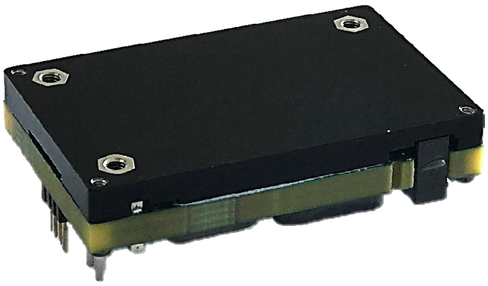


Q54SJ10892
1/4 Brick DC/DC Regulated Power Module
10.8V/92A output, 1000W

The Q54SJ10892 series, 40~60V input, isolated single output, Quarter Brick, is regulated DC/DC converter, and is being offered from a world leader in power system and technology and manufacturing — Delta Electronics, Inc. The Q54SJ10892 offers up to 1000 watts of power and 97.6% peak efficiency in an industry standard footprint. 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 Q54SJ10892 series is fully protected from abnormal input voltage, output current, and temperature conditions and meets 707Vdc isolation; and it can be connected in parallel directly for higher power without external oring-fets.

FEATURES

Electrical

- 40V~60V Vin operating range
- Peak Efficiency up to 97.6%
- 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
- PMbus Communication
- Black Box for fault logging
- Online upgrade firmware by the system processor without being turned off
- 707Vdc isolation

Mechanical

- Size(open frame): 58.4 x 36.8 x 12.2mm (2.30”x1.45”x0.48”)
- Size(with heat spreader): 58.4 x 36.8 x 14.5mm (2.30”x1.45”x0.57”)

Soldering method

- Wave soldering
- Hand soldering
- Reflow soldering

Safety & Reliability

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

OPTIONS

- Analog/Digital option
- Open frame/ 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	Q54SJ10892 Series			
		Min.	Typ.	Max.	Units
ABSOLUTE MAXIMUM RATINGS					
Input Voltage		0		60	Vdc
On/off Pin Voltage		-25		25	Vdc
Other Pin Voltage	Data/Clock/Add1/PG/SMBAlert	-0.3		3.6	V
Operating Ambient Temperature (Ta)		-20		85	°C
Storage Temperature		-55		125	°C
Input / Output Isolation Voltage				707	Vdc
INPUT CHARACTERISTICS					
Operating Input Voltage (continous)	continous	40	54	58	Vdc
Operating Input Voltage (short time operation)	5 minutes	59		60	Vdc
Input Under-Voltage Lockout					
Turn-On Voltage Threshold		38		40	Vdc
Turn-Off Voltage Threshold		35.5		37.5	Vdc
Lockout Hysteresis Voltage			2		Vdc
Input Over-Voltage Protection			61		Vdc
Maximum Input Current	Vin=40V, Io=92A,		26	27	A
Maximum Start Up Input Current	Vin=40V, Io=92A,			40	A
No-Load Input Current	V_{in}=54V, I_o=0A		226	300	mA
Off Converter Input Current	V_{in}=54V			30	mA
Input Terminal Ripple Current	RMS, With 100uF input cap.			700	mA
OUTPUT CHARACTERISTICS					
Output Voltage Set Point	Vin=54V, Io=0, Tc=25°C	11.16	11.20	11.24	Vdc
	Vin=54V, Io=92A, Tc=25°C	10.76	10.80	10.84	
Output Voltage Regulation, Load regulation	Io=0 to 92A	340	400	460	mV
Line regulation	Vin=40V to 58V, Io=0A		+/-20	+/-60	mV
Temperature regulation	Tc = -20°C to 85°C	-30		+90	mV
Total Output Voltage Range	over sample load, and temperature	10.64		11.36	Vdc
Output Voltage Ripple and Noise	5Hz to 20MHz bandwidth				
Peak-to-Peak	Full Load,Co=700uF, 50% ceramic, 50% Oscon			150	mV
RMS	Full Load,Co=700uF, 50% ceramic, 50% Oscon			50	mV
Operating Output Current Range	Vin=40V~58V	0		92	A
Output Over Current Protection		100		120	A
DYNAMIC CHARACTERISTICS					
Output Voltage Current Transient	54V Vin				
Output voltage overshoot and undershoot	1A/µs, 50% to 75% Io.max, 1000uF Load cap		350		mV
Setting Time (within 1% Vout nominal)			200		µs
Turn-On Transient					
Start-Up Delay Time From Input Voltage	On/Off=On, from V_{in}=Turn-on Threshold to V_o=10% $V_{o,nom}$	20		35	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		5	ms
Vo rise time (from 10% Vo set to 90% Vo set)		0		15	ms
Output Capacitance Range	50% ceramic, 50% Oscon or POSCAP	700		10000	µF
EFFICIENCY					
70% Load	Vin=54V		97.6		%
100% Load	Vin=54V		97.3		%
ISOLATION CHARACTERISTICS					
Input to Output				707	Vdc
Isolation Capacitance			54		nF
FEATURE CHARACTERISTICS					
Current Share accuracy	Droop current sharing mode, full load, Vin=54V, Ta=25°C			10	%
Switching Frequency		350		1200	kHz
ON/OFF Control, Negative logic					
Logic Low		-0.7		0.8	V
Logic High		2.4		25	V
ON/OFF pin output current	Ion/off at Von/off=0.0V			0.2	mA
	Ion/off at Von/off=2.4V	10			uA
On/off pin resistor			249		Kohm
Open circuit Voltage				5	V
Output Over-Voltage Protection	Over full temp range		12.5	15.5	V
GENERAL SPECIFICATIONS					
MTBF	With heatspread, Io=80%*Io,max; 300LFM; Ta=25°C		4.1		Mhours
Weight	Open frame		71		grams
Weight	With heat spreader		84		grams
Over-Temperature Shutdown (Open Frame)	Refer to Figure 18 for Hot spot 1 location (54V_{in}, 800W, 200LFM,Airflow from V_{in-} to V_{in+})		138		°C
Over-Temperature Shutdown (With Heat Spreader)	Refer to Figure 20 for Hot spot 2 location (54V_{in}, 800W, 200LFM,Airflow from V_{in-} to V_{in+})		138		°C
Over-Temperature Shutdown (NTC Resistor)	Refer to Figure 18&20 for NTC Resistor location		135		°C

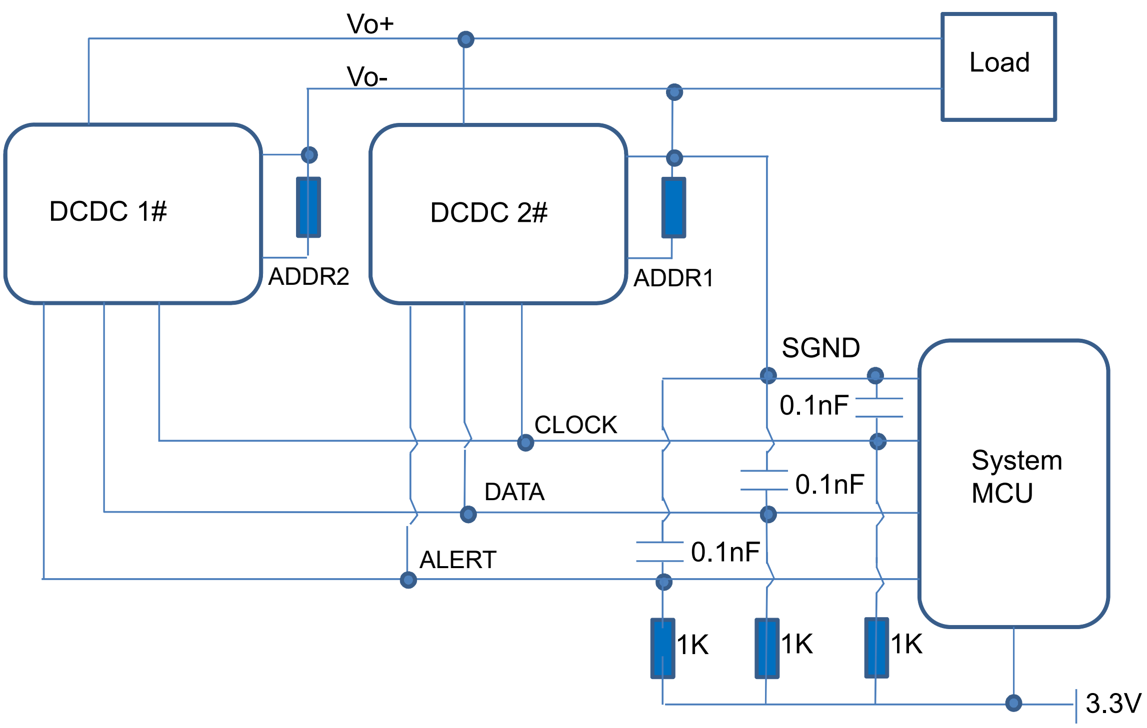
Note: Please attach thermocouple on NTC resistor to test OTP function, the hot spots' temperature is just for reference.

PARAMETER	NOTES and CONDITIONS	Q54SJ10892 Series			
		Min.	Typ.	Max.	Units
PMBUS SIGNAL INTERFACE CHARACTERISTICS					
Logic Input Low (V_{IL})	Data, Clock pin	0		0.8	V
Logic Input High (V_{IH})	Data, Clock pin	2.1		3.3	V
Logic Output Low (V_{OL})	Data, SMBAlert, Clock pin; IOL=4mA			0.65	V
Logic Output High (V_{OH})	Data, SMBAlert, Clock pin; IOH=-4mA	2.3			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;	-3		+3	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+		7	VO+	
2	ON/OFF	Primary on/off control pin	8	Data	PMBus data line
3	VIN-		9	Alert	PMBus alert line
4	VO-		10	Clock	PMBus clock line
5	VO-		11	Addr	PMBus address pin
6	VO+				

PMBUS APPLICATION CIRCUIT



T_A=25°C

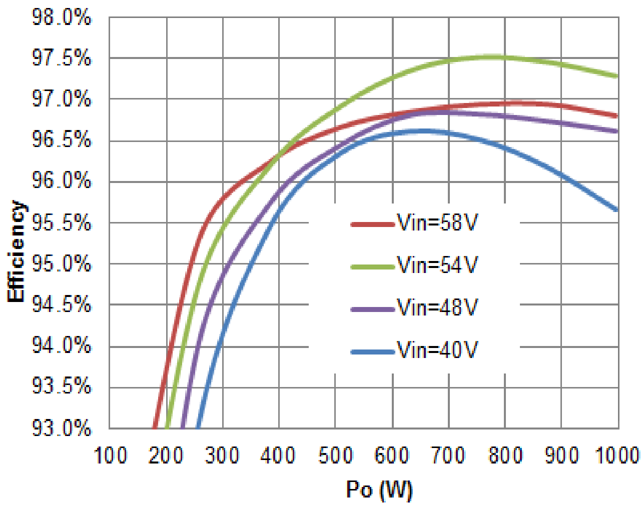


Figure 1: Efficiency vs. Output Power

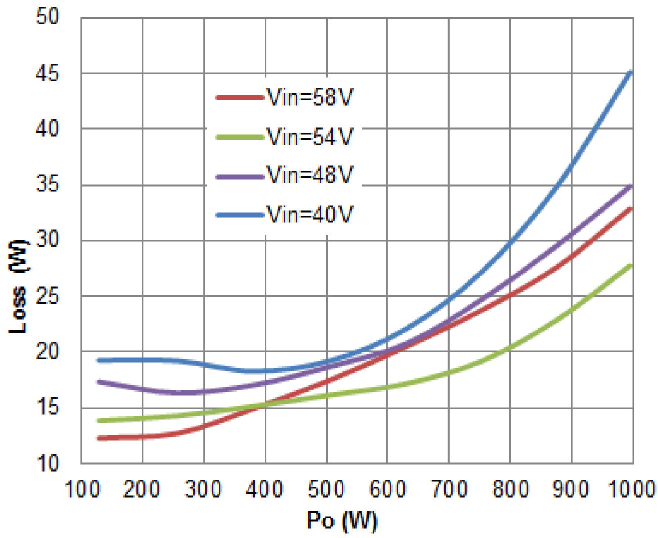


Figure 2: Loss vs. Output Power

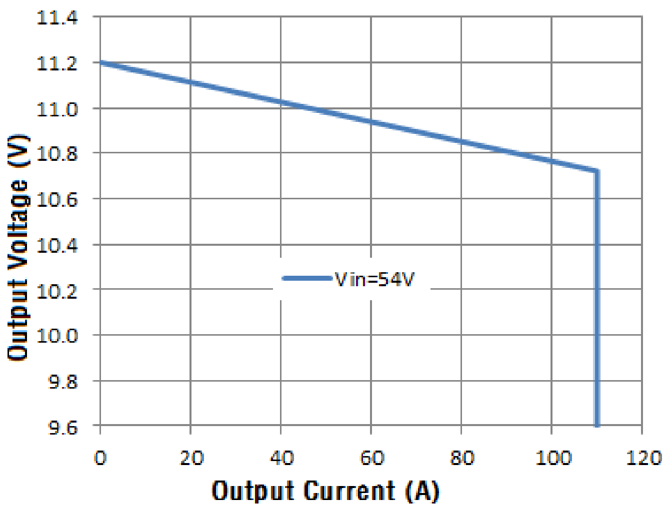


Figure 3: Output Voltage vs. Output Current showing typical current limit curves and converter shutdown points.

T_A=25°C,

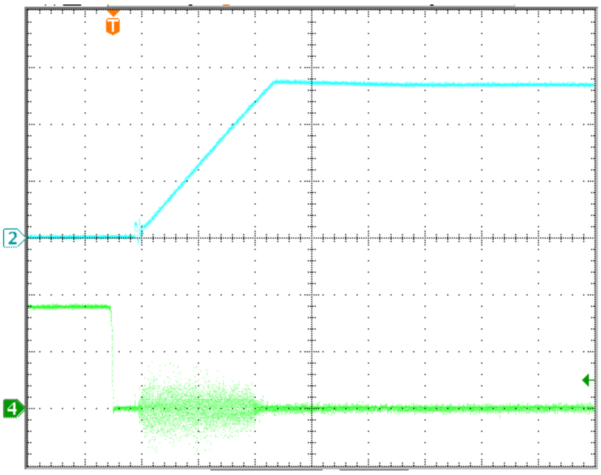


Figure 5: Remote On/Off (negative logic) at full load
Vin=54V, I_{out} = full load
Time: 4ms/div.
V_{out} (top trace): 4V/div;
$V_{remote\ On/Off\ signal}$ (bottom trace): 2V/div.

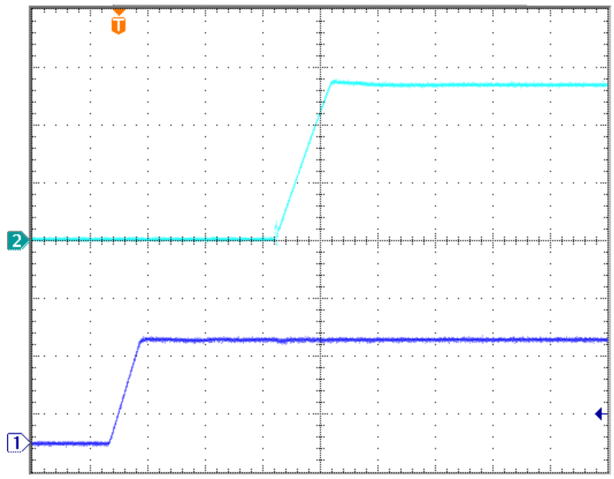


Figure 6: Input Voltage Start-up at full load
Vin=54V, I_{out} = full load
Time: 10ms/div.
V_{out} (top trace): 4V/div;
V_{in} (bottom trace): 30V/div.

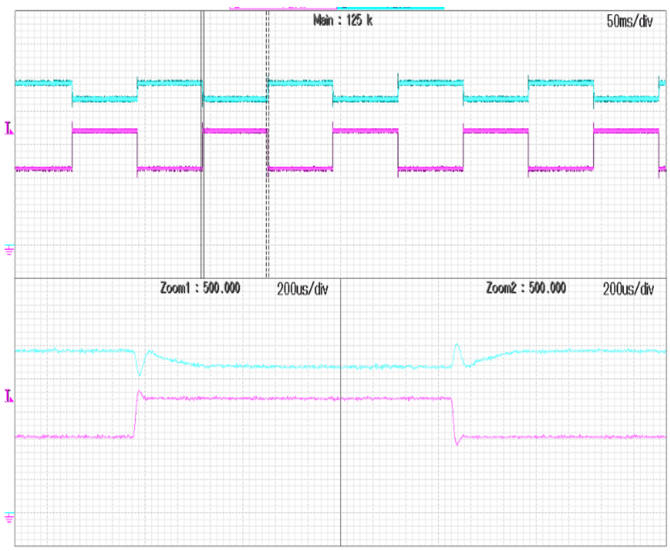


Figure 7: Transient Response
(Vin=54V, 10A/µs step change in load from 50% to 75% of $I_{o,\ max}$)
V_{out} (top trace): 0.2 V/div, 10VDC bias.
I_{out} (bottom trace): 20A/div.
Load cap: 10uF/16V/X7R/1206*10pcs ceramic cap + 100uF/16V*9pcs Oscon cap. *Scope measurement should be made using a BNC cable (length shorter than 20 inches). Position the load between 51 mm to 76 mm (2 inches to 3 inches) from the module*

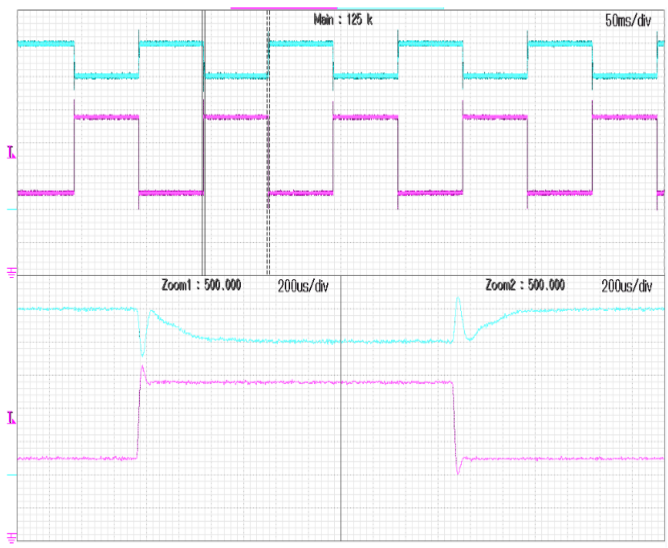


Figure 8: Transient Response
(Vin=54V, 10A/µs step change in load from 50% to 100% of $I_{o,\ max}$)
V_{out} (top trace):0.2V/div, 10VDC bias.
I_{out} (bottom trace): 20A/div.
Load cap: 10uF/16V/X7R/1206*10pcs ceramic cap + 100uF/16V*9pcs Oscon cap. *Scope measurement should be made using a BNC cable (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,

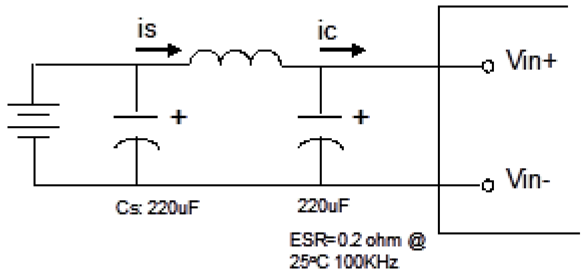


Figure 9: Test Diagram for Input Terminal Current ic

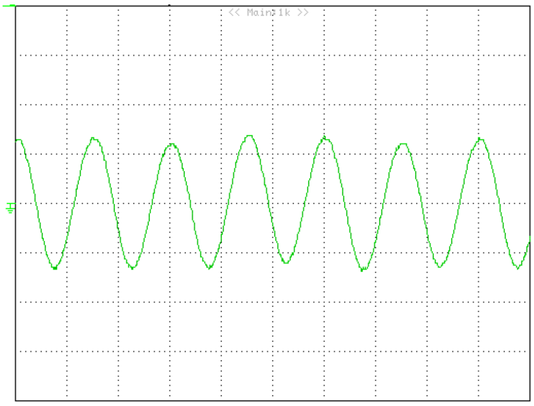


Figure 10: Input Terminal Ripple Current, ic
Vin=51V, I_{out} = full load
200 mA/div, 0.5us/div.
Bandwidth: 20MHz

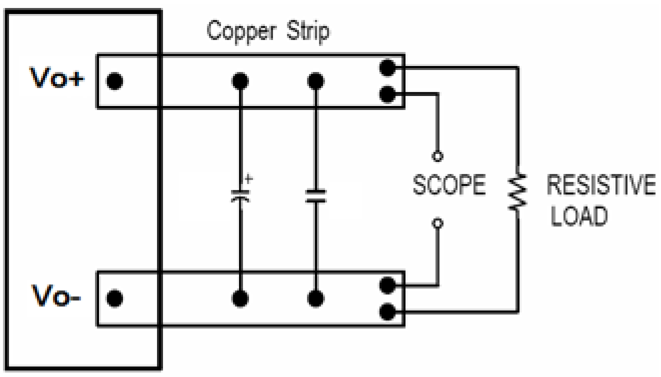


Figure 11: Test Setup for Output Voltage Noise and Ripple

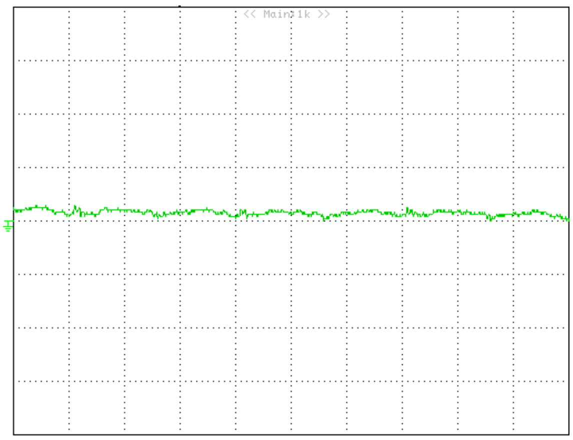


Figure 12: Output Voltage Ripple and Noise
Vin=51V, I_{out} = full load
20 mV/div, 0.5us/div
Load cap: 700uF, 50% ceramic, 50% Oscon.
Bandwidth: 20MHz

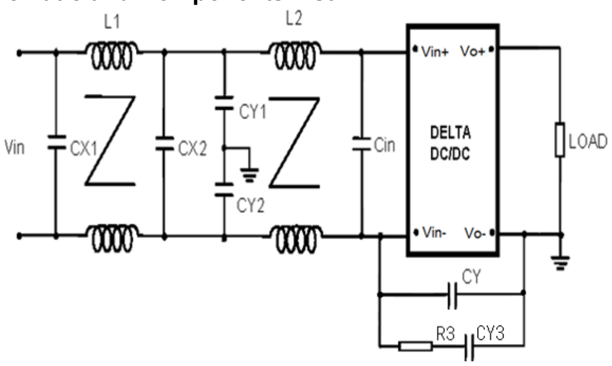
Input Source Impedance

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 220μF (ESR < 0.2Ω 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. Below is the reference design for an input filter tested with Q54SJ10892 to meet class B in CISSPR 22.

Schematic and Components List



Cin is 100uF low ESR Aluminum cap×2pcs in parallel;
CX1 is 2.2uF ceramic cap×2pcs in parallel;
CY1 and CY2 are 10nF ceramic cap;
CX2 is NC;
CY is 33nF;
CY3 is 100nF, R3 is 1ohm;
L1 and L2 is 0.22mH;

Figure 13: Recommended Input Filter

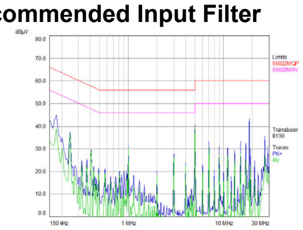


Figure 14: Test Result of EMC (V_{in}=54V, I_o=92A).

Note: Input EMI filter is recommended in front of power module application. For incomplete EMI circuit, EMI risk does exist in the system. For example, the parasitic inductance of long input cable may form LC resonant circuit with Y capacitance. Undesired oscillation may happen If the resonant frequency is within the switching frequency range of the power module. An RC circuit (R3/CY3 are 1ohm/100nF) as shown in Figure 13 is strongly recommended even there is no EMI requirement for the DCDC converter. If customer encounter any EMI issue. please contact Delta design team for solution.

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 125A 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. If the remote on/off feature is not used, please short the on/off pin to Vi(-); If the remote on/off signal has a large noise, and a RC (R1 is 499 ohm; C1 is 4.7nF) filter circuit is recommended.

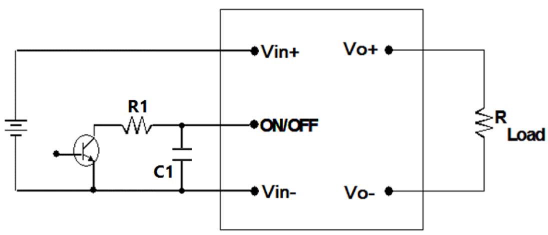


Figure 15: Remote On/Off Implementation

Over-Current Protection

The modules include an internal output over-current protection circuit. If the output current exceeds the OCP set point, the modules will shut down, and enter a hiccup mode. For hiccup mode, the module will try to restart after shutdown 1 second. If the overload condition still exists, the module will shut down again. This restart trial will continue until the overload condition is corrected.

Over-Temperature Protection

The modules include an internal over-temperature protection circuit. If the module temperature exceeds the over-temperature threshold the module will shut down, and enter in a auto-recovery mode. For auto-recovery mode, the module will monitor the module hot spot temperature after shutdown. Once the hot spot temperature is dropped below 100C, the module will be auto-recovery.

Over-Voltage Protection

The modules include an internal output over-voltage protection circuit. If output voltage exceeds the over-voltage set point, the module will shut down, and enter in a hiccup mode. For hiccup mode, the module will try to restart after shutdown 1 second. If the output overvoltage condition still exists, the module will shut down again. This restart trial will continue until the over-voltage condition is corrected.

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 400mV 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.

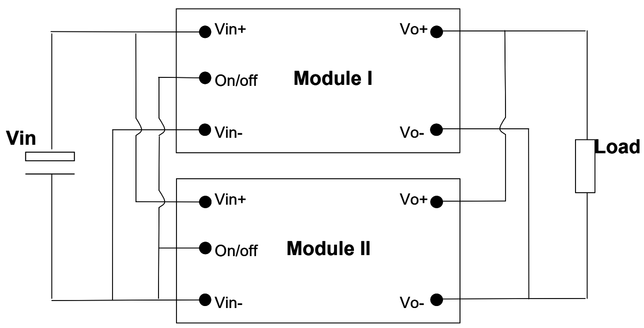


Figure 16: *Parallel and droop current sharing configuration for no redundancy requirement system*

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.

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, and 1 Address line Addr. 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.

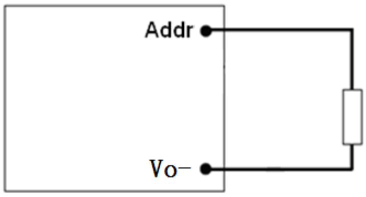
The module supports the Packet Error Checking (PEC) protocol. It can check the PEC byte provided by the PMBus master, and include a PEC byte in all message responses to the master.

SMBALERT protocol is also supported by the module. SMBALERT is a wired-AND signal just as the CLOCK and DATA signals are, by which the module can alert the PMBus master that it has a fault condition via pulling the SMBALERT pin to an active low. The master to response the SMBALERT method is that the master will communicate with the slave module using the programmed address, and using the various STATUS commands to determine the cause for the SMBALERT. The CLEAR_FAULTS command can retire the active SMBALERT.

Note: If PMBus is not used. The "Data, Alert, Clock. Addr" can be unconnected.

PMBUS Addressing

The Module has flexible PMBUS addressing capability. When connect different resistor from Addr pin to Vo- 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

Black Box Function

There is a black box function realized by the page 43~63 of D-flash, which has 20K erase cycles; Page 43 are used to save the page number which record the newest history event. Page 44~63, total 20 pages and 32 byte per page, are assigned to record 20 history events. Every page has the same record content, which is shown as below:

Address offset	Content
0	EVENT#
1	Status_Word_High_Byte
2	Status_Word_Low_Byte
3	Status_Vout
4	Status_Iout
5	Status_Input
6	Status_Temperature
7	Status_cml
8	Vin_data_high_byte
9	Vin_data_low_byte
10	Vout_data_high_byte
11	Vout_data_low_byte
12	Iout_data_high_byte
13	Iout_data_low_byte
14	temperature_data_high_byte
15	temperature_data_low_byte
16~31	N/A

PMBus Data Format

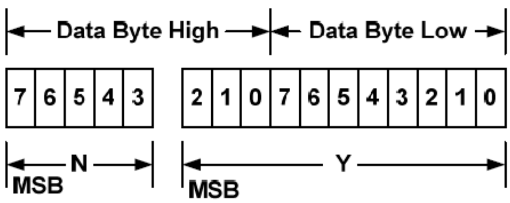
The module receives and reports data in LINEAR format. The Linear Data Format is typically used for commanding and reporting the parameters such as (but not only) the following:

- Output Current,
- Input Voltage,
- Input Current,
- Operating Temperatures,
- Time (durations), and
- Energy Storage Capacitor Voltage.

The Linear Data Format is a two byte value with:

- An 11 bit, two's complement mantissa and
- A 5 bit, two's complement exponent (scaling factor).

The format of the two data bytes is illustrated below:

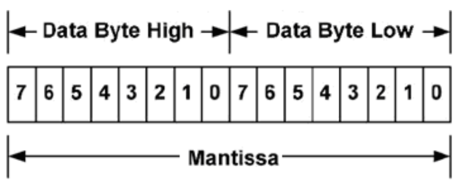


The relation between Y, N and the "real world" value is:
$X = Y \cdot 2^N$
Where, as described above:
X is the "real world" value;
Y is an 11 bit, two's complement integer; and
N is a 5 bit, two's complement integer.
Devices that use the Linear format must accept and be able to process any value of N.

The Exponent of the data words is fixed at a reasonable value for the command. 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	/

For commands that report 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:
$Vout = Mantissa \times 2^{-12}$

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 some differences with the definition in PMBus 1.2 specification. All the supported PMBus commands are summarized in detail summarized in the table below table.

Command	Code	Description	Type	Compatible with PMBUS standard or not?	Data Format	Default value	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	/	/	Such command has keyword protection to prevent accidental write by system firmware;
CLEAR_FAULTS	0x03	Clear any fault bits that have been set	Send byte	Yes	/	/	/	/	
WRITE_PROTECTIO N	0x10	Set or Clear the bit of Write protection	R/W byte	Refer to below description	Bit field	/	/	/	
STATUS_WORD	0x79	Returns the information with a summary of the module's fault/warning	R/W word	Refer to below description	Bit field	/	/	/	ALL of the warning or fault bits set in the status registers remain set, even if the fault or warning condition is removed or corrected, until one of the following occur: 1) The bit is individually cleared; 2) The device receives a CLEAR_FAULTS command; 3) Bias power is removed from the module.
STATUS_VOUT	0x7A	Returns the information of the module's output voltage related fault/warning	R/W byte	Refer to below description	Bit field	/	/	/	
STATUS_IOUT	0x7B	Returns the information of the module's output current related fault/warning	R/W byte	Refer to below description	Bit field	/	/	/	
STATUS_INPUT	0x7C	Returns the information of the module's input over voltage and under voltage fault	R/W byte	Refer to below description	Bit field	/	/	/	
STATUS _TEMPERATURE	0x7D	Returns the information of the module's temperature related fault/warning	R/W byte	Refer to below description	Bit field	/	/	/	
STATUS_CML	0x7E	Returns the information of the module's communication related faults.	R/W 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 NTC 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	22	/	/	/
READ_HISTORY EVENTS	0xE0	Read history event from black box	Read Block	Refer to below description	/	/	/	/	/
SET_HISTORY_EVE NT_OFFSET	0xE1	Set history event offset	R/W	Refer to below description	/	/	/	/	/

OPERATION [0x01]

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

WRITE PROTECTION [0x10]

Bit number	Purpose	Bit Value	Meaning
7	Enable / Disable the protection	1	Protection is enabled
		0	Protection is disabled
6:0	Reserved		

STATUS_WORD [0x79]

High byte

Bit number	Purpose	Bit Value	Meaning
7	An output 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 under voltage	1	Occurred
		0	No Occurred
4	Reserved		
3	Power_Good	1	is negated
		0	ok
2:1	Reserved		
0	A fault type not given in bits [15:1] of the STATUS_WORD has been detected	1	Detected
		0	No Detected

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	A fault or warning not listed in bits [7:1] of this byte has occurred	1	Occurred ;
		0	No Occurred

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	Output under voltage warning	1	Occurred ;
		0	No Occurred
4	Output under voltage fault	1	Occurred ;
		0	No Occurred
3:0	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	Input over voltage warning	1	Occurred ;
		0	No Occurred
5	Input under voltage warning	1	Occurred ;
		0	No Occurred
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		

HISTORY EVENT READ SECTION:

- 0xE1 command: Write the Offset Value to Slave to decide which history data for read.
- 0XE0 command: read the history data after 0xE1 command

READ HISTORY EVENT OFFSET (0XE1):

Send command 0XE1 and read one byte, it will return the next event log offset value x.

Start	Device Address & R/W	Command byte(0XE1)	Repeated Start	Device Address & R/W

Event log offset value	PEC	Stop

SET HISTORY EVENT OFFSET (0XE1):

Then send command 0XE1 and write the offset value x-1, if send command 0XE0 to read data after this write command 0XE1, the last event data will be read back. The maximum value of the offset is 20, if the history data is large than 20, it will recount from 20 to 0.

Start	Device Address & R/W	Command byte(0XE1)	Offset value	PEC	Stop

READ_HISTORY EVENTS [0xE0]

Start	Device Address & R/W	Command byte(0XE0)	Repeated Start

Device Address & R/W	EVENT#	Status_Word_High_Byte	Status_Word_Low_Byte	Status_Vout

Status_Iout	Status_Input	Status_Temperature	Status_cml	Vin_data_high_byte

Vin_data_low_byte	Vout_data_high_byte	Vout_data_low_byte	Iout_data_high_byte

Iout_data_low_byte	temperature_data_high_byte	temperature_data_low_byte	PEC	Stop

E-mail: dcdc@deltaww.com
http://www.deltaww.com/dcdc

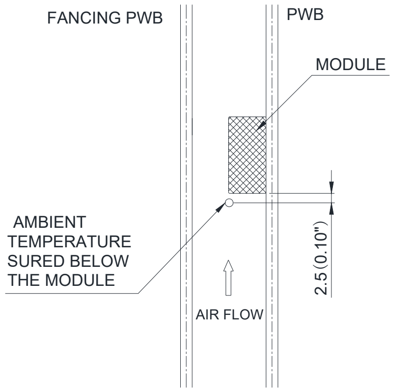
Thermal Testing Setup

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)

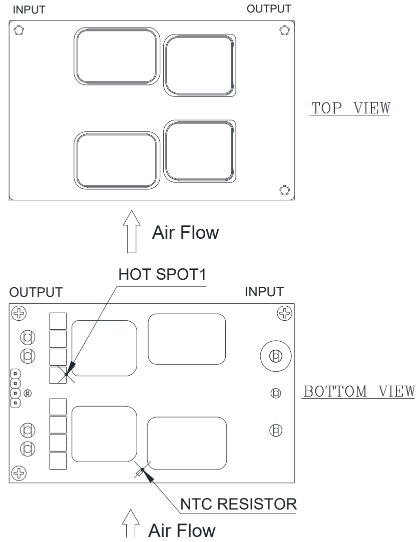


Figure 18: *Hot spot 1 temperature measurement location*
The allowed maximum hot spot 1 temperature is defined at 120℃.

Thermal Curves (With Heat Spreader)

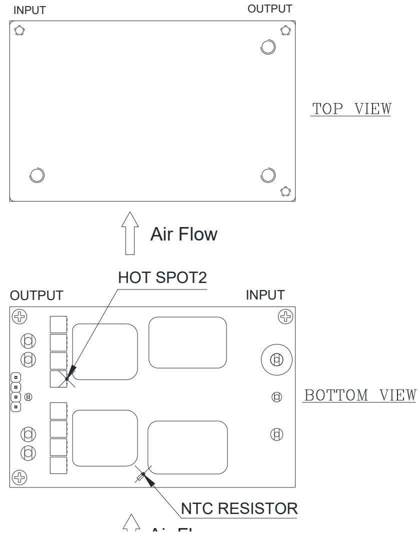


Figure 20: *Hot spot 2 temperature measurement location*
The allowed maximum hot spot 2 temperature is defined at 120℃.

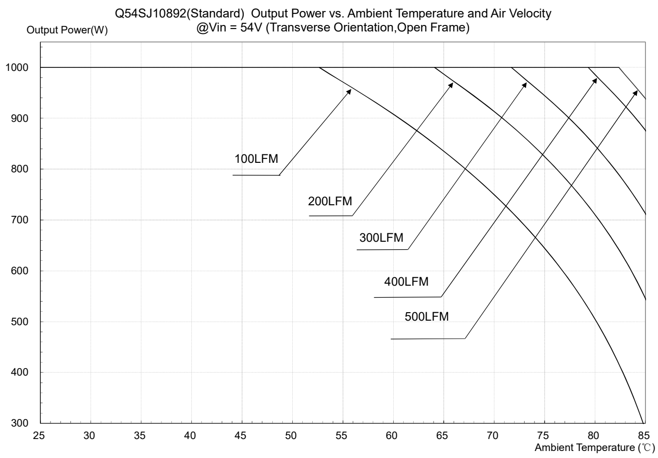


Figure 19: *Output Power vs. Ambient Temperature and Air Velocity @Vin = 54V (Transverse Orientation, Open Frame)*

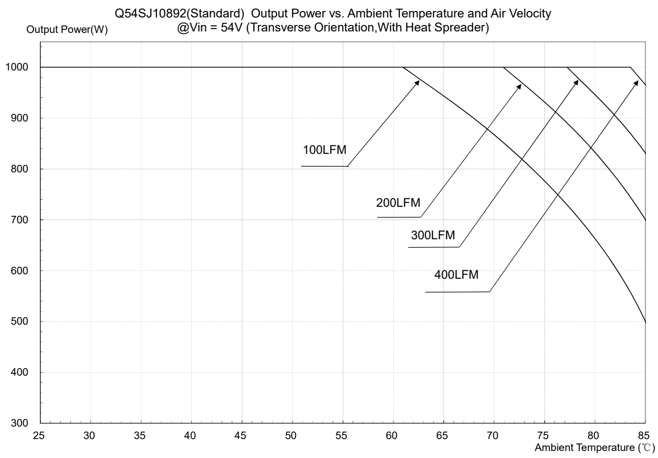
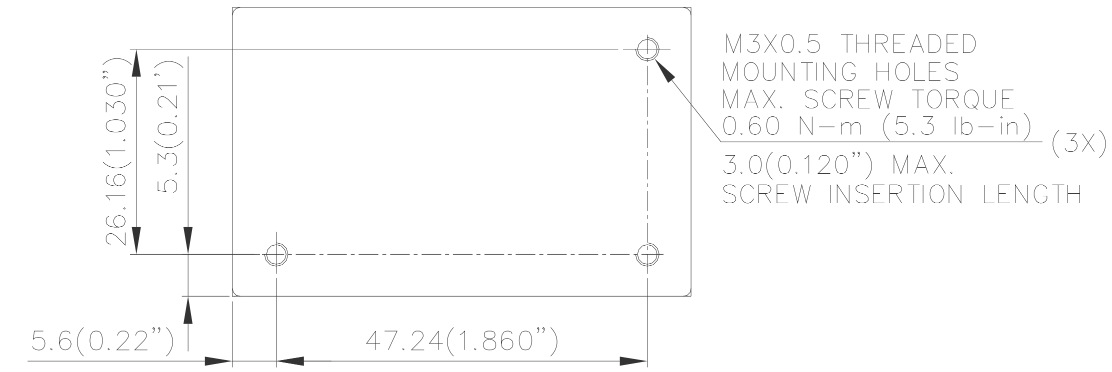
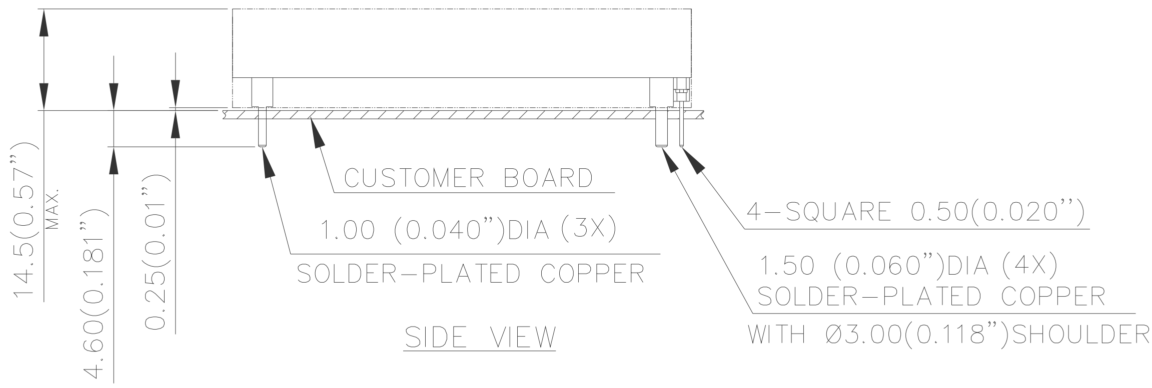


Figure 21: *Output Power vs. Ambient Temperature and Air Velocity @ Vin = 54V (Transverse Orientation, With Heat Spreader)*

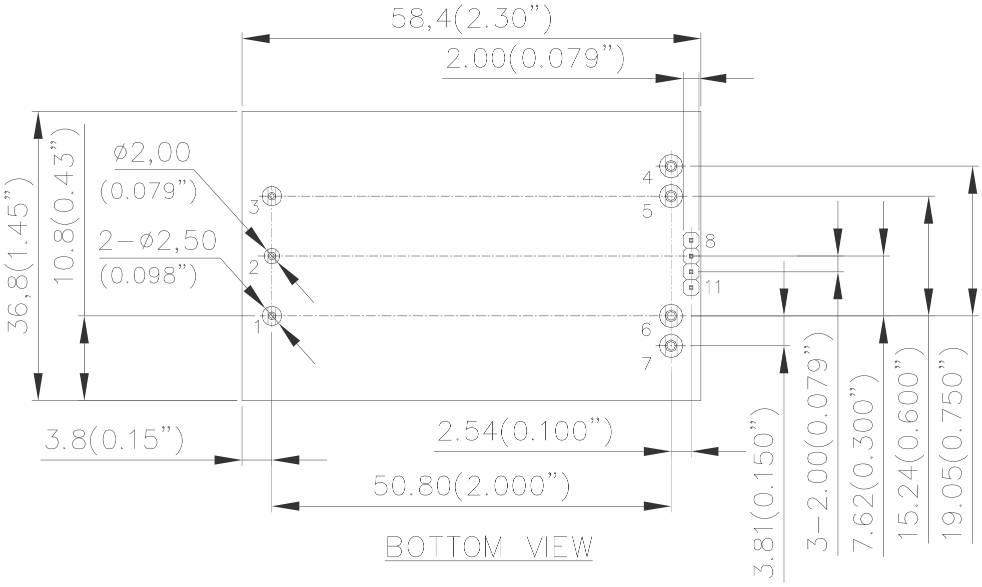
Mechanical Drawing (With Baseplate)



TOP VIEW



SIDE VIEW

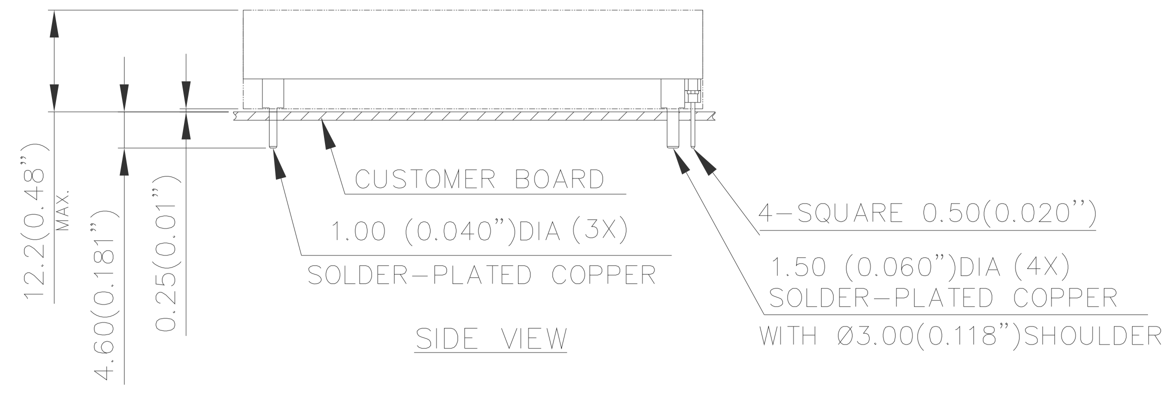


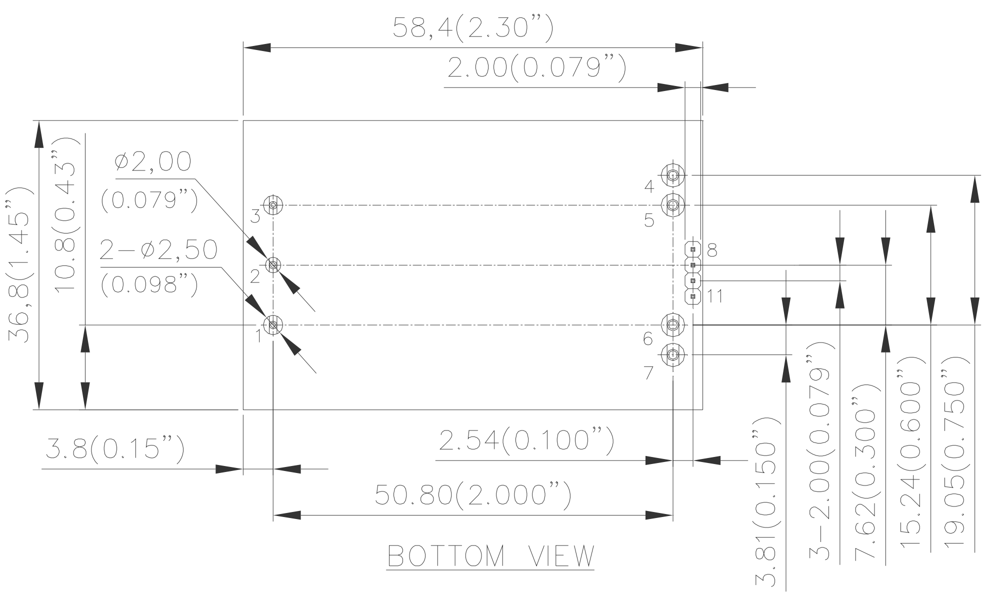
BOTTOM VIEW

Pin#	Function
1	VIN+
2	ON/OFF
3	VIN−
4	Vo−
5	Vo−
6	Vo+
7	Vo+
8	Data
9	ALERT
10	Clock
11	Addr

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.)

Mechanical Drawing (open frame)





Pin#	Function
1	VIN+
2	ON/OFF
3	VIN-
4	Vo-
5	Vo-
6	Vo+
7	Vo+
8	Data
9	ALERT
10	Clock
11	Addr

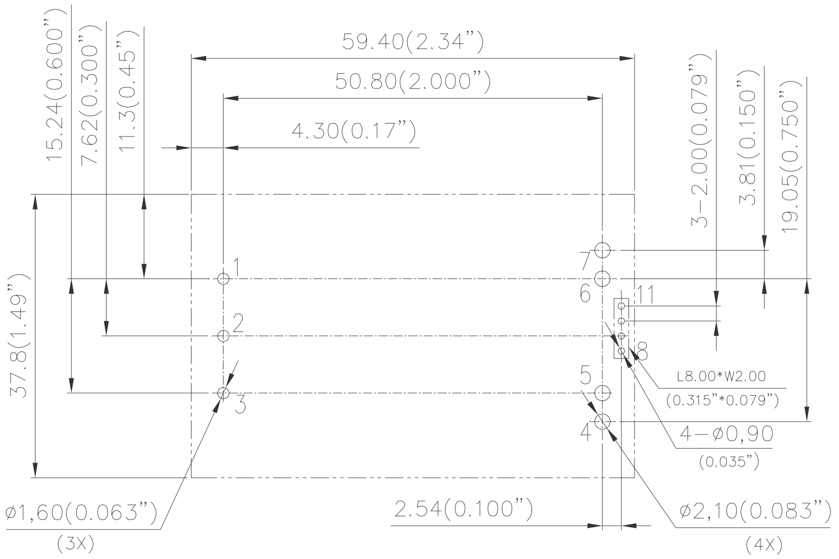
NOTES:
DIMENSIONS ARE IN MILLIMETERS AND (INCHES)
TOLERANCES: X.Xmm±0.5mm(X.XX in.±0.02 in.)
X.XXmm±0.25mm(X.XXX in.±0.010 in.)

Pin No.	Name	Function
1	Vin+	Positive input voltage
2	ON/OFF	Remote ON/OFF
3	Vin-	Negative input voltage
4	Vo-	Negative output voltage
5	Vo-	Negative output voltage
6	Vo+	Positive output voltage
7	Vo+	Positive output voltage
8	Data	PMBus data line
9	Alert	PMBus Alert line
10	Clock	PMBus clock line
11	Addr	PMBUS Address pin

Pin Specification:

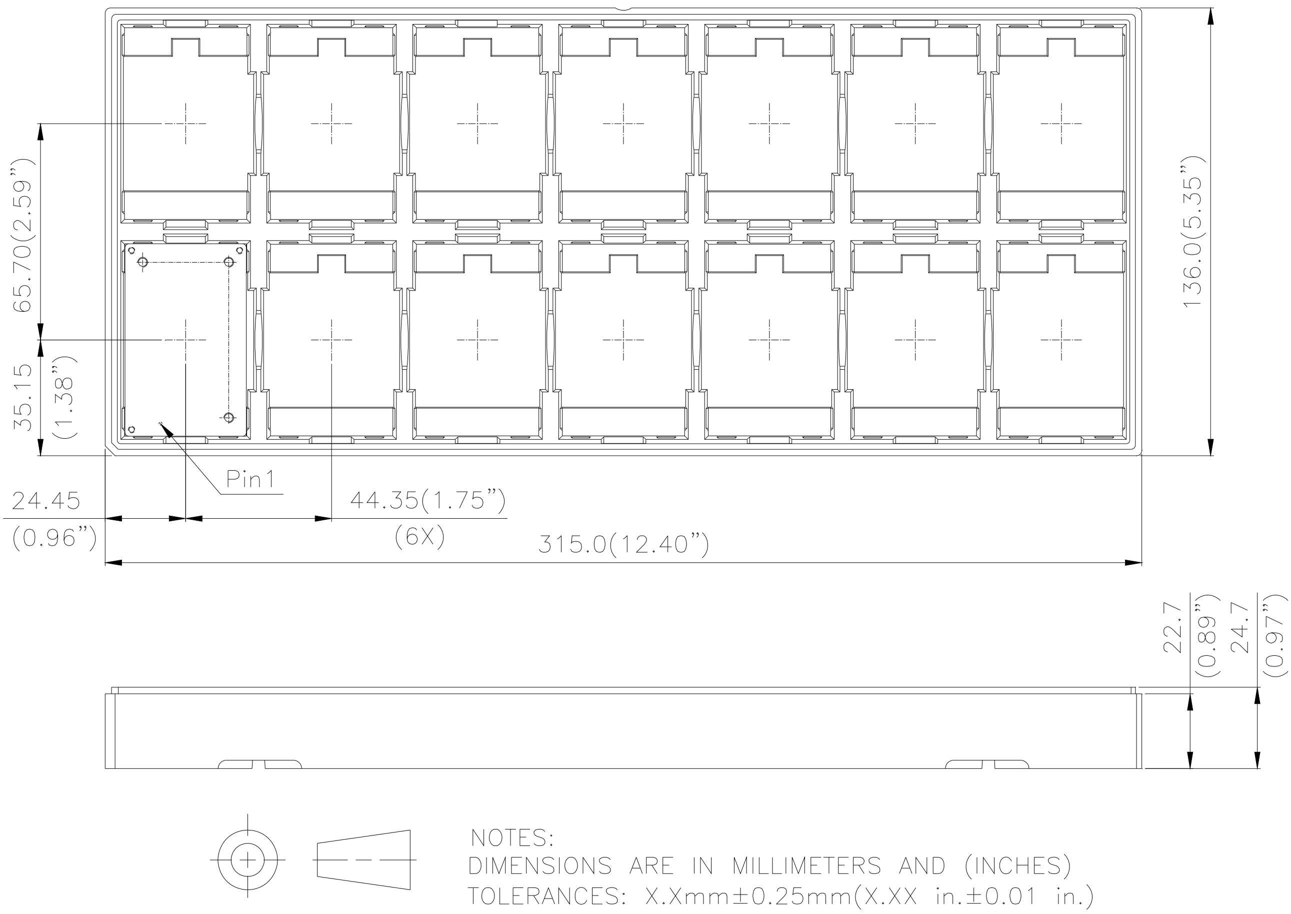
Pins 1,2,3	1.00mm (0.040") diameter; copper with matte Tin plating and Nickel under plating
Pins 4,5,6,7	1.50mm (0.060") diameter; copper with matte Tin plating and Nickel under plating
Pins 8~11	PMBus pins;Square 0.50mm (0.020"); copper with golden flash plating

Recommended Layout



Pin#	Function
1	VIN+
2	ON/OFF
3	VIN-
4	Vo-
5	Vo-
6	Vo+
7	Vo+
8	Data
9	ALERT
10	Clock
11	Addr

Packing information(JEDEC Tray for base plate version)



NOTES:
DIMENSIONS ARE IN MILLIMETERS AND (INCHES)
TOLERANCES: X.Xmm±0.25mm(X.XX in.±0.01 in.)
X.XXmm±0.15mm(X.XXX in.±0.006 in.)

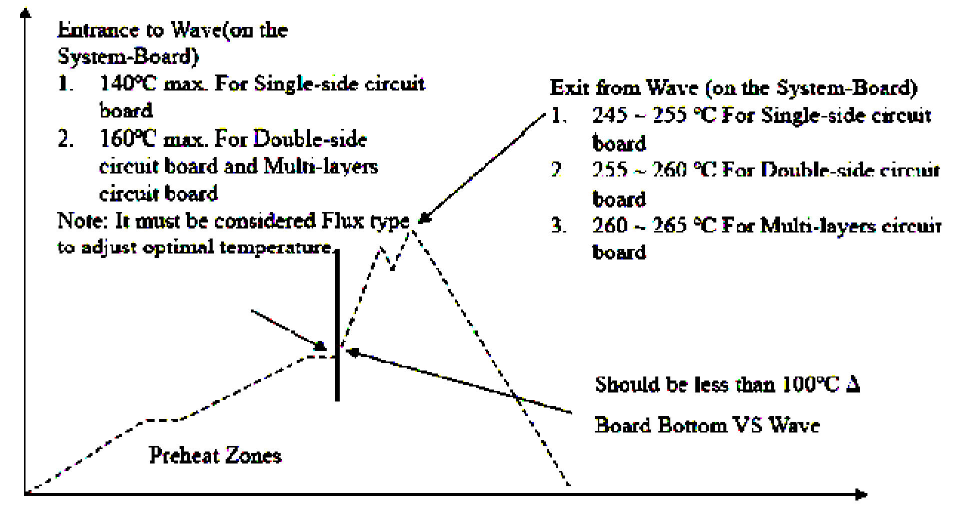
Soldering method

Generally, as the most common mass soldering method for the solder attachment, wave soldering is used for through-hole power modules and reflow soldering is used for surface-mount ones. Delta recommended soldering methods and process parameters are provided in this document for solder attachment of power modules onto system board. SAC305 is the suggested lead-free solder alloy for all soldering methods.

Reflow soldering is not a suggested method for through-hole power modules due to many process and reliability concerns. If you have this kind of application requirement, please contact Delta sales or FAE for further confirmation.

Wave Soldering (Lead-free)

Delta's power modules are designed to be compatible with single-wave or dual wave soldering. The suggested soldering process must keep the power module's internal temperature below the critical temperature of 217 ℃ continuously. The recommended wave-soldering profile is shown in following figure.



Recommended Temperature Profile for Lead-free Wave Soldering

Note: The temperature is measured on solder joint of pins of power module.

The typical recommended (for double-side circuit board) preheat temperature is 115+/-10℃ on the top side (component side) of the circuit board. The circuit-board bottom-side preheat temperature is typically recommended to be greater than 135℃ and preferably within 100 ℃ of the solder-wave temperature. A maximum recommended preheat up rate is 3℃ /s. A maximum recommended solder pot temperature is 255+/-5℃ with solder-wave dwell time of 3~6 seconds. The cooling down rate is typically recommended to be 6℃/s maximum.

Hand Soldering (Lead Free)

Hand soldering is the least preferred method because the amount of solder applied, the time the soldering iron is held on the joint, the temperature of the iron, and the temperature of the solder joint are variable. The recommended hand soldering guideline is listed in Table 1. The suggested soldering process must keep the power module's internal temperature below the critical temperature of 217℃ continuously.

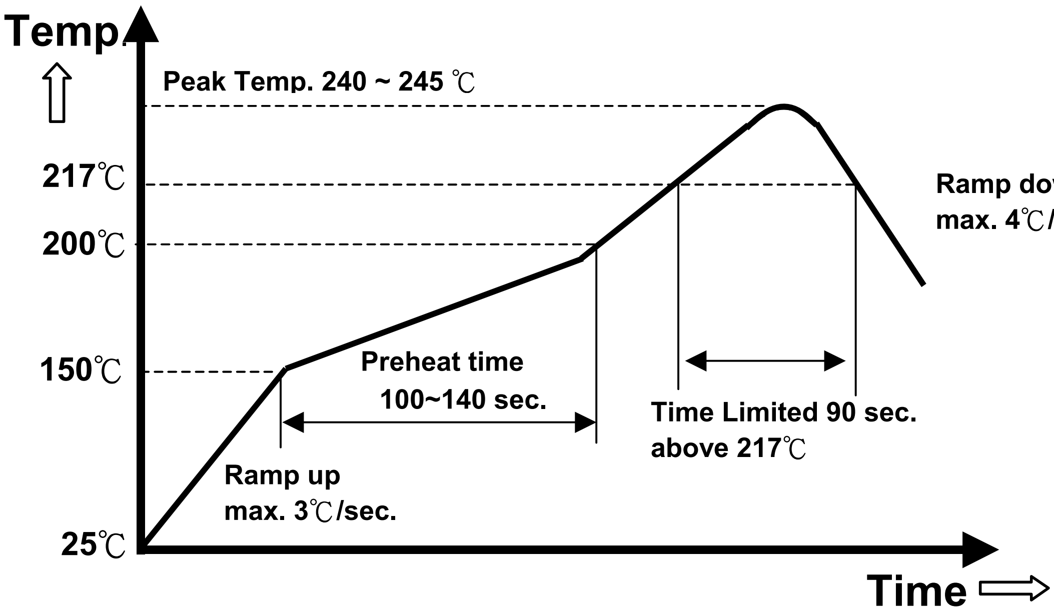
Table 1 Hand-Soldering Guideline

Parameter	Single-side Circuit Board	Double-side Circuit Board	Multi-layers Circuit Board
Soldering Iron Wattage Tip Temperature	90 385+/-10℃	90 420+/-10℃	90 420+/-10℃
Soldering Time	2 ~ 6 seconds	4 ~ 10 seconds	4 ~ 10 seconds

Reflow Soldering (Lead-free)

High temperature and long soldering time will result in IMC layer increasing in thickness and thereby shorten the solder joint lifetime. Therefore the peak temperature over 245℃ is not suggested due to the potential reliability risk of components under continuous high-temperature. In the meanwhile, the soldering time of temperature above 217℃ should be less than 90 seconds. Please refer to following fig for recommended temperature profile parameters.

Shielding cap is requested to mount on DCDC module if with heat-spreader/heat-sink, to prevent the customer side high temperature of reflow to re-melt the DCDC module's internal component's soldering joint.



Note: The temperature is measured on solder joint of pins of power module.

PART NUMBERING SYSTEM

Q	54	S	J	108	92	N	C	D	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
Q - Quarter Brick	54 - 40~60V	S - Single	J - Series number	108 - 10.8V	92 - 92A	N - Negative	C - 0.180" R - 0.170" N - 0.145"	D - With PMbus Pins; A - Without PMbus Pins P - With PMbus Pins & for PIH process	A - Open frame H - With base plate

RECOMMENDED PART NUMBER

Model Name	Input		Output		Peak Eff.
Q54SJ10892NCDH	40V~60V	27	10.8V	92A	97.6%

*the model can't be processed with reflow process.

RECOMMENDED PART NUMBER

Model Name	Input		Output		Peak Eff.
Q54SJ10892NCPH	40V~60V	27	10.8V	92A	97.6%

*the model can be processed with reflow process and packing by JEDEC tray

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.

Information furnished by Delta is believed to be accurate and reliable. However, no responsibility is assumed by Delta for its use, nor for any infringements of patents or other rights of third parties, which may result from its use. No license is granted by implication or otherwise under any patent or patent rights of Delta. Delta reserves the right to revise these specifications.