DELPHI SERIES

FEATURES

- High efficiency: 94.5% at 12V/38A
- Industry standard Quarter brick footprint
- Size: 57.9mm x 36.8mm x 12.7mm
  (2.28in x 1.45in x 0.50in)
- 2250V isolation
- Low output ripple and noise
- Output over current/voltage protection
- Latch after OCP & Output OVP shutdown
- Over-temperature protection
- Parallel operation (droop current sharing)
- Power Good (POK) (option)
- RoHS 6/6 (lead free)
- 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 D48S1238, 450W Quarter Brick DC/DC Power Modules: 48V in, 12V/38A out

The Delphi series D48S1238, quarter Brick, 43~57V 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 450 watts of regulated 12V output power in an industry standard quarter brick 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

- Positive On/Off logic
- Heatspreader
- Case ground pin
- Power Good pin

APPLICATIONS

- Data Communication
- Distributed power architecture
- Servers and workstations
- LAN / WAN applications
- Data processing applications

DATASHEET
DS_D48S1238_05142009

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	D48S1238 (Standard)			
		Min.	Typ.	Max.	Units
ABSOLUTE MAXIMUM RATINGS					
Input Voltage		43	48	57	Vdc
Operating Case Temperature (open frame)	Please refer to Figure13	-40		110	°C
Operating Case Temperature (with heatspreader)	Please refer to Figure14	-40		90	°C
Storage Temperature		-40		125	°C
Input/Output Isolation Voltage	1 minute			2250	Vdc
INPUT CHARACTERISTICS					
Operating Input Voltage		43	48	57	Vdc
Input Under-Voltage Lockout					
Turn-On Voltage Threshold			42		Vdc
Turn-Off Voltage Threshold			40		Vdc
Lockout Hysteresis Voltage			2		Vdc
Maximum Input Current	100% Load, 43Vin			12.5	A
No-Load Input Current			TBD	TBD	mA
Off Converter Input Current			TBD	TBD	mA
Inrush Current(I^2t)				TBD	A^2s
Input Reflected-Ripple Current	P-P thru 12µH inductor, 5Hz to 20MHz		TBD		mA
Input Voltage Ripple Rejection	120 Hz		TBD		dB
OUTPUT CHARACTERISTICS					
Initial Set Point Accuracy	Vin=51.4V, Io=20A	12.19		12.21	Vdc
Output Voltage Regulation					
Over Load	Io=Io,min to Io,max	11.4		12.6	Vdc
Over Line	Vin=43V to 57V	11.4		12.6	Vdc
Total Output Voltage Range	over load, line and temperature	11.4		12.6	Adc
Output Voltage Ripple and Noise	Cout 2200µF x2 (max ESR 20 mΩ) with 10µF Tantalum & 0.47µF Ceramic cap. 5Hz to 20MHz Bandwidth		35	70	mVp-p
Operating Output Current Range		3.75		38	A
Output DC Current-Limit Inception	Output Voltage 10% Low	105		130	%
DYNAMIC CHARACTERISTICS					
Output Voltage Current Transient	48V, 2200µFx2pcs load cap, 0.1A/µs				
Positive Step Change in Output Current	50% Io.max to 75% Io.max	11.4		12.6	Vdc
Negative Step Change in Output Current	75% Io.max to 50% Io.max	11.4		12.6	Vdc
Settling Time (within 1% Vout nominal)			TBD		uS
Turn-On Transient					
Start-Up Time, From On/Off Control	From On/Off falling edge to 10%Vo,set	0		10	mS
Start-Up Time, From Input	From 90% of Vin to Vo = 10%Vo,set	10		40	mS
Rise Time	10% of Vo to 90% of Vo	1		30	mS
Capacitive Loading	For D48S1238-2 A/E	1000		25000	µF
	For D48S1238-2C	4400		25000	µF
Overshoot at Turn-On/Turn-Off	Vin=48V, Io=min-max	TBD		TBD	Vdc
PROTECTION					
Short Circuit Protection	Withstand continuous short-circuit, latch mode				
Over Current Protection (OCP)	**Vin=48V, Vo=12V shall exist for at least 250ms ~ 1Sec**	**105**		**130**	**% of Io**
Over Voltage Protection (OVP)	**Vin=48V**	**12.9**		**14.2**	**Vdc**
EFFICIENCY					
100% Load	Vin=48V, Vo=12V, Io=38A		94.5		%
ISOLATION CHARACTERISTICS					
Input to Output				2250	Vdc
Isolation Resistance		10			MΩ
Isolation Capacitance			1000		pF
FEATURE CHARACTERISTICS					
Switching Frequency			350		KHz
ON/OFF Control, Negative Remote On/Off logic					
Logic Low (Module On)	Von/off at Ion/off=1.0mA	0		0.8	V
Logic High (Module Off)	Von/off at Ion/off=0.0 µA			15	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
Power Good Assertion Time	From 90% of Vo to Power Good fell to ground	1		10	mS
Power Good out of regulation	From 90% of Vo (falling) to Power Good rise	0		2	mS
GENERAL SPECIFICATIONS					
MTBF	Io=80% of Io, max; Tc=40°C		1		M hours
	Io=80% of Io, max; Tc=25°C		1.3		
Weight	With heatspreader		61		grams

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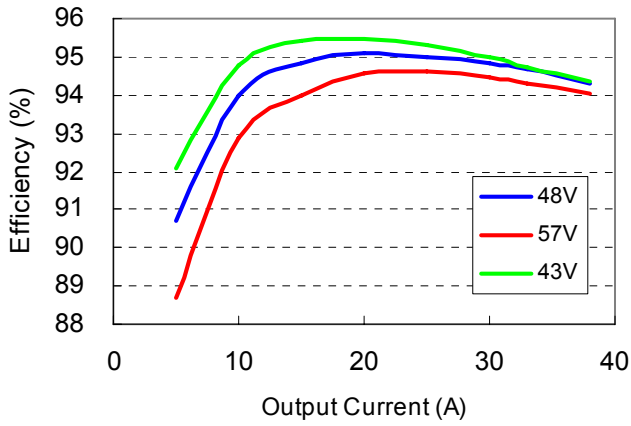
Figure 1: Efficiency vs. load current for minimum, nominal, and maximum input voltage at 25°C.
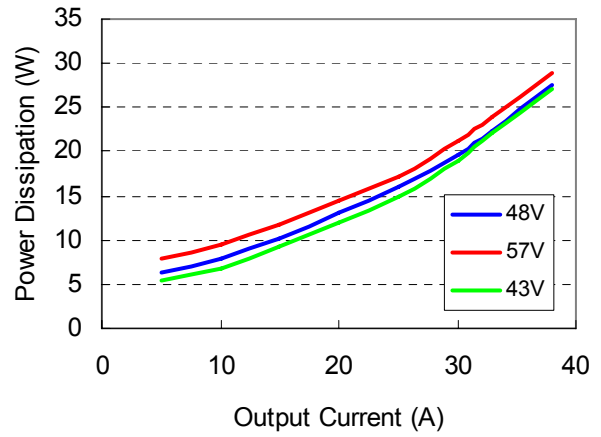

Figure 2: Power dissipation vs. load current for minimum, nominal, and maximum input voltage at 25°C.
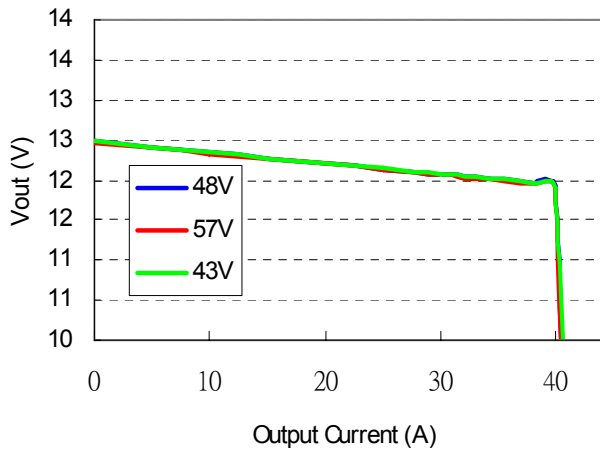

Figure 3: Output voltage regulation vs. load current showing typical current limit curves and converter shutdown point for minimum, nominal, and maximum input voltage at room temperature.

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ELECTRICAL CHARACTERISTICS CURVES

For Negative Remote On/Off Logic
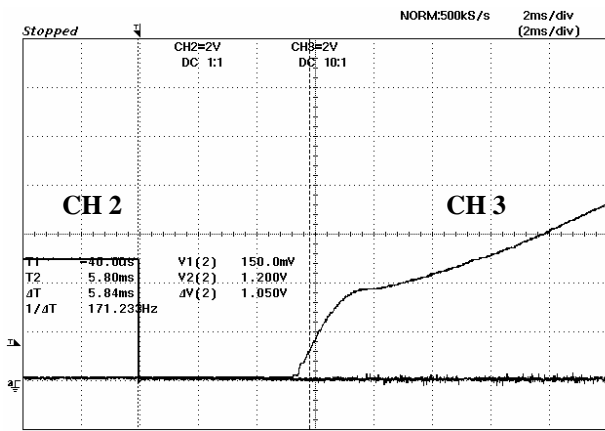
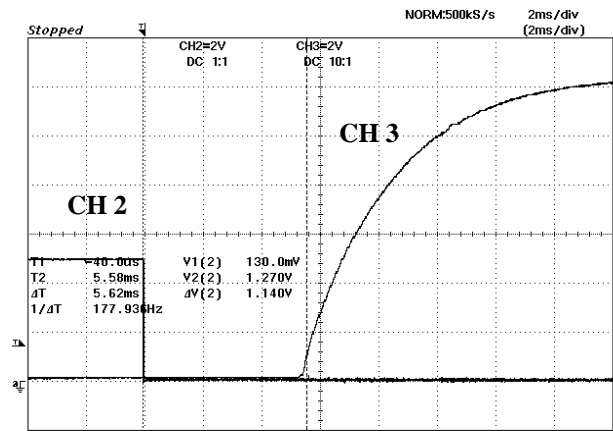**Figure 4:** *Turn-on transient at full load current) (2ms/div). Ch3 : Vout; 2V/div; Ch2 : ON/OFF input: 2V/div.*

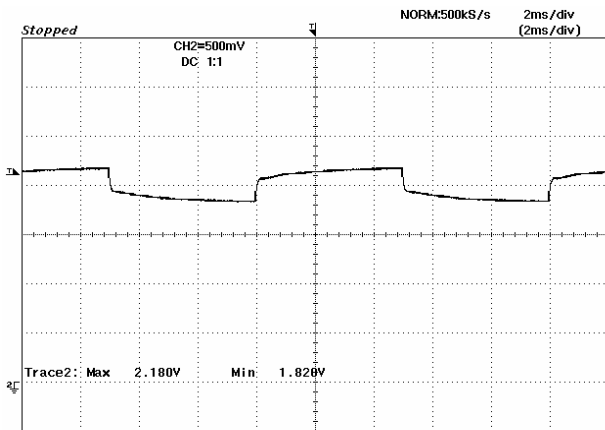**Figure 5:** *Turn-on transient at zero load current (2 ms/div). Ch3 : Vout; 2V/div; Ch2: ON/OFF input: 2V/div*

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 0.47μF ceramic capacitor. Trace: Vout (500mV/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.*
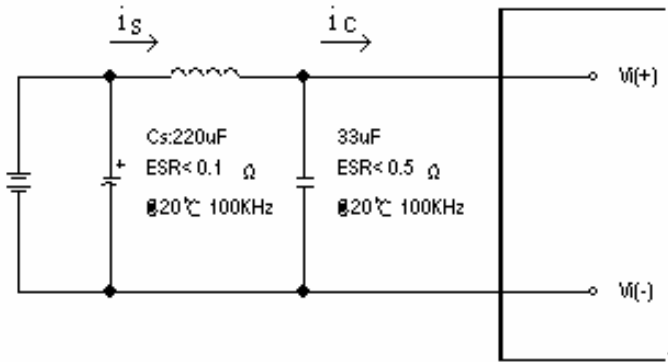
ELECTRICAL CHARACTERISTICS CURVES

Figure 7: *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.
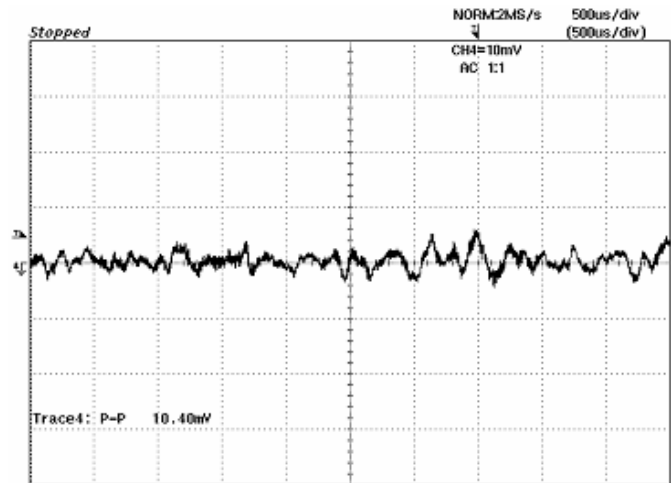
Figure 8: *Input Terminal Ripple Current, i_c, at full rated output current and nominal input voltage with 12µH source impedance and 33µF electrolytic capacitor (50 mA/div).*
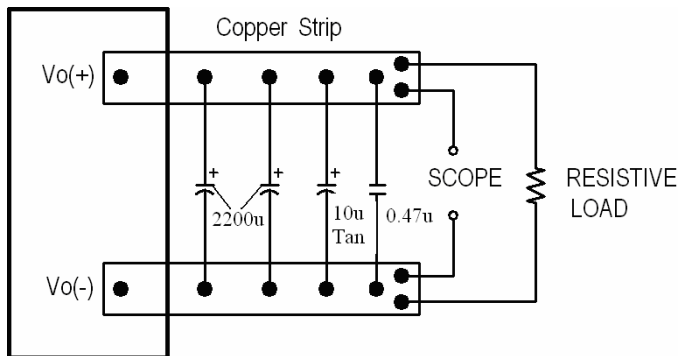

Figure 9: *Output voltage noise and ripple measurement test setup.*

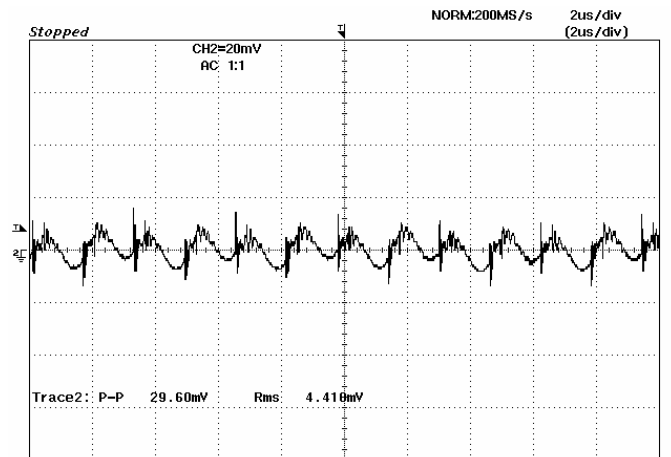**Figure 10:** *Output voltage ripple at nominal input voltage and rated load current (20mV/div). Load capacitance: 2200uF*2 electrical capacitor, 0.47µF ceramic capacitor and 10µF tantalum capacitor. Bandwidth: 20 MHz. Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module.*

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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 / heatspreader is grounded the output must be also 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 module will shut down and latch off. The over-voltage latch is reset by either cycling the input power or by toggling the on/off signal for one second.

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.
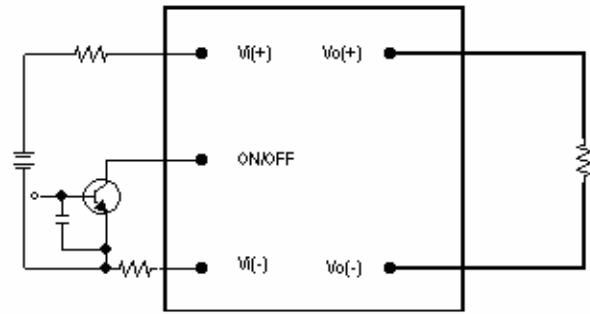

Figure 11: Remote on/off implementation

Power Good

The converter (C, D option code) provides an open collector signal called Power Good (POK).

This output pin uses negative logic. It is set high when the output is not within regulation of output voltage or Enable is OFF. The power good signal is pulled low when output is within regulation of output voltage.

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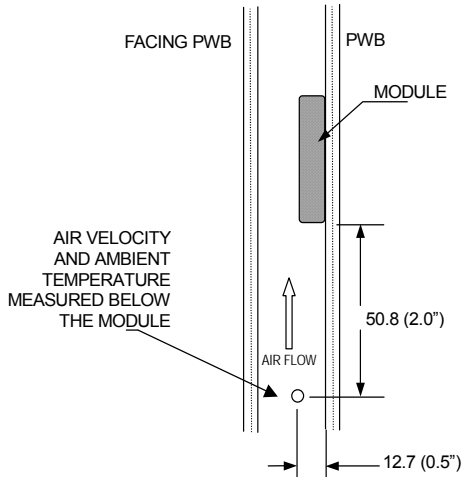
Note: Wind Tunnel Test Setup Figure Dimensions are in millimeters and (Inches)

Figure 12: *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.
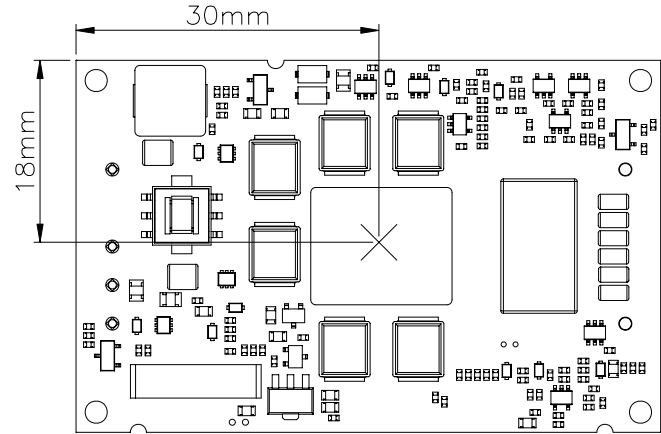
THERMAL CURVES

Figure 13: *Temperature measurement location (open frame)*
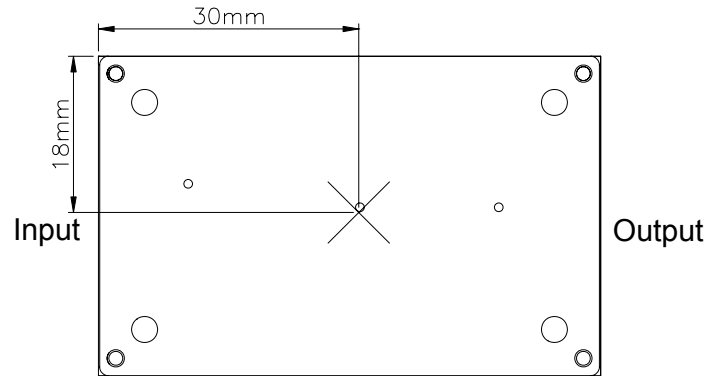** The allowed maximum hot spot temperature is defined at 110℃.*

Figure 14: *Temperature measurement location (with heatspreader)*
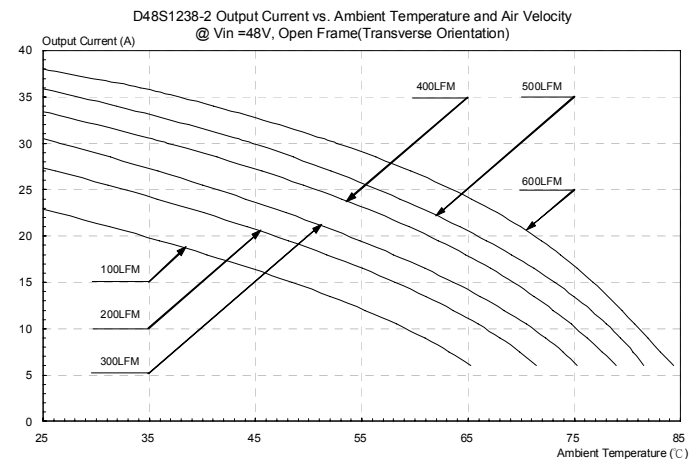** The allowed maximum hot spot temperature is defined at 90℃.*

Figure 15: *Output current vs. ambient temperature and air velocity@ V_{in}=48V (Open frame, Transverse orientation)*
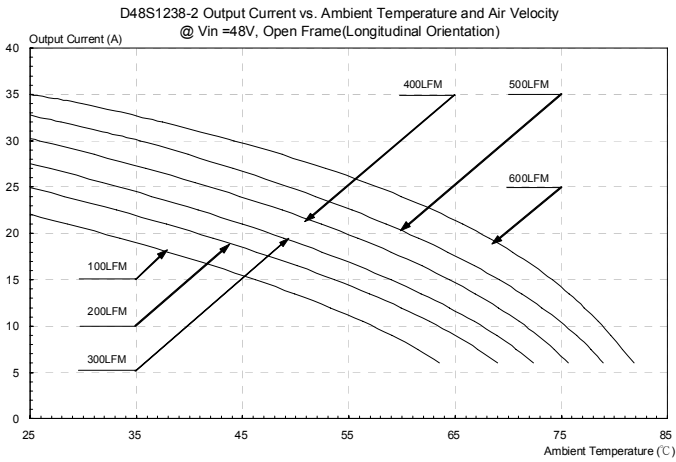
Figure 16: *Output current vs. ambient temperature and air velocity @ V_{in}=48V (Open frame, Longitudinal orientation)*
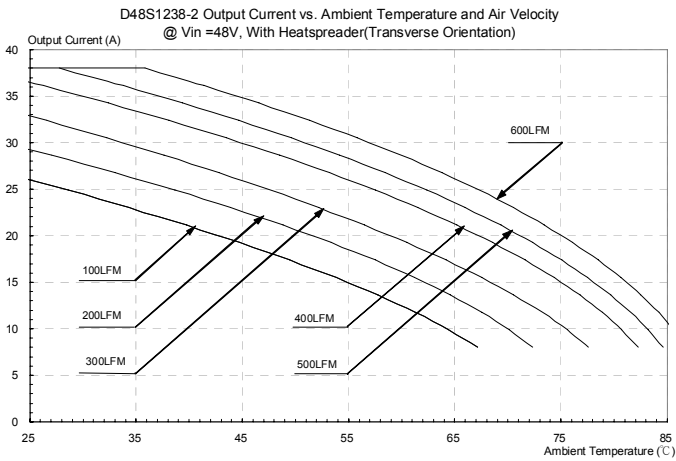

Figure 17: *Output current vs. ambient temperature and air velocity @ V_{in}=48V (With heatspreader, Transverse orientation)*
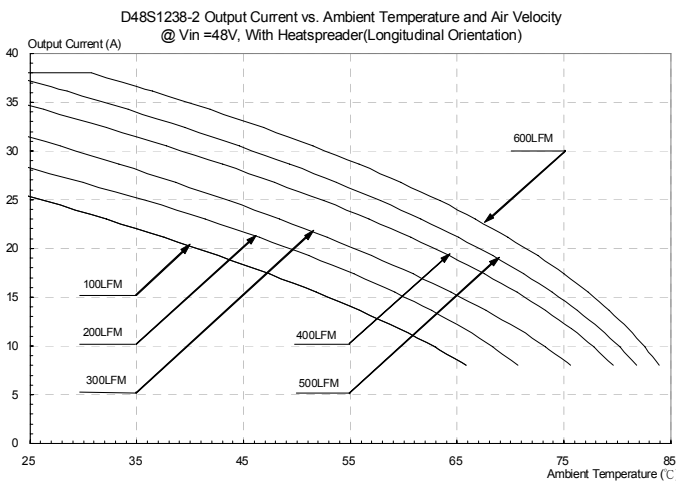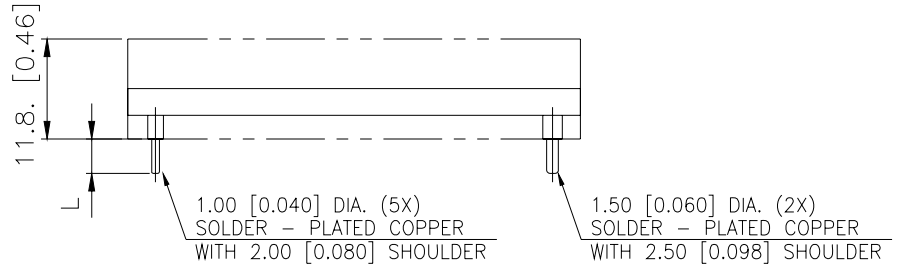

Figure 18: *Output current vs. ambient temperature and air velocity @ V_{in}=48V(With heatspreader, Longitudinal Orientation)*

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MECHANICAL DRAWING (WITHOUT HEATSPREADER)
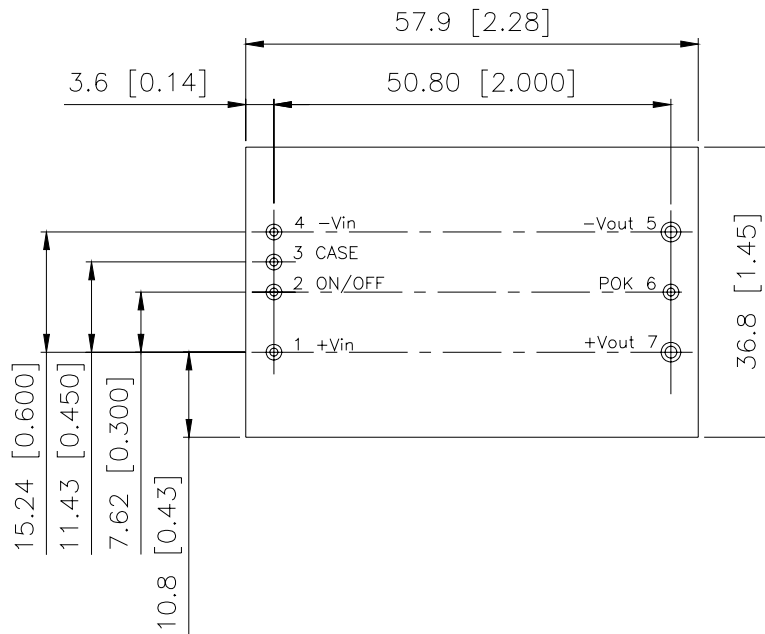
11.8 [0.46]
11.8

1.00 [0.040] DIA. (5X)
SOLDER – PLATED COPPER
WITH 2.00 [0.080] SHOULDER

1.50 [0.060] DIA. (2X)
SOLDER – PLATED COPPER
WITH 2.50 [0.098] SHOULDER

SIDE VIEW

57.9 [2.28]

3.6 [0.14]   50.80 [2.000]

36.8 [1.45]

4 −Vin   −Vout 5
3 CASE
2 ON/OFF   POK 6
1 +Vin   +Vout 7

15.24 [0.600]
11.43 [0.450]
7.62 [0.300]
10.8 [0.43]

BOTTOM 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.)

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MECHANICAL DRAWING (WITH HEATSPREADER)

* 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.

TOP VIEW

- 5.3 [0.21]
- 47.2 [1.86]
- 26.16 [1.03]
- 5.3 [0.21]

M3X0.5 THREADED
MOUNTING HOLES
MAX. SCREW TORQUE
0.48 N-m (4.3 lb-in)
2.0 (0.78") MAX. (4X)
SCREW INSERTION LENGTH

SIDE VIEW

- 12.7 [0.50]
- 1.00 [0.040] DIA. (5X) SOLDER – PLATED COPPER WITH 2.00 [0.080] SHOULDER
- 1.50 [0.060] DIA. (2X) SOLDER – PLATED COPPER WITH 2.50 [0.098] SHOULDER

BOTTOM VIEW

- 57.9 [2.28]
- 3.6 [0.14]
- 50.80 [2.000]
- 36.8 [1.45]
- 15.24 [0.600]
- 11.43 [0.450]
- 7.62 [0.300]
- 10.8 [0.43]

4 -Vin   -Vout 5
3 CASE
2 ON/OFF   POK 6
1 +Vin   +Vout 7
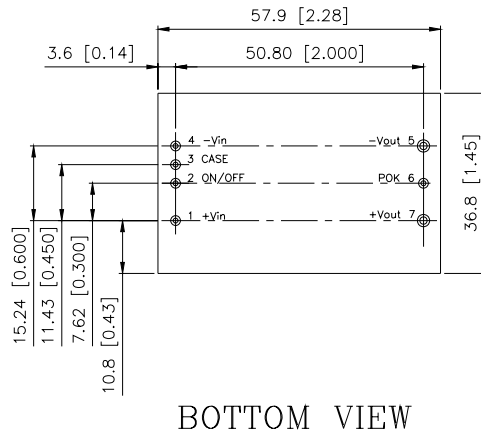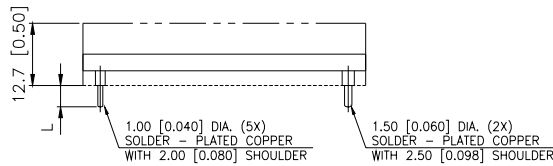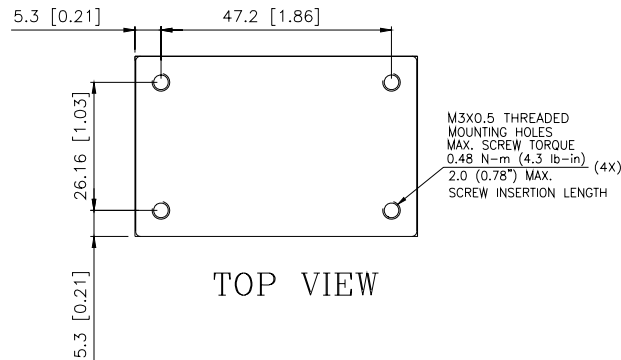
NOTES:
DIMENSIONS ARE IN MILLIMETERS AND (INCHES)
TOLERANCES: X.Xmm±0.5mm(X.XX in.±0.02 in.)
X.XXmm±0.25mm(X.XXX in.±0.010 in.)

Pin No.	Name	Function
1	+Vin	Positive input voltage
2	ON/OFF	Remote ON/OFF
3	CASE	CASE (Optional)
4	-Vin	Negative input voltage
5	-Vout	Negative output voltage
6	POK	Power Good (Optional)
7	+Vout	Positive output voltage

Notes:
1. Pin1, 2, 3, 4 and 6 are1.00mm (0.040") diameter.
2. All pins are copper with Tin Plating (Lead Free)

MECHANICAL DRAWING (WITH HEATSINK, OPTION CODE D)

* 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.

TOP VIEW

FRONT VIEW

30.6 [1.20] MAX.

4.6 [0.181]

1.00 [0.040] (5x)
2.00 [0.080] (5x)

1.50 [0.060] (2x)
2.50 [0.098] (2x)

57.9 [2.28]

3.6 [0.14]

50.80 [2.000]

36.8 [1.45]

4 −Vin
3 CASE
2 ON/OFF
1 +Vin

−Vout 5
POK 6
+Vout 7

15.24 [0.600]
11.43 [0.450]
7.62 [0.300]
10.8 [0.43]

BOTTOM 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.)

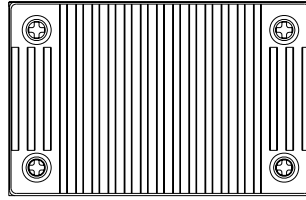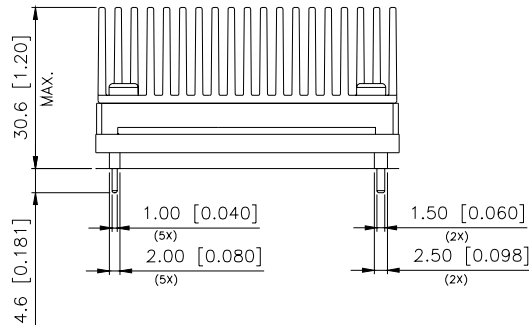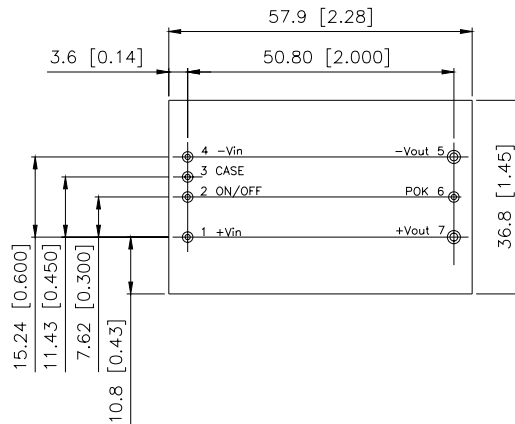## PART NUMBERING SYSTEM

D	48	S	12	38	−2 A/C/D/E
Type of Product	Input Voltage	Number of Outputs	Output Voltage	Output Current	Option Code
D - DC/DC modules	48 - 43 ~57V	S - Single	12 - 12V	38 - 38A	2 A - standard, with heatspreader and case pin, pin length 0.180" 2 C - with heatspreader, no case pin, with PowerGood pin, pin length 0.180" 2 D - with heat sink, no case pin, with PowerGood pin, pin length 0.180" 2 E - same as 2 A, but with 0.250" pin length

MODEL LIST

Part Number	INPUT		OUTPUT		Pin Length(L)	Case Pin	POK Pin	EFF @ 100% LOAD
D48S1238-2 A	43V~57V	12.5A	12V	38A	4.60(0.180")	Yes	No	94.5%
D48S1238-2 C	43V~57V	12.5A	12V	38A	4.60(0.180")	No	Yes	94.5%
D48S1238-2 D	43V~57V	12.5A	12V	38A	4.60(0.180")	No	Yes	94.5%
D48S1238-2 E	43V~57V	12.5A	12V	38A	6.35(0.250")	Yes	No	94.5%

Default remote on/off logic is negative
For different remote on/off logic or heatspreader assembly, please 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._

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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.

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