100	mV
Operating Output Current Range		0		33	A
Output DC Current-Limit Inception	Output Voltage 10% Low	110		140	%
DYNAMIC CHARACTERISTICS					
Output Voltage Current Transient	48V, 10µF Tan & 100µF Ceramic load cap, 0.1A/µs				
Positive Step Change in Output Current	50% Io.max to 75% Io.max		300		mV
Negative Step Change in Output Current	75% Io.max to 50% Io.max		300		mV
Settling Time (within 1% Vout nominal)			100		µs
Turn-On Transient					
Start-Up Time, From On/Off Control			200	300	ms
Start-Up Time, From Input			200	300	ms
Maximum Output Capacitance	Full load; 5% overshoot of Vout at startup			10000	µF
EFFICIENCY					
100% Load			94.5		%
60% Load			94.8		%
ISOLATION CHARACTERISTICS					
Input to Output				2250	Vdc
Isolation Resistance		10			MΩ
Isolation Capacitance			1000		pF
FEATURE CHARACTERISTICS					
Switching Frequency			140		kHz
ON/OFF Control, Negative Remote On/Off logic					
Logic Low (Module On)	Von/off at Ion/off=1.0mA	0		1.2	V
Logic High (Module Off)	Von/off at Ion/off=0.0 µA	3		50	V
ON/OFF Control, Positive Remote On/Off logic					
Logic Low (Module Off)	Von/off at Ion/off=1.0mA	0		1.2	V
Logic High (Module On)	Von/off at Ion/off=0.0 µA	3		50	V
ON/OFF Current (for both remote on/off logic)	Ion/off at Von/off=0.0V			1	mA
Leakage Current (for both remote on/off logic)	Logic High, Von/off=15V			50	uA
Output Over-Voltage Protection	Over full temp range; % of nominal Vout	115		140	%
GENERAL SPECIFICATIONS					
MTBF	Io=80% of Io, max; Tc=40°C		1.1		M hours
Weight			47		grams
Over-Temperature Shutdown (Without heat spreader)	Please refer to Fig. 18		126		°C
Operating Case Temperature (With heat spreader)	Please refer to Fig. 20		108		°C

ELECTRICAL CHARACTERISTICS CURVES

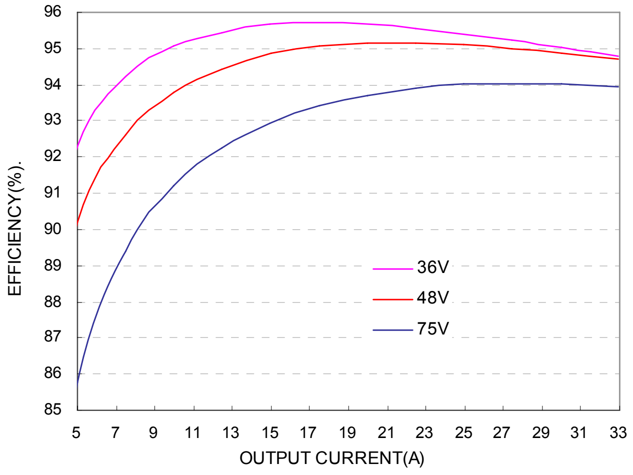


Figure 1: *Efficiency vs. load current for minimum, nominal, and maximum input voltage at 25°C.*

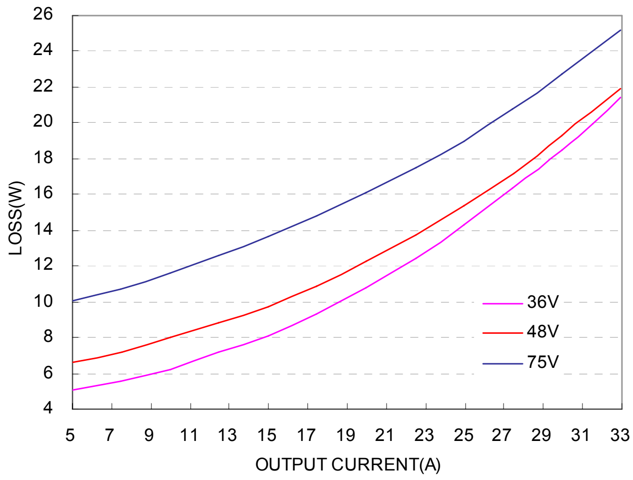


Figure 2: *Power dissipation vs. load current for minimum, nominal, and maximum input voltage at 25°C.*

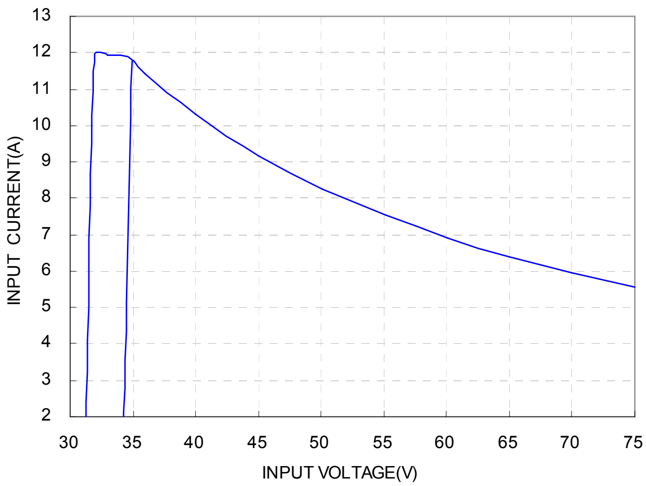


Figure 3: *Typical full load input characteristics at room temperature.*

ELECTRICAL CHARACTERISTICS CURVES

For Negative Remote On/Off Logic

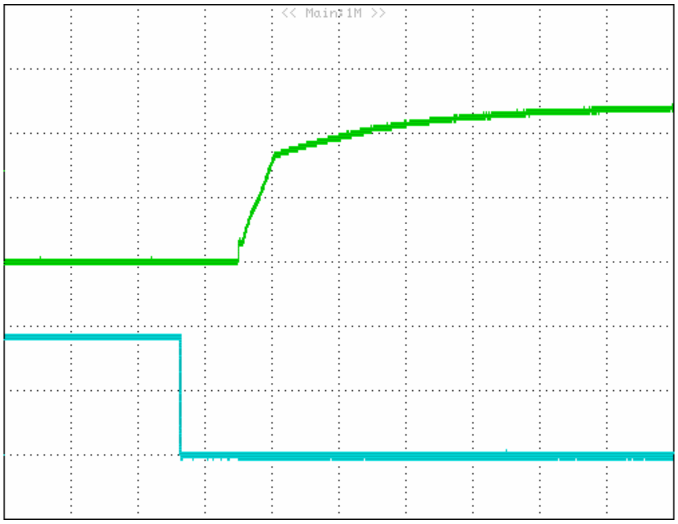


Figure 4: *Turn-on transient at zero load current) (50ms/div). Top Trace: Vout; 5V/div; Bottom Trace: ON/OFF input: 2V/div.*

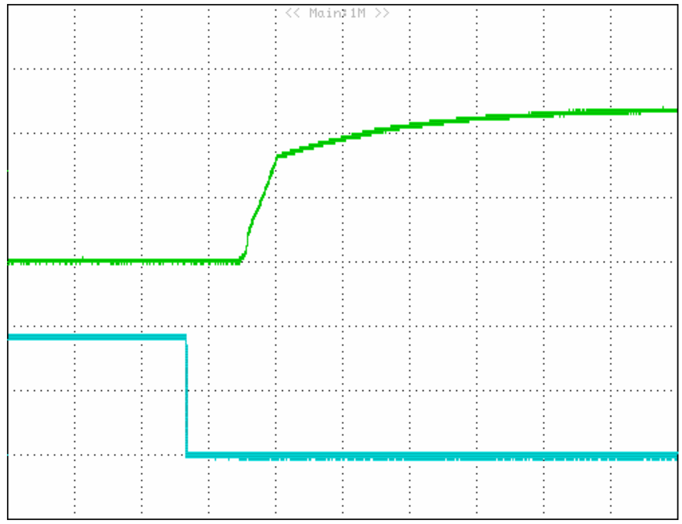


Figure 5: *Turn-on transient at full rated load current (50 ms/div). Top Trace: Vout: 5V/div; Bottom Trace: ON/OFF input: 2V/div.*

For Input Voltage Start up

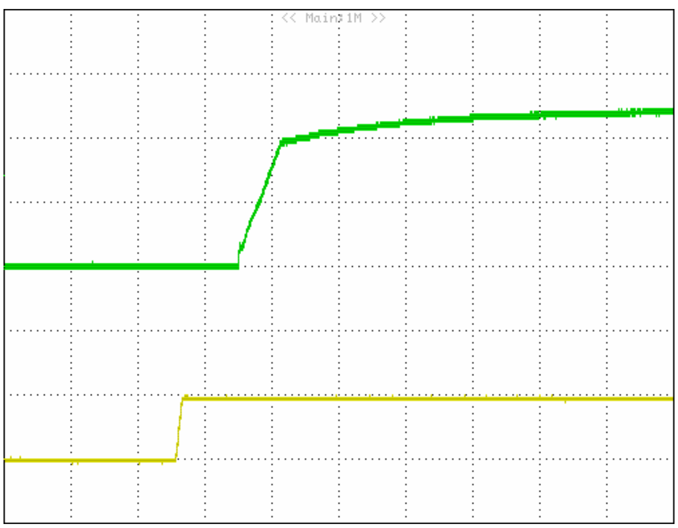


Figure 6: *Turn-on transient at zero load current (50 ms/div). Top Trace: Vout; 5V/div; Bottom Trace: input voltage: 50V/div.*

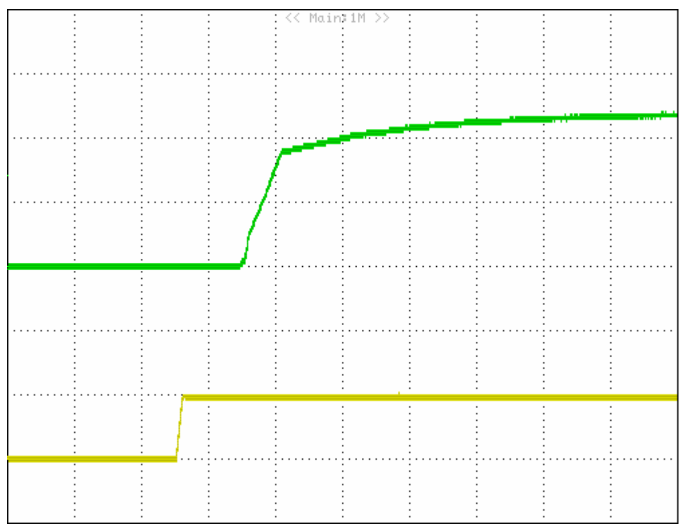


***Figure 7**: Turn-on transient at full rated load current (50 ms/div). Top Trace: Vout; 5V/div; Bottom Trace: input voltage: 50V/div.*

ELECTRICAL CHARACTERISTICS CURVES

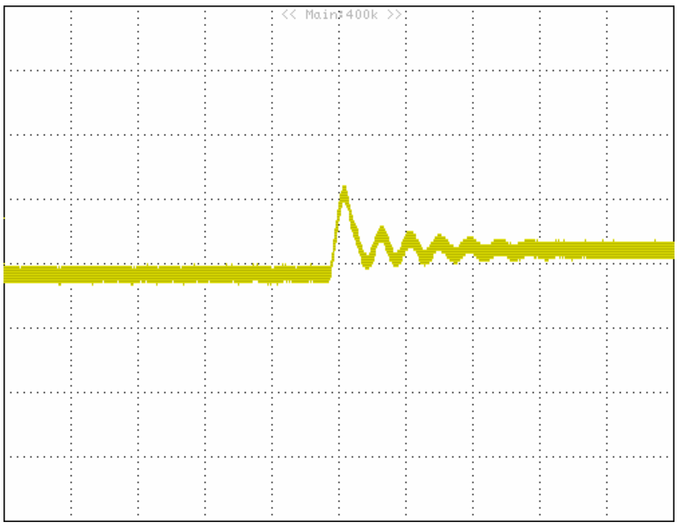


Figure 8: *Output voltage response to step-change in load current (75%-50% of Io, max; di/dt = 0.1A/µs). Load cap: 10µF, tantalum capacitor and 100µF ceramic capacitor. Trace: Vout (200mV/div), Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51mm to 76mm (2 inches to 3 inches) from the module.*

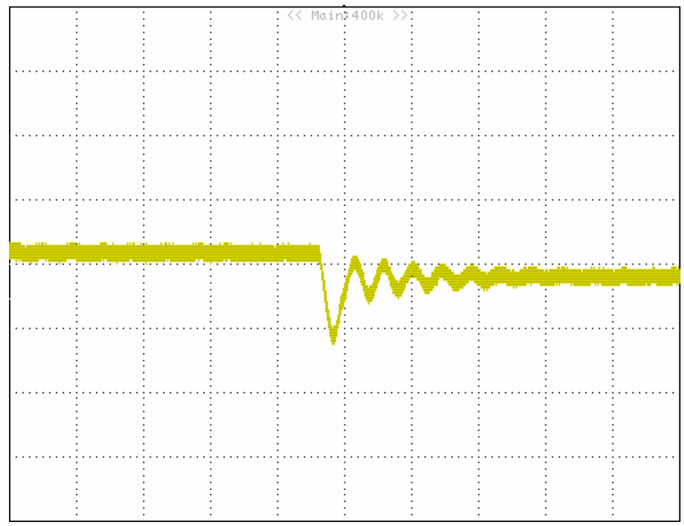


Figure 9: *Output voltage response to step-change in load current (50%-75% of Io, max; di/dt = 0.1A/µs). Load cap: 10µF, tantalum capacitor and 100µF ceramic capacitor. Trace: Vout (200mV/div), Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51mm to 76mm (2 inches to 3 inches) from the module.*

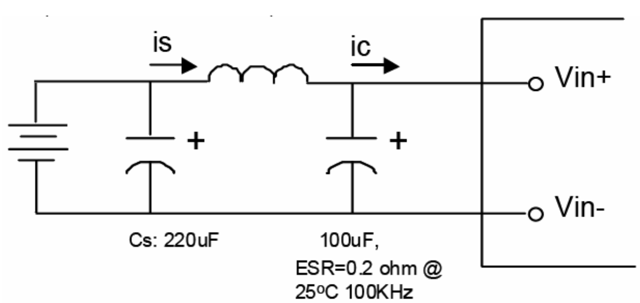


Figure 10: *Test set-up diagram showing measurement points for Input Terminal Ripple Current and Input Reflected Ripple Current.*
Note: Measured input reflected-ripple current with a simulated source Inductance (L_{TEST}) of 12 µH. Capacitor Cs offset possible battery impedance. Measure current as shown above.

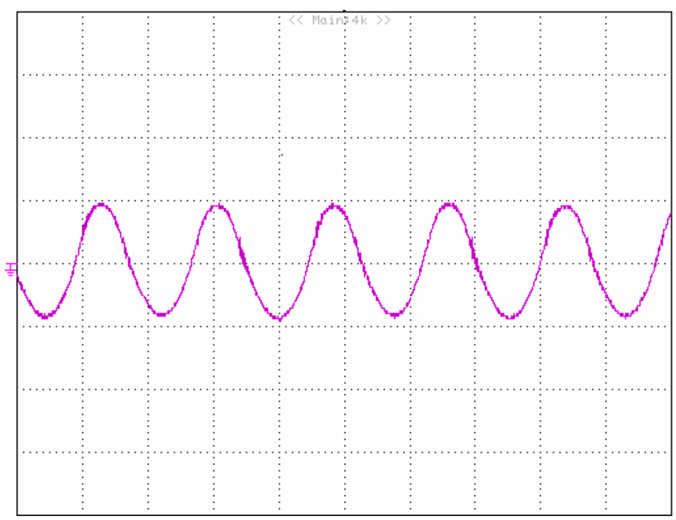


Figure 11: *Input Terminal Ripple Current, i_c, at full rated output current and nominal input voltage with 12µH source impedance and 100µF electrolytic capacitor (1000 mA/div，2us/div).*

ELECTRICAL CHARACTERISTICS CURVES

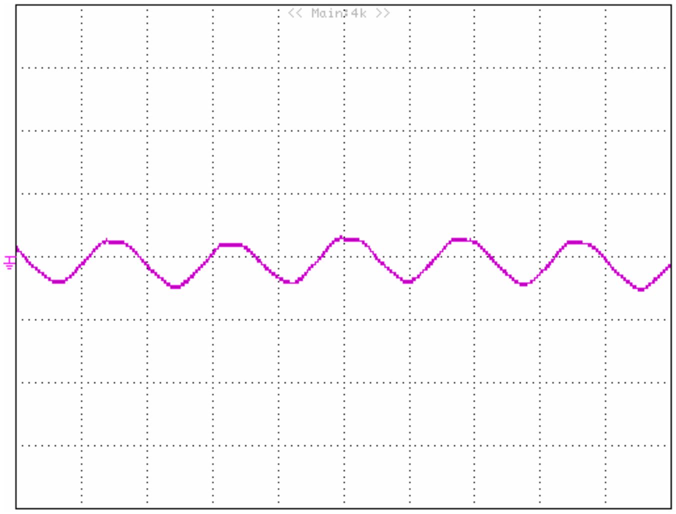


Figure 12: *Input reflected ripple current, i_s, through a 12µH source inductor at nominal input voltage and rated load current (20 mA/div， 2us/div).*

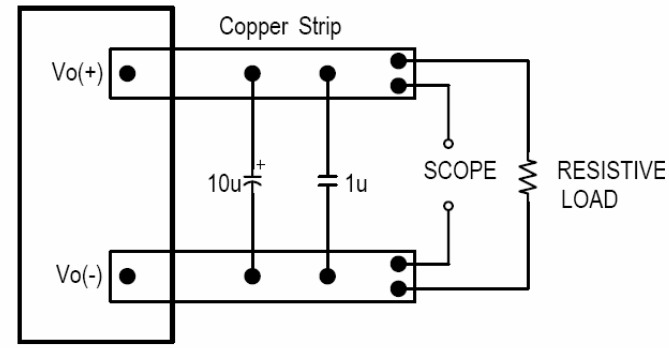


Figure 13: *Output voltage noise and ripple measurement test setup.*

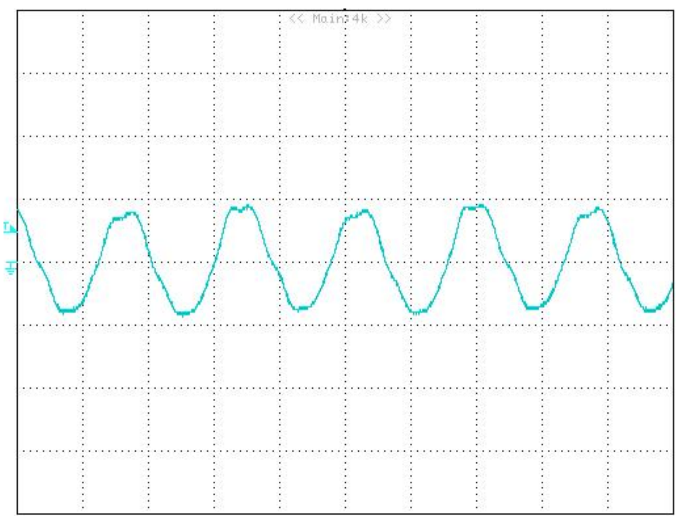


Figure 14: *Output voltage ripple at nominal input voltage and rated load current (Io=33A)(50 mV/div, 2us/div)*
Load capacitance: 1µF ceramic capacitor and 10µF tantalum capacitor. Bandwidth: 20 MHz. Scope measurements should be made using a BNC cable (length shorter than 20 inches). Position the load between 51mm to 76mm (2 inches to 3 inches) from the module.

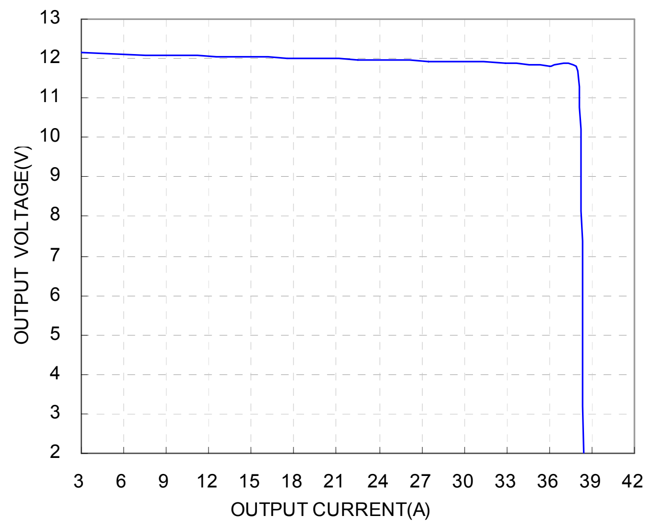


Figure 15: *Output voltage vs. load current showing typical current limit curves and converter shutdown points.*

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 10μF to 100μF electrolytic capacitor (ESR < 0.7 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.

Safety Considerations

The power module must be installed in compliance with the spacing and separation requirements of the end-user's safety agency standard, i.e., UL60950-1, CAN/CSA-C22.2, No. 60950-1 and EN60950-1+A11 and IEC60950-1, if the system in which the power module is to be used must meet safety agency requirements.

Basic insulation based on 75 Vdc input is provided between the input and output of the module for the purpose of applying insulation requirements when the input to this DC-to-DC converter is identified as TNV-2 or SELV. An additional evaluation is needed if the source is other than TNV-2 or SELV.

When the input source is SELV circuit, the power module meets SELV (safety extra-low voltage) requirements. If the input source is a hazardous voltage which is greater than 60 Vdc and less than or equal to 75 Vdc, for the module's output to meet SELV requirements, all of the following must be met:

- The input source must be insulated from the ac mains by reinforced or double insulation.
- The input terminals of the module are not operator accessible.
- If the metal baseplate is grounded, one Vi pin and one Vo pin shall also be grounded.
- A SELV reliability test is conducted on the system where the module is used, in combination with the module, to ensure that under a single fault, hazardous voltage does not appear at the module's output.

When installed into a Class II equipment (without grounding), spacing consideration should be given to the end-use installation, as the spacing between the module and mounting surface have not been evaluated.

The power module has extra-low voltage (ELV) outputs when all inputs are ELV.

This power module is not internally fused. To achieve optimum safety and system protection, an input line fuse is highly recommended. The safety agencies require a normal-blow fuse with 20A maximum rating to be installed in the ungrounded lead. A lower rated fuse can be used based on the maximum inrush transient energy and maximum input current.

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-Voltage Protection

The modules include an internal output over-voltage protection circuit, which monitors the voltage on the output terminals. If this voltage exceeds the over-voltage set point, the modules will automatically shut down (hiccup mode).

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

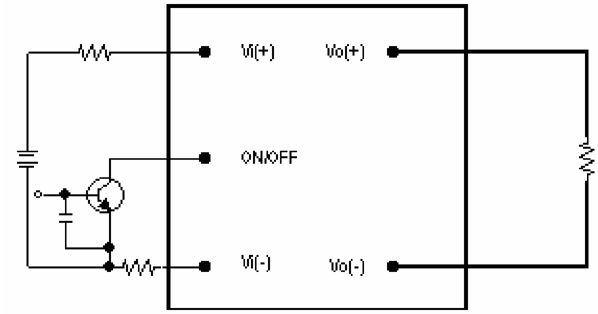


Figure 16: *Remote on/off implementation*

THERMAL CONSIDERATIONS

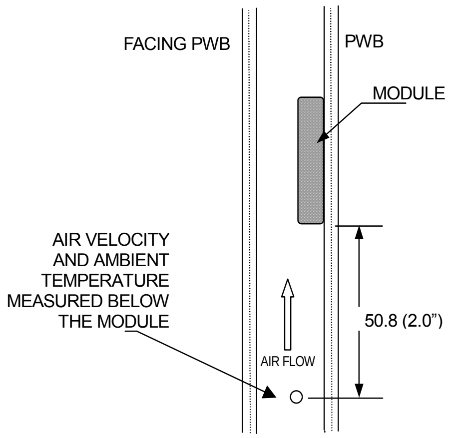
Thermal management is an important part of the system design. To ensure proper, reliable operation, sufficient cooling of the power module is needed over the entire temperature range of the module. Convection cooling is usually the dominant mode of heat transfer.

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 17: *Wind tunnel test setup*

Thermal Derating

Heat can be removed by increasing airflow over the module. 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 (WITHOUT HEAT SPREADER)

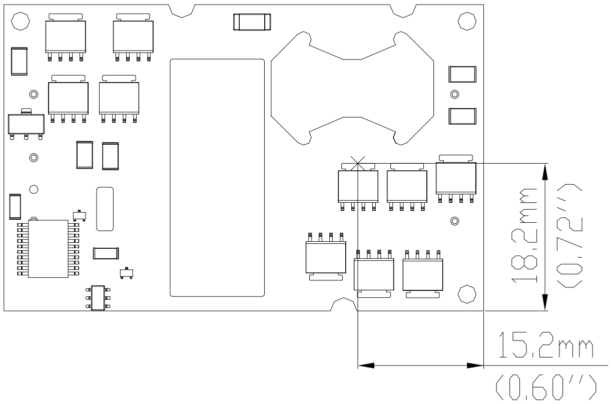


Figure 18: *Temperature measurement location*
** The allowed maximum hot spot temperature is defined at 121℃*

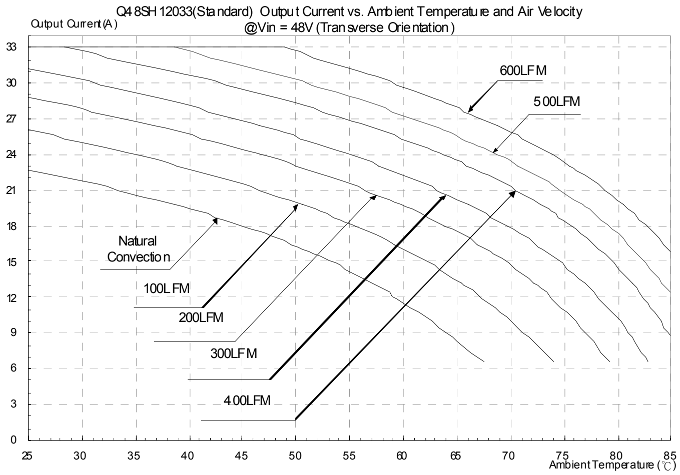


Figure 19: *Output current vs. ambient temperature and air velocity @Vin=48V(Transverse Orientation, without heat spreader)*

THERMAL CURVES (WITH HEAT SPREADER)

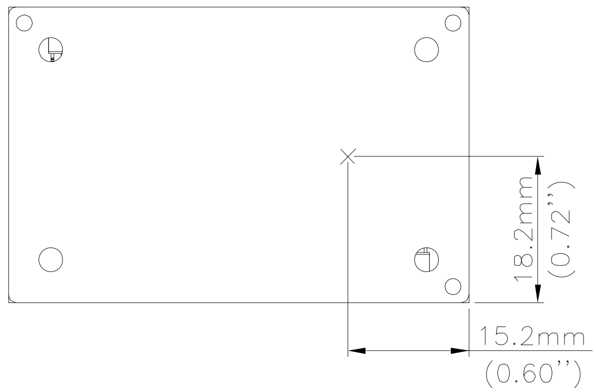


Figure 20: *Temperature measurement location*
** The allowed maximum hot spot temperature is defined at 103℃*

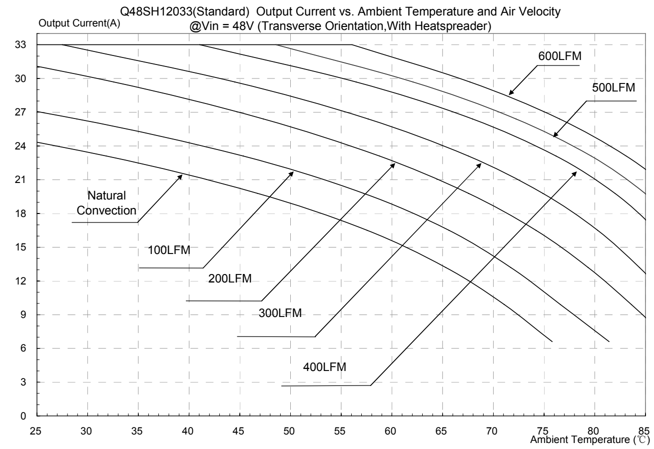
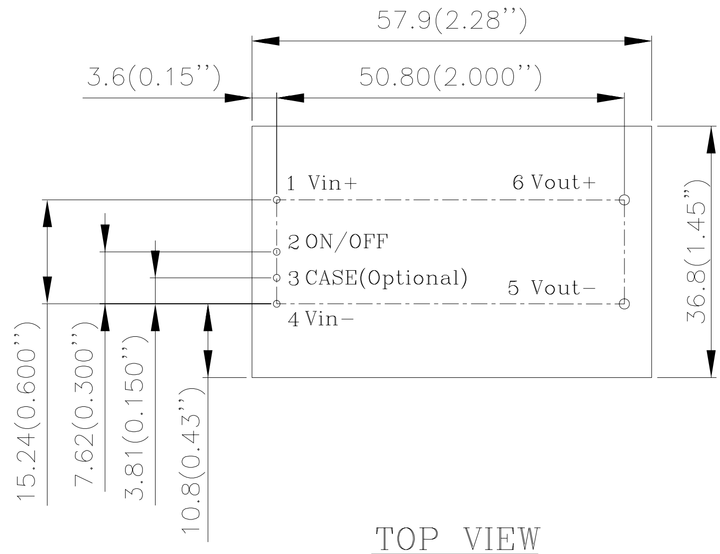
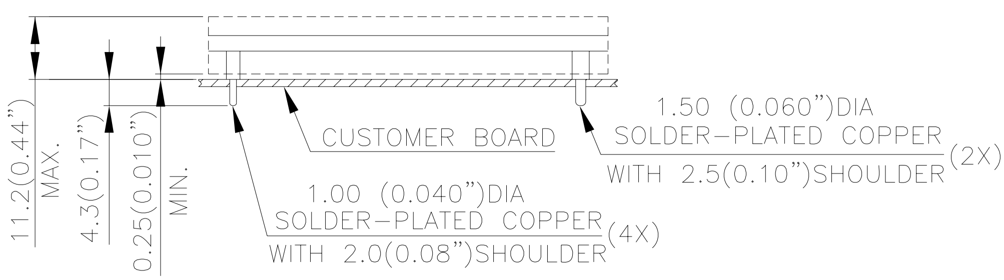


Figure 21: *Output current vs. ambient temperature and air velocity @Vin=48V(Transverse Orientation, with heat spreader)*

MECHANICAL DRAWING (WITHOUT HEAT SPREADER)



TOP VIEW



SIDE VIEW

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	Positive input voltage
2	ON/OFF	Remote ON/OFF
3	Case	Optional
4	-Vin	Negative input voltage
5	-Vout	Negative output voltage
6	+Vout	Positive output voltage

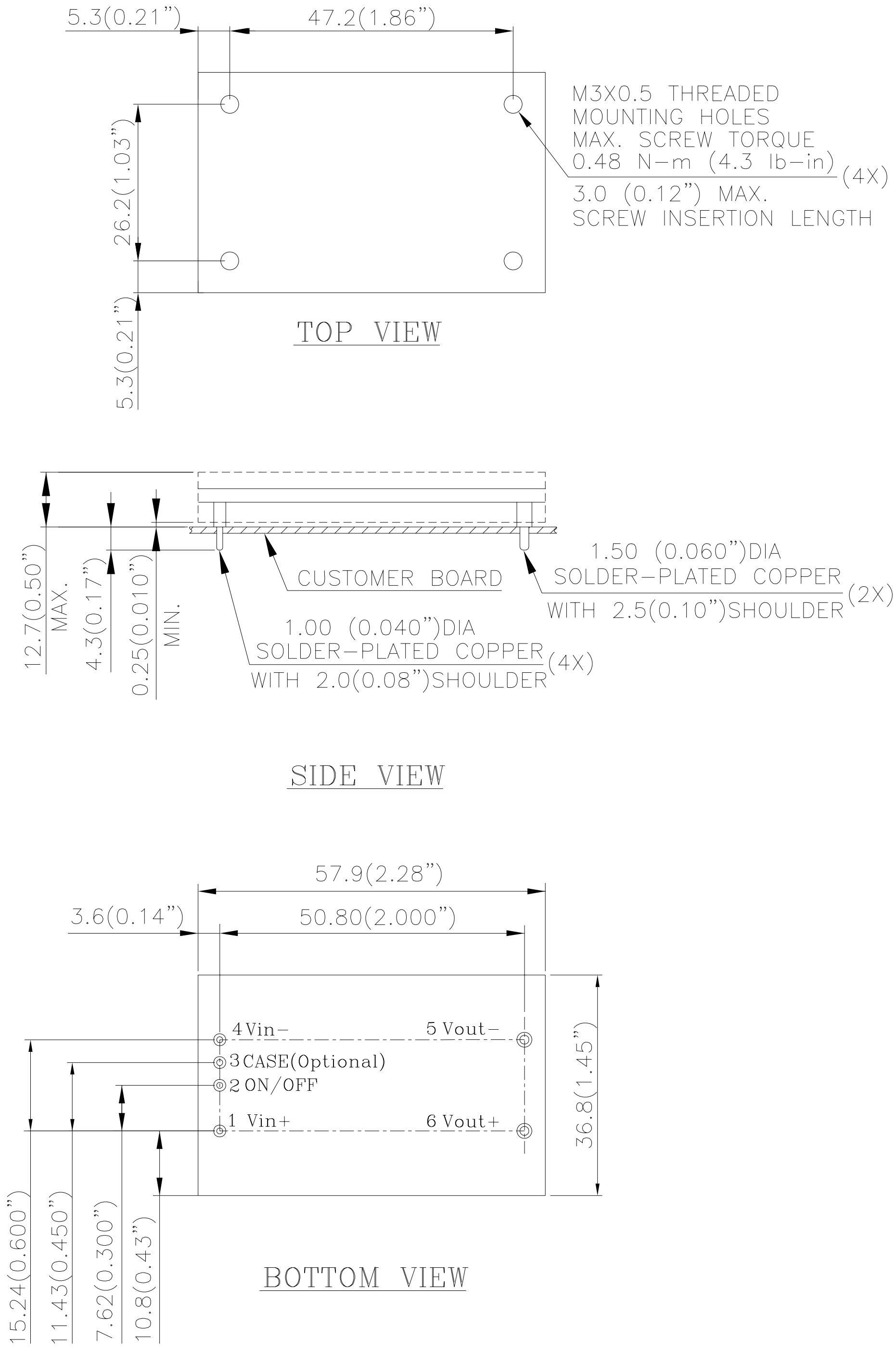
Pin Specification:

Pins 1-4	1.00mm (0.040") diameter
Pins 5 &6	1.50mm (0.059") diameter

All pins are copper with Tin plating.

MECHANICAL DRAWING (WITH HEAT SPREADER)

For modules with through-hole pins and the optional heatspreader, they are intended for wave soldering assembly onto system boards; please do not subject such modules through reflow temperature profile.



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	H	120	33	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- 36~75V	S- Single	H- High Power	120 - 12V	33 - 33A	N - Negative	R - 0.170" N - 0.145"	F- RoHS 6/6 (Lead Free) Space - RoHS 5/6	A- Standard, no Case Pin H- With Heat spreader and Case Pin N- With Heat spreader, no Case Pin

MODEL LIST

MODEL NAME	INPUT		OUTPUT		EFF @ 100% LOAD
Q48SH12033NRFA	36V~75V	15A	12V	33A	94.5%
Q48SH12033NN H	36V~75V	15A	12V	33A	94.5%

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

For modules with through-hole pins and the optional heatspreader, they are intended for wave soldering assembly onto system boards; please do not subject such modules through reflow temperature profile.

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:
Phone: +41 31 998 53 11
Fax: +41 31 998 53 53
Email: DCDC@delta-es.com

Asia & the rest of world:
Telephone: +886 3 4526107
ext 6220~6224
Fax: +886 3 4513485
Email: DCDC@delta.com.tw

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.