E54SJ12040

1/8 Brick DC/DC Regulated Power Module

40~60V in, 11.8V/40.7A out, 480W

The Delphi series E54SJ12040 , eighth brick, 40~60V input, single output 11.8V, isolated DC/DC converter is the latest offering from a world leader in power system and technology and manufacturing — Delta Electronics, Inc. This product provides up to 480 watts of power at 40~60V input in an industry standard footprint and pin out. 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. The E54SJ12040 offers peak 97.2% high efficiency. The E54SJ12040 is fully protected from abnormal input/output voltage, current, and temperature conditions and meets 707V isolation. And it can be connected in parallel directly for higher power without external oring-fet.

FEATURES

Electrical

- Peak Efficiency up to 97.2% at 60Vin, 96.7% at 54Vin
- Input range: 40~60Vdc
- Over current protection
- Input UVP/OVP,
- Over Temperature Protection
- Remote ON/OFF
- Pre-bias startup
- No minimum load required
- Active Droop Performance
- Parallel Operation with Direct Output Connection
- 707Vdc isolation

Mechanical

Size(open frame):
58.4 x 22.8 x 12.2mm (2.30"x0.9"x0.48")
Size(with heat spreader):
58.4 x 22.8 x 14.5mm (2.30"x0.9"x0.57")
Size(with heat sink):
58.4 x 22.8 x 30.0mm (2.30"x0.9"x1.18")

Safety & Reliability

- UL 60950-1
- ISO 9001, TL 9000, ISO 14001, QS 9000, OHSAS18001 certified manufacturing facility

OPTIONS

- Negative/Positive Remote on/off
- Optional Power-Good Signal
- HSP/HSK optional

APPLICATIONS

- Optical Transport
- Data Networking
- Communications
- Servers

TECHNICAL SPECIFICATIONS

(T_A=25°C, airflow rate=300 LFM, V_{in}=54Vdc, nominal V_{out} unless otherwise noted.)

PARAMETER	NOTES and CONDITIONS	E54SJ12040			
		Min.	Typ.	Max.	Units
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					Vdc
Continuous		0		60	Vdc
Transient	100mS			65	Vdc
Operating Ambient Temperature (Ta)		-20		85	°C
Storage Temperature		-55		125	°C
Input/Output Isolation Voltage				707	Vdc
INPUT CHARACTERISTICS					
Operating Input Voltage		40	54	60	Vdc
Input Under-Voltage Lockout					
Turn-On Voltage Threshold		38.5	39.5	40	Vdc
Turn-Off Voltage Threshold		36.9	38.0	39.0	Vdc
Lockout Hysteresis Voltage			1.5		Vdc
Input Over-Voltage Protection		60.5	62	63.5	Vdc
Maximum Input Current	Full Load, 40V_{in}			13	A
No-Load Input Current	V_{in}=54V, I_o=0A		190		mA
Off Converter Input Current	V_{in}=54V		20		mA
Internal Input Filter	L + C Structure, Lin and Cin shown in Figure 9		40+19.8		nH+μF
Internal Input Ripple Current	100uF AL cap and 20μF ceramic cap		300		mArms
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	Vin=54V, Io=Open Load, Ta=25°C	12.16	12.2	12.24	Vdc
	Vin=54V, Io=Full Load, Ta=25°C	11.76	11.8	11.84	Vdc
Output Regulation					
Load Regulation	V_{in}=54V, I_o=I_o min to I_o max Ta= full operating temperature range		400	480	mV
Line Regulation	V_{in}=40V to 60V, I_o=0	-0.4		0.4	% Vo.set
Temperature Regulation	T_a=-20°C to 85°C		1		% Vo.set
Total Output Voltage Range	Over sample load, line and temperature	11.6		12.4	V
Output Voltage Ripple and Noise	5Hz to 20MHz bandwidth				
Peak-to-Peak	Full Load, Co=500uF, 1μF ceramic, 10μF tantalum			150	mV
RMS	Full Load, Co=500uF, 1μF ceramic, 10μF tantalum			80	mV
Operating Output Current Range		0		40.7	A
Output Over Current Protection(hiccup mode)	when V_o<10%$V_{o.nom}$	45		57	A
Output Over Voltage Protection(hiccup mode)			14		V
DYNAMIC CHARACTERISTICS					
Output Voltage Current Transient	Vin=40~60V, 560μF & 1μF Ceramic load cap,1.6A/μs				
Positive Step Change in Output Current	75% $I_{o.max}$ to 25% $I_{o.max}$			600	mV
Negative Step Change in Output Current	25% $I_{o.max}$ to 75% $I_{o.max}$			600	mV
Settling Time (within 1% nominal V_{out})			200		μs
Turn-On Delay Time					
Start-Up Delay Time From Input Voltage	On/Off=On, from V_{in}=Turn-on Threshold to V_o=10% $V_{o,nom}$	5		30	mS
Start-Up Delay Time From On/Off Control	V_{in}=$V_{in,nom}$, from On/Off=On to V_o=10% $V_{o,nom}$	0		10	mS
Output Voltage Rise Time	V_o=10% to 90% $V_{o,nom}$	0		15	mS
Output Capacitance	50% ceramic, 50% Oscon or AO	300		4000	μF
EFFICIENCY					
100% Load	Vin=60V		97.2		%
100% Load	Vin=54V		96.7		%
ISOLATION CHARACTERISTICS					
Input to Output				707	Vdc
Isolation Capacitance			20		nF
FEATURE CHARACTERISTICS					
Switching Frequency	V_{in}=40~60V	400		1100	KHz
On/Off Control, Negative Remote On/Off logic					
Logic Low (Module On)	$V_{on/off}$			0.8	V
Logic High (Module Off)	$V_{on/off}$	2.4		20	V
ON/OFF Current	Ion/off at Von/off=0.0V			0.2	mA
Leakage Current	Logic High, Von/off=15V	10		500	uA
Power Good (Optional Function), Positive Logic					
Vout Low Threshold			10.5		V
Vout High Threshold			14.5		V
Vin Low Threshold		37		40	V
Vin High Threshold		60.5		63.5	V
Logic High of Power Good		1.2		5.5	V
High State Leakage Current (into Pin)				10	uA
Logic Low of Power Good		0		0.8	V
Low State Leakage Current (into Pin)				5	mA
Power Good Assert/De-assert Response		0		3	mS
Over Temp Warning			10°C lower than OTP point		
GENERAL SPECIFICATIONS					
MTBF	I_o=80% of $I_{o,max}$; T_a=25°C	6.6			Mhours
Weight(OPEN FRAME)	Open frame		40.5		grams
Weight(HSP)	With heat spreader		47.5		grams
Weight(HSK)	With heat sink		60.0		grams
Over-Temperature Shutdown (Open Frame)	Refer to Figure 18 for Hot spot 1 location (54V_{in}, 80% I_o, 200LFM,Airflow from V_{in-} to V_{in+})		133		°C
Over-Temperature Shutdown (With Heat Spreader)	Refer to Figure 20 for Hot spot 2 location (54V_{in}, 80% I_o, 200LFM,Airflow from V_{in-} to V_{in+})		123		°C
Over-Temperature Shutdown (With 0.61" Heat Sink)	Refer to Figure 22 for Hot spot 3 location (54V_{in}, 80% I_o, 200LFM,Airflow from V_{in-} to V_{in+})		118		°C
Over-Temperature Shutdown (NTC Resistor)	Refer to Figure 18 for NTC resistor location	125	130	135	°C
Note: Please attach thermocouple on NTC resistor to test OTP function, the hot spots' temperature is just for reference.					

T_A=25°C

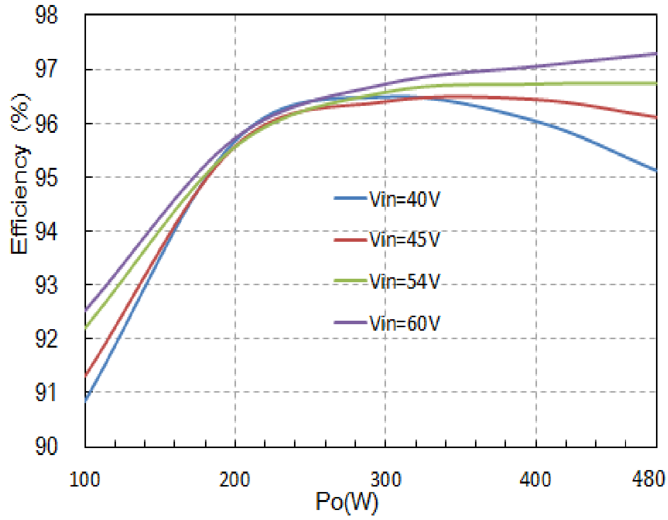


Figure 1: Efficiency vs. Output Power

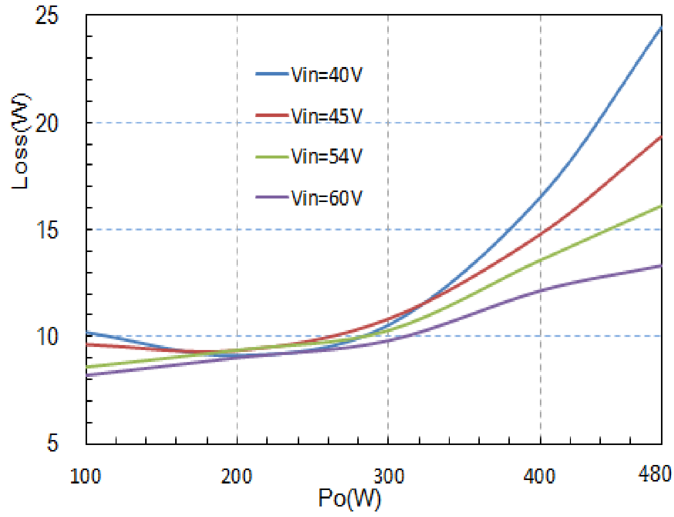


Figure 2: Loss vs. Output Power

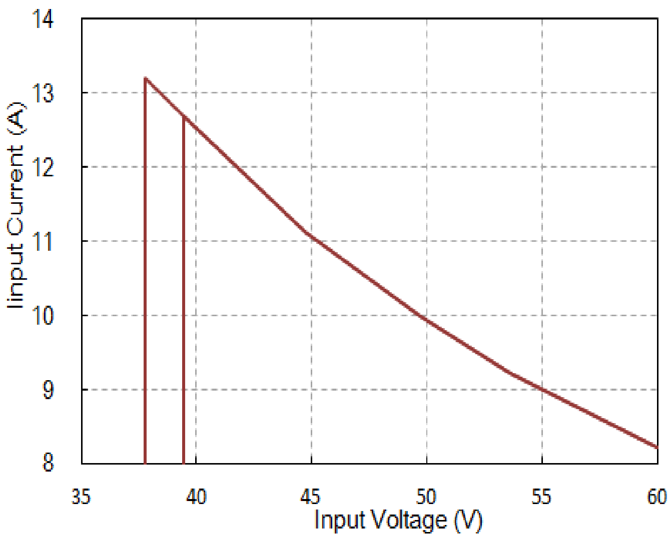


Figure 3: Full Load Input Characteristics

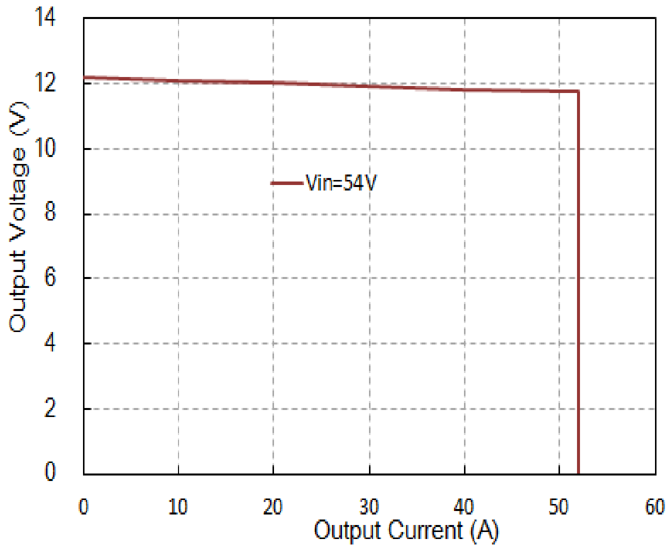


Figure 4: Output Voltage vs. Output Current showing typical current limit curves and converter shutdown points.

T_A=25°C,

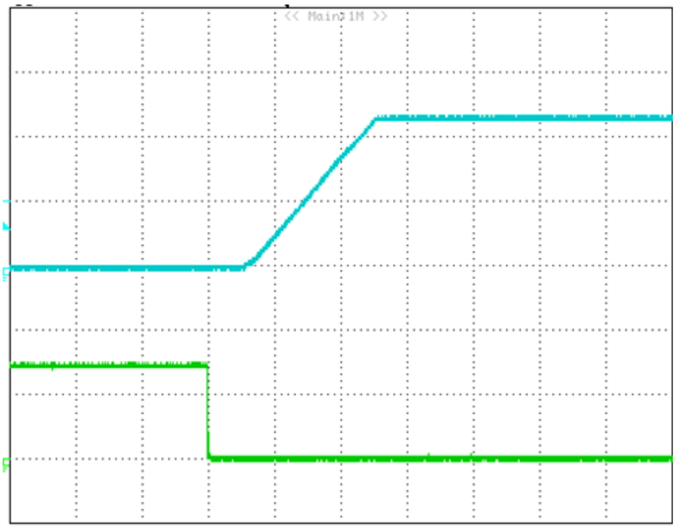


Figure 5: Remote On/Off (negative logic) at full load
Vin=54V, I_{out} =40.7A
Time: 5ms/div.
V_{out} (top trace): 5V/div;
$V_{remote\ On/Off\ signal}$ (bottom trace): 2V/div.

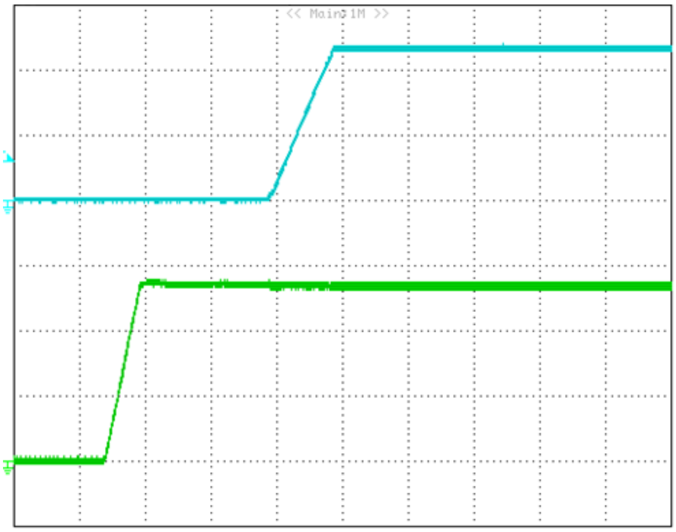


Figure 6: Input Voltage Start-up at full load
Vin=54V, I_{out} =40.7A
Time: 10ms/div.
V_{out} (top trace): 5V/div;
V_{in} (bottom trace): 20V/div.

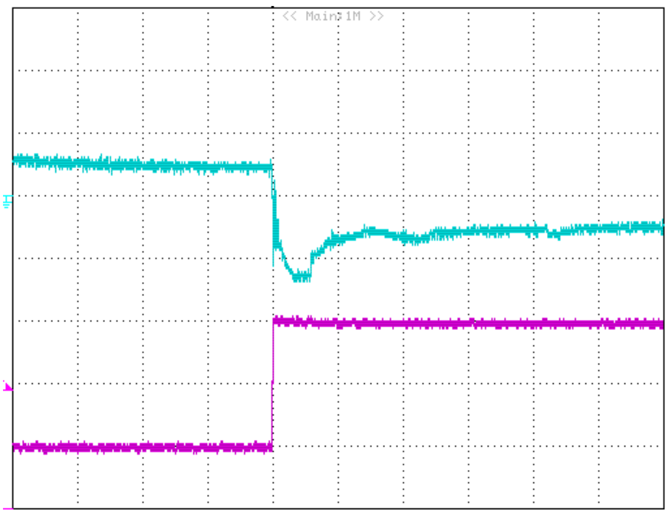


Figure 7: Transient Response
(Vin=54V, 560μF AL & 1μF Ceramic load cap,1.6A/μs step change in load from 25% to 75% of $I_{o,\ max}$)
V_{out} (top trace): 0.2 V/div, 1000us/div;
I_{out} (bottom trace): 10A/div.
Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module

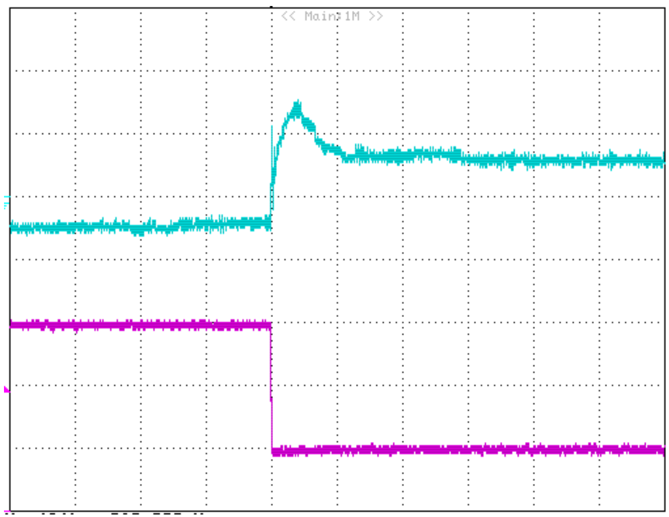


Figure 8: Transient Response
(Vin=54V, 560μF AL & 1μF Ceramic load cap ,1.6A/μs step change in load from 75% to 25% of $I_{o,\ max}$)
V_{out} (top trace):0.2V/div, 1000us/div;
I_{out} (bottom trace): 10A/div.
Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module

T_A=25°C

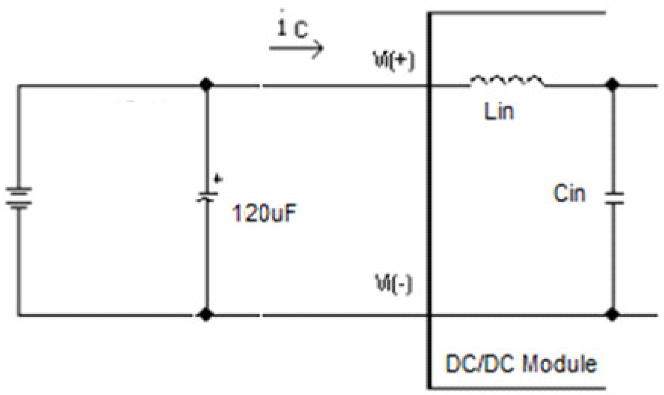


Figure 9: Test Setup Diagram for Input Ripple Current
Note: Measured input ripple current with a simulated source, with 100uF AL cap and 20μF ceramic cap. Measure current as shown above.

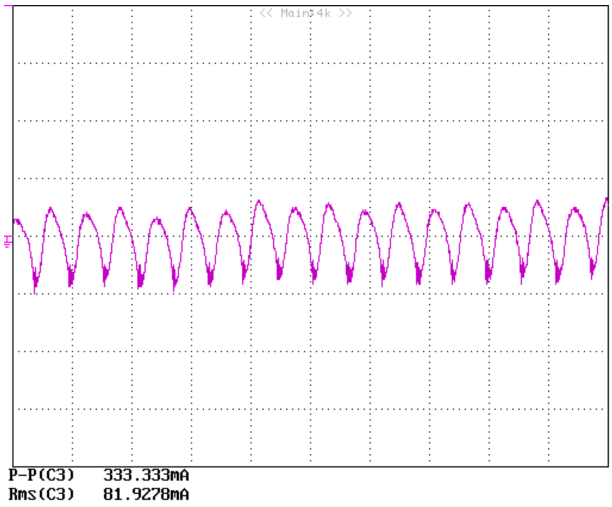


Figure 10: Input Ripple Current, i_c, at max output current and nominal input voltage with 100uF AL cap and 20μF ceramic cap. (200 mA/div, 2us/div).

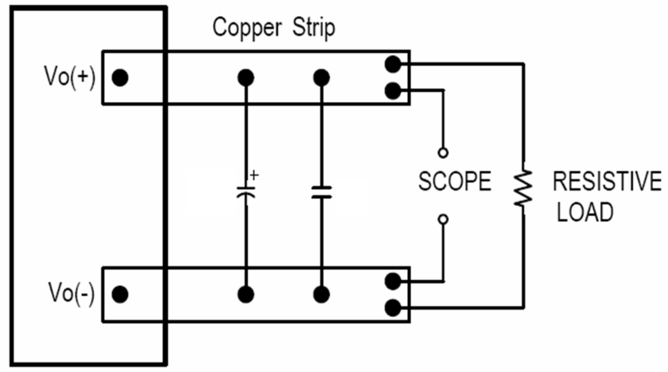


Figure 11: Test Setup for Output Voltage Noise and Ripple

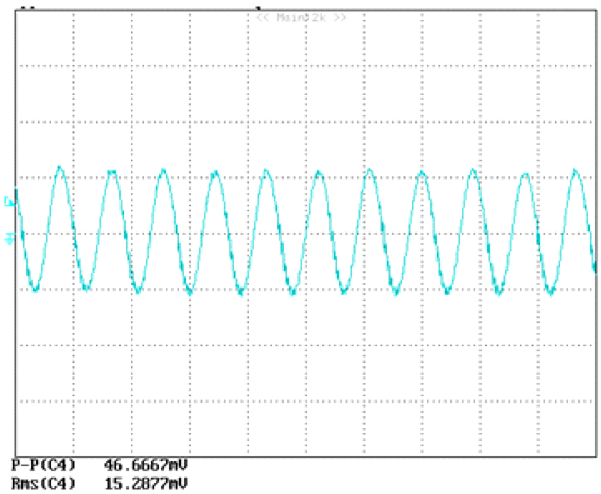


Figure 12: Output Voltage Ripple and Noise at nominal input voltage and max load current (20 mV/div, 2us/div)
Load cap: 500uF, 50% ceramic, 50% Oscon.
Bandwidth: 20MHz.

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. A low ESR electrolytic capacitor higher than 100µF (ESR < 0.7Ω at 100kHz) is suggested.

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.

Schematic and Components List
CX1, CX2, CX3, CX4, CX5 is 1000nF ceramic caps;
Cin1 is 100nF ceramic cap;
CY1, CY2, CY3, CY4 is 0.22uF ceramic caps;
Cin2 is 100uF Aluminum cap;
L1.L2 is common-mode inductor, L1, L2=473uH.

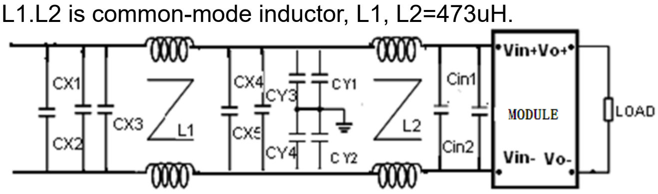


Figure 13-1: Recommended Input Filter

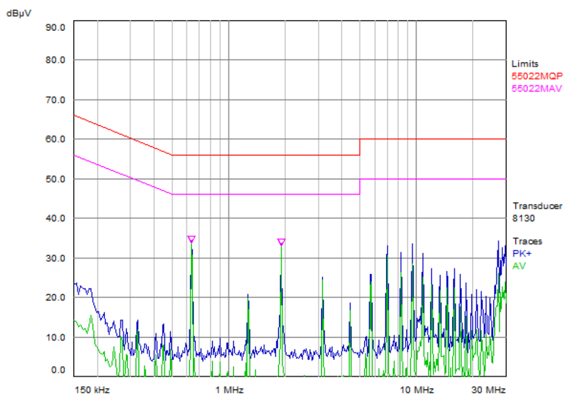


Figure 13-2: Test Result of EMC(V_{in}=54V, I_o=40.7A).

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., UL 60950-1, 2nd Edition, 2014-10-14, CSA C22.2 No. 60950-1-07, 2nd Edition, 2014-10, IEC 60950-1: 2005 + A1: 2009 + A2: 2013 and EN 60950-1: 2006 + A11: 2009 + A1: 2010 + A12: 2011 + A2: 2013, if the system in which the power module is to be used must meet safety agency requirements.

Both the input and output of this product meet SELV requirement. This module has function insulation with 707Vdc isolation. The input source must be insulated from the ac mains by reinforced or double insulation. The input terminals of the module are not considered as operator accessible.

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 15A 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.

Remote On/Off

The remote on/off feature on the module is a default negative logic. Negative logic turns the module on during a logic low and off during a logic high.

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 a negative logic on/off model, please short the on/off pin to Vi (-) if the remote on/off feature is not used.

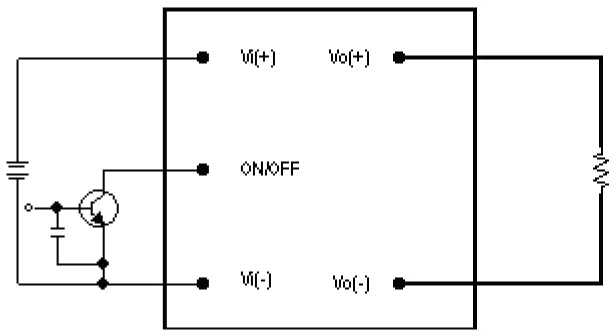


Figure 14: Remote On/Off Implementation

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 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 input over-voltage protection circuit, which monitors the voltage on the input terminals. If this voltage exceeds the over-voltage set point, the protection circuit will shut down, and then restart with a time delay after the fault no long exists.

Over-Temperature Protection

The over-temperature protection provides a 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.

Power Good Function

There is an optional Power Good function. An additional pin is used to provide a Power good signal.
The default is a positive logic. When the output voltage is within the specified range, the Power-good will provide an open drain output; otherwise it is pulled down to a low level voltage. An external pull up resistor is needed for this positive logic Power Good function.

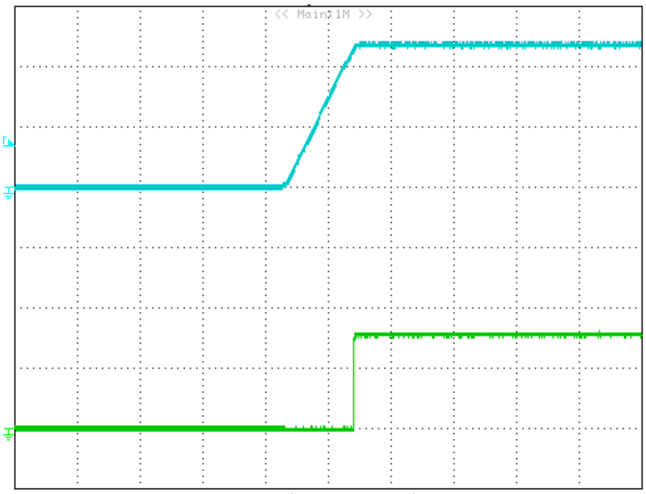


Figure 15: *Typical Power Good Waveform (Positive Logic).*
Vin=54V, I_{out} =40.7A
Time: 10ms/div.
V_{out} (top trace): 5V/div;
P-Good (bottom trace): 2V/div.

Parallel and Droop Current Sharing

The modules are capable of operating in parallel, and realizing current sharing by droop current sharing method. There is about 500mV output voltage droop from 0A to full output Load, and there is no current sharing pin. By connecting the Vin pin and the Vo pin of the parallel module together, the current sharing can be realized automatically.

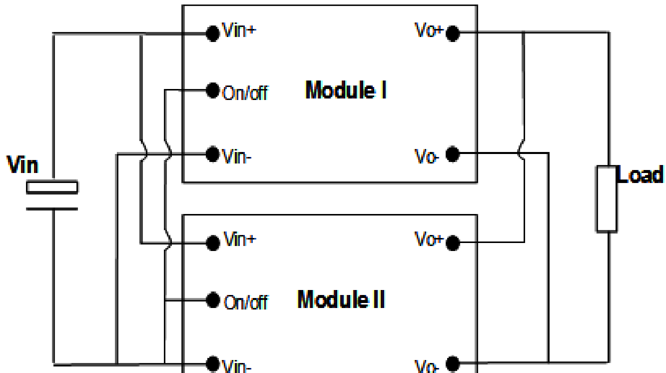


Figure 16: *Parallel and droop current sharing configuration for no redundancy requirement system*

If system has no redundancy requirement, the module can be parallel directly for higher power without adding external oring-fet; whereas, if the redundancy function is required, the external oring-fet should be added.

For a normal parallel operation the following precautions must be observed:

1. The current sharing accuracy equation is:
   X% = | Io1–Io2 | / Irated, Where,
   Io1 is the output current of module1;
   Io2 is the output current of module2
   Irated is the rated full load current of per module.

2. To ensure a better steady current sharing accuracy, below design guideline should be followed:
   a) The inputs of the converters must be connected to the same voltage source; and the PCB trace resistance from Input voltage source to Vin+ and Vin- of each converter should be equalized as much as possible.
   b) The PCB trace resistance from each converter's output to the load should be equalized as much as possible.
   c) For accurate current sharing accuracy test, the module should be soldered in order to avoid the unbalance of the touch resistance between the modules to the test board.

3. To ensure the parallel module can start up monotonically without trigging the OCP circuit, below design guideline should be followed:
   a) Before all the parallel modules finished start up, the total load current should be lower than the rated current of 1 module.
   b) The ON/OFF pin of the converters should be connected together to keep the parallel modules start up at the same time.
   c) The under voltage lockout point will slightly vary from unit to unit. The dv/dt of the rising edge of the input source voltage must be greater than 1V/ms to ensure that the parallel module start up at the same time.

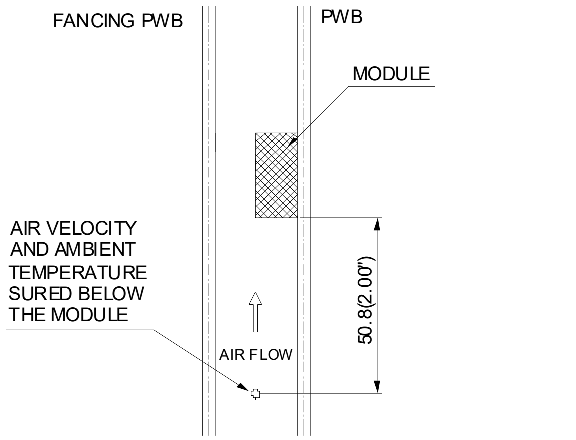
Thermal Testing Setup

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.

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 185mmX185mm,105μm (3Oz),6 layers 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 (open frame)

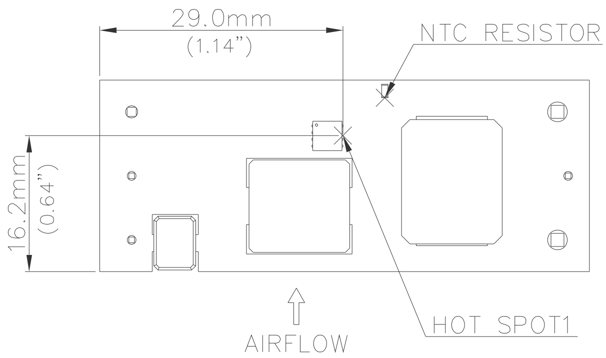


Figure 18: *Hot spot 1 temperature measurement location*
The allowed maximum hot spot 1 temperature is defined at 123℃.

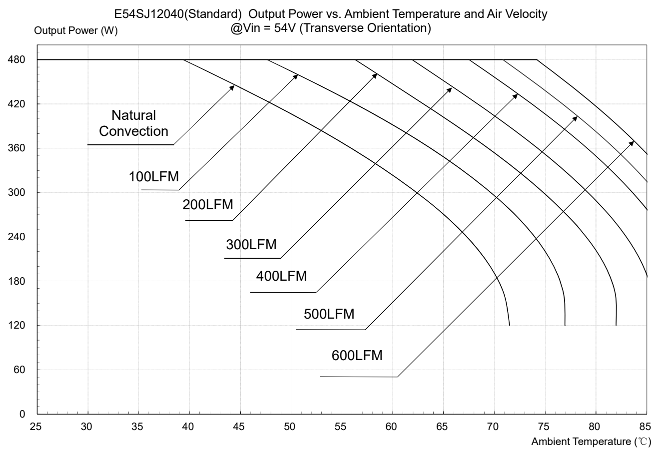


Figure 19: *Output Power vs. Ambient Temperature and Air Velocity @Vin = 54V (Transverse Orientation, Airflow from Vin- to Vin+, Open Frame)*

THERTHERMAL CONSIDERATIONS

Thermal Curves (with heat spreader)

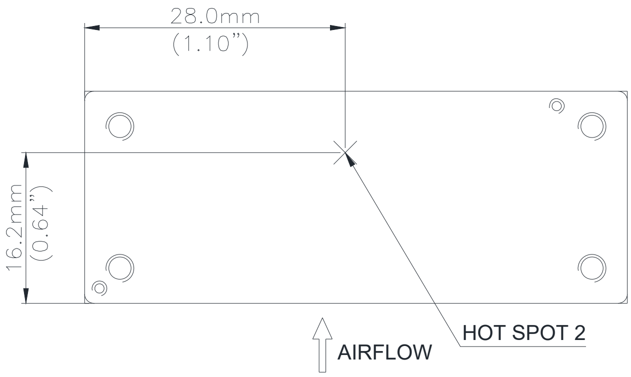


Figure 20: *Hot spot 2 temperature measurement location The allowed maximum hot spot 2 temperature is defined at 113℃.*

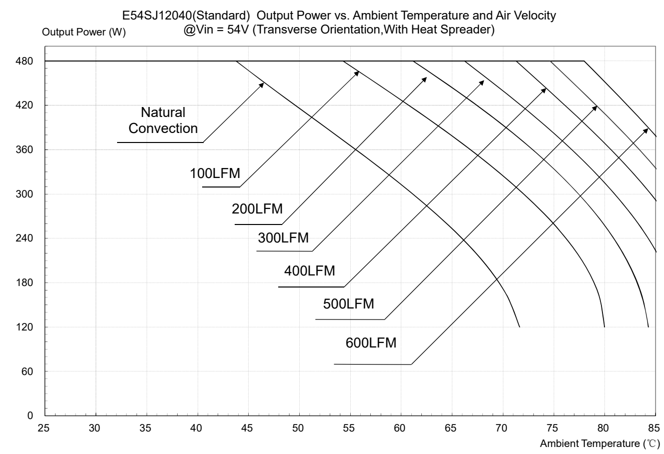


Figure 21: *Output Power vs. Ambient Temperature and Air Velocity @Vin = 54V (Transverse Orientation, Airflow from Vin- to Vin+, With Heat Spreader)*

Thermal Curves (with 0.61" pin fin heat sink)

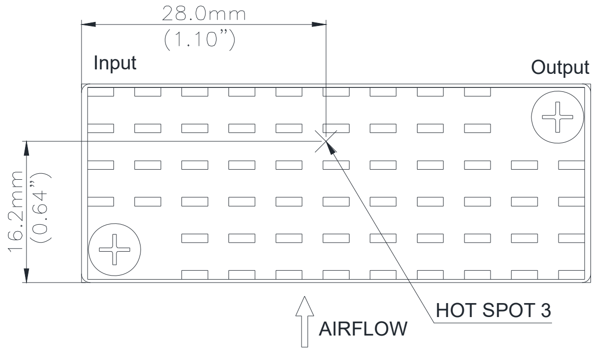


Figure 22: *Hot spot 3 temperature measurement location The allowed maximum hot spot 3 temperature is defined at 108℃.*

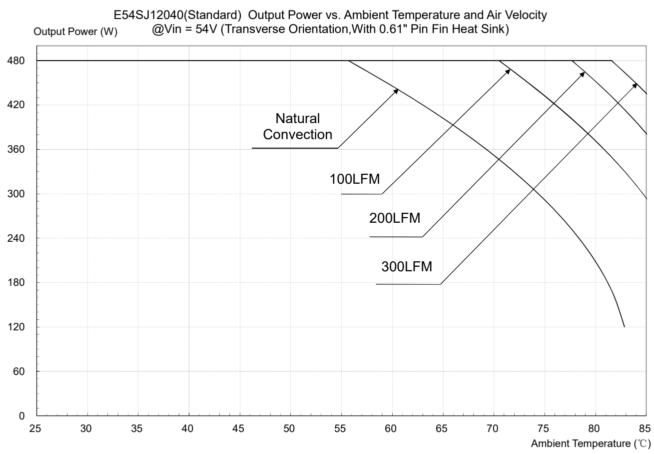
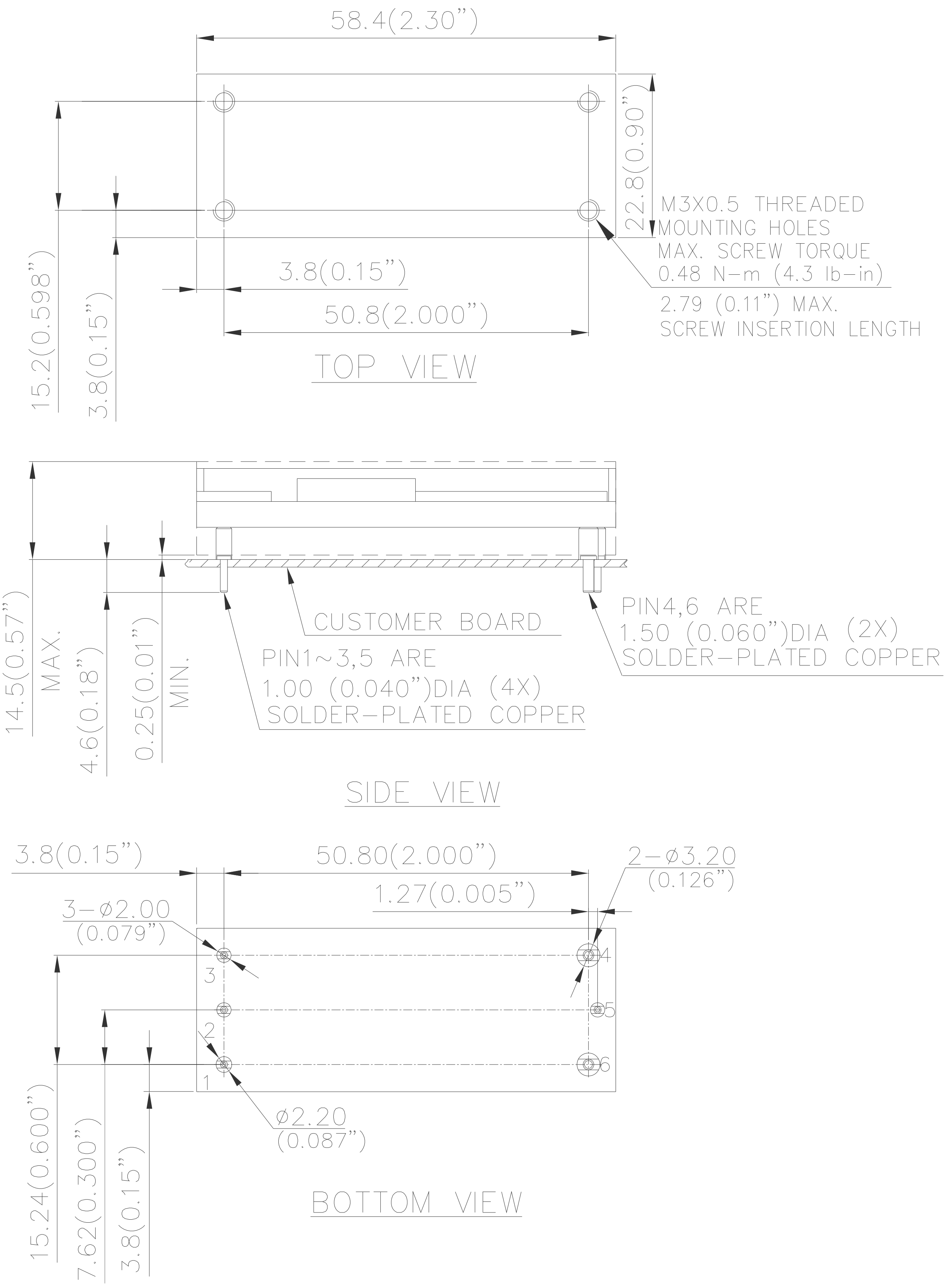
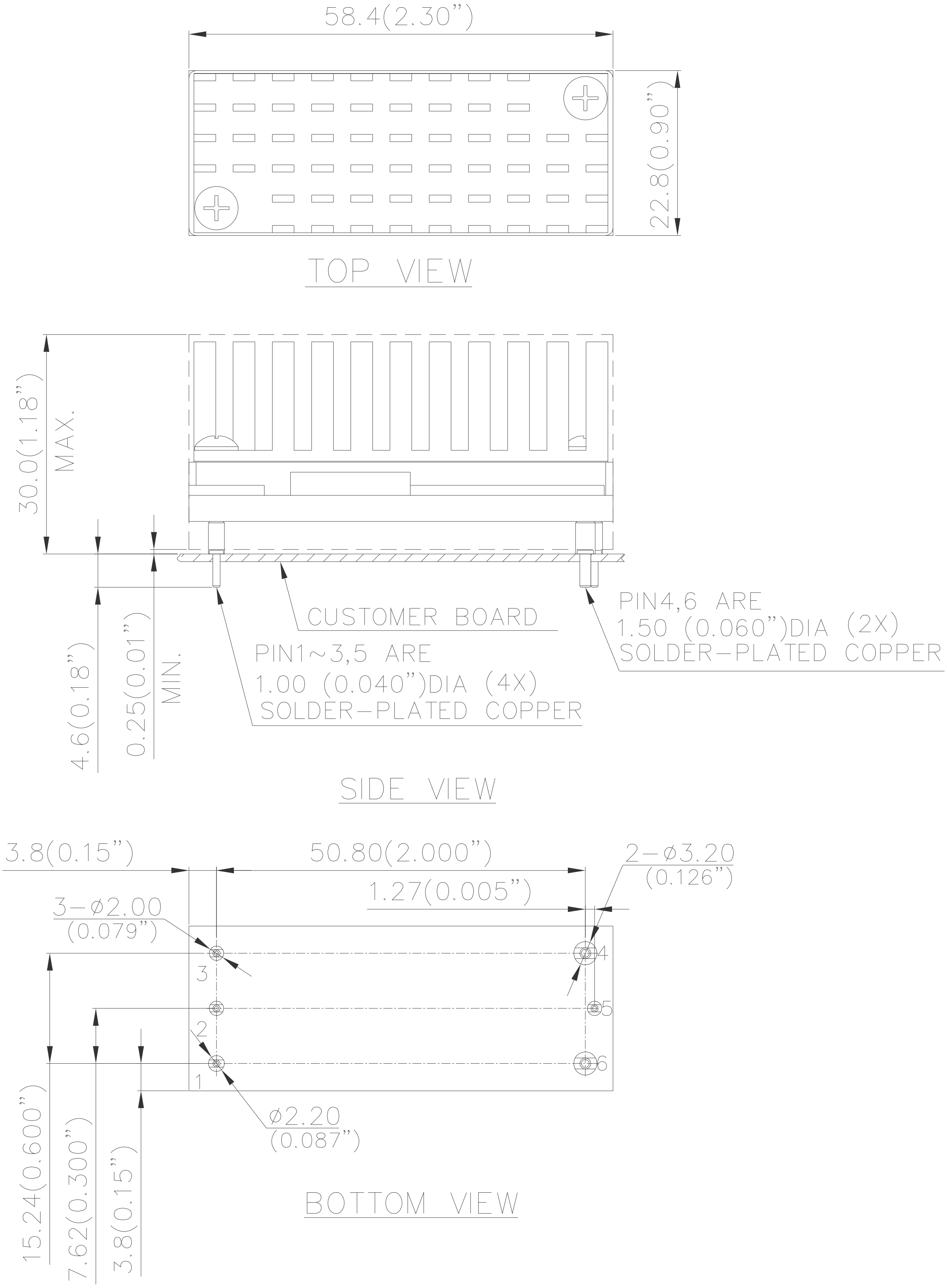


Figure 23: *Output Power vs. Ambient Temperature and Air Velocity @Vin = 54V (Transverse Orientation, Airflow from Vin- to Vin+, With 0.61" Height Pin Fin Heat Sink)*

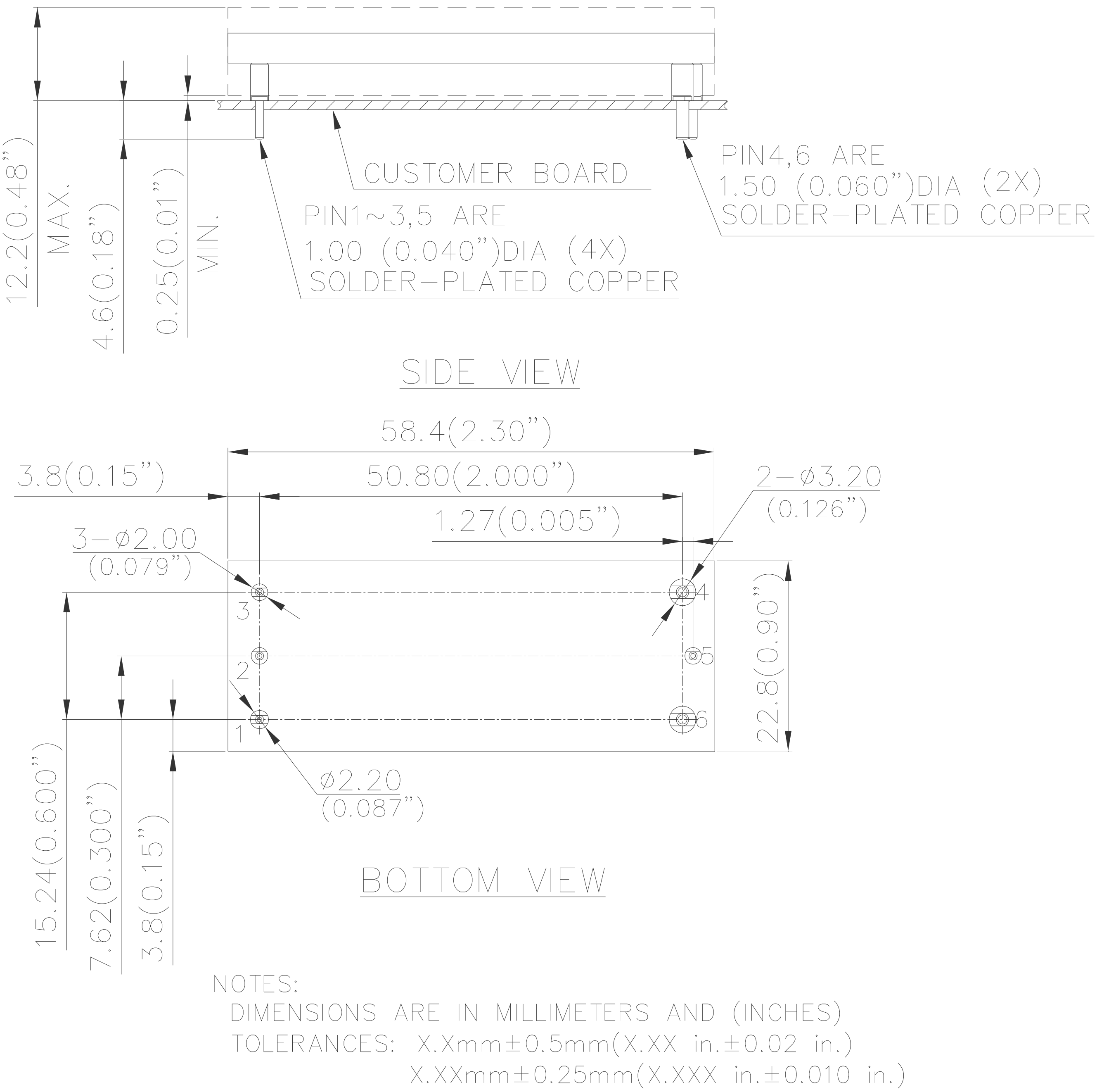
Mechanical Drawing (heat spreader)



Mechanical Drawing (With heat sink)



Mechanical Drawing (Open Frame)

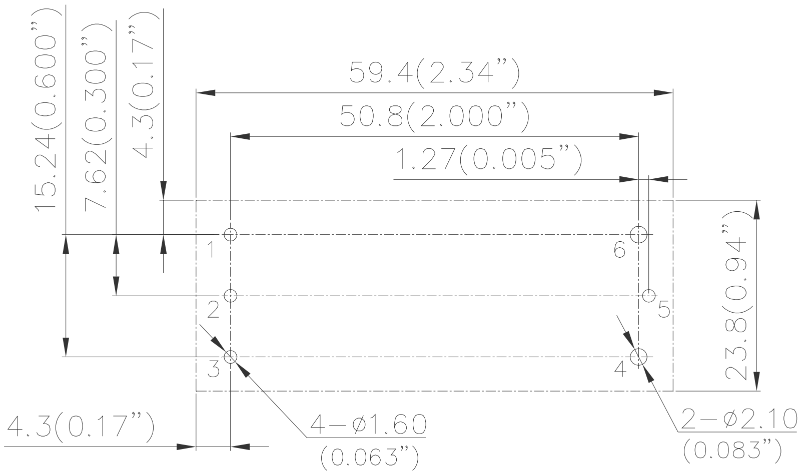


Pin No.	Name	Function
1	+Vin	Positive input voltage
2	ON/OFF	Remote ON/OFF
3	-Vin	Negative input voltage
4	-Vout	Negative output voltage
5	PGood	Power good sensor(optional)
6	+Vout	Positive output voltage

Pin Specification:

Pins 1,2,3,5	1.00mm (0.040”) diameter; copper with matte Tin plating and Nickel under plating
Pins 4,6	1.50mm (0.060”) diameter; copper with matte Tin plating and Nickel under plating

Recommended Layout



Pin#	Function
1	Vin+
2	ON/OFF
3	Vin−
4	Vout−
5	PGood
6	Vout+

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.)

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

PART NUMBERING SYSTEM

E	54	S	J	120	40	N	N	F	H
Type of Product	Input Voltage	Number of Outputs	Product Series	Output Voltage	Output Current	ON/OFF Logic	Pin Length /Type	Pin assignment	Option Code
E- Eight Brick	54 - 40~60V	S - Single	J - Series number	120 - 11.8V	40 - 40.7A	P - Positive N - Negative	C - 0.180” R - 0.170” N - 0.145” K - 0.110”	F - ROHS	A - Open; with PG B - Open; no PG H - HSP; with PG N - HSP; no PG F - HSK; with PG E - HSK; no PG

HSP: heat spreader version; HSK: heat sink
Default pin length 4.60mm(0.180”)

MODEL LIST

Model Name	Input		Output		Peak Eff.
E54SJ12040NNFH	40V~60V	13A	11.8V	40.7A	97.2%

Default remote On/Off logic is negative.
Please contact with Delta sales/FAE for different optional functions.

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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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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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