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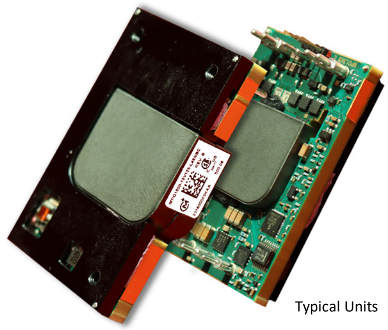
INNOVATOR IN ELECTRONICS



FEATURES

- Input Range of 40-60V, (54V nominal)
- Semi-regulated 12V output
- Continuous Output of 12V @ 125A
- Peak Efficiency of 97.2%
- 500Vdc Input/Output Isolation
- Industry Standard ¼ Brick Package
- Baseplate for Cooling Optimization
- 3+ units can be operated in parallel
- Overcurrent and Overvoltage protection
- PMBus™ 1.2 Interface (optional)
- Black Box Stored Data
- Power-Good Signal
- Remote On/Off Control
- RoHS Compliant

For full details go to
https://www.murata-ps.com/rohs

SAFETY APPROVALS

- UL 62368-1 3rd Edition
- CSA C22.2 No. 62368-1-19
- IEC 62368-1:2018

PRODUCT OVERVIEW

The MPQ1500-12V125-L48 is a highly efficient, 1.5kW digitally controlled isolated intermediate bus converter, which converts 40-60Vdc input into an isolated, semi-regulated 12Vdc output, fully protected from overcurrent, overtemperature. and overvoltage. Industry standard quarter-brick with optional PMBus™ interface.

ORDERING GUIDE

Part Number[1]	V_{IN}	V_{OUT}	P_{OUT}	L inch(mm)	W inch(mm)	H inch(mm)
MPQ1500-12V125-L48NBC	40-60Vdc	12Vdc	1500W	2.3 (58.42)	1.45 (36.83)	0.535 (13.6)
MPQ1500-12V125-L48NBMC	40-60Vdc	12Vdc	1500W	2.3 (58.42)	1.45 (36.83)	0.535 (13.6)
MPQ1500-12V125-L48NBSC	40-60Vdc	12Vdc	1500W	2.3 (58.42)	1.45 (36.83)	0.535 (13.6)
MPQ1500-12V125-L48NBMSC	40-60Vdc	12Vdc	1500W	2.3 (58.42)	1.45 (36.83)	0.535 (13.6)

[1] See the Part Number Structure table on page 2 for more information.

ABSOLUTE MAXIMUM RATINGS[1]

Parameter	Conditions	Min.	Nom.	Max.	Units
Input Voltage		-0.5	-	65	Vdc
Isolation Voltage	Input to Output	-	-	500	
On/Off Remote Control	Power on, referred to -Vin	0	-	25	
Output Power[2]	Vin=52-60V	0	-	2000	W
Operating Temperature Range[3]		-40	-	125	°C
Storage Temperature Range	Vin=Zero (no power)	-55	-	125	

[1] Absolute maximum are stress ratings. Exposure of devices to greater than any of these conditions might adversely affect long-term reliability.
[2] Output peak power 2000W continuous 3ms.
[3] See the thermal consideration section.

INPUT VOLTAGE CHARACTERISTICS

Parameter	Conditions	Min.	Nom.	Max.	Units
Input Voltage, Operating		40	54	60	Vdc
Start-up Voltage		36	38	40	
Input Capacitance	Per unit, Nichicon UPM2A271MHD or equivalent	270	-	-	µF
Input Current	Vin @ 40V	-	30.5	35.0	A
Inrush Current[1]		-	-	50%	% of Iin
Ripple Current[2]		-	1.25	-	mA_{RMS}/W

OUTPUT VOLTAGE CHARACTERISTICS

Parameter	Conditions	Min.	Nom.	Max.	Units
Peak Efficiency	Vin=52V, Pout=1000W, Ta=25°C	-	97.2	-	%
Switching Frequency	Input to Output	-	280	-	kHz
Output Voltage Set Point[3] (w/o "S")	Vin=54V, Pout=0W, Tc=25°C	12.00	12.04	12.08	Vdc
Output Voltage Set Point[3] (with "S")	Vin=54V, Pout=0W, Tc=25°C	12.12	12.16	12.20	
Output Current		0	-	125	A
Output Power		-	-	1500	W
Ripple & Noise[4]	20MHz Bandwidth	-	-	120	mVp-p
Output Capacitance	50% ceramic, 50% Oscon or POSCAP	0	-	8,125	µF
Load Regulation (w/o "S")		-	30	-	mV
Load Regulation (with "S")		-	400	-	
Output Voltage Accuracy (w/o "S")	Vin=40-52V, 0-100% of load	9.10	-	12.10	Vdc
Output Voltage Accuracy (with "S")	Vin=40-52V, 0-100% of load	9.10	-	12.35	
Output Voltage Accuracy (w/o "S")	Vin=52-60V, 0-100% of load	11.90	-	12.10	
Output Voltage Accuracy (with "S")	Vin=52-60V, 0-100% of load	11.55	-	12.35	
Current Sharing Accuracy (with "S")		-	-	10	%

NOTES: (continued from page 1)

[1] Iin is defined as the steady-state operating current when the unit is operating at Vin Max and Pout Max. While Vout is rising, Pout is<=25% of Rated Power with a resistive load.

[2] Measured at input pin with maximum specified Cin and <500uH inductance between voltage source and Cin.

[3] The standalone version (without “S” suffix) does not support load sharing. The “S" version only supports load sharing.

[4] Cout = 1uF/W minimum, approximately 50% ceramic, 50% Oscon or POSCAP. bandwidth = 20MHz.

[5] 3+ units from the same supplier operated in parallel, units output power must share within 10% of each other when unit operating at the highest power level is operating at Pout Max. See Load Sharing and Load Sharing Guidelines in the Technical Notes section.

PART NUMBER STRUCTURE														
Product Family	M	P												MP = Murata Power
Form Factor			Q											Q = Quarter Brick
Output Power				1500										1500W
Output Voltage					12V									12Vout
Output Current						125								125A
Input Voltage Range							L48							L48 = 40-60Vin
On/Off Control Logic								N						N = Negative Logic (Default)
Mechanical Configuration									B					B = Baseplate
PMBus (option)										M				M = with PMBus interface, Blank = without PMBus interface
Load Sharing (option)[1]											S			S = Load Sharing, Blank = No Load Sharing Option
Power Good Signal (option)[1]												G		Contact factory.
RoHS													C	C = RoHS Compliant

[1] Contact factory or local sales channels for availability.

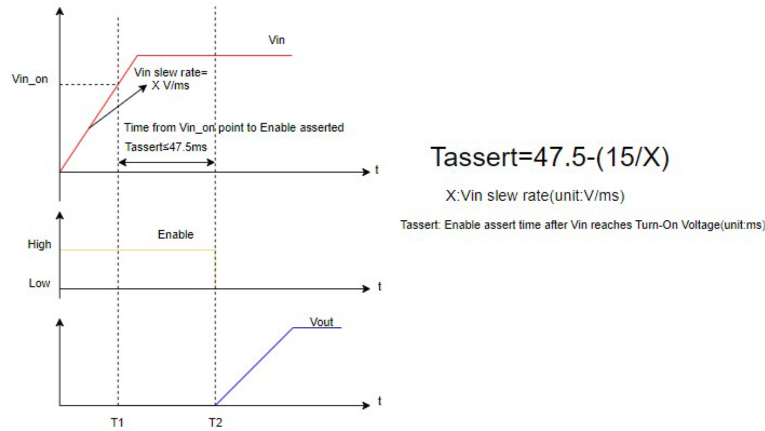
RELIABILITY & SAFETY					
Parameter	**Conditions**	**Min.**	**Nom.**	**Max.**	**Units**
Isolation Voltage	Input to Output Test Voltage	-	-	500	Vdc
	Input to Baseplate Test Voltage	-	-	500	
	Baseplate to Output Test Voltage	-	-	500	
Safety Rating	Functional Insulation	-	-	-	-
Isolation Capacitance		-	1500	-	pF
Calculated MTBF	Telcordia SR-332 @ 90°C baseplate temp.	2	-	-	Mhrs

TURN-ON/TURN-OFF CHARACTERISTICS					
	Conditions	**Min.**	**Nom.**	**Max.**	**Units**
Turn-On Delay-1[1]	From Vin reaching Turn-On voltage, Vin slew rate is 1 v/ms.	30	-	50	ms
Turn-On Delay-2[1]	From Enabled asserted.	-	-	5	
Restart Delay		-	-	250	
Output Voltage Rise Time		-	-	15	
Pre-Bias Voltage		0	-	V_{out}	Vdc

[1.] Different Vin slew rates can lead different delay times. For relationship of the delay time and slew rate, see the following formula:

Turn-On Delay-1=47.5-\frac{15}{X}   (X means Vin slew rate, unit is V/ms)

Start-up Timing, (Vout vs. Vin & On/Off Control)



PROTECTION

	Conditions	Min.	Nom.	Max.	Units
Vin Undervoltage Shutdown		32	34	36	Vdc
Vin UVP Hysteresis		2	-	6	
Vin Overvoltage Shutdown		62	64	67	
Vin Overvoltage Shutdown Recover		59	61	64	
Vin OVP Hysteresis		2	-	6	
Vout Overvoltage Shutdown		-	13.2	-	
Output Over-Current		137.5	-	162.5	%
Over-Temperature (internal temperature sensor)		120	125	130	°C

Note: The protection threshold can be configured through PMBus. See the PMBus section for details.

OUTPUT ENABLE (NEGATIVE LOGIC)

Parameter	Conditions	Min.	Nom.	Max.	Units
Unit OFF: On/Off Pin open or [1, 2, 3]		2.4	-	20	Vdc
Unit ON: On/Off Pin low or [1, 2, 3]		-0.1	-	0.8	Vdc
Enable Pin Current (into pin, ext. pull-up to 15V) [1, 2, 3]		-	-	0.5	mA
Enable Pin Current (into pin, ext. pull-up to 10V) [1, 2, 3]		-	-	0.3	mA

[1] Enable signal is referenced to V_{in}(-).
[2] Unit disabled via Control Pin, open collector configuration.
[3] The enable logic can be changed via the PMBus.

DYNAMIC CHARACTERISTICS

Parameter	Conditions	Min.	Nom.	Max.	Units
Dynamic Load Response [1, 2, 4]	1, 2, 4	-	-	500	µS
Dynamic Load Peak Deviation [1, 2, 4]	1, 2, 4	-	-	±350	mV
Response to Vin Step [3]	3	-	-	1.25	Vdc

[1] 50-75-50% load step of Pout Max at 1A/µS, settling time to within 1% of Vout, measurement method. See Figure 3.
[2] With a 2000µF output capacitance, 50% ceramic, 50% OSCON or POSCAP.
[3] The occurring max 0.1v/us rate within Vin range 52V-60V, Pout = 10% - 100% Rated Power, Cout = Cout Max /2.
[4] 350mV is only for close loop input voltage range 52V-60V.

POWER-GOOD SIGNAL[1]

Parameter	Conditions	Min.	Nom.	Max.	Units
Output Voltage Low (trigger limits)		7.8	8.0	8.2	Vdc
Output Voltage Hysteresis		0.2	0.3	-	
High State Voltage		0	-	5.5	
High State Leakage Current (into pin)		0	-	10	µA
Low State Voltage		0	-	0.8	Vdc
Low State Current (into pin)		0	-	5	mA
Power Good Signal De-assert Response Time		0	-	3	ms
Power Good Signal Assert Response Time		0	-	3	

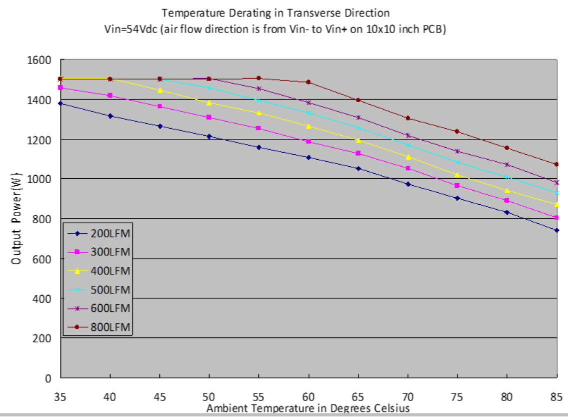
[1] The power good logic can be changed via PMBus.

ENVIRONMENTAL CHARACTERISTICS					
Parameter	**Conditions**	**Min.**	**Nom.**	**Max.**	**Units**
Operating Temperature - Ambient		-5	-	85	°C
Storage Temperature		-55	-	125	
Altitude, Operating		-500	-	13,120	feet
Relative Humidity, Operating, Non-Condensing		10	-	90	%
Relative Humidity, Non-Operating, Non-Condensing		10	-	95	
Thermal Protection/Shutdown			125		°C
Electromagnetic Interference, (External filter required)			B		Class
Conducted, EN55022/CISPR22, Part 15 (With external filter)			See Page 20.		

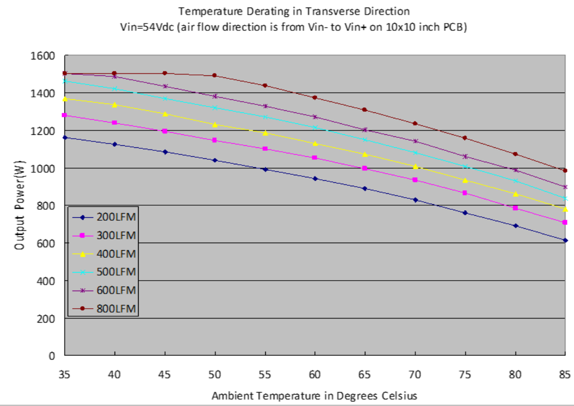
GENERAL INFORMATION					
Parameter	**Conditions**	**Min.**	**Typ.**	**Max.**	**Units**
Mechanical Dimensions (L x W x H)			2.30 x 1.45 x 0.535		Inches
			58.42 x 36.83 x 13.6		mm
Product Weight (per unit)			2.82		Ounces
			80		Grams
Pin Length			0.180		Inches
			4.57		mm
Pin Diameter			0.040/0.060		Inches
			1.016/1.524		mm
Pin Material			Copper with Matte Tin plating over Nickel under plating		
Baseplate Material			Black Anodized Aluminum		

PERFORMANCE CURVES

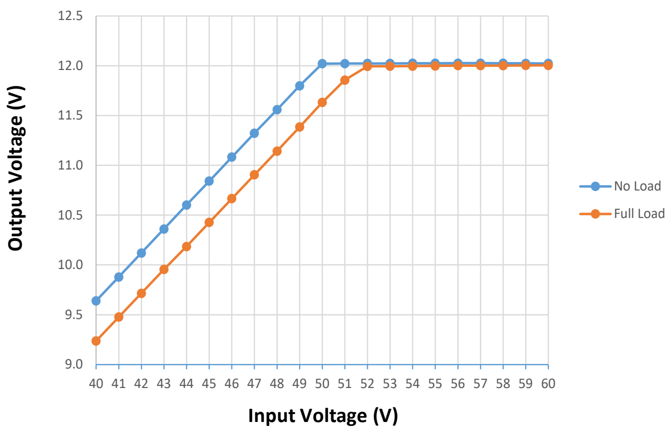
Vin = 54V, with 1" Heatsink



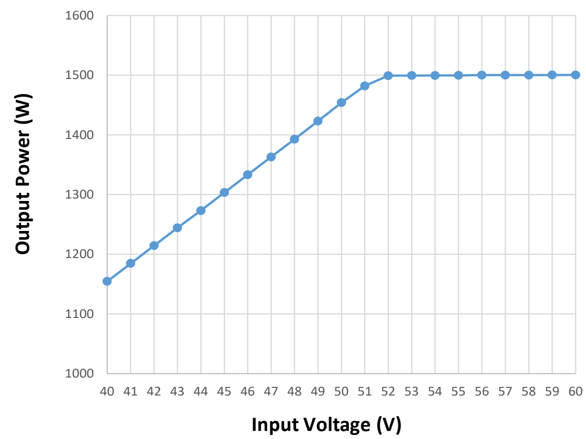
Vin = 54V, with 0.5" Heatsink



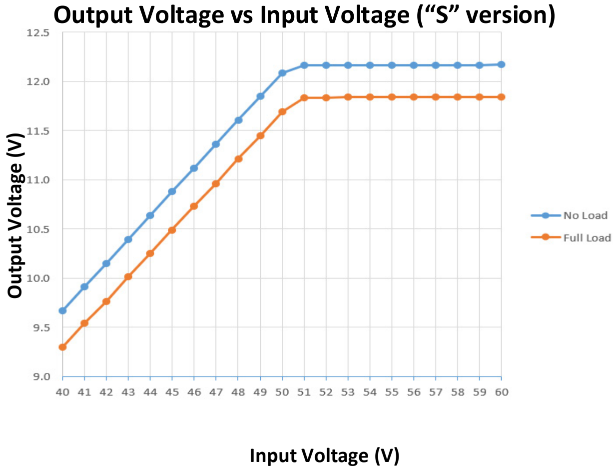
Output Voltage vs Input Voltage



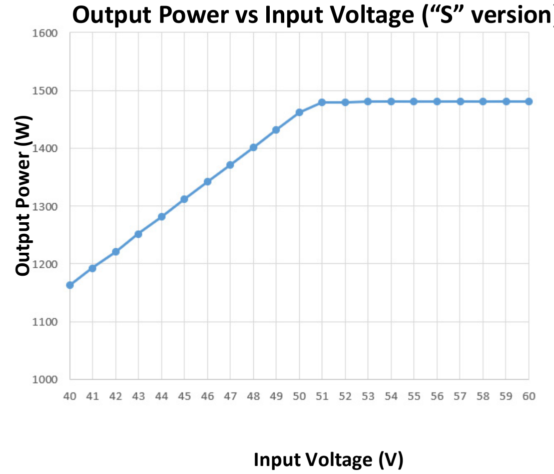
Output Power vs Input Voltage



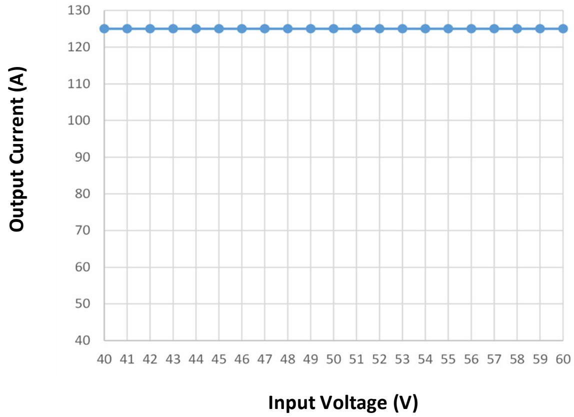
Output Voltage vs Input Voltage ("S" version)



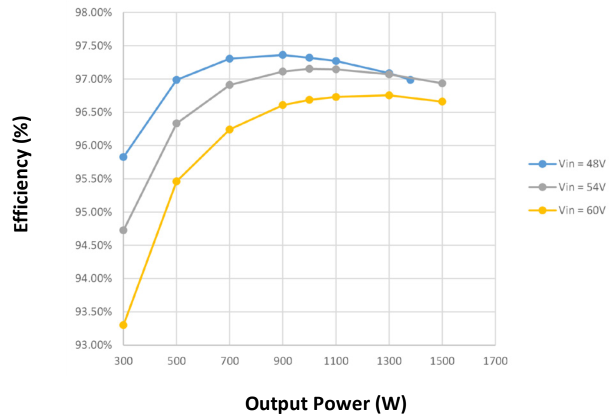
Output Power vs Input Voltage ("S" version)



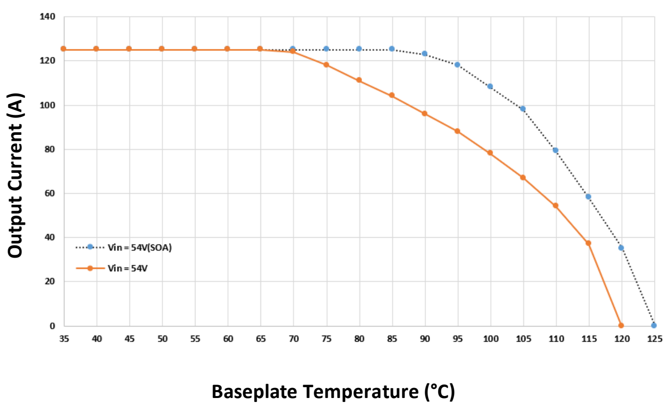
Output Current vs Input Voltage



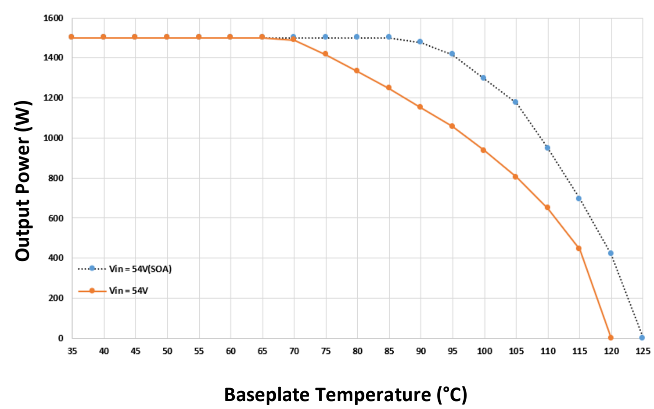
Efficiency vs Output Power



Output Current vs Baseplate Temperature



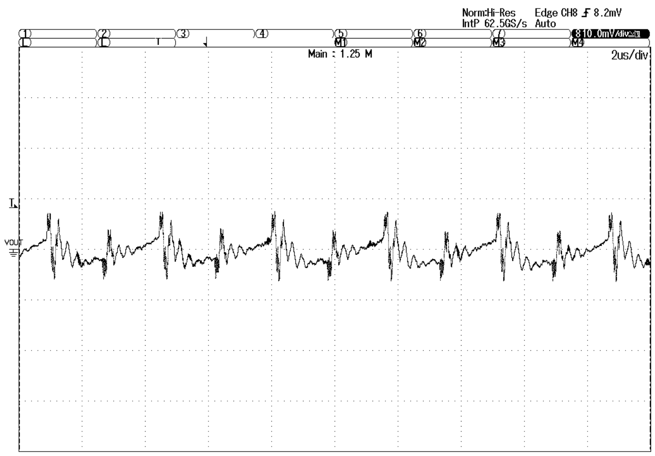
Output Power vs Baseplate Temperature



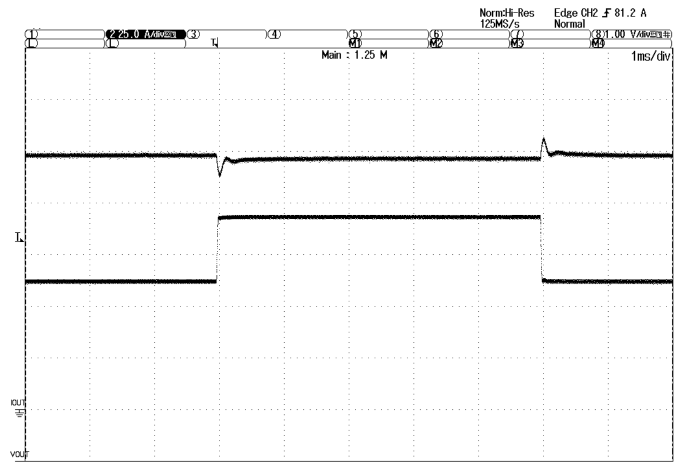
NOTE: The area below the orange curve is the recommended operating conditions following IPC9592 component derating guidelines. The area below the blue curve is the absolute maximum temperature where the components can reach the component manufacturers maximum operating temperatures, not recommended for long-term operation.

PERFORMANCE CURVES

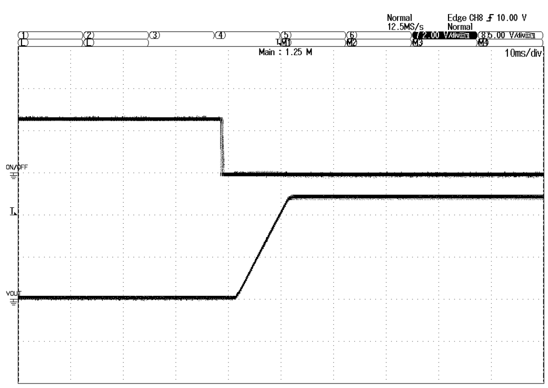
Ripple & Noise Waveform (Vin = 54V, Iout = 125A)



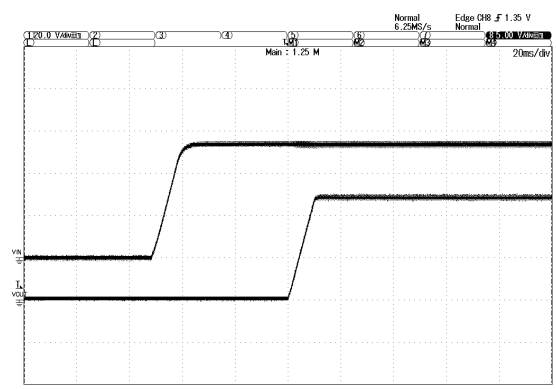
Transient Response (Vin = 54V, 50%-75%-50% Load, 1A/µS)



Enable Turn On – Negative Logic (Vin = 54V, Iout = 125A)



Vin Turn On (Vin = 54V, Iout = 125A)



PMBus Monitoring Accuracy

Parameter	Notes and Conditions	Min.	Typ.	Max.	Units
PMBus General	PMBus Rev. 1.2; SMBALERT# is supported; PEC is supported; Linear data format is used.				
Bus Speed			100/400		kHz
Logic High Input		2.1		3.3	Vdc
Logic Low Input		0		0.8	Vdc
Logic High Output		2.3			Vdc
Logic Low Output				0.4	Vdc
PMBus Monitoring Accuracy					
VIN_READ		-4		4	%
VOUT_READ		-2		2	%
IOUT_READ	Vin=54V, Io=50% ~ 100% of Io, max;	-5		5	%
	Vin=54V, Io=5% ~ 50% of Io, max;	-3		3	A
TEMP_READ		-5		5	°C

PMBus Commands List

CMD	Command Name	SMBus Transaction Type: Writing Data	SMBus Transaction Type: Reading Data	Number Of Data Bytes	Default Value		Data limits	Unit
01h	OPERATION	Write Byte	Read Byte	1	0x80			
02h	ON_OFF_CONFIG	Write Byte	Read Byte	1	0b000111x1			
03h	CLEAR_FAULTS	Send byte	N/A	0	N/A			
10h	WRITE_PROTECT	Write Byte	Read Byte	1	0x00			
11h	STORE_DEFAULT_ALL	Send byte	N/A	0	N/A			
12h	RESTORE_DEFAULT_ALL	Send byte	N/A	0	N/A			
15h	STORE_USER_ALL	Send byte	N/A	0	N/A			
16h	RESTORE_USER_ALL	Send byte	N/A	0	N/A			
19h	CAPABILITY	N/A	Read Byte	1	0b10110000			
1Ah	QUERY	N/A	Block Write-Block Read Process Call	1	N/A			
1Bh	SMBALERT8	N/A	Block Write-Block Read Process Call	2	N/A			
20h	VOUT_MODE	N/A	Read Byte	1	0x1A			
22h	VOUT_TRIM	Write Word	Read Word	2	0x0000	0	-3~2	V
28h	VOUT_DROPP	Write Word	Read Word	2	0x0000	0	0~25	mΩ
35h	VIN_ON	Write Word	Read Word	2	0xE970	38.0	> VIN_OFF	V
36h	VIN_OFF	Write Word	Read Word	2	0xE950	32.0	< VIN_ON	V
40h	VOUT_OV_FAULT_LIMIT	Write Word	Read Word	2	0x034D	13.20	13.0~15.9	V
41h	VOUT_OV_FAULT_RESPONSE	Write Byte	Read Byte	1	0b10000000			
42h	VOUT_OV_WARN_LIMIT	Write Word	Read Word	2	0x0340	13.00	13.00~15.75	V
46h	IOUT_OC_FAULT_LIMIT	Write Word	Read Word	2	0xF244	145.0	120~255	A

47h	IOUT_OC_FAULT_RESPONSE	Write Byte	Read Byte	1	0xFD			
4Ah	IOUT_OC_WARN_LIMIT	Write Word	Read Word	2	0xF208	130.0	90~150	A
4Fh	OT_FAULT_LIMIT	Write Word	Read Word	2	0xF1F4	125	100~150	°C
50h	OT_FAULT_RESPONSE	Write Byte	Read Byte	1	0xC0			
51h	OT_WARN_LIMIT	Write Word	Read Word	2	0xF1CC	115	50~140	°C
55h	VIN_OV_FAULT_LIMIT	Write Word	Read Word	2	0xEA00	64.0	50.25~70	V
56h	VIN_OV_FAULT_RESPONSE	Write Byte	Read Byte	1	0xC0			
57h	VIN_OV_WARN_LIMIT	Write Word	Read Word	2	0xE9F0	62.0	50.25~70	V
58h	VIN_UV_WARN_LIMIT	Write Word	Read Word	2	0xE960	36.0	30~70	V
59h	VIN_UV_FAULT_LIMIT	Write Word	Read Word	2	0xE910	34.0	30~70	V
5Ah	VIN_UV_FAULT_RESPONSE	Write Byte	Read Byte	1	0xC0			
5Eh	POWER_GOOD_ON	Write Word	Read Word	2	0x0200	8.00	4.5~10.5	V
5Fh	POWER_GOOD_OFF	Write Word	Read Word	2	0x0140	5.00	4.5~10.5	V
61h	TON_RISE	Write Word	Read Word	2	0x000A	10	0~1024	ms
78h	STATUS_BYTE	Write Byte	Read Byte	1	N/A			
79h	STATUS_WORD	Write Word	Read Word	2	N/A			
7Ah	STATUS_VOUT	Write Byte	Read Byte	1	N/A			
7Bh	STATUS_IOUT	Write Byte	Read Byte	1	N/A			
7Ch	STATUS_INPUT	Write Byte	Read Byte	1	N/A			
7Dh	STATUS_TEMPERATURE	Write Byte	Read Byte	1	N/A			
7Eh	STATUS_CML	Write Byte	Read Byte	1	N/A			
88h	READ_VIN	N/A	Read Word	2	N/A			V
8Bh	READ_VOUT	N/A	Read Word	2	N/A			V
8Ch	READ_IOUT	N/A	Read Word	2	N/A			A
8Dh	READ_TEMPERATURE_1	N/A	Read Word	2	N/A			°C
94h	READ_DUTY_CYCLE	N/A	Read Word	2	N/A			
95h	READ_FREQUENCY	N/A	Read Word	2	N/A			kHz
96h	READ_POUT	N/A	Read Word	2	N/A			W
98h	PMBUS_REVISION	N/A	Read Byte	1	0x22			
99h	MFR_ID	N/A	Block Read	<=22	"Murata Power Solutions"			
9Ah	MFR_MODEL	Block Write*	Block Read	<=28	"MPQ1500-12V125-L48##########"			
9Bh	MFR_REVISION	Block Write*	Block Read	<=6	"S##.##"			
9Ch	MFR_LOCATION	Block Write*	Block Read	<=9	"Hip Fung"			
9Dh	MFR_DATE	Block Write*	Block Read	<=10	"MM/DD/YY"			
9Eh	MFR_SERIAL	Block Write*	Block Read	<=14	"000000001#####"			
A0h	MFR_VIN_MIN	N/A	Read Word	2	0xE900	32.0		V
A1h	MFR_VIN_MAX	N/A	Read Word	2	0xEA00	64.0		V
A2h	MFR_IIN_MAX	N/A	Read Word	2	0xF0C3	48.75		A
A3h	MFR_PIN_MAX	N/A	Read Word	2	0x1226	2200		W
A4h	MFR_VOUT_MIN	N/A	Read Word	2	0x0220	8.50		V

A5h	MFR_VOUT_MAX	N/A	Read Word	2	0x0340	13.00		V
A6h	MFR_IOUT_MAX	N/A	Read Word	2	0x2A80	170.0		A
A7h	MFR_POUT_MAX	N/A	Read Word	2	0x11F4	2000		W
A8h	MFR_TAMBIENT_MAX	N/A	Read Word	2	0xF154	85.0		°C
A9h	MFR_TAMBIENT_MIN	N/A	Read Word	2	0xF760	-40.0		°C
Adh	IC_DEVICE_ID	N/A	Block Read	26	"Microchip dsPIC33CK64MP103"			
DAh	MFR_EEPROM_ERASE	Write Word*	Read Word	2	N/A			
DDh	MFR_ON_OFF_CONFIG	Write Byte*	Read Byte	1	00			
DEh	MFR_POWER_GOOD_POLARITY	Write Byte	Read Byte	1	0b00000001			
DFh	MFR_BLACK_BOX_CONFIG	Write Byte	Read Byte	1	0b00000011			
E0h	MFR_READ_HISTORY EVENTS	N/A	Block Read	32	N/A			
E1h	MFR_SET_HISTORY_EVENT_OFFSET	Write Byte	Read Byte	1	N/A			
E8h	MFR_VIN_OV_HYS	Write Word*	Read Word	2	N/A			V
E9h	MFR_VIN_UV_HYS	Write Word*	Read Word	2	N/A			V
EAh	MFR_TEMPERATURE_OT_HYS	Write Word*	Read Word	2	N/A			°C
F6h	MFR_CALIBRATION_STATUS	N/A	Read Byte	1	N/A			
F8h	CAL_READ_VOUT	Block Write*	Block Read	4	N/A			
F9h	CAL_READ_VIN	Block Write*	Block Read	4	N/A			
FAh	CAL_READ_IOUT	Block Write*	Block Read	4	N/A			
FBh	CAL_VOUT_ADJUST	Write Word	Read Word	2	N/A			
FCh	MFR_SUPERVISOR_PASSWORD	Block Write	N/A	N/A	N/A			

Notes:

* Only available in supervisor mode (default state is user mode, send password to command 0xFC to change to supervisor mode).

a) Unit restores the entire contents of the non-volatile User Store memory when power up.
b) PEC is needed for writing or sending data to the power module.
c) Maximum bus speed: 400kHz.
d) Linear data format used.
e) Addressing: If PMBus address setting out of the address table, default PMBus address 64d is assigned instead.

MFR Commands

01-CFh Refer to PMBUS 1.2 SPEC

DAh MFR_EEPROM_ERASE

Erase the data stored in EEPROM

DDh MFR_ON_OFF_CONFIG

Set the ON/OFF polarity

Bits	Meaning
7:3	RSVD
2	Controls how the unit responds to the CONTROL pin 1:Unit requires the primary ON/OFF pin to start the unit. 0:Unit ignores the primary ON/OFF pin.
1	Polarity of primary ON/OFF logic 1:Active high (Pull high or open to start the unit). 0:Active low (Pull pin low to start the unit).
0	RSVD

DEh MFR_POWER_GOOD_POLARITY

Set the POWER GOOD signal polarity

Bits	Meaning
7:1	RSVD
0	1:Negative logic, output low if Vout rises to specific value 0:Positive logic, output high if Vout rises to specific value

DFh MFR_BLACK_BOX_CONFIG

Config black box enable/disable and store mode

If overwrite function is disabled, black box only records 7 faults, then it will lock and no more faults will be recorded. If overwrite function is enabled, when fault log is full, the new fault will overwrite the previous fault, starting from entry 1.

Bits	Meaning
7:2	RSVD
1	Overwrite function; 1: Enable 0: Disable
0	Black box function; 1: Enable 0: Disable

E0h MFR_READ_HISTORY_EVENTS

Read the black box stored data

Bytes	Meaning	Bytes	Meaning
0	Event Number	16	Power On Timer Byte0
1	Status Word High Byte	17	Power On Timer Byte1
2	Status Word Low Byte	18	Power On Timer Byte2
3	Status Vout	19	Power On Timer Byte3
4	Status Iout	20	RSVD
5	Status Input	21	RSVD
6	Status Temperature	22	RSVD
7	Status CML	23	RSVD
8	READ_VIN High Byte	24	RSVD
9	READ_VIN Low Byte	25	RSVD
10	READ_VOUT High Byte	26	RSVD
11	READ_VOUT Low Byte	27	RSVD
12	READ_IOUT High Byte	28	RSVD
13	READ_IOUT Low Byte	29	RSVD
14	READ_TEMPERATURE High Byte	30	RSVD
15	READ_TEMPERATURE Low Byte	31	RSVD

E1h MFR_SET_HISTORY_EVENT_OFFSET

READ HISTORY EVENT OFFSET(0xE1):
Send command 0XE1 and read one byte, it will return the next event log offset value x.

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 is read back. The maximum value of the offset is 6, if the history data is large than 20, it recounts from 6 to 0.

E8h MFR_VIN_OV_FAULT_HYS

Hysteresis of VIN_OV_FAULT recover, Linear data format

E9h MFR_VIN_UV_FAULT_HYS

Hysteresis of VIN_UV_FAULT recover, Linear data format

EAh MFR_OT_FAULT_HYS

Hysteresis of OT_FAULT recover, Linear data format

Status Word and Byte

GREEN = supported

STATUS_VOUT
7 VOUT_OV_FAULT
6 VOUT_OV_WARNING
5 VOUT_UV_WARNING
4 VOUT_UV_FAULT
3 VOUT_MAX Warning
2 TON_MAX_FAULT
1 TOFF_MAX_WARNING
0 VOUT Tracking Error

STATUS_WORD
7 VOUT
6 IOUT/POUT
5 INPUT
4 MFR_SPECIFIC
3 POWER_GOOD#
2 FANS
1 OTHER
0 UNKNOWN
7 BUSY
6 OFF
5 VOUT_OV_FAULT
4 IOUT_OC_FAULT
3 VIN_UV_FAULT
2 TEMPERATURE
1 CML
2 CML

STATUS_INPUT
7 VIN_OV_FAULT
6 VIN_OV_WARNING
5 VIN_UV_WARNING
4 VIN_UV_FAULT
5 VIN_UV_FAULT
2 IIN_OC_FAULT
1 IIN_OC_WARNING
0 PIN_OP_WARNING

STATUS_IOUT
7 IOUT_OC_FAULT
6 IOUT_OC_LV_FAULT
5 IOUT_OC_WARNING
4 IOUT_UC_FAULT
3 Current Share Fault
2 In Power Limiting Mode
1 POUT_OP_FAULT
0 POUT_OP_WARNING

STATUS_MFR_SPECIFIC
Manufacturer Defined
Manufacturer Defined
Manufacturer Defined
Manufacturer Defined
Manufacturer Defined
Manufacturer Defined
Manufacturer Defined
Manufacturer Defined

STATUS_OTHER
7 Reserved
6 Reserved
5 Input A Fuse/Breaker Fault
4 Input B Fuse/Breaker Fault
3 Input A OR-ing Device Fault
2 Input B OR-ing Device Fault
1 Output OR-ing Device Fault
0 Reserved

STATUS_TEMPERATURE
7 OT_FAULT
6 OT_WARNING
5 UT_WARNING
4 UT_FAULT
3 Reserved
2 Reserved
1 Reserved
0 Reserved

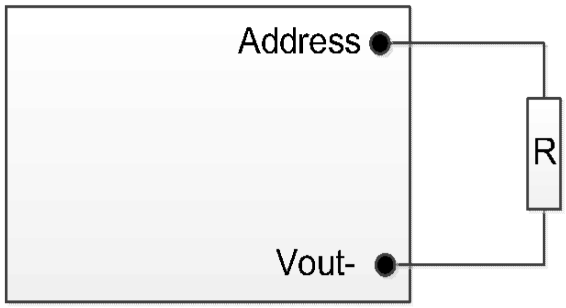
STATUS_FANS_1_2
7 Fan 1 Fault
6 Fan 2 Fault
5 Fan 1 Warning
4 Fan 2 Warning
3 Fan 1 Speed Override
2 Fan 2 Speed Override
1 Air Flow Fault
0 Air Flow Warning

STATUS_CML
7 Invalid/Unsupported Command
6 Invalid/Unsupported Data
5 Packet Error Check Failed
4 Memory Fault Detected
3 Processor Fault Detected
2 Reserved
1 Other Communication Fault
0 Other Memory Or Logic Fault

STATUS_FANS_3_4
7 Fan 3 Fault
6 Fan 4 Fault
5 Fan 3 Warning
4 Fan 4 Warning
3 Fan 3 Speed Override
2 Fan 4 Speed Override
1 Reserved
0 Reserved

PMBus Address List

The module has flexible PMBus addressing capability. By connecting different resistors from Address pin to GND pin, 14 possible addresses can be acquired. The 7-bit PMBus address is defined by the value of the resistor as shown in the following table and +/-1% resistor accuracy is acceptable. If there is any resistance exceeding the requested range, default address 126 is returned.



PMBus address is selected by applying an external resistor from the Address to Vout (-) as defined in the following table.

PMBus Address	Resistor Value (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
+/-1% resistor accuracy is acceptable	

If the PMBus address setting is out of the address table, default PMBus address 64d is assigned instead.

PIN DEFINITION/DETAILS

Input/Output Pinout Table:

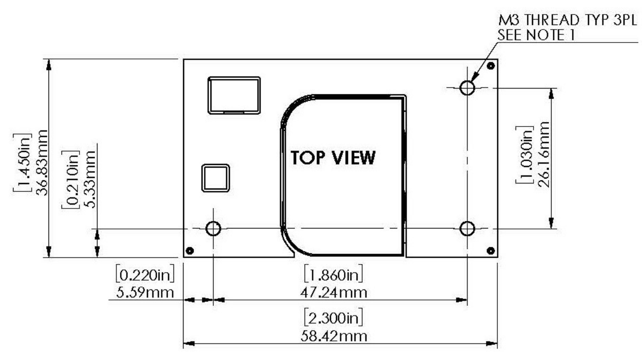
Pin #	Notes	Diameter (inches)	Length (inches)	Name	Function
J1	1, 2	0.040	0.180	Vin(+)	Positive input voltage
J2	1, 2	0.040	0.180	Enable	Turns Unit On (low) and Off (high or open)
J3	1, 2	0.040	0.180	Vin(-)	Negative input voltage
J4	1, 2	0.060	0.180	Vout(-)	Negative output voltage
J5	1, 2	0.060	0.180	Vout(-)	Negative output voltage
J6	1, 2	0.040	0.180	PG	Power Good
J7	1, 2	0.060	0.180	Vout(+)	Positive output voltage
J8	1, 2	0.060	0.180	Vout(+)	Positive output voltage
J9-1		0.028	0.150	Addr0	
J9-2		0.028	0.150	Clock	
J9-3		0.028	0.150	Alert	
J9-4		0.028	0.150	Data	

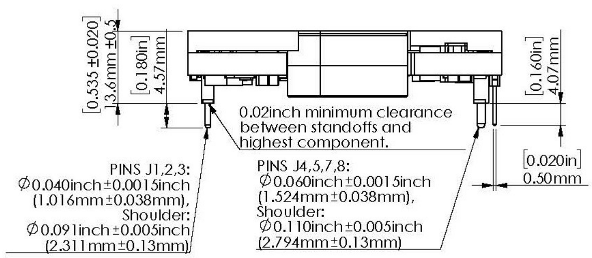
1 Tolerance on pin diameter is ± 0.0015”, tolerance on pin length is ± 0.010”.

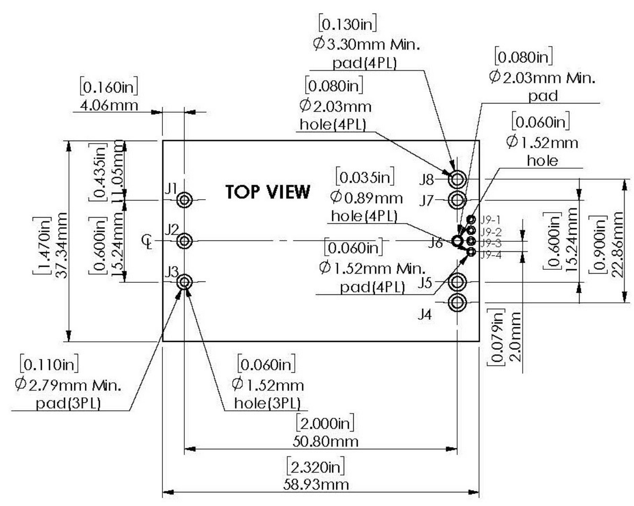
2 Unit’s footprint on Customer’s PCB will have pin holes that are 40mils larger than Unit pin diameter. Design of Unit must prevent Unit from mounting lower on Customer’s PCB than intended. If pin shoulders are used for this purpose, they must be a minimum (including tolerance) of 45mils larger than Unit’s nominal pin diameter. Shoulder design must allow out-gassing from pin holes during Customer’s manufacturing process.

MECHANICAL INFORMATION

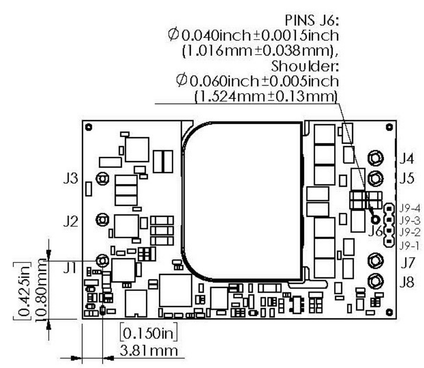
Through-Hole Mount, Baseplate Version







RECOMMENDED FOOTPRINT



Pin	Designation
J1	Vin+
J2	On/Off
J3	Vin-
J4	Vout-
J5	Vout-
J6	PG
J7	Vout+
J8	Vout+
J9-1	Addr0
J9-2	Clock
J9-3	Alert
J9-4	Data

NOTES:
UNLESS OTHERWISE SPECIFIED:
1: M3 SCREW USED TO BOLT UNIT'S BASEPLATE TO OTHER SURFACES MUST NOT EXCEED 0.079"(2.0mm) DEPTH BELOW THE SURFACE OF BASEPLATE. APPLIED TORQUE PER SCREW SHOULD NOT EXCEED 5.3In-lb(0.6Nm)

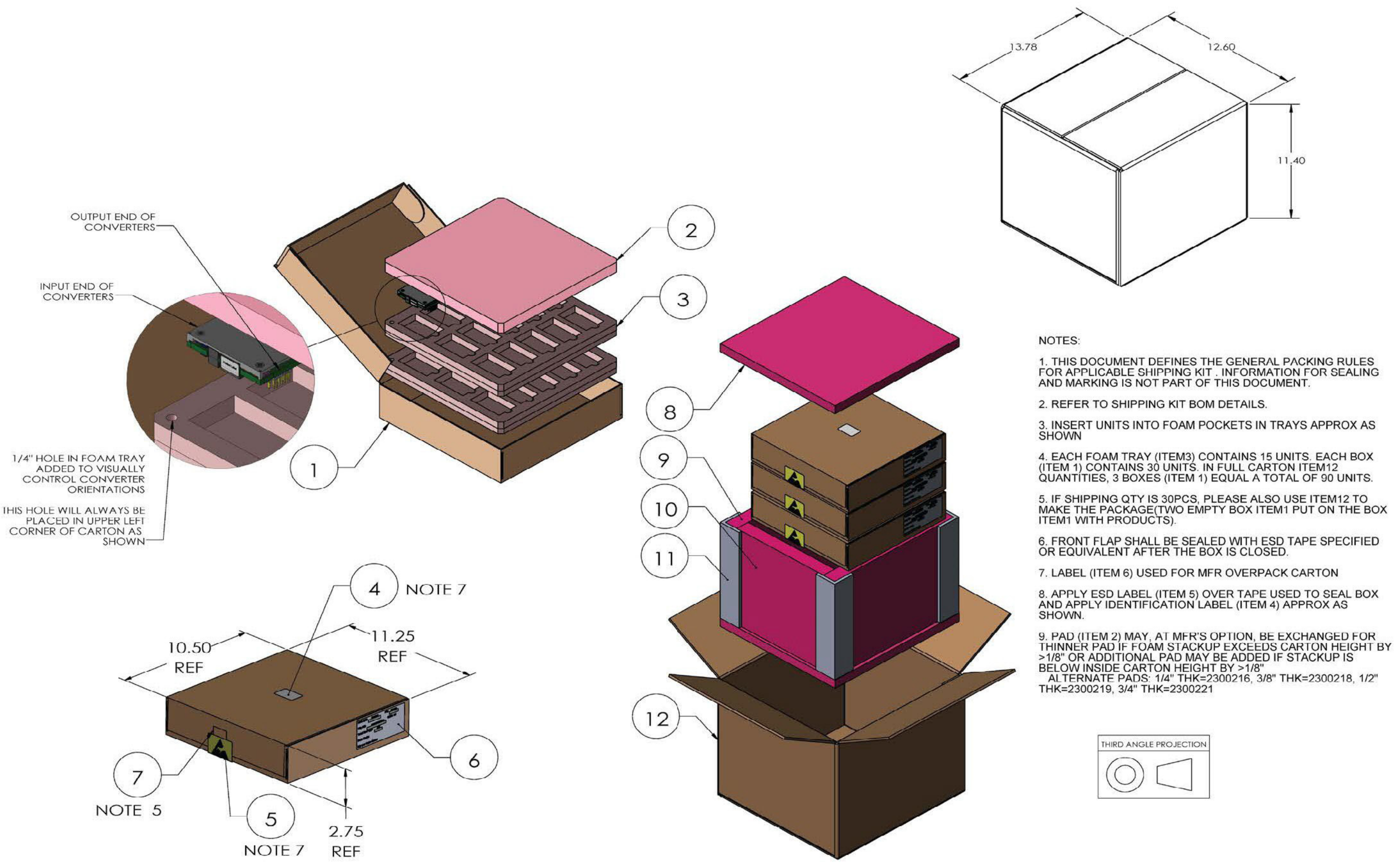
2: FOR COSMETIC SPECIFICATION AND PRODUCTION WORKMANSHIP STANDARD, PLS FOLLOW THE FILE No. 60887.

3: ALLDIMENSION ARE IN INCHES[MILLIMETER].

4: ALL TOLERANCES: x.xxin, ±0.02in(x.xmm, ±0.5mm),
x.xxxin, ±0.01in(x.xxmm, ±0.25mm).

NOTES:
1. The PMBus interface pins (J9-1, J9-2, J9-3, J9-4) are only available on the MPQ1500-12V125-L48NBMC and MPQ1500-12V125-L48NBMSC.
2. The Power Good pin (J6) is optional. Contact the factory.

PACKAGING INFORMATION



MPQ = 90

(15 units per tray, 2 trays per box, 3 boxes/cartons)

Shipping Box Dimensions = 10.0 inches x 10.0 inches x 2.5 inches

TECHNICAL NOTES

THROUGH-HOLE SOLDERING GUIDELINES

Murata Power Solutions recommends the specifications below when installing these converters. These specifications vary depending on the solder type. Exceeding these specifications can cause damage to the product. Your production environment can differ; therefore, thoroughly review these guidelines with your process engineers.

Wave Solder Operations for through-hole mounted products (THMT)

For Sn/Ag/Cu based solders:

Maximum Preheat Temperature	115ºC.
Maximum Pot Temperature	270ºC.
Maximum Solder Dwell Time	7 seconds

For Sn/Pb based solders:

Maximum Preheat Temperature 105ºC.
Maximum Pot Temperature 250ºC.
Maximum Solder Dwell Time 6 seconds

Input Fusing

Certain applications and/or safety agencies might require fuses at the inputs of power conversion components. Fuses should also be used when there is the possibility of sustained input voltage reversal which is not currently limited. For optimal safety, Murata Power Solutions recommends a fast blow fuse installed in the ungrounded input supply line with a value which is approximately twice the maximum line current, calculated at the lowest input voltage. The installer must observe all relevant safety standards and regulations. For safety agency approvals, install the converter in compliance with the end-user safety standard.

Input Under-Voltage Shutdown and Start-Up Threshold

Under normal start-up conditions, converters will not begin to regulate properly until the rising input voltage exceeds and remains at the Start-Up Threshold Voltage (see Specifications). Once operating, converters will not turn off until the input voltage drops below the Under-Voltage Shutdown Limit. Subsequent restart will not occur until the input voltage rises again above the Start-Up Threshold. This built-in hysteresis prevents any unstable on/off operation at a single input voltage. Users should be aware however of input sources near the Under-Voltage Shutdown whose voltage decays as input current is consumed (such as capacitor inputs), the converter shuts off and then restarts as the external capacitor recharges. Such situations could oscillate. To prevent this, ensure the operating input voltage is above the UV shutdown voltage at all times.

Start-Up Delay

Assuming that the output current is set at the rated maximum, the Vin to Vout Start-Up Time (see Specifications) is the time interval between the point when the rising input voltage crosses the Start-Up Threshold and the fully loaded regulated output voltage enters and remains within its specified regulation band. Actual measured times will vary with input source impedance, external input capacitance, input voltage slew rate and final value of the input voltage as it appears at the converter.

These converters include a soft start circuit to moderate the duty cycle of the PWM controller at power up, thereby limiting the input inrush current. The On/Off Remote Control interval from inception to Vout regulated assumes that the converter already has its input voltage stabilized above the Start-Up Threshold before the On command. The interval is measured from the On command until the output enters and remains within its specified regulation band. The specification assumes that the output is fully loaded at maximum rated current.

Input Source Impedance

To ensure peak performance and stability of this module in all applications, the input source impedance and load conditions must be understood. The input source and load conditions will affect the performance of the module in the application. The input source must have a low impedance and to ensure this, a minimum input capacitor of 270uF is recommended, mounted as close as possible to the input pins of the module. The type of capacitor should also be considered, an electrolytic capacitor will degrade at lower temperatures therefore, the chosen capacitor should allow for temperature variations during operation of the module and maintain 270uF. If the input source is inductive, additional low ESR ceramic capacitors in the range of 22-100pF is required across the Vin terminals to ensure stable operation. The output load also influences the minimum input capacitor requirements. Higher power, dynamic loading conditions might require higher input capacitance to ensure stable operation.

I/O Filtering, Input Ripple Current and Output Noise

All models in this converter series are tested and specified for input reflected ripple current and output noise using designated external input/output components, circuits and layout as shown in the figures below. External input capacitors (Cin in the figure) serve primarily as energy storage elements, minimizing line voltage variations caused by transient IR drops in the input conductors. Users should select input capacitors for bulk capacitance (at appropriate frequencies), low ESR and high RMS ripple current ratings. In the figure below, the Cbus and Lbus components simulate a typical DC voltage bus. Your specific system configuration might require additional considerations. Note that the values of Cin, Lbus and Cbus will vary according to the specific converter model.

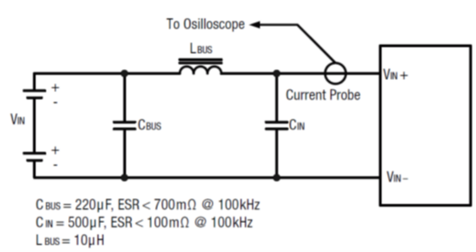


Figure 2. Measuring Input Ripple Current

In critical applications, output ripple and noise (also referred to as periodic and random deviations (PARD) can be reduced by adding filter elements such as multiple external capacitors. Be sure to calculate component temperature rise from reflected AC current dissipated inside the capacitor ESR.

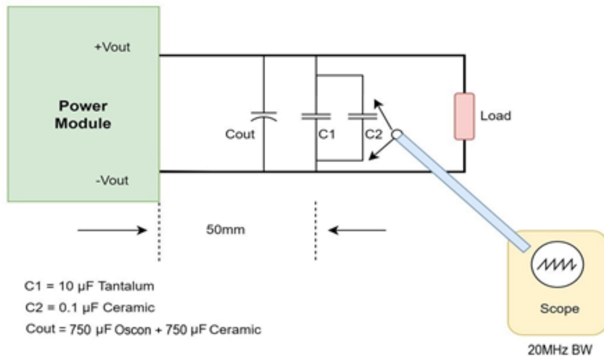


Figure 3. Measuring Output Ripple and Noise (PARD)

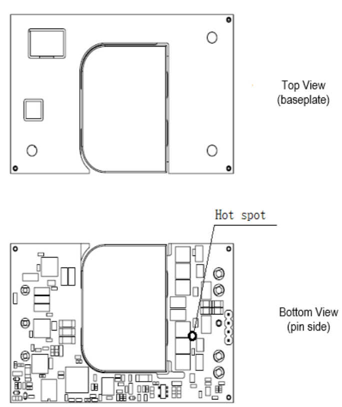
Minimum Output Loading Requirements

All models regulate within specification and are stable under no load to full load conditions. Operation under no load might slightly increase output ripple and noise.

Product Operating Temperature

Product operating temperature is used to monitor the temperature of the product, and proper thermal conditions can be verified by measuring the temperature at position. Temperature at these positions (Tref_point) should not exceed the maximum temperature as detailed in the following table. The number of measurement points can vary with different thermal design and topology. Temperatures above maximum Tref_point, measured at the reference point are not allowed and can cause permanent damage.

Position	Description	Maximum Temperature
Reference point	PCB Pin side	Tref_point = 125°C



Thermal Shutdown

To protect against thermal overstress, these converters include thermal shutdown circuitry. If environmental conditions cause the temperature of the DC/DC to rise above operating temperature range (up to the shutdown temperature), an on-board electronic temperature sensor powers down the unit. When the temperature decreases below the turn-on threshold, the converter automatically restarts. There is a small amount of hysteresis to prevent rapid on/off cycling. The temperature sensor is typically located adjacent to the switching controller in the center of the unit. See the Performance and Functional Specifications.

CAUTION: If you operate too close to the thermal limits, the converter might shut down suddenly without warning. Ensure to thoroughly test the application to the fan flowrate specifications.

Temperature Derating Curves

The graphs in this datasheet illustrate a typical operation under a variety of conditions. The Derating curves show the maximum continuous ambient air temperature and decreasing maximum output current, which is acceptable under increasing forced (airflow measured in Linear Feet per Minute “LFM”). Note that these are average measurements. The converter accepts brief increases in current or reduced airflow if the average is not exceeded.

Note that the temperatures are of the ambient airflow (not the converter), which is running at higher temperature than the outside air. Also note that very low flow rates (below about 25 LFM) are similar to "natural convection," that is, not using fan-forced airflow.

Murata Power Solutions performs characterization measurements in a closed cycle wind tunnel with calibrated airflow. Both thermocouples and an infrared camera system are used to observe thermal performance. It is difficult to insert an anemometer to precisely measure airflow in most applications. Often it is possible to estimate the effective airflow if you understand the enclosure geometry, entry/exit orifice areas, and the fan flowrate specifications.

CAUTION: If you exceed these derating guidelines, the converter might have an unplanned over-temperature shut down. Also, these graphs are collected near sea level altitude. Ensure to reduce the derating for higher altitude.

Output Current Limiting

When the output current increases to 125% to 150% of its maximum rated value, the DC/DC converter enters current limiting mode. The output voltage decreases proportionally with an increase in output current, thereby maintaining a constant power output. This is also referred to as power limiting.

Current limiting inception is defined as the point at which full power falls below the rated tolerance. See the Performance/Functional Specifications. Note that the output current might briefly rise above its rated value in normal operation if the average power is not exceeded. This enhances reliability and continued operation of the application. If the output current is too high the converter enters short circuit protection.

Output Short Circuit Protection

When a converter is in current-limit mode, the output voltage drops as the output current demand increases. If the output voltage drops too low (approximately 98% of nominal output voltage for most models), the magnetically coupled voltage used to develop the PWM bias voltage also drops, thereby shutting down the PWM controller.

Following a time-out period, the PWM restarts, causing the output voltage to begin rising to its appropriate value. If the short-circuit condition persists, another shutdown cycle initiates. This rapid on/off cycling is called "hiccup mode." The hiccup cycling reduces the average output current, thereby preventing excessive internal temperatures and component damage.

The "hiccup" system differs from older latching short circuit systems because you do not have to power down the converter to make it restart. The system automatically restores operation as soon as the short circuit condition is removed.

Remote On/Off Control

On the input side, a remote On/Off Control can be used with negative logic.

Negative: Models with negative logic are on (enabled) when the On/Off is grounded or brought to within a low voltage (see Specifications) with respect to –Vin. The device is off (disabled) when the On/Off is left open or is pulled high to +15V with respect to –Vin.

Dynamic control of the On/Off function should be able to sink the specified signal current when brought low and withstand appropriate voltage when brought high. There is a finite time in milliseconds (see Specifications) between the time of On/Off Control activation and a stable, regulated output. This time varies slightly with output load type and current and input conditions.

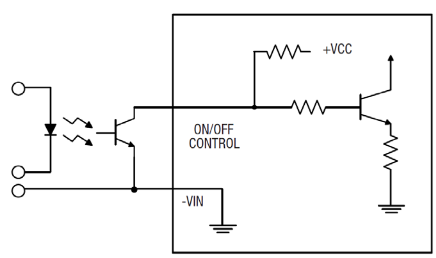


Figure 4. Driving the On/Off Control Pin (suggested circuit)

Output Capacitive Load

These converters do not require external capacitance added to achieve rated specifications. Users should only consider adding capacitance to reduce switching noise and to handle spike current step loads. Install only enough capacitance to achieve noise objectives. Excess external capacitance can cause regulation problems, slower transient response and possible instability. Proper wiring of the sense inputs improves these factors under capacitive load.

The maximum rated output capacitance and ESR specification is given for a capacitor installed immediately adjacent to the converter. Any extended output wiring or smaller wire gauge or less ground plane can tolerate higher capacitance. Also, capacitors with higher ESR might use a larger capacitance.

Load Sharing

Load sharing occurs when two or more MPQs are connected in parallel, at both the input and output terminals, to supply greater output current than one unit alone or to offer system redundancy for moderate loads. If one converter fails, the other converter carries the load until the system is repaired.

The MPQ's design allows load sharing using the "droop" method, also called the "direct connect" technique. At light loads, the converter exhibits slightly higher output voltage and carries more of the output current. Since the MPQ's synchronous rectifier design cannot accept appreciable reverse output current, starting at zero load, the MPQ with the higher output voltage carries more of the full load until the voltage at the output drops to that of the lower MPQ's.

Load Sharing Guidelines

If you want to operate two or more MPQ's in load sharing, use the following guidelines:

1. Operate both converters connected in parallel from the same 48V input power source. This simplifies the design and makes for more balanced power sharing. Using two different 48V input supplies must analyze to avoid overloading one of the converters and is not recommended. Make sure the single 48V input source can supply the total current needed by all the parallel-connected MPQ's. (It is possible to rate the full system at more than the current capacity of a single MPQ. However, you lose the redundancy protection feature.)
2. Use conservative loading. Do not assume for example that two parallel MPQ's can always supply "times two" amounts of output current. Allow for limits in input voltage and other factors. The maximum load of the paralleled modules equals to (max load of single module-6.25A) * number of paralleled modules. The maximum load during ramp up is still limited to number of modules x maximum load of single module x 90% (modules x Ioutmax x 0.9).
3. If one MPQ overloads while in load share, it protects itself by entering overcurrent mode. If the whole system is running close to maximum output current, the remaining good MPQ soon enters overcurrent mode. These two events might not happen together, possibly leaving the system operating in degraded mode for a while. The solution is conservative design to avoid getting close to the load limits.
4. Make the input wiring lengths and wire gauges identical on both inputs and outputs. If in doubt, make some precision measurements under full load. If you attempt to measure the current in one of the converters using a series shunt, the current meter might introduce enough finite resistance to affect the readings. Note: Use a non-contacting "clamp-on" Hall effect DC current meter with zero IR loss.)

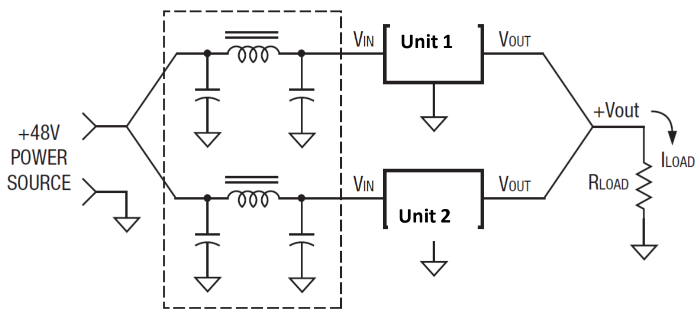


Figure 5. Load Sharing Block Diagram

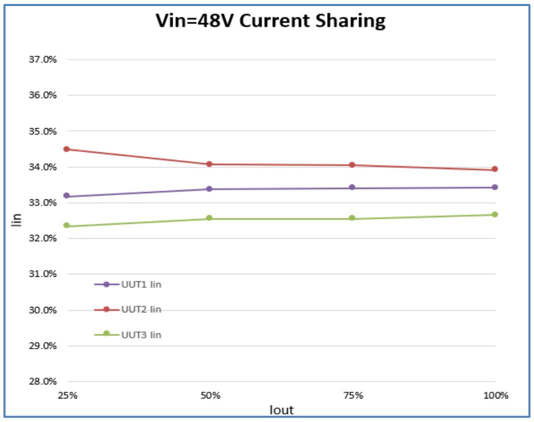
5. If you add the optional input filters, use identical components with the same layout.
6. Operate both converters in the same temperature and airflow environment. Under load sharing, small differences in cooling can amplify into load imbalances.
7. Avoid operation near the low input voltage limit of the converter. Another subtle factor here is the external source impedance of the input supply. A source with higher impedance at full load might make the net input voltage seen by the converter close to its minimum input voltage. Ensure to account for the decrease in effective input voltage under load.

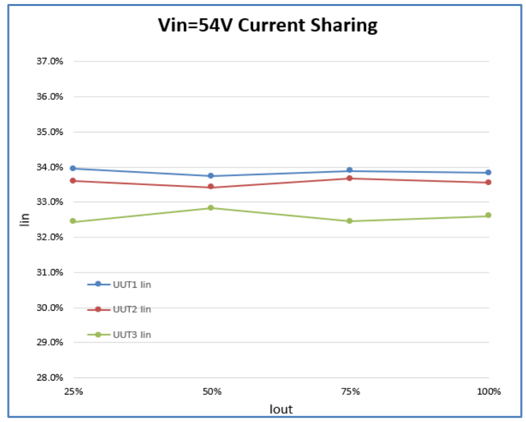
For battery sources, this means that the batteries should be charged and the AC trickle charger is in good working order. Note that older batteries increase their internal cell impedance even if their no-load output voltage appears acceptable. The voltage at the MPQ input connections with full current is important.

As with any system design, thoroughly test the MPQ's connected in load sharing before committing the design to a real application.

Below are the test results of three units in parallel. Murata Power Solutions can meet 10% accuracy of current share. For 48Vin, the module operates in open loop. For 54Vin, the module operates in closed loop.

Current Share - Three Units in Parallel Test									
Vin (V)	I Load (A)	Io Load	UUT1 Iin (A)	UUT2 Iin (A)	UUT3 Iin (A)	I1 Load %	I2 Load %	I3 Load %	Current Share Accuracy ((Max-Min)/Max) %
48	93.75	25%	7.7	8.0	7.5	33.2%	34.5%	32.3%	6.2
48	187.5	50%	15.3	15.6	15.0	33.4%	34.1%	32.6%	4.4
48	281.25	75%	22.8	23.2	22.2	33.4%	34.0%	32.6%	4.4
48	355	100%	28.7	29.1	28.0	33.4%	33.9%	32.7%	3.71
54	93.75	25%	7.5	7.4	7.2	34.0%	33.6%	32.4%	4.4
54	187.5	50%	14.6	14.5	14.2	33.7%	33.4%	32.8%	2.7
54	281.25	75%	21.8	21.7	20.9	33.9%	33.7%	32.4%	4.2
54	355	100%	27.4	27.2	26.4	33.8%	33.6%	32.6%	3.63

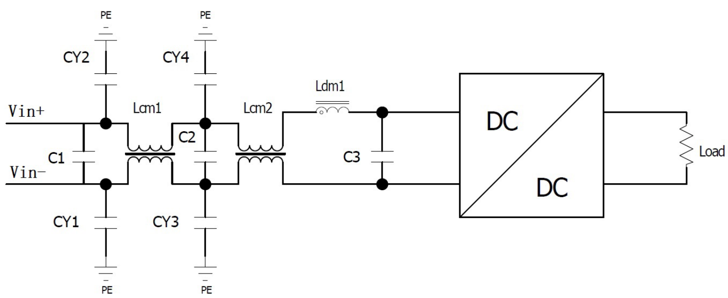




Emissions Performance

Murata Power Solutions measures its products for conducted emissions against the EN 55022 and CISPR 22 standards. Passive resistance loads are employed and the output is set to the maximum voltage. If you set up your own emissions testing, ensure the output load is rated at continuous power while conducting the tests.

The recommended external input and output capacitors (if required) are included. Refer to the fundamental switching frequency. This information is detailed in the Product Specifications. An external discrete filter is installed and the circuit diagram is shown as follows:



[1] Conducted Emissions Parts List

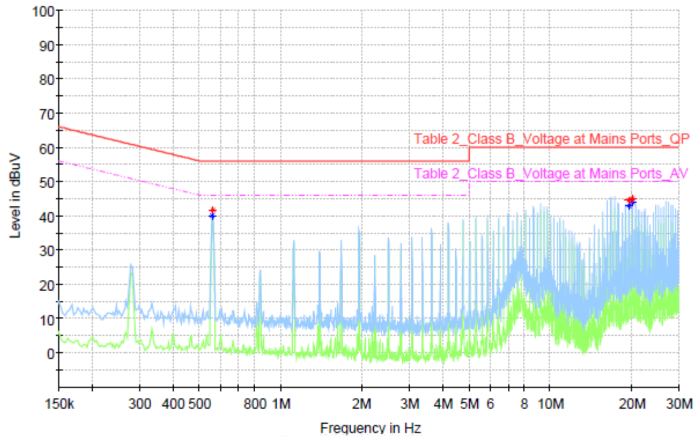
Reference	Description
C1	10µF*2
C2	10µF*2+4.7µF
C3	10µF*2+4.7µF+220µF(e-lyt)
CY1, CY2, CY3, CY4	22nF
Lcm1	3mH
Lcm2	1.4mH
Ldm1	22µH

[2] Conducted Emissions Test Equipment Used

Hewlett Packard HP8594L Spectrum Analyzer – S/N 3827A00153

2Line V-networks LS1-15V 50Ω/50Uh Line Impedance Stabilization Network

[3] Conducted Emissions Test Results – Negative Line



Conducted emissions performance, Negative Line
CISPR 22, Class B, full load

[4] Layout Recommendations

Most applications can use the filtering that is already installed inside the converter or with the addition of the recommended external capacitors. For greater emissions suppression, consider additional filter components and shielding. Emissions performance depends on the user's PC board layout, the chassis shielding environment, and choice of external components. Since many factors affect both the amplitude and spectra of emissions, Murata Power Solutions recommends using an engineer who is experienced at emissions suppression.

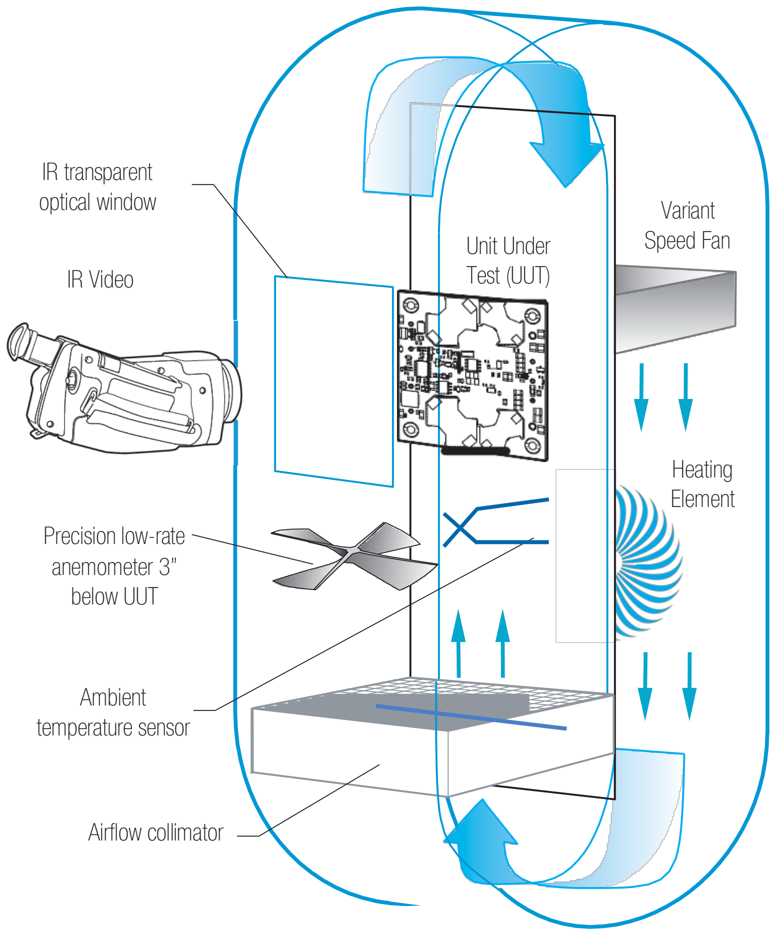


Figure 6. Vertical Wind

Vertical Wind Tunnel

Murata Power Solutions employs a computer controlled custom designed closed loop vertical wind tunnel, infrared video camera system, and test instrumentation for accurate airflow and heat dissipation analysis of power products.

The system includes a precision low flow-rate anemometer, variable speed fan, power supply input and load controls, temperature gauges, and adjustable heating element.

The IR camera monitors the thermal performance of the Unit Under Test (UUT) under static steady-state conditions. A special optical port is used which is transparent to infrared wavelengths.

Both through-hole and surface mount converters are soldered down to a 10" x 10" host carrier board, for realistic heat absorption and spreading. Both longitudinal and transverse airflow studies are possible by rotation of this carrier board since there are often significant differences in the heat dissipation in the two airflow directions.

The combination of adjustable airflow, adjustable ambient heat, and adjustable Input/Output currents and voltages mean that a very wide range of measurement conditions can be studied.

The collimator reduces the amount of turbulence adjacent to the UUT. Such turbulence influences the effective heat transfer characteristics and gives false readings. Excess turbulence removes more heat from some surfaces and less heat from others, possibly causing uneven overheating.

Both sides of the UUT are studied since there are different thermal gradients on each side. The adjustable heating element and fan, built-in temperature gauges, and no-contact IR camera mean that power supplies are tested in real-world conditions.