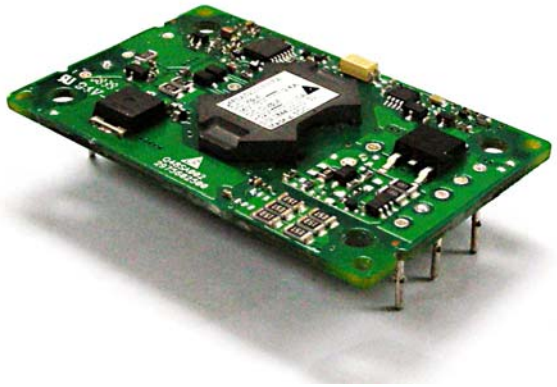
DELPHI SERIES



FEATURES

- High efficiency 91.0% @ 52V/1.15A
- Size: 57.9x36.8x9.8mm (2.28”x1.45”x0.39”)
- 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), and CE - pending

Delphi Series Q48SA, 60W Quarter Brick Family DC/DC Power Modules: 36~75V in, 52V/1.15A out

The Delphi Q48SA52001 series, quarter brick, 36~75V 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. The Q48SA52001 product family operates from a wide 36~75V input voltage range and provides up to 60 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

- Positive, negative, or no On/Off
- OTP and Output OVP, OCP mode, Auto-restart or latch-up
- Short pin lengths

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	Q48SA52001 (Standard)			
		Min.	Typ.	Max.	Units
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					
Continuous				80	Vdc
Transient (100ms)	100ms			100	Vdc
Operating Case Temperature	Please refer to Figure 19	-40		120	°C
Storage Temperature		-55		125	°C
Input/Output Isolation Voltage	1 minute			2250	Vdc
INPUT CHARACTERISTICS					
Operating Input Voltage		36	48	75	Vdc
Input Under-Voltage Lockout					
Turn-On Voltage Threshold		32		35	Vdc
Turn-Off Voltage Threshold		29		32	Vdc
Lockout Hysteresis Voltage		2		4	Vdc
Maximum Input Current	100% Load, 36Vin			2.4	A
No-Load Input Current			50		mA
Off Converter Input Current	Vin=48V		8		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		50		dB
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	Vin=48V, Io=Io.max, Tc=25°C	51.0	52.0	53.0	Vdc
Output Voltage Regulation					
Over Load	Io=Io,min to Io,max		±20	±200	mV
Over Line	Vin=36V to 75V		±20	±200	mV
Over Temperature	Tc=-40°C to 120°C			0.02	%Vo/°C
Total Output Voltage Range	over load, line and temperature	50.4		53.6	V
Output Voltage Ripple and Noise	5Hz to 20MHz bandwidth, with external output capacitors				
Peak-to-Peak	Full Load (high frequency low ESR)		500	700	mV
RMS			50	150	mV
Operating Output Current Range		0		1.15	A
Output DC Current-Limit Inception	Output Voltage 10% Low	1.27		1.65	A
DYNAMIC CHARACTERISTICS					
Output Voltage Current Transient	48V, 10µF electrolytic & 1µF ceramic load cap, 0.1A/µs				
Positive Step Change in Output Current	50% to 75% Io.max		750		mV
Negative Step Change in Output Current	75% to 50% Io.max		750		mV
Settling Time (within 1% Vout nominal)					µs
Turn-On Transient					
Start-Up Time, From On/Off Control			25	100	ms
Start-Up Time, From Input			25	100	ms
External Output Capacitance	Full load; 5% overshoot of Vout at startup	10		1000	µF
EFFICIENCY					
100% Load	Vin=48V		91.0		%
60% Load	Vin=48V		90.0		%
ISOLATION CHARACTERISTICS					
Input to Output				2250	Vdc
Isolation Resistance		10			MΩ
Isolation Capacitance			2000		pF
FEATURE CHARACTERISTICS					
Switching Frequency			330		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	3.5		20	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	3.5		20	V
ON/OFF Current (for both remote on/off logic)	Ion/off at Von/off=0.0V			1.0	mA
Leakage Current (for both remote on/off logic)	Logic High, Von/off=15V				µA
Output Over-Voltage Protection(latch mode)	Over full temp range;	55		60	V
GENERAL SPECIFICATIONS					
MTBF	Io=80% of Io, max; Tc=40°C		TBD		M hours
Weight			27.8		grams
Over-Temperature Shutdown	Please refer to Figure 19		125		°C

ELECTRICAL CHARACTERISTICS CURVES

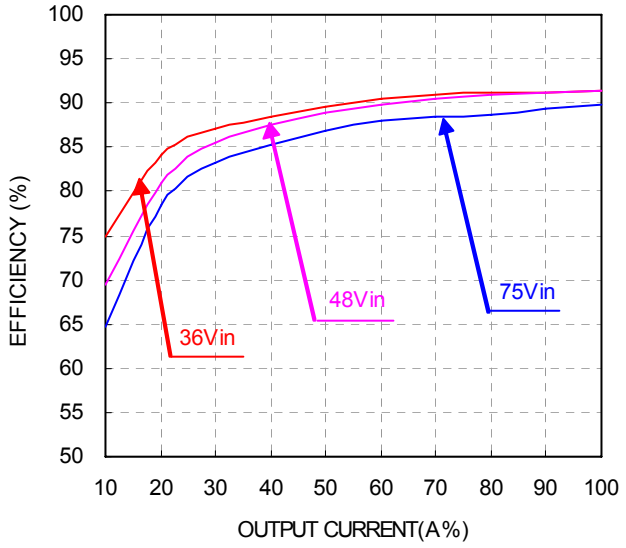


Figure 1: *Efficiency vs. load current for minimum, nominal, and maximum input voltage at 25°C.*

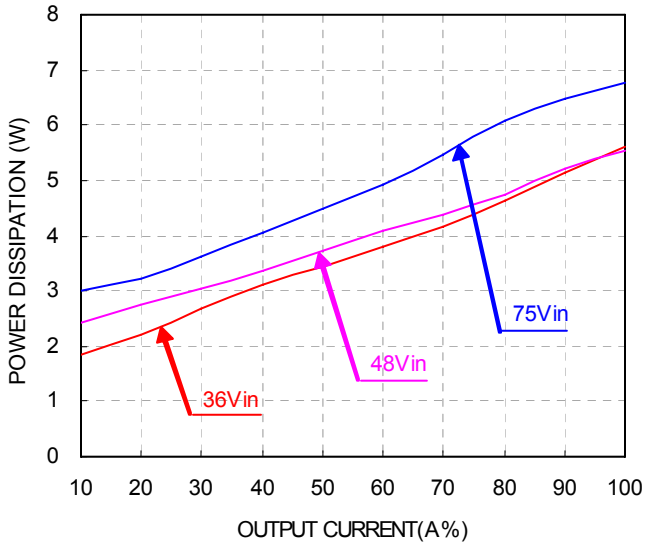


Figure 2: *Power dissipation vs. load current for minimum, nominal, and maximum input voltage at 25°C.*

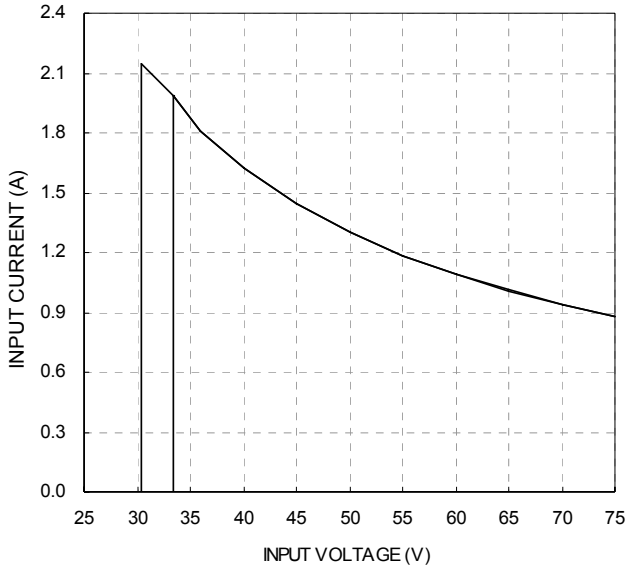


Figure 3: *Typical full load input characteristics at room temperature.*

ELECTRICAL CHARACTERISTICS CURVES

For Negative Remote On/Off Logic

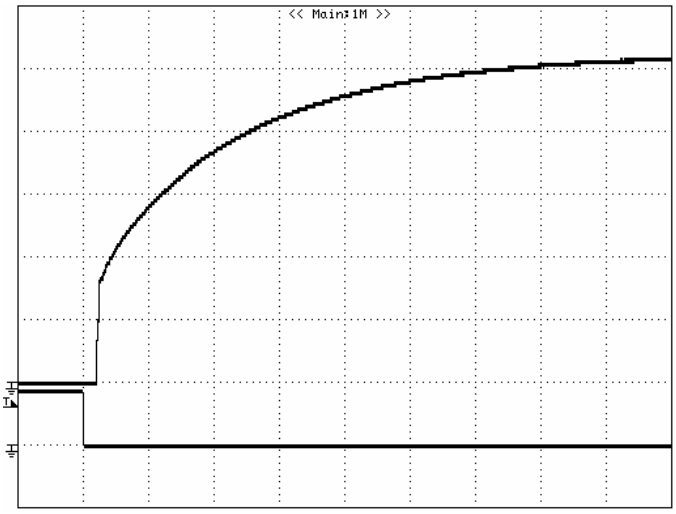


Figure 4: *Turn-on transient at full rated load current (5ms/div). Top Trace: Vout; 10V/div; Bottom Trace: ON/OFF input: 5V/div.*

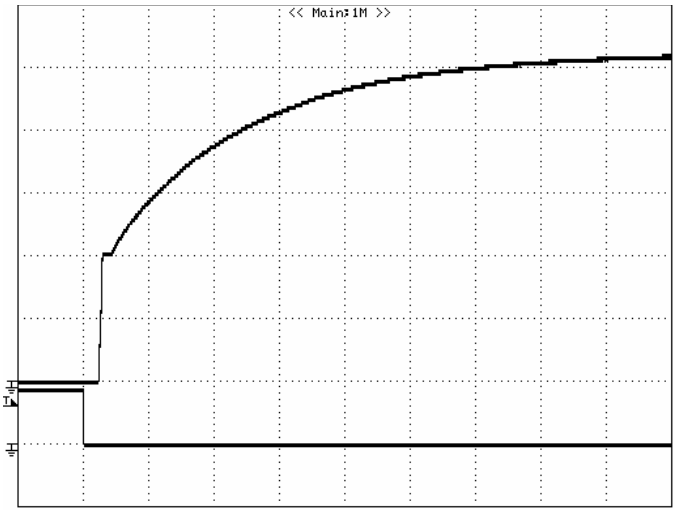


Figure 5: *Turn-on transient at zero load current (5 ms/div). Top Trace: Vout: 10V/div; Bottom Trace: ON/OFF input: 5V/div.*

For Input Voltage Start up

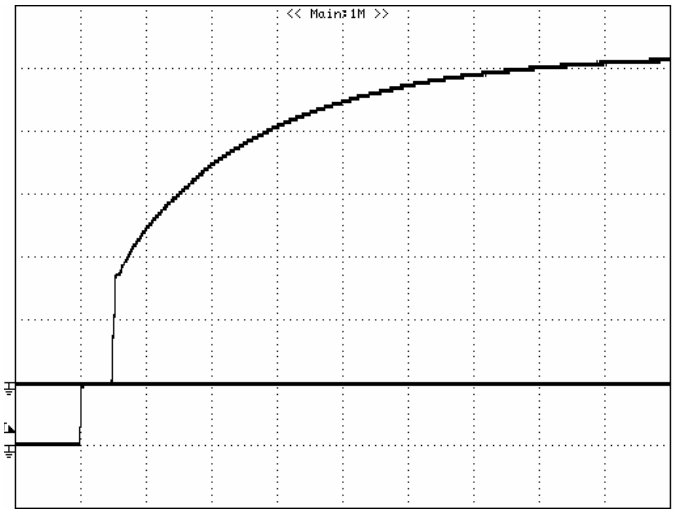


Figure 6: *Turn-on transient at full rated load current (5 ms/div). Top Trace: Vout; 10V/div; Bottom Trace: input voltage: 50V/div.*

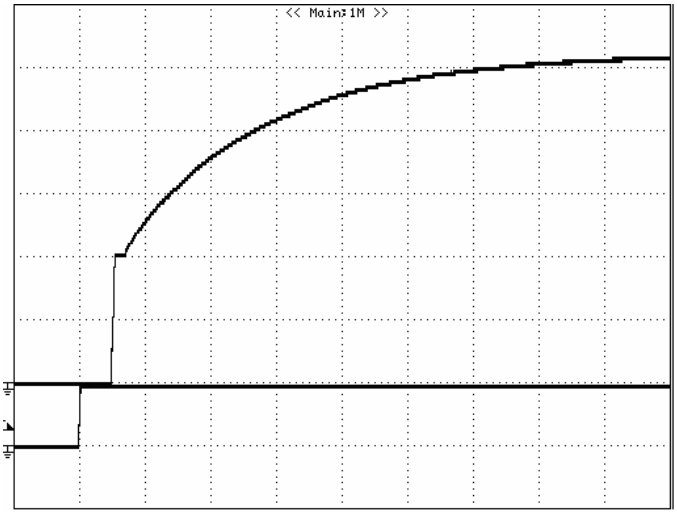


Figure 7*: Turn-on transient at zero load current (5 ms/div). Top Trace: Vout; 10V/div; Bottom Trace: input voltage: 50V/div.*

ELECTRICAL CHARACTERISTICS CURVES

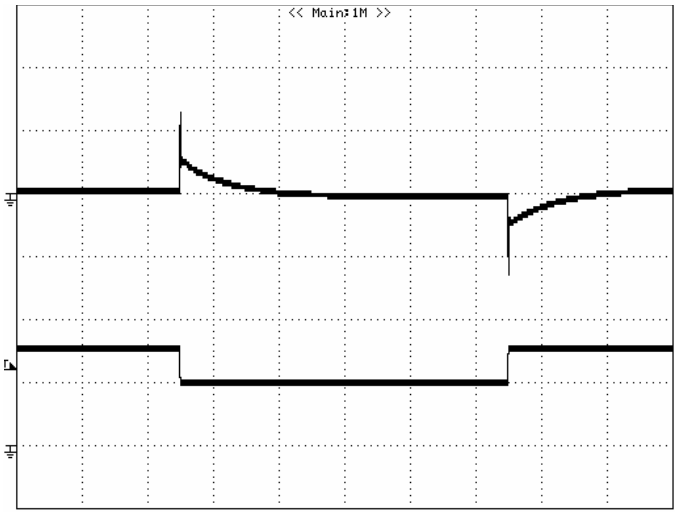


Figure 8: *Output voltage response to step-change in load current (75%-50%-75% of Io, max; di/dt = 0.1A/μs). Load cap: 10μF aluminum capacitor and 1μF ceramic capacitor. TOP Trace: Vout (500mV/div), Bottom Trace: Iout (500mA/div), Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module.*

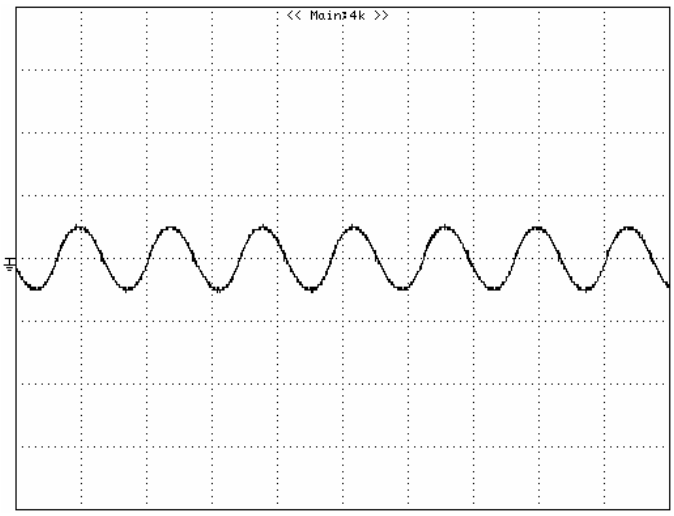


Figure 9: *Input Terminal Ripple Current, i_c, at full rated output current and nominal input voltage with 12μH source impedance and 33μF electrolytic capacitor (500 mA/div，2us/div).*

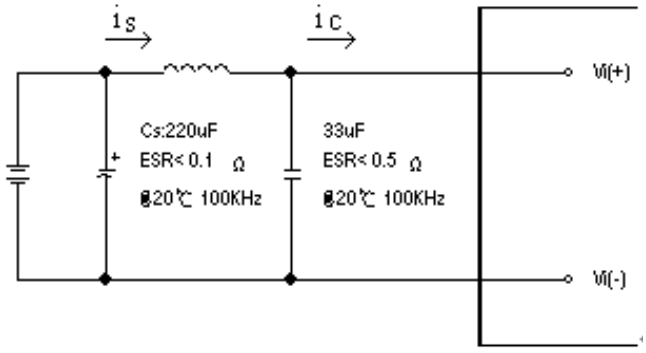


Figure 10: *Test set-up diagram showing measurement points for Input Terminal Ripple Current and Input Reflected Ripple Current.*
Note: Measured input reflected-ripple current with a simulated source Inductance (L_{TEST}) of 12 μH. Capacitor Cs offset possible battery impedance. Measure current as shown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

ELECTRICAL CHARACTERISTICS CURVES

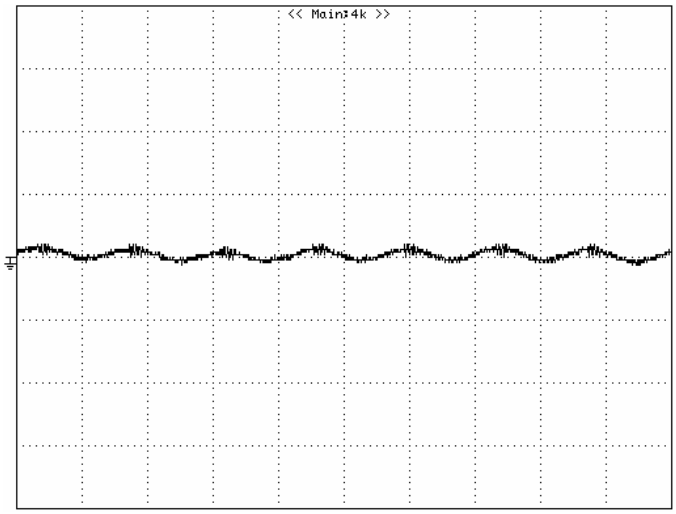


Figure 11: *Input reflected ripple current, i_s, through a 12μH source inductor at nominal input voltage and rated load current (20 mA/div，2us/div).*

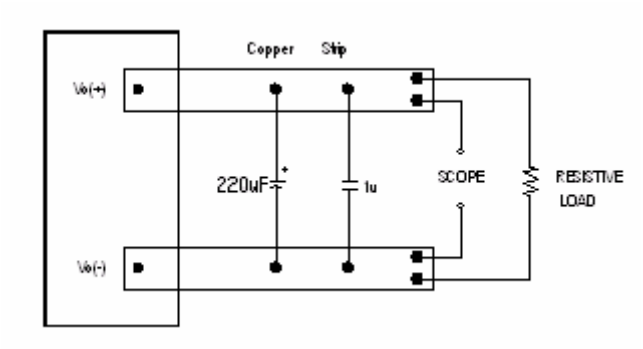


Figure 12: *Output voltage noise and ripple measurement test setup.*

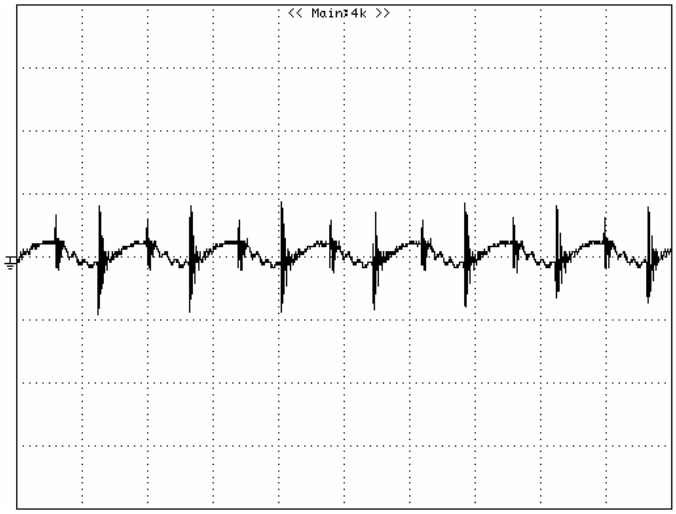


Figure 13: *Output voltage ripple at nominal input voltage and rated load current (Io=1.15A)(50 mV/div, 2us/div)*
Load capacitance: 1μF ceramic capacitor and 10μF electrolytic capacitor. Bandwidth: 20MHz. Scope measurements should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module.

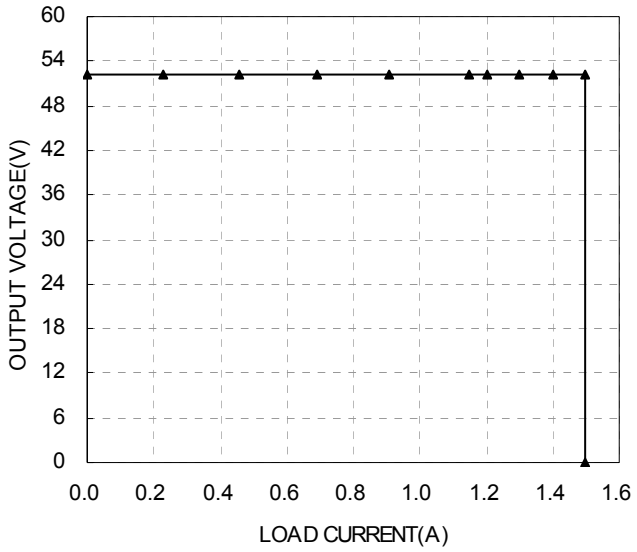


Figure 14: *Output voltage vs. load current showing typical current limit curves and converter shutdown points.*

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, 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.

Also, an option of hiccup mode for OVP is available. Under hiccup mode, the modules will try to restart after shutdown. If the over voltage condition still exists, the module will shut down again. This restart trial will continue until the over voltage 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.

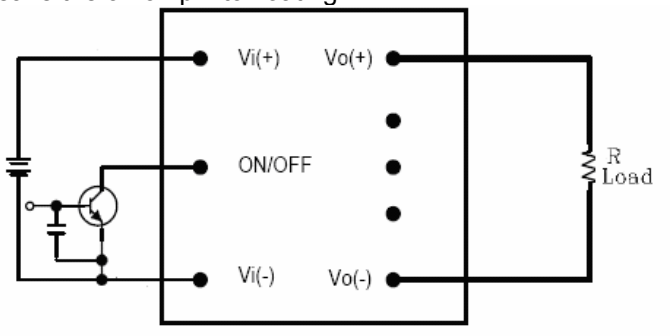


Figure 15: *Remote on/off implementation*

Output Voltage Adjustment (TRIM)

To increase or decrease the output voltage set point, the modules may be connected with an external resistor between the TRIM pin and either Vo(+) or Vo(-).The TRIM pin should be left open if this feature is not used.

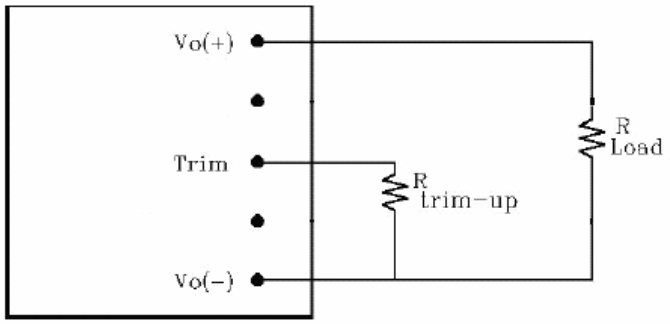


Figure 16: *Circuit configuration for trim-up (increase output voltage)*

If the external resistor is connected between the TRIM and Vo(-) pin, the output voltage set point increases (Fig. 17). The external resistor value required value required to obtain output voltage change △U is defined as:

$$R_{trim-up} = \frac{127.5}{\Delta U} - 4.7(K\Omega)$$

Ex. When Trim-up 5%，*△U is*

*5%*Vnormal=0.05*52.5=2.625*

$$R_{trim-up} = \frac{127.5}{2.625} - 4.7 = 43.87K\Omega$$

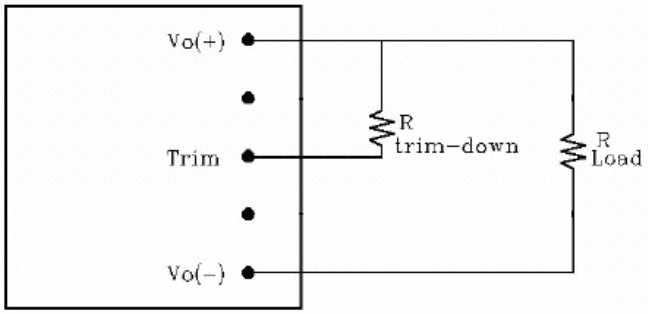


Figure 17: *Circuit configuration for trim-down (decrease output voltage)*

If the external resistor is connected between the TRIM and Vo(+), Vout decreases (Fig. 18). The external resistor value required to obtain output voltage change $\triangle U$ is defined as:

$$R_{trim-down} = \frac{51*51}{\Delta U} - 55.7(K\Omega)$$

Ex. When Trim-down 15%，$\triangle U$ *is*

*15%*Vnormal=0.15*52.5=7.875*

$$R_{trim-down} = \frac{51*51}{7.875} - 55.7 = 274.6(K\Omega)$$

When using trim-up, the output voltage of the module is usually increased, which increases the power output of the module with the same output current.Care should be taken to ensure that the maximum output power of the module remains at or below the maximum rated power.

THERMAL CONSIDERATIONS

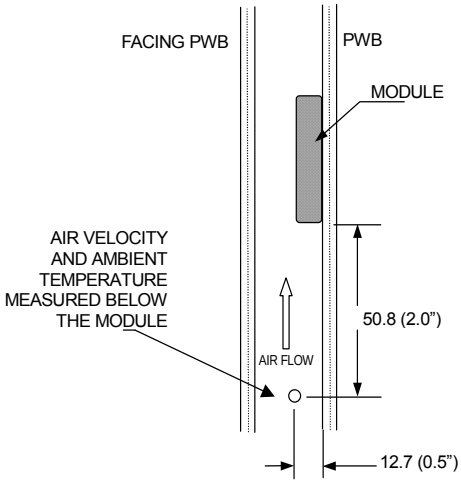
Thermal management is an important part of the system design. To ensure proper, reliable operation, sufficient cooling of the power module is needed over the entire temperature range of the module. Convection cooling is usually the dominant mode of heat transfer.

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 18: *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

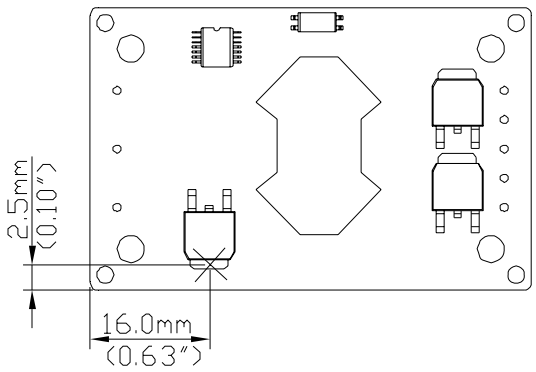


Figure 19: *Temperature measurement location*
** The allowed maximum hot spot temperature is defined at 120℃*

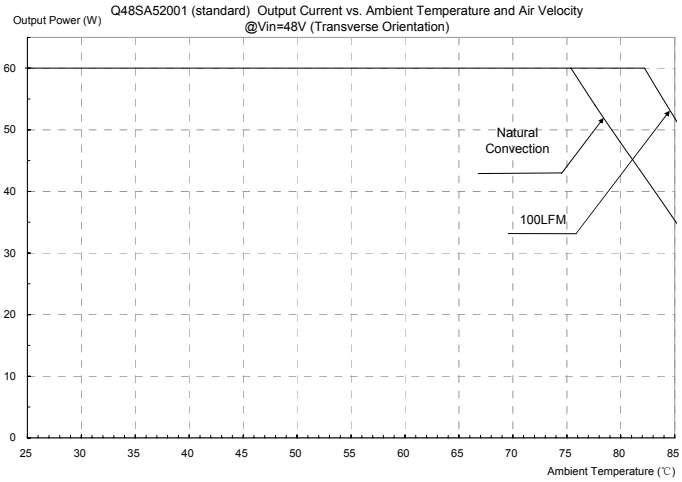
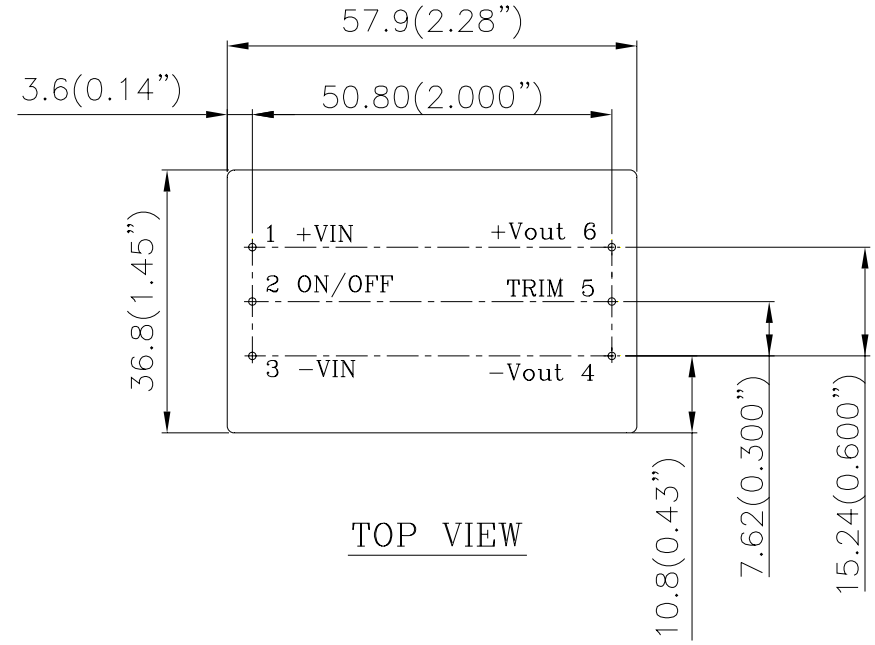
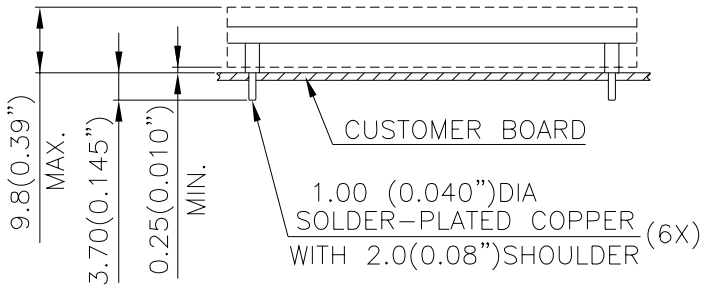


Figure 20: *Output current vs. ambient temperature and air velocity @Vin=48V(Transverse Orientation)*

MECHANICAL DRAWING



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	-Vin	Negative input voltage
4	-Vout	Negative output voltage
5	Trim	Output voltage trim
6	+Vout	Positive output voltage

Pin Specification:

Pins 1-6 1.00mm (0.040") diameter

All pins are copper with Tin plating.

PART NUMBERING SYSTEM

Q	48	S	A	520	01	N	N		A
Form Factor	**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	A - Advanced	520 - 52V	01- 1.15A	N - Negative	R - 0.170” N - 0.145”	Space- RoHs 5/6 F- RoHS 6/6 (Lead Free)	A - Open Frame

MODEL LIST

MODEL NAME	INPUT		OUTPUT		EFF @ 100% LOAD
Q48SA52001NNFA	36V~75V	2.4 A	52V	1.15A	91%

**** 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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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.

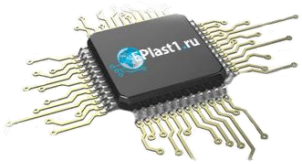
Компания «ЭлектроПласт» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Оперативные поставки широкого спектра электронных компонентов отечественного и импортного производства напрямую от производителей и с крупнейших мировых складов;
- Поставка более 17-ти миллионов наименований электронных компонентов;
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- Лицензия ФСБ на осуществление работ с использованием сведений, составляющих государственную тайну;
- Поставка специализированных компонентов (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Aeroflex, Peregrine, Syfer, Eurofarad, Texas Instrument, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits,General Dynamics и др.);

Помимо этого, одним из направлений компании «ЭлектроПласт» является направление «Источники питания». Мы предлагаем Вам помощь Конструкторского отдела:

- Подбор оптимального решения, техническое обоснование при выборе компонента;
- Подбор аналогов;
- Консультации по применению компонента;
- Поставка образцов и прототипов;
- Техническая поддержка проекта;
- Защита от снятия компонента с производства.



Как с нами связаться

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