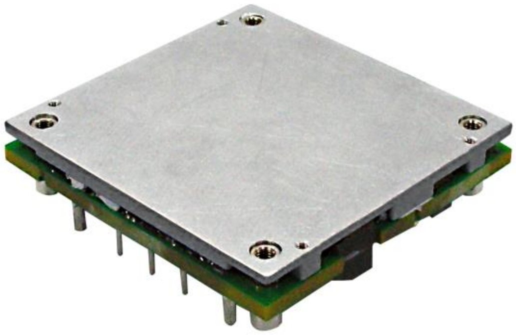
DELPHI SERIES



FEATURES

- High Efficiency: 92.7% @ 28V/16A
- Size: 61.0x57.9x12.7mm (2.40”×2.28”×0.50”)
- Standard footprint
- Industry standard pin out
- Fixed frequency operation
- Metal baseplate (heatspreader)
- Input UVLO, Output OCP, OVP, OTP
- Basic insulation
- 1500V isolation
- 2:1 Input voltage range
- ISO 9001, TL 9000, ISO 14001, QS9000, OHSAS18001 certified manufacturing facility
- UL/cUL 60950-1 (US & Canada) recognized

Delphi Series H48SA, 450W Half Brick Family DC/DC Power Modules: 48V in, 28V/16A out

The Delphi Series H48SA Half Brick, 48V input, single output, isolated DC/DC converters are the latest offering from a world leader in power systems technology and manufacturing -- Delta Electronics, Inc. The H48SA28016 product provides up to 450 watts of power or 28V/16A in an industry standard footprint. It provides 92.7% efficiency for 28V at full load. With creative design technology and optimization of component placement, these converters possess outstanding electrical and thermal performance, 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. A variety of optional heatsinks are available for extended thermal operation as well as for use in higher air flow applications: 200 to 400 LFM.

OPTIONS

- Positive on/off logic
- Output OVP hiccup option

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	H48SA28016 (Standard)			
		Min.	Typ.	Max.	Units
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					
Continuous				80	Vdc
Transient	100ms			100	Vdc
Operating Temperature	Please refer to Fig. 21 for measuring point	-40		98	°C
Storage Temperature		-55		125	°C
Input/Output Isolation Voltage				1500	Vdc
INPUT CHARACTERISTICS					
Operating Input Voltage		36	48	75	Vdc
Input Under-Voltage Lockout					
Turn-On Voltage Threshold		33		35	Vdc
Turn-Off Voltage Threshold		31		33	Vdc
Lockout Hysteresis Voltage			2		Vdc
Maximum Input Current	100% Load, 36Vin			16	A
Minimum -Load Input Current			100		mA
Off Converter Input Current	Per ETSI EN300 132-2		15		mA
Inrush Current(I^2t)				1	A^2s
Input Reflected-Ripple Current	P-P thru 12µH inductor, 5Hz to 20MHz		12		mA
Input Voltage Ripple Rejection	120 Hz		60		dB
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	Vin=48V, Io=Io.max, Tc=25°C	27.58	28.00	28.42	Vdc
Output Voltage Regulation					
Over Load	Io=Io,min to Io,max		±28	±56	mV
Over Line	Vin=36V to 75V		±28	±56	mV
Over Temperature	Tc=-40°C to 100°C		±140	±280	mV
Total Output Voltage Range	over sample load, line and temperature	27.16	28.00	28.84	V
Output Voltage Ripple and Noise	5Hz to 20MHz bandwidth				
Peak-to-Peak	Full Load, 1µF ceramic, 10µF Low ESR cap		280	560	mV
RMS	Full Load, 1µF ceramic, 10µF Low ESR cap			100	mV
Operating Output Current Range				16	A
Output DC Current-Limit Inception	Output Voltage 10% Low	105	120	140	%
DYNAMIC CHARACTERISTICS					
Output Voltage Current Transient	48V, Tested with 10µF aluminum, Low ESR cap an 1µF Ceramic load cap, △Io/△t=1A/10µS				
Positive Step Change in Output Current	50% to 75% Io.max			560	mV
Negative Step Change in Output Current	75% to 50% Io.max			560	mV
Settling Time (within 1% Vout nominal)			300		µs
Turn-On Transient					
Start-Up Time, From On/Off Control			20	50	ms
Start-Up Time, From Input			20	50	ms
Output Capacitive Load	Full load; 5% overshoot of Vout at startup	220		5000	µF
EFFICIENCY					
100% Load			92.7		%
80% Load			93		%
ISOLATION CHARACTERISTICS					
Input to Output				1500	Vdc
Input to Case				1500	Vdc
Output to Case				500	Vdc
Isolation Resistance		10			MΩ
Isolation Capacitance			1900		pF
FEATURE CHARACTERISTICS					
Switching Frequency			280		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	2.4		15	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	2.4		15	V
ON/OFF Current	Ion/off at Von/off=0.0V			1	mA
Leakage Current	Logic High, Von/off=15V			50	uA
Output Voltage Trim Range	Across Pins 9 & 5, Vin=48V	-50		+18	%
Output Voltage Remote Sense Range	Pout ≦ max rated power			0.5	V
Output Over-Voltage Protection				140	%
GENERAL SPECIFICATIONS					
MTBF	Io=80% of Io, max; Ta=25°C		1.6		M hours
Weight			97		grams
Over-Temperature Shutdown	Please refer to Fig.21 for measuring point		104		°C

ELECTRICAL CHARACTERISTICS CURVES

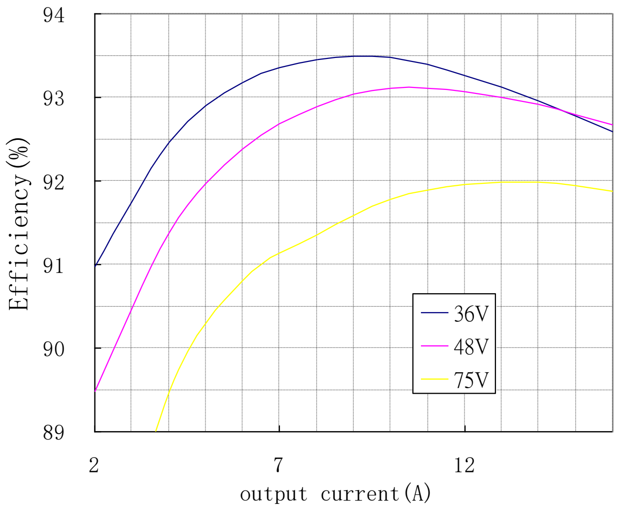


Figure 1: *Efficiency vs. load current for minimum, nominal, and maximum input voltage at 25°C.*

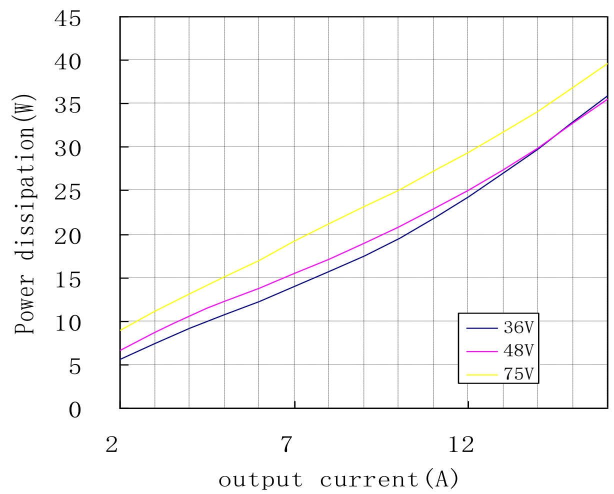


Figure 2: *Power dissipation vs. load current for minimum, nominal, and maximum input voltage at 25°C.*

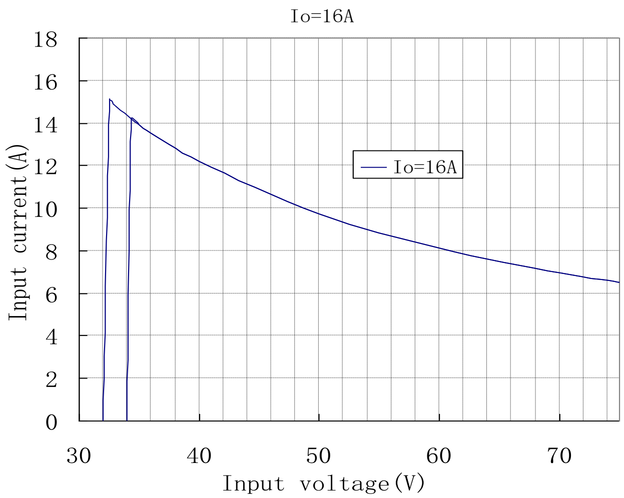


Figure 3: *Typical input characteristics at room temperature*

ELECTRICAL CHARACTERISTICS CURVES

For Negative Remote On/Off Logic

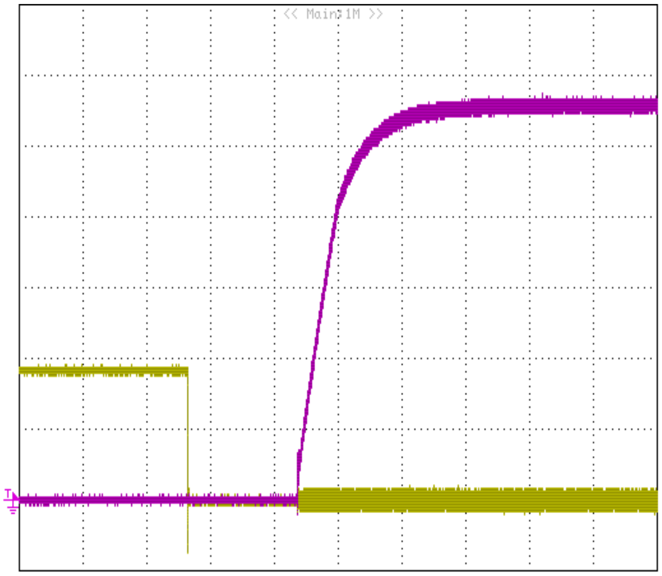


Figure 4: *Turn-on transient at full load current (resistive load) (10ms/div). CH3: Vout; 5V/div; CH1: ON/OFF input: 2V/div*

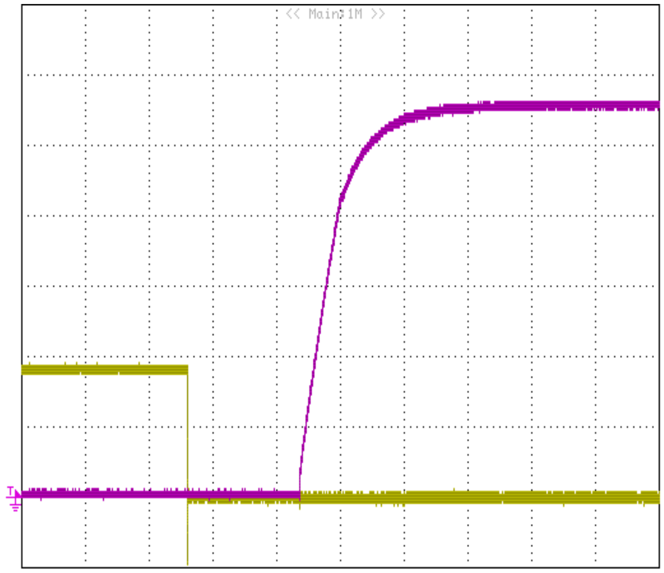


Figure 5: *Turn-on transient at minimum load current (10ms/div). CH3: Vout: 5V/div; CH1: ON/OFF input: 2V/div*

For Positive Remote On/Off Logic

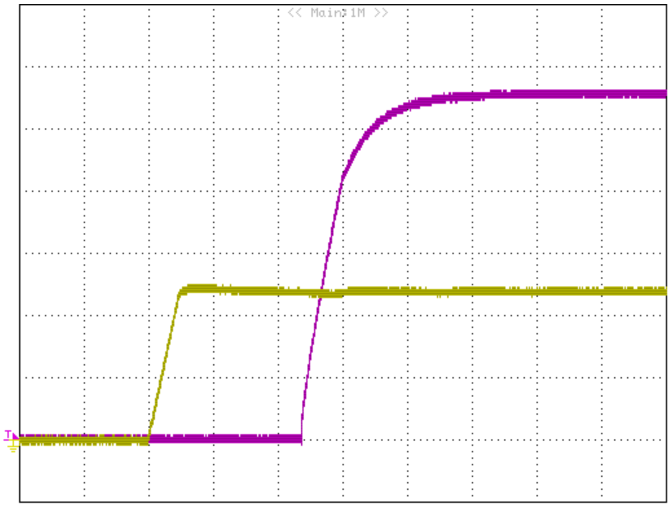


Figure 6: *Turn-on transient at full load current (resistive load) (10ms/div). CH3 Vout; 5V/div; CH1:Vin: 20V/div*

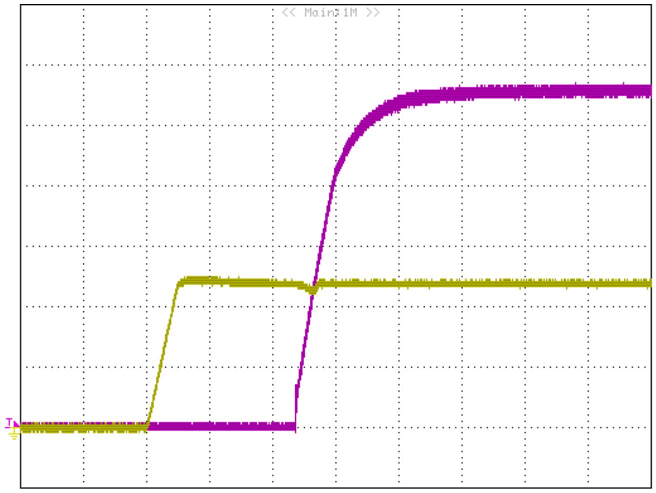


Figure 7: *Turn-on transient at zero load current (10ms/div). CH3 Vout; 5V/div; CH1:Vin: 20V/div*

ELECTRICAL CHARACTERISTICS CURVES

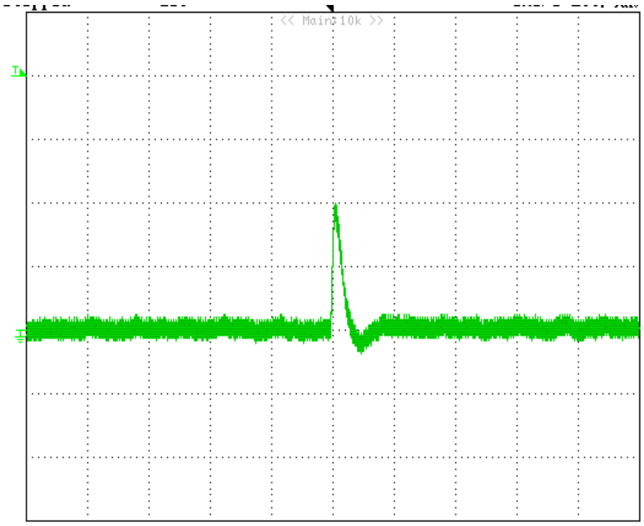


Figure 8: *Output voltage response to step-change in load current (75%-50% of Io, max; di/dt = 1A/10µS). Load cap: 220µF aluminum,10uF Low ESR capacitor and 1µF ceramic capacitor. Top Trace: Vout (100mV/div), Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module.*

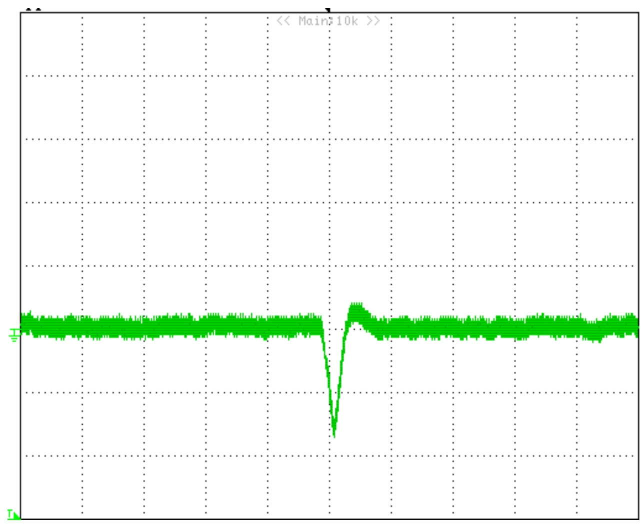


Figure 9: *Output voltage response to step-change in load current (50%-75% of Io, max; di/dt = 1A/10µS). Load cap: 220µF aluminum,10uF Low ESR capacitor and 1µF ceramic capacitor. Top Trace: Vout (100mV/div), Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module.*

ELECTRICAL CHARACTERISTICS CURVES

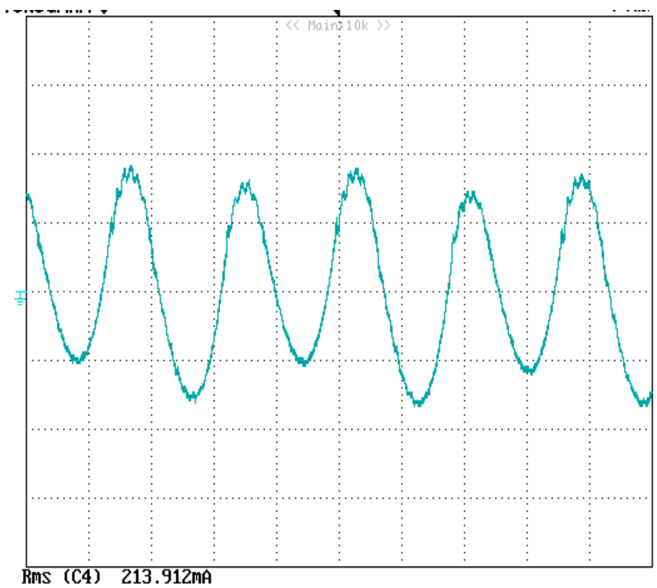


Figure 10: *Input Terminal Ripple Current, i_c, at full rated output current and nominal input voltage with 12µH source impedance and 220µF electrolytic capacitor (1A/div).*

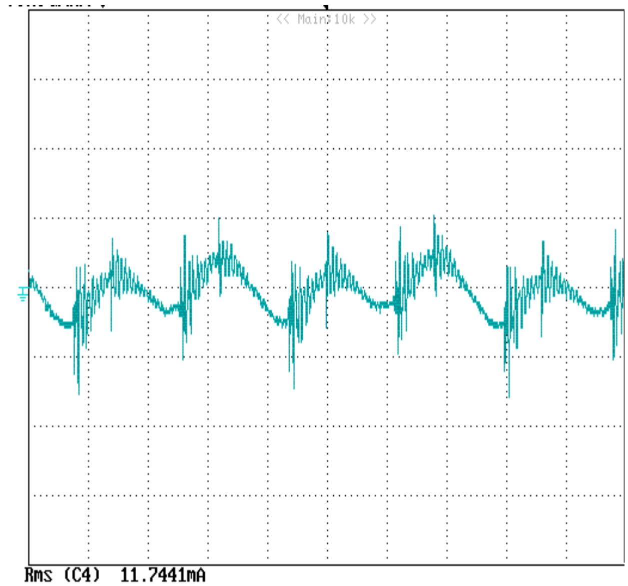


Figure 11: *Input reflected ripple current, i_s, through a 12µH source inductor at nominal input voltage and rated load current (10 mA/div)*

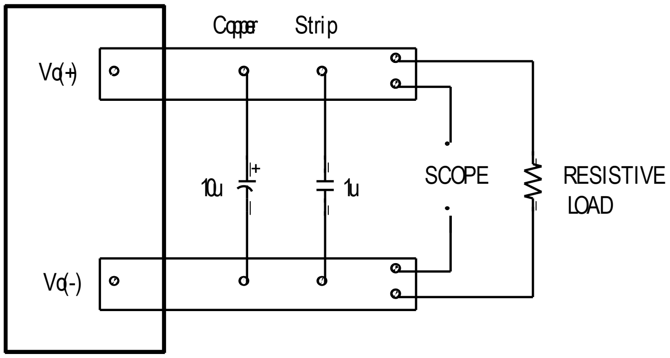


Figure 12: *Output voltage noise and ripple measurement test setup*

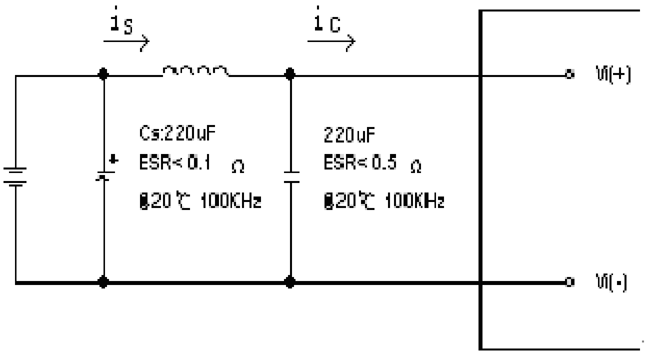


Figure 13: *Test set-up diagram showing measurement points for Input Terminal Ripple Current and Input Reflected Ripple Current.*
Note: Measured input reflected-ripple current with a simulated source Inductance (L_{TEST}) of 12 μH. Capacitor Cs offset possible battery impedance. Measure current as shown above.

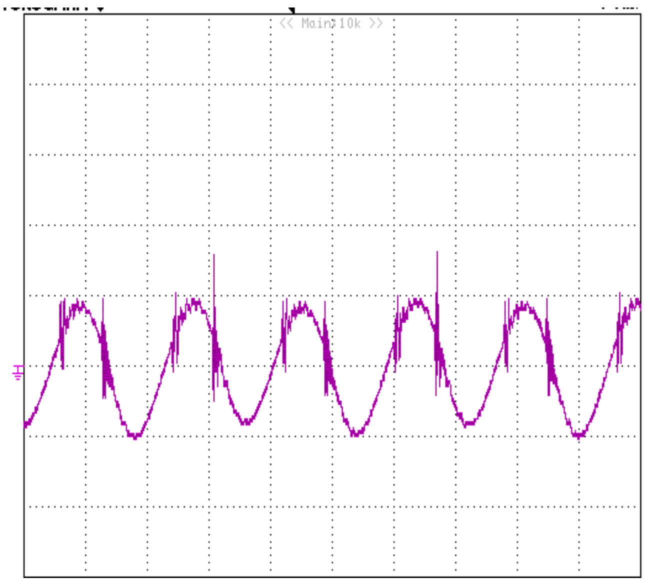


Figure 14: *Output voltage ripple at nominal input voltage and rated load current (100mV/div). Load capacitance: 330uF aluminum, 1μF ceramic capacitor and 10μFlow ESR capacitor. Bandwidth: 20 MHz. Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module.*

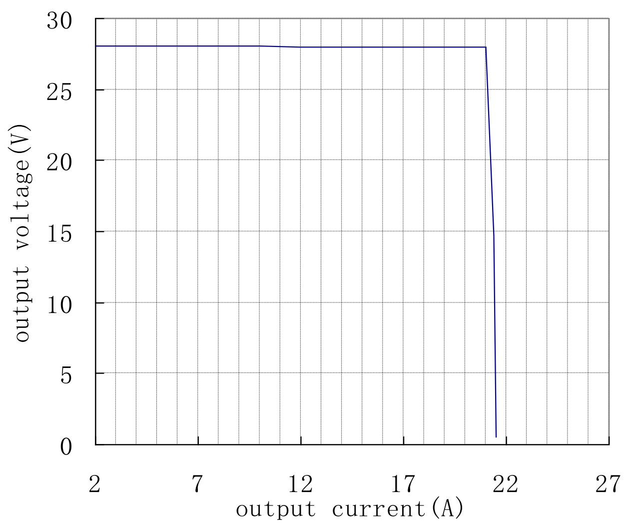


Figure 15: *Output voltage vs. load current showing typical current limit curves and converter shutdown points.*

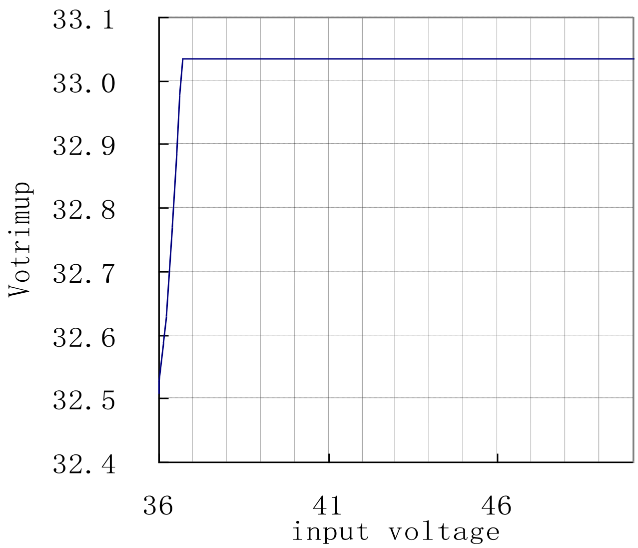


Figure 16: *maximum trim up output voltage vs input voltage under full load*

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 220 to 470 μF electrolytic capacitor (ESR < 0.1 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, 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 50A 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 module provides two over current protection levels. When the output current exceeds the low current limit level, the module will endure current limiting till the output voltage is lower than 10V. If the output current exceeds the high current limit level, the module will shut down immediately.

The modules will try to restart after shutdown (hiccup mode). 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 not start up. 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 logic low and off during logic high. Positive logic turns the modules on during logic high and off during 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.

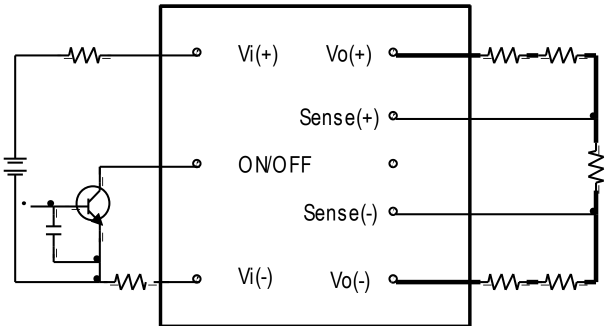


Figure 16: *Remote on/off implementation*

Remote Sense

Remote sense compensates for voltage drops on the output by sensing the actual output voltage at the point of load. The voltage between the remote sense pins and the output terminals must not exceed the output voltage sense range given here:

[Vo(+) – Vo(–)] – [SENSE(+) – SENSE(–)] ≤ 10% × Vout

This limit includes any increase in voltage due to remote sense compensation and output voltage set point adjustment (trim).

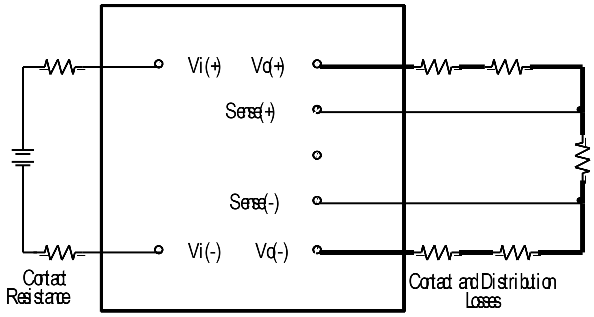


Figure 17: *Effective circuit configuration for remote sense operation*

If the remote sense feature is not used to regulate the output at the point of load, please connect SENSE(+) to Vo(+) and SENSE(–) to Vo(–) at the module.

The output voltage can be increased by both the remote sense and the trim; however, the maximum increase is the larger of either the remote sense or the trim, not the sum of both.

When using remote sense and trim, 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 does not exceed the maximum rated power.

FEATURES DESCRIPTIONS (CON.)

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 the SENSE(+) or SENSE(-). The TRIM pin should be left open if this feature is not used.

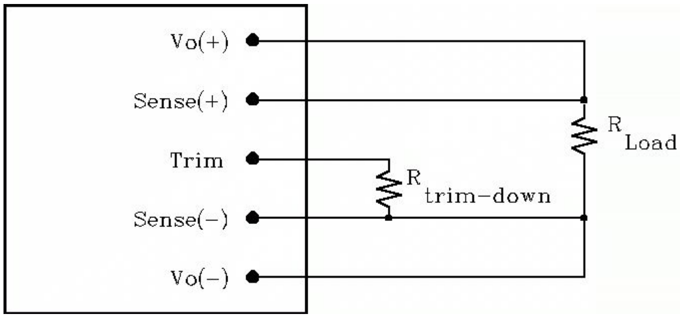


***Figure 18:** Circuit configuration for trim-down (decrease output voltage)*

If the external resistor is connected between the TRIM and SENSE (-) pins, the output voltage set point decreases (Fig. 18). The external resistor value required to obtain a percentage of output voltage change △% is defined as:

$$\text{Rtrim down} = \left(\frac{100}{\Delta} - 2\right)\ \text{K}\Omega$$

Ex. When Trim-down 40% (28.0V×0.6=16.8V)

$$Vo := 28.0\,V \qquad \Delta := 40$$

$$\frac{100}{\Delta} - 2 = 0.5\text{K}\Omega$$

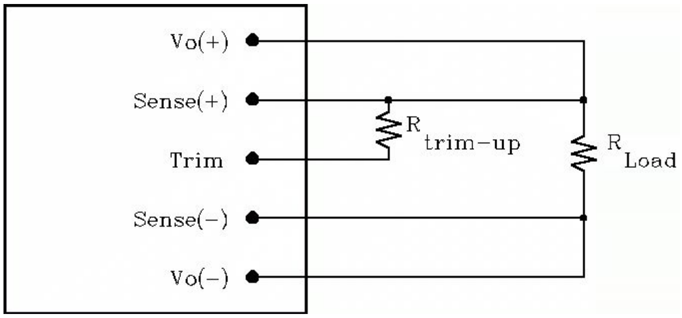


***Figure 19:** Circuit configuration for trim-up (increase output voltage)*

If the external resistor is connected between the TRIM and SENSE (+) the output voltage set point increases (Fig. 19). The external resistor value required to obtain a percentage output voltage change △% is defined as:

$$\text{Rtrim up} = \left[\frac{Vo\cdot(100+\Delta)}{1.225\cdot\Delta} - \frac{100+2\Delta}{\Delta}\right]\quad \text{K}\Omega$$

Ex. When Trim-up +10%(28.0V×1.1=30.8V)

$$Vo := 28.0\text{ V} \qquad \Delta := 10$$

$$\frac{Vo\cdot(100+\Delta)}{1.225\cdot\Delta} - \frac{100+2\cdot\Delta}{\Delta} = 239.429\quad \text{K}\Omega$$

The output voltage can be increased by both the remote sense and the trim, however the maximum increase is the larger of either the remote sense or the trim, not the sum of both.

When using remote sense and trim, 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

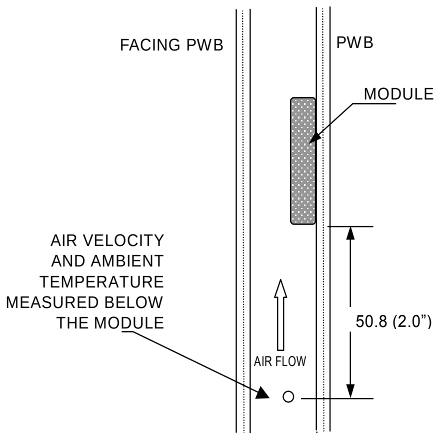
Thermal management is an important part of the system design. To ensure proper, reliable operation, sufficient cooling of the power module is needed over the entire temperature range of the module. Convection cooling is usually the dominant mode of heat transfer.

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 20: *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

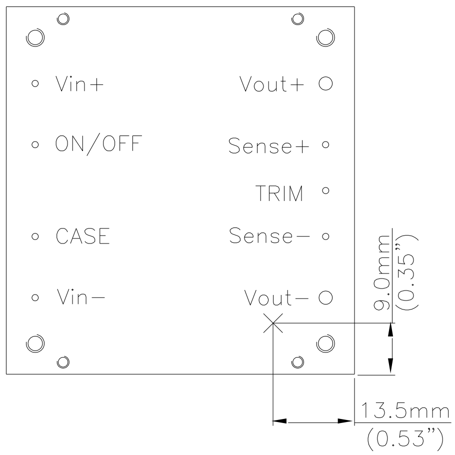


Figure 21: *Temperature measurement location viewed from top side.*
The allowed maximum hot spot temperature is defined at 98℃

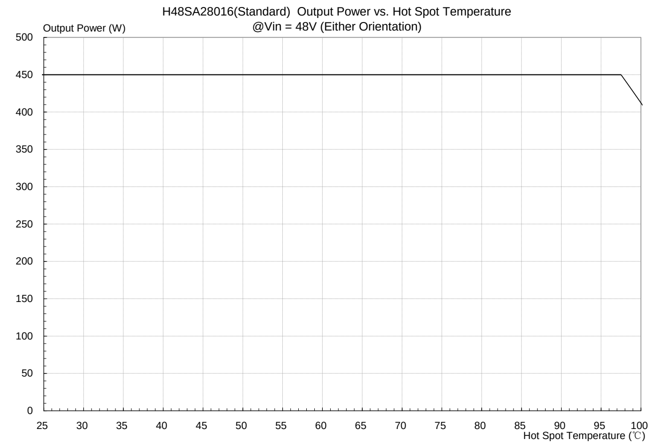
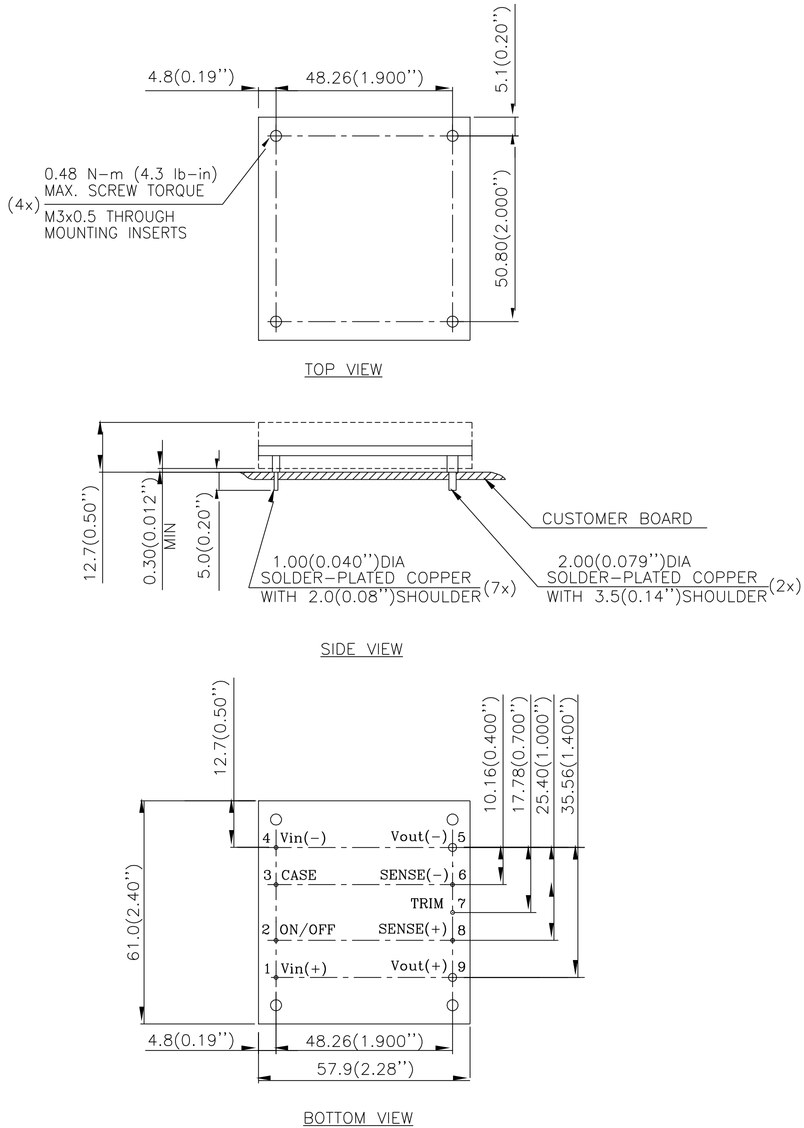


Figure 22: *Output power vs. Hot spot temperature @Vin=48V (Either Orientation)*

MECHANICAL DRAWING



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 ground
4	-Vin	Negative input voltage
5	-Vout	Negative output voltage
6	-SENSE	Negative remote sense
7	TRIM	Output voltage trim
8	+SENSE	Positive remote sense
9	+Vout	Positive output voltage

Pin Specification:

Pins 1-4, 6-8	1.00mm (0.040") diameter
Pins 5 & 9	2.00mm (0.079") diameter

All pins are copper with Tin plating.

PART NUMBERING SYSTEM

H	48	S	A	280	16	N	Y	F	H
Form Factor	Input Voltage	Number of Outputs	Product Series	Output Voltage	Output Current	ON/OFF Logic	Pin Length		Option Code
H - Half Brick	48 - 36~75V	S - Single	A - Advanced	280 - 28V	16- 16A	N - Negative P - Positive	Y - 0.200"	F - RoHS 6/6 (Lead Free) space - RoHS 5/6	H - with heatspreader

RECOMMENDED PART NUMBER

MODEL NAME	INPUT		OUTPUT		EFF @ 100% LOAD
H48SA28016NYFH	36V~75V	16A	28V	16A	92.7%

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.deltaww.com/dcdc **Email:** dcdc@deltaww.com

USA:
Telephone:
East Coast: 978-656-3993
West Coast: 510-668-5100
Fax: (978) 656 3964

Europe:
Phone: +31-20-655-0967
Fax: +31-20-655-0999

Asia & the rest of world:
Telephone: +886 3 4526107
ext 6220~6224
Fax: +886 3 4513485

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

Телефон: 8 (812) 309 58 32 (многоканальный)
Факс: 8 (812) 320-02-42
Электронная почта: org@eplast1.ru
Адрес: 198099, г. Санкт-Петербург, ул. Калинина, дом 2, корпус 4, литера А.