E54SJ05040

1/8 Brick DC/DC Regulated Power Module
40~60V in, 5V/40A out, 200W

The Delphi series E54SJ05040 , eighth brick, 40~60V input, single output 5V, 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 200 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 E54SJ05040 offers peak 96% high efficiency. The E54SJ05040 is fully protected from abnormal input/output voltage, current, and temperature conditions and meets 707V isolation.

FEATURES

Electrical

- Peak Efficiency up to 96%
- Input range: 40~60Vdc
- Over current protection
- Input UVP/OVP,
- Over Temperature Protection
- Remote ON/OFF
- Pre-bias startup
- No minimum load required
- PMBus Communication
- 707Vdc isolation

Mechanical

Size:

Open frame:

58.4x22.8x12.2mm (2.30”x0.90”x0.48”)

With base plate:

58.4x22.8x14.5mm (2.30”x0.90”x0.57”)

Safety & Reliability

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

OPTIONS

- Negative/Positive Remote on/off
- Analog/Digital option
- Open/with heat spreader

APPLICATIONS

- Optical Transport
- Data Networking
- Communications
- Servers

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

PARAMETER	NOTES and CONDITIONS	E54SJ05040			
		Min.	Typ.	Max.	Units
ABSOLUTE MAXIMUM RATINGS					
Input Voltage					Vdc
Continuous		0		60	Vdc
Transient	100mS			63	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		39		40	Vdc
Turn-Off Voltage Threshold		37			Vdc
Lockout Hysteresis Voltage		1			Vdc
Input Over-Voltage Protection			63		Vdc
Maximum Input Current	Full Load, 40V_{in}			6	A
No-Load Input Current	V_{in}=54V, I_o=0A		62		mA
Off Converter Input Current	V_{in}=54V		15		mA
Internal Input Filter	L + C Structure		0.22+6.6		μH+μF
Internal Input Ripple Current			60		mArms
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	Vin=54V, Io=Open Load, Tc=25°C	4.95	5	5.05	Vdc
Output Regulation					
Load Regulation	V_{in}=54V, I_o=I_o min to I_o max			0.4	%Vo,set
Line Regulation	V_{in}=40V to 60V, I_o=0			0.4	%Vo,set
Temperature Regulation	T_a=-20°C to 85°C			0.7	%Vo,set
Total Output Voltage Range	Over sample load, line and temperature	4.9		5.1	Vdc
Output Voltage Ripple and Noise	5Hz to 20MHz bandwidth				
Peak-to-Peak	Full Load, Co=800uF, 1μF ceramic, 10μF tantalum		50	100	mV
RMS	Full Load, Co=800uF, 1μF ceramic, 10μF tantalum		20	50	mV
Operating Output Current Range		0		40	A
Output Over Current Protection(hiccup mode)	when V_o<10%$V_{o.nom}$	44		56	A
Output Over Voltage Protection(hiccup mode)				5.5	V
DYNAMIC CHARACTERISTICS					
Output Voltage Current Transient	1500μF Oscon & 500uF ceramic, 1A/μs				
Positive Step Change in Output Current	75% $I_{o.max}$ to 50% $I_{o.max}$		150		mV
Negative Step Change in Output Current	50% $I_{o.max}$ to 75% $I_{o.max}$		150		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% $V_{o,nom}$	10		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		7	mS
Output Voltage Rise Time	V_o=10% to 90% $V_{o,nom}$	5		15	mS
Maximum Output Capacitance	25% ceramic, 75% Oscon or AL			2000	μF
EFFICIENCY					
100% Load			95.6		%
75% Load			96.0		%
ISOLATION CHARACTERISTICS					
Input to Output				707	Vdc
Isolation Capacitance			33		nF
FEATURE CHARACTERISTICS					
Switching Frequency	V_{in}=40~60V	330		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
GENERAL SPECIFICATIONS					
MTBF	I_o=80% of $I_{o,max}$; T_a=25°C	18.6			Mhours
Weight	Open frame		34.0		grams
Weight	With base-plate		46.0		grams
Over-Temperature Shutdown (Open Frame)	Refer to Figure 17 for Hot spot 1's location (54V_{in}, 80% I_o, 200LFM,Airflow from V_{in+} to V_{in-})		135		°C
Over-Temperature Shutdown (With Base-plate)	Refer to Figure 19 for Hot spot 2's location (54V_{in}, 80% I_o, 200LFM,Airflow from V_{in+} to V_{in-})		130		°C
Over-Temperature Shutdown (NTC Resistor)	Refer to Figure 17 for NTC Resistor's location		130		°C

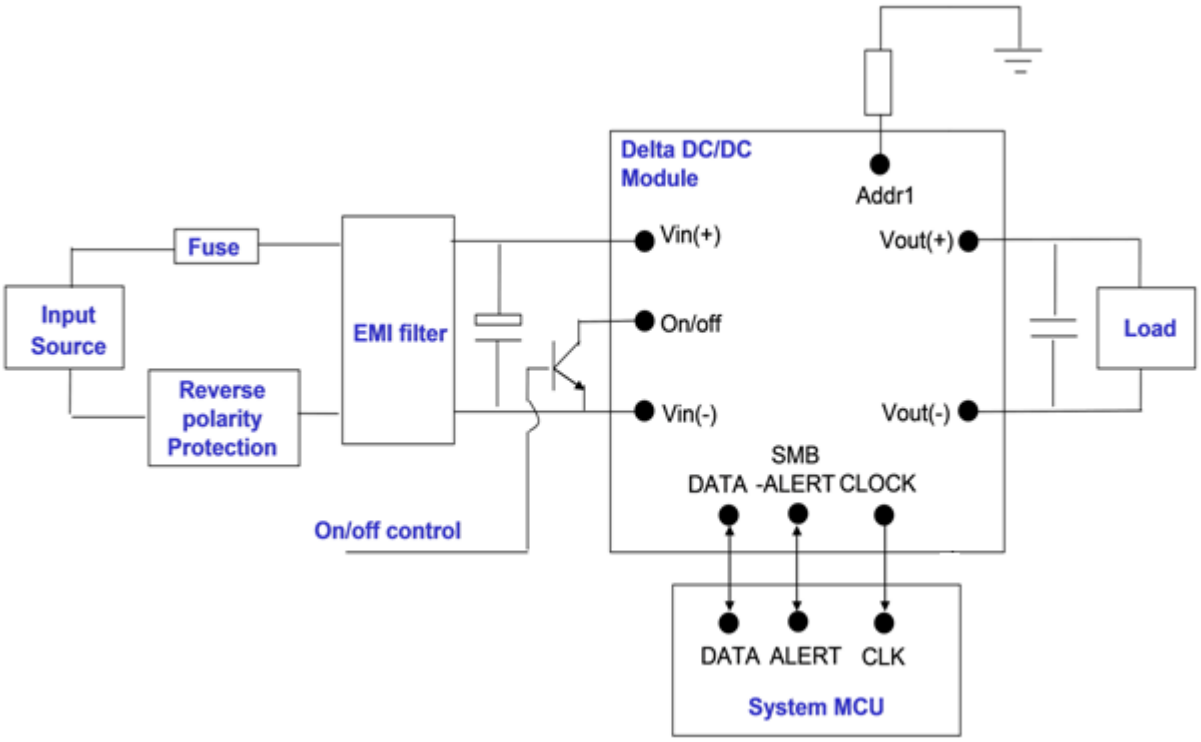
Note: Please attach thermocouple on NTC resistor to test OTP function, the hot spots' temperature is just for reference.

PARAMETER	NOTES and CONDITIONS	E54SJ05040			
		Min.	Typ.	Max.	Units
PMBUS SIGNAL INTERFACE CHARACTERISTICS					
Logic Input Low (V_{IL})	Data, SMBAlert, Clock pin	0		0.8	V
Logic Input High (V_{IH})	Data, SMBAlert, Clock pin	2.1		3.3	V
Logic Output Low (V_{OL})	Data, SMBAlert, Clock pin; IOL=6mA			0.4	V
Logic Output High (V_{OH})	Data, SMBAlert, Clock pin; IOH=-6mA	2.6			V
PMBus Operating Frequency Range			100/400		KHz
PMBUS MONITORING CHARACTERISTICS					
Output Current Reading Accuracy	Vin=54V, Io=50% ~ 100% of Io, max;	-5		+5	%
	Vin=54V, Io=5% ~ 50% of Io, max;	-2		+2	A
Output Voltage Reading Accuracy		-2		+2	%
Input Voltage Reading Accuracy		-4		+4	%
Temperature Reading Accuracy		-5		+5	℃

PIN DEFINATION

Pin#	Name	Function	Pin#	Name	Function
1	VIN(+)		6	Data	PMBus data line
2	ON/OFF	Primary on/off control pin	7	SMBAlert	
3	VIN(-)		8	Clock	PMBus clock line
4	VOUT(-)		9	Addr1	ADDR1 pin sets the high order digit of the address.
5	VOUT(+)				

SIMPLIFIED APPLICATION CIRCUIT



T_A=25°C

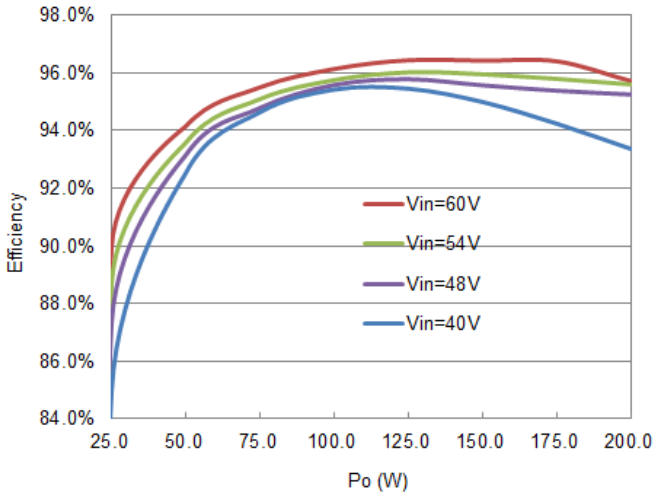


Figure 1: Efficiency vs. Output Power

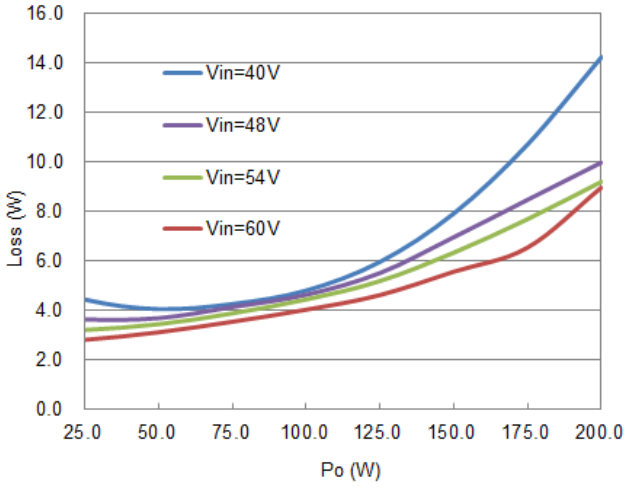


Figure 2: Loss vs. Output Power

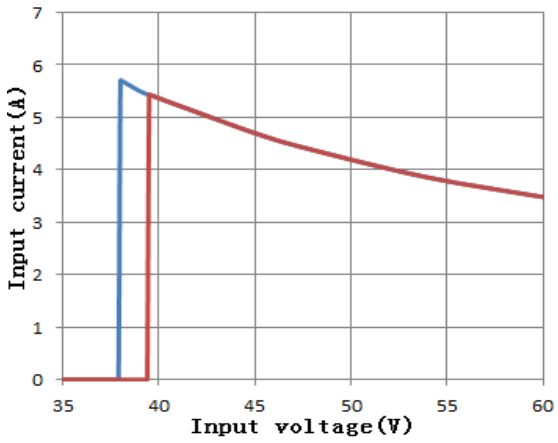


Figure 3: Typical full load input characteristics at room temperature.

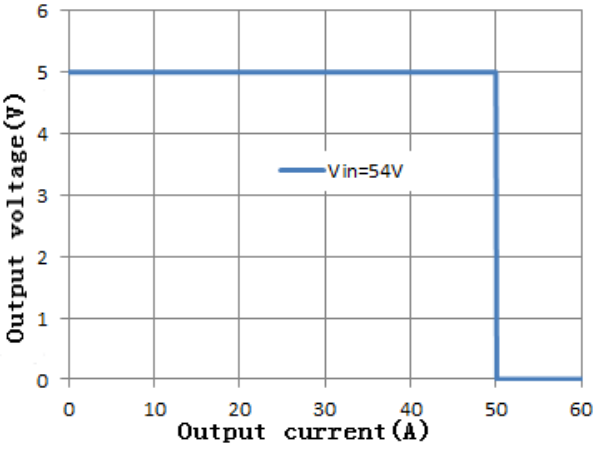


Figure 4: Output Voltage vs. Output Current showing typical current limit curves and converter shutdown points.

T_A=25°C,

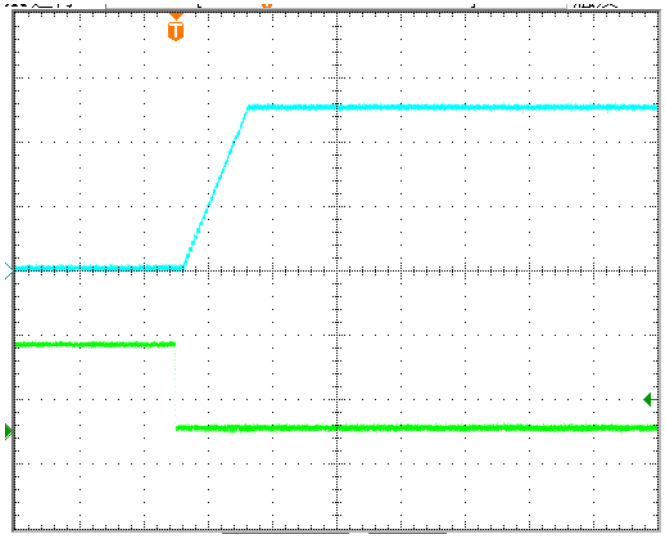


Figure 5: Remote On/Off (negative logic) at full load
Vin=54V, I_{out} =40A
Time: 10ms/div.
V_{out} (top trace): 2V/div;
$V_{remote\ On/Off\ signal}$ (bottom trace): 2V/div.

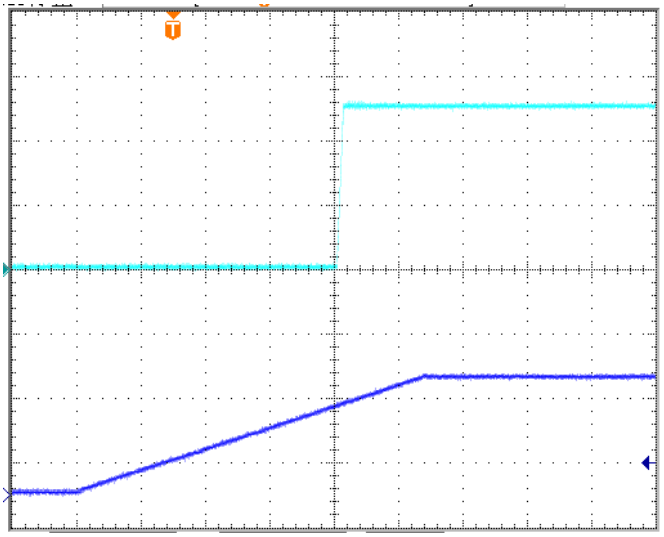


Figure 6: Input Voltage Start-up at full load
Vin=54V, I_{out} =40A
Time: 100ms/div.
V_{out} (top trace): 2V/div;
V_{in} (bottom trace): 30V/div.

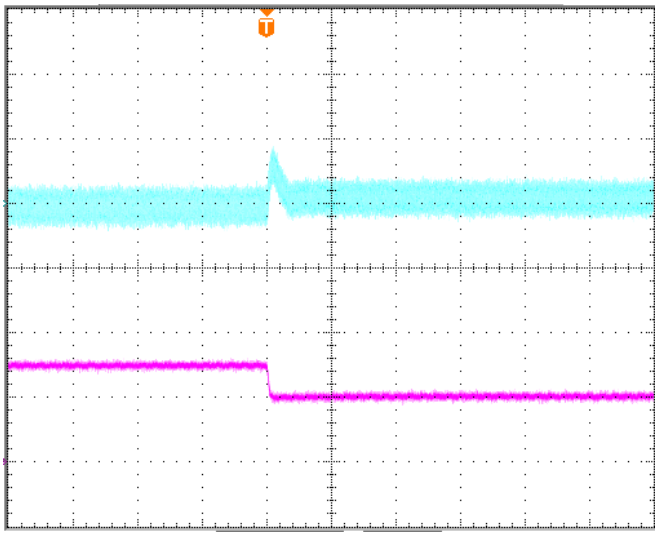


Figure 7: Transient Response
(Vin=54V, 1A/μs step change in load from 50% to 75% of $I_{o,\ max}$)
V_{out} (top trace): 0.1 V/div, 200us/div;
I_{out} (bottom trace): 20A/div.
Load cap: 33uF/16V/X7R/1812*18pcs ceramic cap + 470uF/16V*3pcs Oscon cap. *Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module*

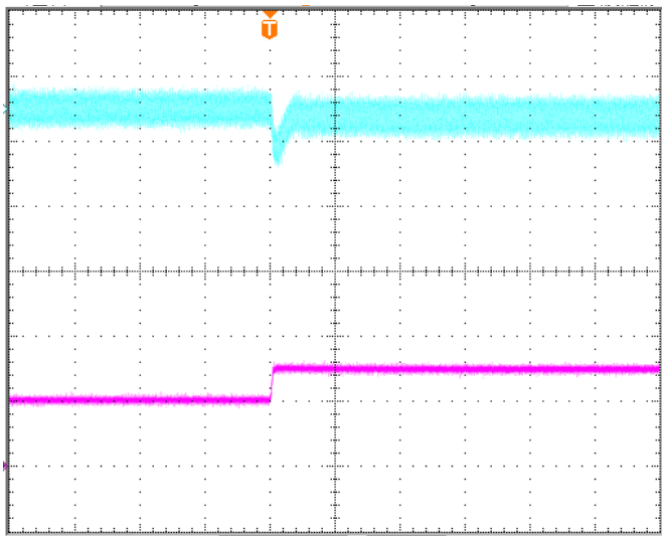


Figure 8: Transient Response
(Vin=54V, 1A/μs step change in load from 75% to 50% of $I_{o,\ max}$)
V_{out} (top trace):0.1V/div, 200us/div;
I_{out} (bottom trace): 20A/div.
Load cap: 33uF/16V/X7R/1812*18pcs ceramic cap + 470uF/16V*3pcs Oscon cap. *Scope measurement should be made using a BNC cable (length 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, V_{in}=54Vdc

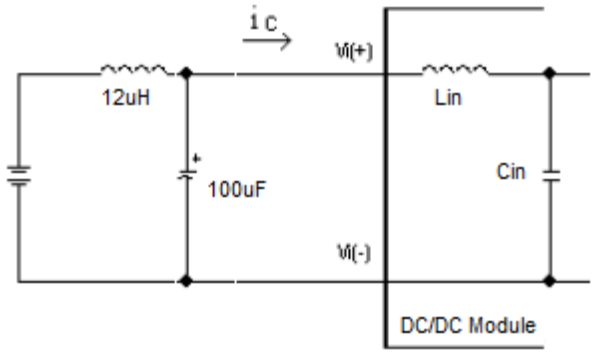


Figure 9: Test Setup Diagram for Input Ripple Current
Note: Measured input reflected-ripple current with a simulated source Inductance of 12µH. Measure current as shown above.

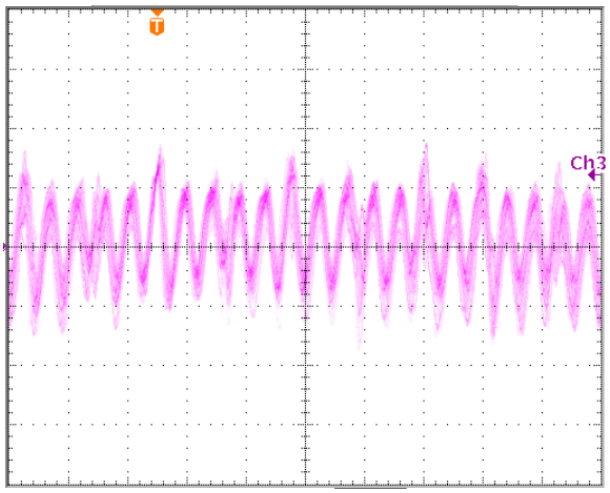


Figure 10: Input Terminal Ripple Current, i_c, at max output current and nominal input voltage with 12µH source impedance and 100µF electrolytic capacitor (100 mA/div, 2us/div).

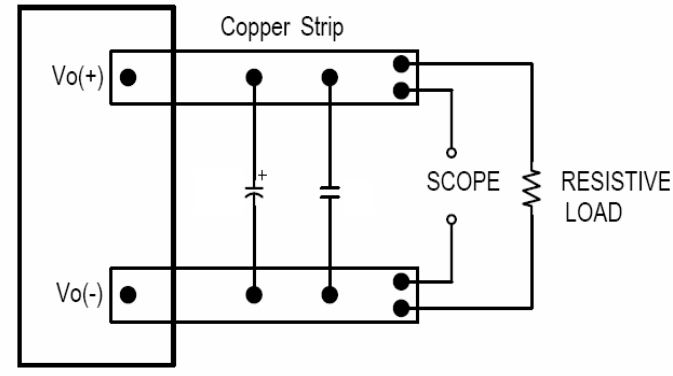


Figure 11: Test Setup for Output Voltage Noise and Ripple

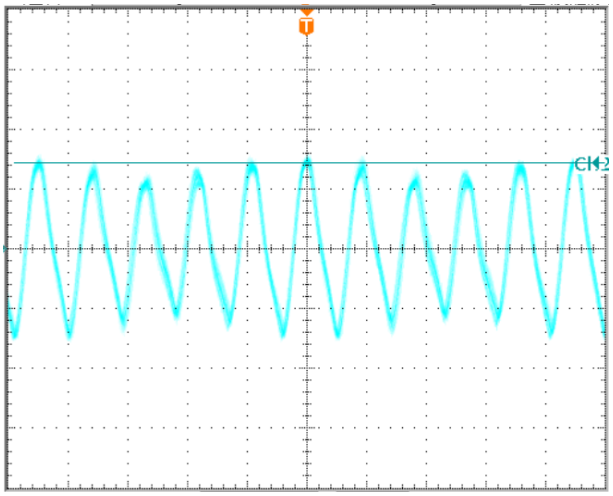


Figure 12: Output Voltage Ripple and Noise at nominal input voltage and max load current (20 mV/div, 2us/div)
Load cap: 800uF, 50% ceramic, 50% Oscon.
Bandwidth: 20MHz.

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
Cin is 100uF low ESR Aluminum cap×3pcs in parallel;
CX1 is 2.2uF ceramic cap×3pcs in parallel;
CY1 and CY2 are 220nF ceramic cap;
CX2 is 2.2uF ceramic cap×3pcs in parallel;
Cin is 100uF;
L1 is 0.47mH;
L2 is 0.47mH;

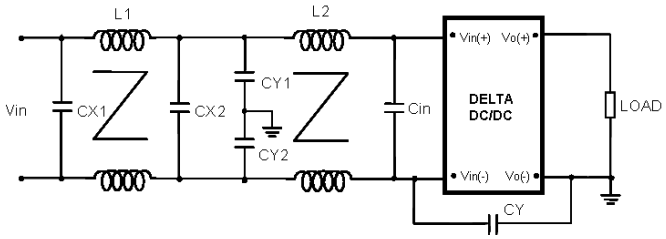


Figure 13-1: Recommended Input Filter

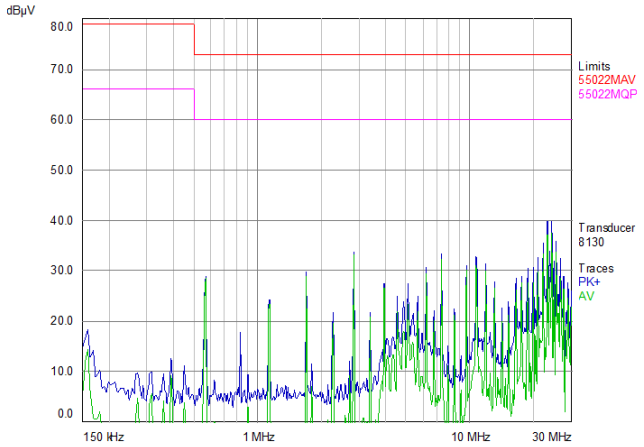


Figure 13-2: Test Result of EMC(V_{in}=54V, I_o=40A).

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, CSA C22.2 NO. 60950-1 2nd and IEC 60950-1 2nd: 2005 and EN 60950-1 2nd: 2006+A11+A1: 2010, 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.

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.

Remote On/Off

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

The DC level on/off signal is suggested.

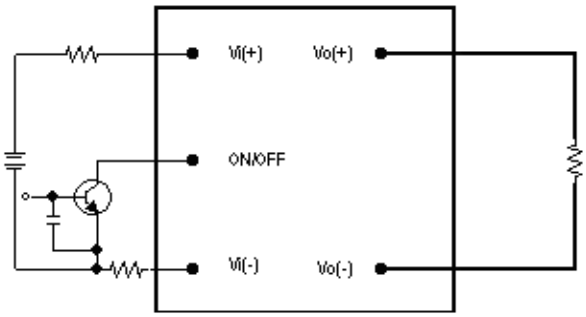


Figure 14: Remote On/Off Implementation

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 exist.

Over-Temperature Protection

The over-temperature protection consists of circuitry that provides protection from thermal damage. If the temperature exceeds the over-temperature threshold the module will shut down. The module will restart after the temperature is within specification.

PMBus Communication

The module has a digital PMBus interface to allow the module to be monitored, controlled and configured by the system. The module supports 3 PMBus signal lines, Data, Clock, SMBALERT (optional), and 1 Address line Addr1. More detail PMBus information can be found in the PMB Power Management Protocol Specification, Part I and part II, revision 1.2; which is shown in http://pmbus.org . Both 100kHz and 400kHz bus speeds are supported by the module. Connection for the PMBus interface should be following the High Power DC specifications given in section 3.1.3 in the SMBus specification V2.0 or the Low Power DC specifications in section 3.1.2. The complete SMBus specification is shown in http://smbus.org.

The module supports the Packet Error Checking (PEC) protocol. It can check the PEC byte provided by the PMBus master, and include a PEC byte in all message responses to the master.

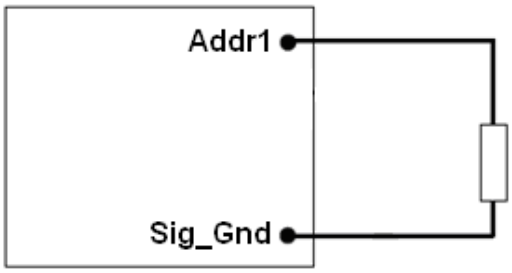
SMBALERT protocol is also supported by the module. SMBALERT line is also a wired-AND signal; by which the module can alert the PMBUS master via pulling the SMBALERT pin to an active low. There are two ways that the master and the module response to the alert of SMBALERT line.

One way is for the module used in a system that does not support Alert Response Address (ARA). The module is to retain its resistor programmed address, when it is in an ALERT active condition. The master will communicate with the slave module using the programmed address, and using the various READ_STATUS commands to find who cause for the SMBALERT. The CLEAR_FAULTS command will clear the SMBALERT.

The module contains a data flash used to store configuration settings, which will not be programmed into the device data flash automatically. The STORE_DEFAULT_ALL command must be used to commit the current settings are transfer from RAM to data flash as device defaults

PMBUS Addressing

The Module has flexible PMBUS addressing capability. When connect different resistor from Addr1 pin to GND pin, 14 possible addresses can be acquired.



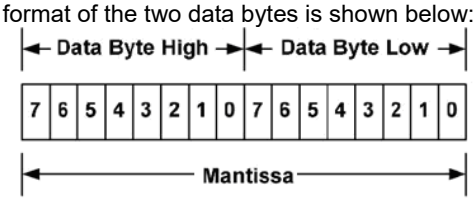
Different PMBUS address is defined by the value of the resistor as below, and +/-1% resistors accuracy can be accepted. If there is any resistance exceeding the requested range, address 127 will be return..

PMBUS address	Resistor(Kohm)
96	10
97	15
98	21
99	28
100	35.7
101	45.3
102	56.2
103	69.8
104	88.7
105	107
106	130
107	158
108	191
109	232

PMBus Data Format

The module receives and report date in LINEAR format. The Exponent of the data words is fixed at a reasonable value for the command; altering the exponent is not supported. DIRECT format is not supported by the module.

For commands that set or report any voltage thresholds related to the output voltage, the module supports the linear data format consisting of a two byte value with a 16-bit, unsigned mantissa, and a fixed exponent of -12. The format of the two data bytes is shown below:



The equation can be written as:
Vout = Mantissa x 2^{-12}
For example, considering set Vout to 12V by VOUT_COMMAND, the read/write data can be calculated refer to below process:

1. Mantissa =Vout/2^{-12}= 12/2^{-12}=49152;
2. Converter the calculated Mantissa to hexadecimal 0xC000.

For example, considering set the turn on threshold of input under voltage lockout to 34V by VIN_ON command; the read/write data can be calculated refer to below process:

1. Get the exponent of Vin, -3; whose binary is 11101
2. Mantissa =Vin/2^{-3}=34/2^{-3}=272;
3. Converter the calculated Mantissa to hexadecimal 110, then converter to binary 00100010000;
4. Combine the exponent and the mantissa, 11101 and 00100010000;
5. Converter binary 1110100100010000 to hexadecimal E910.

The detail exponent and resolution of main parameter is summarized as below:

	Exponent	Resolution
Vin	-3	0.125V
Vo	-12	0.244mV
Io	-3	125mA
Temperature	-2	/
Switching frequency	1	2Khz
Time	-1	0.5ms

Supported PMBus Commands

The main PMBus commands described in the PMBus 1.2 specification are supported by the module. Partial PMBus commands are fully supported; Partial PMBus commands have difference with the definition in PMBus 1.2 specification. All the supported PMBus commands are detail summarized in below table. To ensure PMBus module initialization successfully, PMBus commands must be sent after 20ms when input voltage achieving startup condition.

Command	Code	Description	Type	Compatible with standard PMBUS or not?	Data Format	Default value	Range limit	Data units	Expon-ent	Note
OPERATION	0x01	Turn the module on or off by PMBUS command	R/W byte	Refer to below description	Bit field	0x80	/	/	/	/
ON_OFF_CONFIG	0x02	Configures the combination of primary on/off pin and PMBUS command	R/W byte	Refer to below description	Bit field	0x1D (Neg Logic); 0x1F (Pos Logic);	/	/	/	/
CLEAR_FAULTS	0x03	Clear any fault bits that have been set	Send byte	Yes	/	/	/	/	/	/
STORE_DEFAULT_ALL	0x11	Stores operating parameters from RAM to data flash	Send byte	Yes	/	/	/	/	/	The FLASH must be unlocked (referring to Command 0xEC) before sending this command. This command is effective to the parameter of all command in the table except 0xEC
RESTORE_DEFAULT_ALL	0x12	Restores operating parameters from data flash to RAM	Send byte	Yes	/	/	/	/	/	This command can't be issued when the power unit is running.
VOUT_MODE	0x20	To read Vo data format	Read byte	Yes	mode+exp	0x14	/	/	/	/
VOUT_COMMAND	0x21	Set the output voltage	R/W word	Yes	Vout Linear	5	4.9~5.05	Volts	-12	/
FREQUENCY_SWITCH	0x95	Set the switching frequency	Read word	Yes	Linear Data	NA	330 ~1100	KHz	1	/
VIN_ON	0x35	Set the turn on voltage threshold of Vin under voltage lockout	R/W word	Yes	Vin Linear	39	38~40	V	-3	VIN_ON should be higher than VIN_OFF, and keep 2V hystersis.
VIN_OFF	0x36	Set the turn off voltage threshold of Vin under voltage lockout	R/W word	Yes	Vin Linear	37	36~38	V	-3	VIN_ON should be higher than VIN_OFF, and keep 2V hystersis.
VOUT_OV_FAULT_LIMIT	0x40	Set the output overvoltage fault threshold.	R/W word	Yes	Vout Linear	5.4	5.2~5.5	V	-12	Must be higher than the value of VOUT_COMMAND and VOUT_OV_WARN_LIMIT
VOUT_OV_WARN_LIMIT	0x42	Set a threshold causing an output voltage high warning.	R/W word	Yes	Vout Linear	5.2	5.1~5.5	V	-12	Must be less than VOUT_OV_FAULT_LIMIT value
IOUT_OC_FAULT_LIMIT	0x46	Set the output overcurrent fault threshold.	R/W word	Yes	Iout Linear	50	44~56	A	-3	Must be greater than IOUT_OC_WARN_LIMIT value
IOUT_OC_WARN_LIMIT	0x4A	Set a threshold causing an output current high warning.	R/W word	Yes	Iout Linear	44	40~48	A	-3	Must be less than IOUT_OC_FAULT_LIMIT value
OT_FAULT_LIMIT	0x4F	Set the over temperature fault threshold.	R/W word	Yes	TEMP Linear	130	125~135	Deg. C	-2	Must be greater than OT_WARN_LIMIT value
OT_WARN_LIMIT	0x51	Set a threshold causing a temperature high warning.	R/W word	Yes	TEMP Linear	100	80~120	Deg. C	-2	Must be less than OT_FAULT_LIMIT value
VIN_OV_FAULT_LIMIT	0x55	Set the input overvoltage fault threshold.	R/W word	Yes	Vin Linear	63	62~64	V	-3	/
TON_DELAY	0x60	Sets the time from a start condition is received until the output voltage starts to rise	R/W word	Yes	Time Linear	22	18~26	ms	-1	/
TON_RISE	0x61	Sets the time from the output starts to rise until the voltage has entered the regulation band.	R/W word	Yes	Time Linear	10	5~15	ms	-1	/
STATUS_WORD	0x79	Returns the information with a summary of the module's fault/warning	Read word	Refer to below description	Bit field	/	/	/	/	/
STATUS_VOUT	0x7A	Returns the information of the module's output voltage related fault/warning	Read byte	Refer to below description	Bit field	/	/	/	/	/
STATUS_IOUT	0x7B	Returns the information of the module's output current related fault/warning	Read byte	Refer to below description	Bit field	/	/	/	/	/
STATUS_INPUT	0x7C	Returns the information of the module's input over voltage and under voltage fault	Read byte	Refer to below description	Bit field	/	/	/	/	/

Command	Code	Description	Type	Compatible with standard PMBUS or not?	Data Format	Default value	Range limit	Data units	Expon-ent	Note
STATUS_TEMPERATURE	0x7D	Returns the information of the module's temperature related fault/warning	Read byte	Refer to below description	Bit field	/	/	/	/	/
STATUS_CML	0x7E	Returns the information of the module's communication related faults.	Read byte	Refer to below description	Bit field	/	/	/	/	/
READ_VIN	0x88	Returns the input voltage of the module	Read word	Yes	Vin Linear	/	/	Volts	-3	/
READ_VOUT	0x8B	Returns the output voltage of the module	Read word	Yes	Vout Linear	/	/	Volts	-12	/
READ_IOUT	0x8C	Returns the output current of the module	Read word	Yes	Iout Linear	/	/	Amps	-3	/
READ_TEMPERATURE_1	0x8D	Returns the module's hot spot temperature of the module	Read word	Yes	TEMP Linear	/	/	Deg. C	-2	/
PMBUS_REVISION	0x98	Reads the revision of the PMBus	Read byte	Yes	Bit field	12	/	/	/	/
PMBUS_CMD_FLASH_KEY_WRITE	0xEC	Write the key to unlock the Flash before Storing operating parameters from RAM to data flash	R/W	No	/	0xA5A5A5A5		/	/	A data block:7E,15,DC,42 should be send to unlock the FLASH.

OPERATION [0x01]

Bit number	Purpose	Bit Value	Meaning	Default Settings， 0x80
7:	Enable/Disable the module	1	Output is enabled	1
		0	Output is disabled	
6:0	Reserved			0000000

ON_OFF_CONFIG [0x02]

Bit number	Purpose	Bit Value	Meaning	Default Settings， 0x1D (negative) /0x1F (positive)
7:5	Reserved			000
4	Controls how the unit responds to the primary on/off pin and the OPERATION command;	1	Module does not power up until commanded by the primary ON/OFF pin and the OPERATION	1
		0	Module power up at any time regardless of the state of the primary ON/OFF pin and the OPERATION	
3	Controls how the unit responds to the OPERATION command	1	Module responds to the 7 bit in the OPERATION	1
		0	Module ignores the 7 bit in the OPERATION	
2	Controls how the unit responds to the primary on/off pin	1	Module requires the primary ON/OFF pin to be asserted to start the unit	1
		0	Module ignores the state of the primary ON/OFF pin	
1	Control logic of primary on/off pin	1	Positive Logic	0, negative; 1, positive.
		0	Negative Logic	
0	Unit turn off delay time control	1	Shut down the module with 0 delay cycle	1

STATUS_WORD [0x79]

High byte

Bit number	Purpose	Bit Value	Meaning
7	An output over voltage fault or warning	1	Occurred
		0	No Occurred
6	An output over current fault or warning	1	Occurred
		0	No Occurred
5	An input voltage fault, including over voltage and undervoltage	1	Occurred
		0	No Occurred
4	Reserved		
3	Power_Good	1	is negated
		0	ok
2:0	Reserved		

Low byte

Bit number	Purpose	Bit Value	Meaning
7	Reserved		
6	OFF (The unit is not providing power to the output, regardless of the reason)	1	Occurred
		0	No Occurred
5	An output over voltage fault	1	Occurred
		0	No Occurred
4	An output over current fault	1	Occurred
		0	No Occurred
3	An input under voltage fault	1	Occurred
		0	No Occurred
2	A temperature fault or warning	1	Occurred
		0	No Occurred
1	CML (A communications, memory or logic fault)	1	Occurred ;
		0	No Occurred
0	Reserved		

STATUS_VOUT [0x7A]

Bit number	Purpose	Bit Value	Meaning
7	Output over voltage fault	1	Occurred ;
		0	No Occurred
6	Output over voltage warning	1	Occurred ;
		0	No Occurred
5:0	Reserved		

STATUS_IOUT [0x7B]

Bit number	Purpose	Bit Value	Meaning
7	Output over current fault	1	Occurred ;
		0	No Occurred
6	Reserved		
5	Output over current warning	1	Occurred ;
		0	No Occurred
4:0	Reserved		

STATUS_INPUT [0x7C]

Bit number	Purpose	Bit Value	Meaning
7	Input over voltage fault	1	Occurred ;
		0	No Occurred
6: 5	Reserved		
4	Input under voltage fault	1	Occurred ;
		0	No Occurred
3:0	Reserved		

STATUS_TEMPERATURE [0x7D]

Bit number	Purpose	Bit Value	Meaning
7	Over temperature fault	1	Occurred ;
		0	No Occurred
6	Over temperature warning	1	Occurred ;
		0	No Occurred
5:0	Reserved		

STATUS_CML [0x7E]

Bit number	Purpose	Bit Value	Meaning
7	Invalid/Unsupported Command Received	1	Occurred ;
		0	No Occurred
6	Invalid/Unsupported Data Received	1	Occurred ;
		0	No Occurred
5	Packet Error Check Failed	1	Occurred ;
		0	No Occurred
4:0	Reserved		

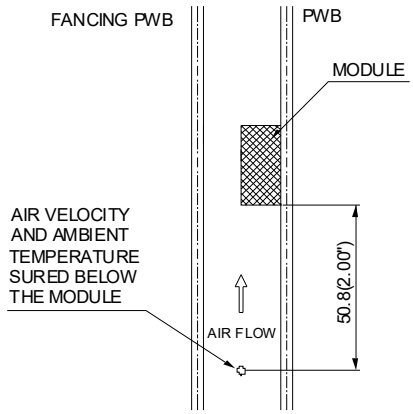
Thermal Testing Setup

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 16: 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)

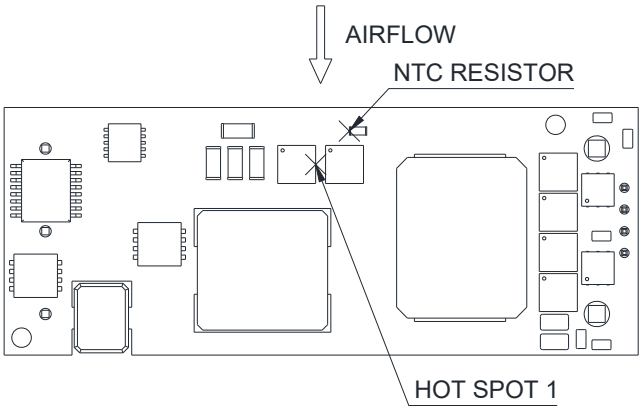


Figure 17: *Hot spot 1 temperature measurement location*
The allowed maximum hot spot 1 temperature is defined at 120℃

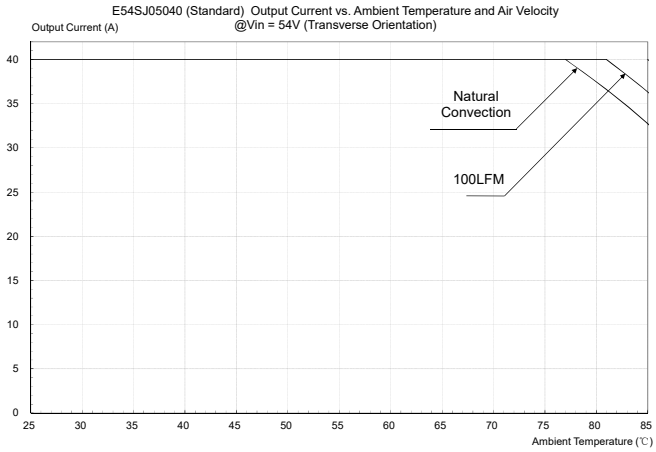


Figure 18: *Output Current vs. Ambient Temperature and Air Velocity @Vin = 54V (Transverse Orientation, Airflow from Vin+ to Vin-, Open Frame)*

Thermal Curves (With Base-plate)

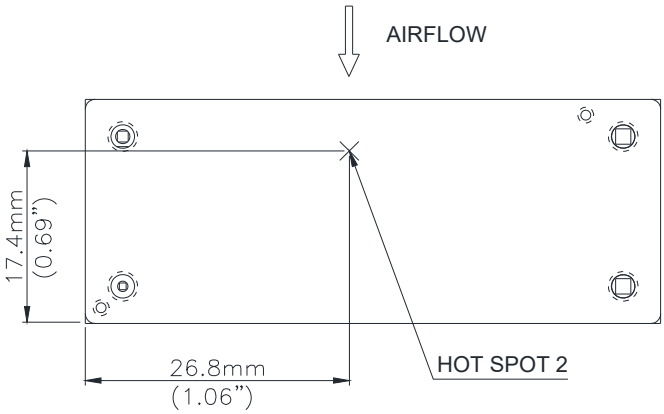


Figure 19: *Hot spot 2 temperature measurement location*
The allowed maximum hot spot 2 temperature is defined at 115℃

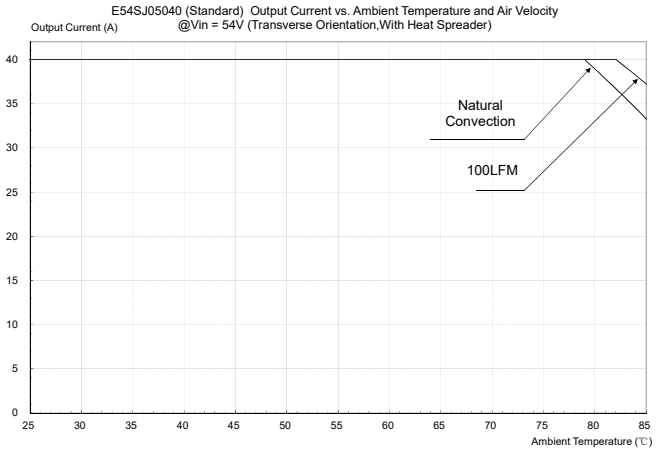
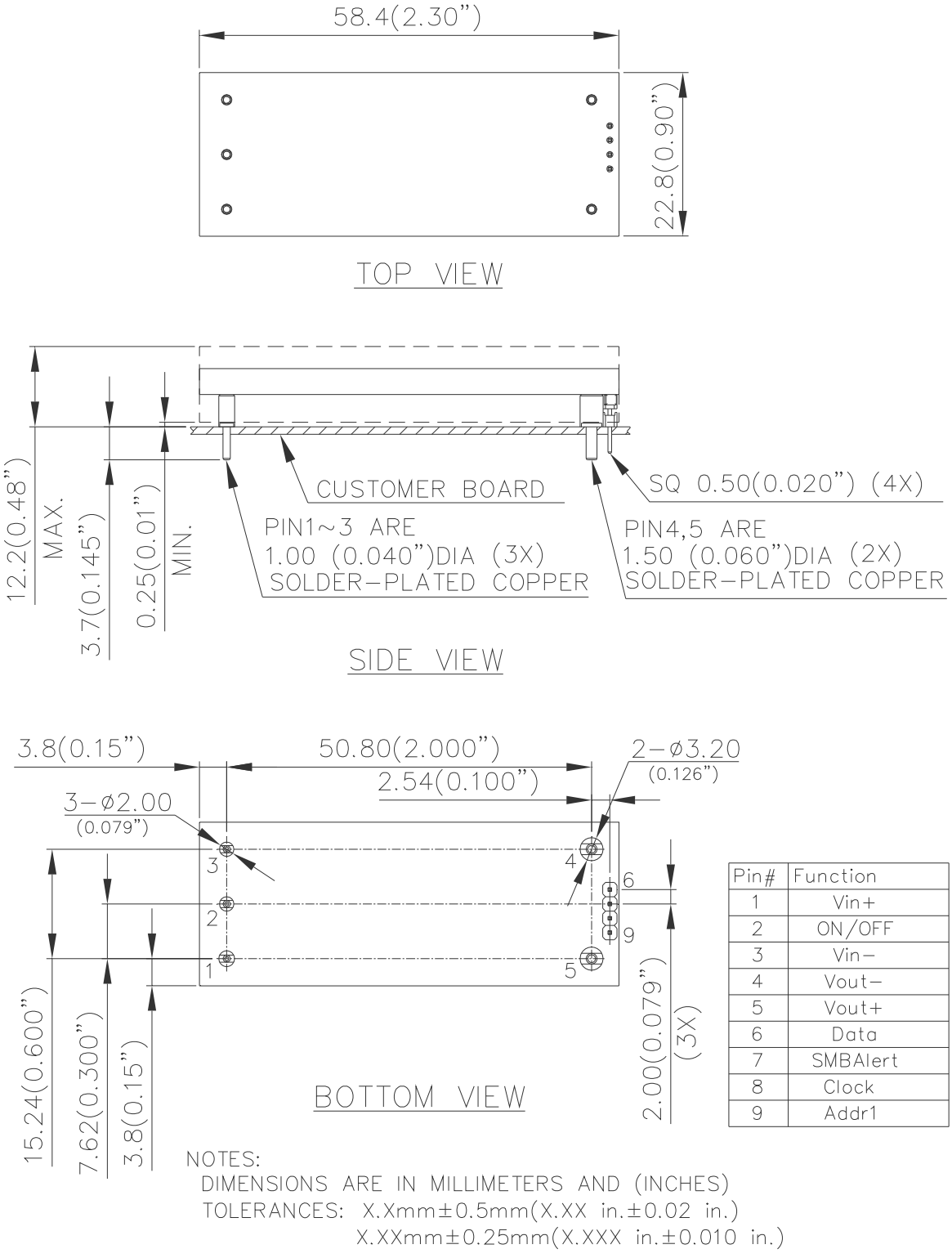


Figure 20: *Output Current vs. Ambient Temperature and Air Velocity @Vin = 54V (Transverse Orientation, Airflow from Vin+ to Vin-, With Base-plate)*

Mechanical Drawing (Open frame)

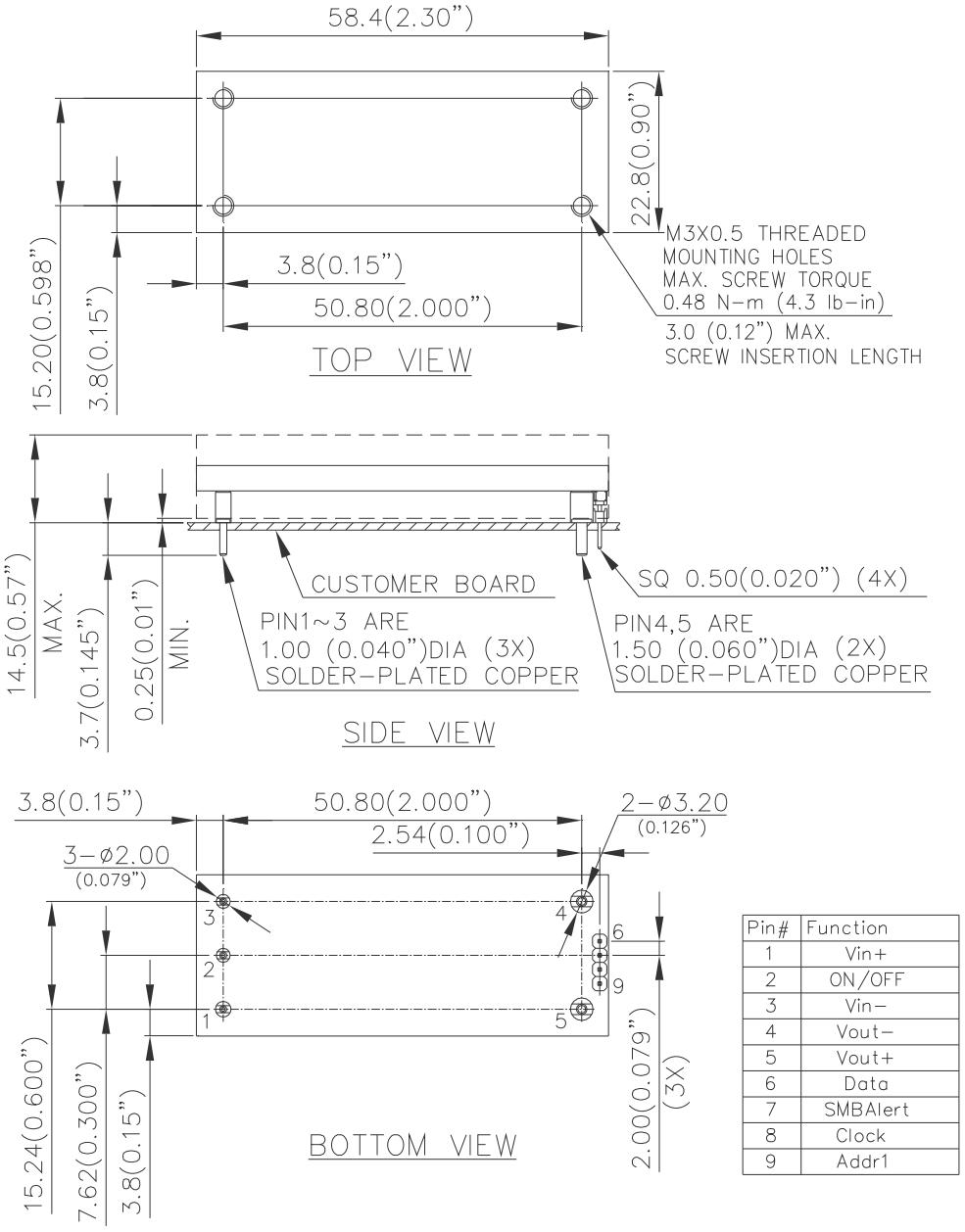


Pin#	Function
1	Vin+
2	ON/OFF
3	Vin-
4	Vout-
5	Vout+
6	Data
7	SMBAlert
8	Clock
9	Addr1

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.)

Note: No pin 6~9 for E54SJ05040XXAX, and with pin 6~9 for E54SJ05040XXDX.

Mechanical Drawing (With base-plate)



Pin#	Function
1	Vin+
2	ON/OFF
3	Vin-
4	Vout-
5	Vout+
6	Data
7	SMBAlert
8	Clock
9	Addr1

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.)

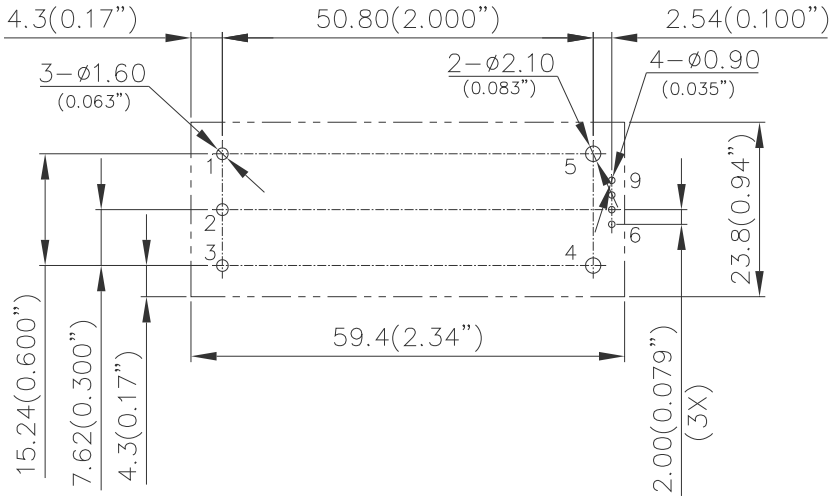
Note: No pin 6~9 for E54SJ05040XXAX, and with pin 6~9 for E54SJ05040XXDX.

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	+Vout	Positive output voltage
6	Data	PMBus data line
7	SMBAlert	PMBus SMBAlert line
8	Clock	PMBus clock line
9	ADD1	ADDR1 pin sets the high order digit of the address

Pin Specification:

Pins 1,2,3	1.00mm (0.040") diameter; copper with matte Tin plating and Nickel under plating
Pins 4,5	1.50mm (0.060") diameter; copper with matte Tin plating and Nickel under plating
Pins 6~9	Digital pins;Square 0.50mm (0.020"); copper with golden flash plating

Recommended Pad Layout



Pin#	Function
1	Vin+
2	ON/OFF
3	Vin−
4	Vout−
5	Vout+
6	Data
7	SMBAlert
8	Clock
9	Addr1

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.

PART NUMBERING SYSTEM

E	54	S	J	050	40	N	N	D *note	A
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 - Eighth Brick	54 - 40~60V	S - Single	J - Series number	050 - 5V	40 - 40A	P - Positive N - Negative	C - 0.180” R - 0.170” N - 0.145” K - 0.110”	D - Digital pins A - Analog pins	A - Open frame Version H - Heatspreader Version

Note for mechanical pins option:

1. D - Digital pins*: with digital pins(Pin6~9)
2. A - Analog pins*: without digital pins(Pin6~9)

MODEL LIST

Model Name	Input		Output		Peak Eff.
E54SJ05040NNDA	40V~60V	6	5V	40A	96%
E54SJ05040NNAH	40V~60V	6	5V	40A	96%
E54SJ05040NNAA	40V~60V	6	5V	40A	96%

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

CONTACT US:

Website: www.deltaww.com/dcdc
USA:
Telephone:
East Coast: 978-656-3993
West Coast: 510-668-5100
Fax: (978) 656 3964

Email: dcdc@deltaww.com
Europe:
Telephone: +31-20-655-0967
Fax: +31-20-655-0999

Asia & the rest of world:
Telephone: +886 3 4526107
Ext. 6220/6221/6222/6223/6224
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.