Murata Power Solutions

PAE Series

Up to 100W 29.8V Nom Output Eighth-Brick Isolated DC-DC Converter with 2:1 Wide Input Range







Typical units

KEY PRODUCT FEATURES

- 2:1 Input Voltage Range (36V – 75V)
- Trimmable 23.84 (-20%) to 32.78 (10%) Volts output (29.8V, nom)
- Up to 100W output power @ 36 - 75Vin
- Efficiency = 92.5% (typ)
- Industry standard 1/8 brick package
- Optional Baseplate for conduction cooling applications
- Optional Baseplate to ground connection pin
- Positive & negative logic on/off control option
- Monotonic startup into pre-bias/pre load output conditions
- Over-current (power limiting); Over-temperature protection; Over-Voltage Protection
- Low output ripple and noise
- Strong thermal derating performance
- Operational temperature range –40°C to +100°C (baseplate temperature)
- 1500V I/O isolation
- Certified to UL 60950-1, CSA-C22.2 No. 60950-1, 2nd edition with Am1 safety approvals

PRODUCT OVERVIEW

Murata Power Solutions' fully isolated Power Amplifier Eighth-Brick series of DC-DC converters has been designed specifically for use with multi-channel power amplifiers such as those found in the latest generation of microcell wireless transceiver applications requiring up to 100W.

With a typical efficiency of 92.5%, the PAE series keeps power dissipation on the module to a minimum, therefore, reducing system temperatures and helping network operators save energy costs. The through-hole mounted converter is available with an optional baseplate for conduction cooled/cold wall applications typically found in base-station applications and remote radio heads.

The converter operates over the industry standard TNV input voltage range of + 36 to +75 VDC around a nominal +48 VDC. The single +29.8 Vout can be adjusted over a wide range, from +23.84 to 32.78 VDC, to maximize flexibility for power amplifier system designers.

Controls include remote On/Off control of either negative or positive polarity. In addition the converter has a number of protection features including over current, over temperature, input under voltage and output short circuit.

The PAE series has been designed to meet the demanding "low noise" requirements in modern communications systems and will require minimal Vout filtering in most applications. Other example applications for the PAE include indoor/outdoor Wi-Fi installations, RF test equipment, CATV systems and MRI imaging equipment.

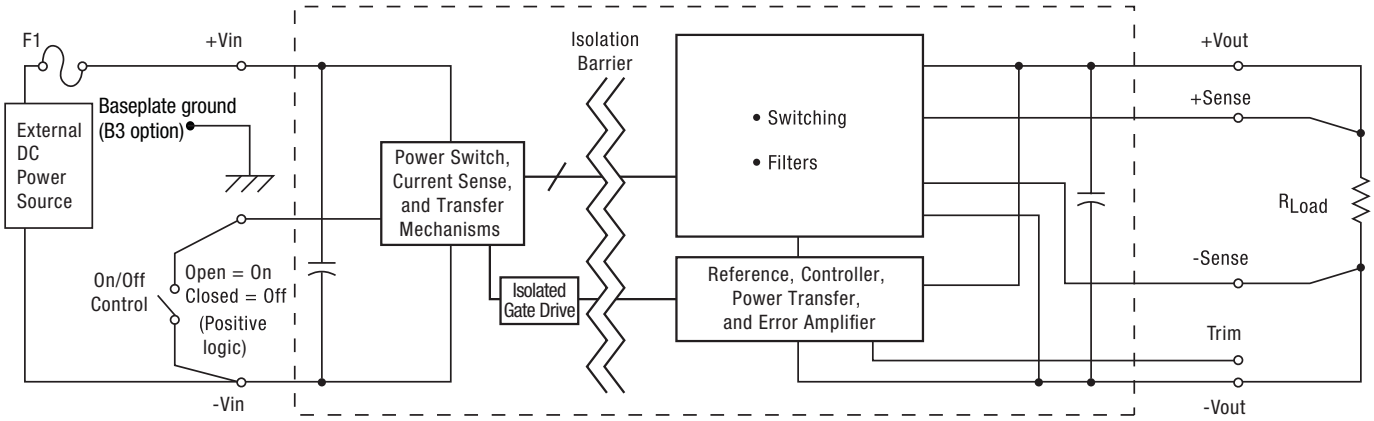


Figure 1. Connection Diagram

Typical topology is shown. Murata Power Solutions recommends an external fuse.

RoHS COMPLIANT

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

c UL us

Up to 100W 29.8V Nom Output Eighth-Brick Isolated DC-DC Converter with 2:1 Wide Input Range

ORDERING GUIDE ①

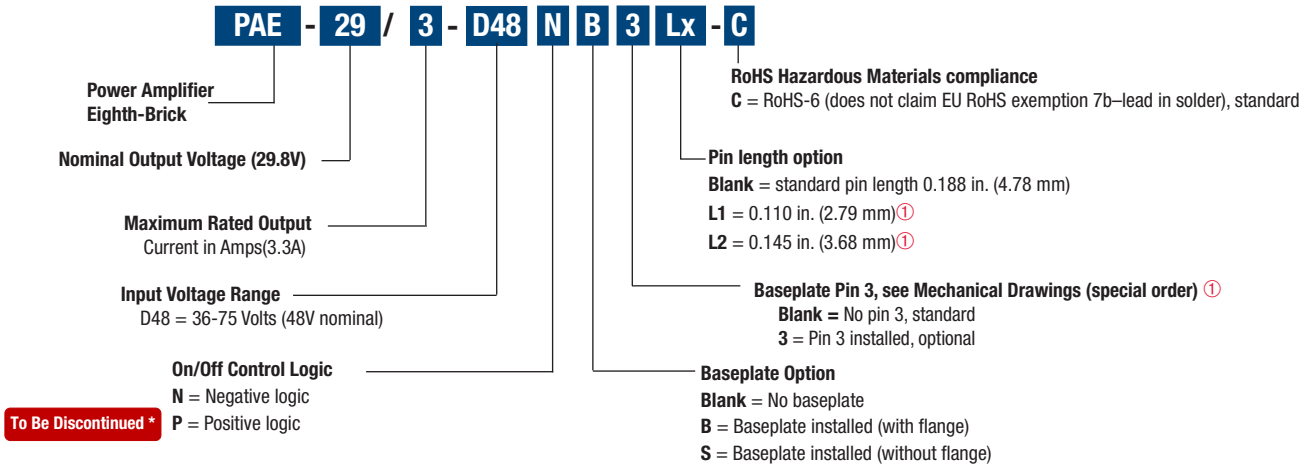
Root Model ①	Output							Input				Efficiency		Dimensions (open frame)	
	VOUT (Volts)	IOUT (Amps, max.)	Power (Watts)	R/N (mV pk-pk) Typ.	R/N (mV pk-pk) Max.	Regulation (Max.) ② Line	Regulation (Max.) ② Load	VIN Nom. (Volts)	Range (Volts)	IIN no load (mA)	IIN full load (Amps)	Min.	Typ.	(inches)	(mm)
PAE-29/3-D48	29.8	3.3	98.34	65	100	±0.1%	±0.1%	48	36-75	12	2.21	91%	92.5%	2.3 x 0.90 x 0.44	58.4 x 22.9 x 11.1

① Please refer to the part number structure for additional ordering information and options.
② All specifications are typical at nominal line voltage and full load, +25°C unless otherwise noted. See detailed specifications. Output capacitors are 1 µF || 10 µF with a 22µf input capacitor. These caps are necessary for our test equipment and may not be needed for your application.

To Be Discontinued *

NOTE: The following models are **To Be Discontinued**.
PAE-29/3-D48PB3-C, PAE-29/3-D48PB-C and PAE-29/3-D48P-C.

PART NUMBER STRUCTURE



① **Special quantity order is required; samples available with standard pin length only.**
② **Some model number combinations may not be available. See website or contact your local Murata sales representative.**

PAE Pin 3 Baseplate Connection
The PAE module has an additional pin 3 on special order that connects to the baseplate but is electrically isolated from the rest of the converter. Please refer to the mechanical drawings. Pin 3 offers a positive method of controlling the electrical potential of the baseplate, independent of the converter.
The baseplate may be ordered by adding a "B" to the model number tree and pin 3 will be preinstalled by adding a "3." The two options are separate. Please refer to the Ordering Guide. Do not order pin 3 without the baseplate. Note that "pin 3" converters may be on limited forecast, requiring minimum order quantities and scheduled deliveries.

Complete Model Number Example: **PAE-29/3-D48NBL1-C**
Negative On/Off logic, baseplate installed, 0.110˝ pin length, RoHS-6 compliance

* Last Time Buy date is 3/31/2019. Please click here to view the Discontinuance Notification.

FUNCTIONAL SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS	Conditions ① /Comments	Minimum	Typical/Nominal	Maximum	Units
Input Voltage, Continuous		0		80	Vdc
Input Voltage, Transient	100 mS max. duration			100	Vdc
Isolation Voltage	Input to output, continuous			1500	Vdc
On/Off Remote Control	Power on, referred to -Vin	0		13.5	Vdc
Output Power		0		99.32	W
Output Current	Current-limited, no damage, short-circuit protected	0		3.3	A
Storage Temperature Range	Vin = Zero (no power)	-55		125	°C
Absolute maximums are stress ratings. Exposure of devices to greater than any of these conditions may adversely affect long-term reliability. Proper operation under conditions other than those listed in the Performance/Functional Specifications Table is not implied or recommended.					
INPUT	**Conditions ① ③**				
Operating voltage range		36	48	75	Vdc
Recommended External Fuse	Fast blow			6	A
Start-up threshold	Rising input voltage	33	34	35	Vdc
Undervoltage shutdown	Falling input voltage	30	31.5	33	Vdc
Internal Filter Type			LC		
Input current					
Full Load Conditions	Vin = nominal		2.21	2.27	A
Low Line	Vin = minimum		2.97	3.07	A
Inrush Transient			0.09	0.155	A^2-Sec.
Output in Short Circuit			0.1	0.2	A
No Load Current	Iout = minimum, unit = ON		12	25	mA
Shut-Down Input Current (Off, UV, OT)			2.2	4	mA
Reflected (back) ripple current ②	Measured at input with specified filter		10	25	mA, p-p
Pre-biased startup	External output voltage < Vset		Monotonic		
GENERAL and SAFETY					
Efficiency	Vin = 48V, full load	91	92.5		%
	Vin = min.	90	92		%
Isolation					
Isolation Voltage	Input to output (with and w/o baseplate), continuous	1500			Vdc
	Input to baseplate	750			Vdc
	Output to baseplate	750			Vdc
Isolation Resistance			100		MΩ
Isolation Capacitance			14,000		pF
Safety (certified to the following requirements)	Certified to UL-60950-1, CSA-C22.2 No. 60950-1, 2nd edition with Am1		Yes		
Calculated MTBF	Per Telcordia SR332, issue 1, class 3, ground fixed, Tambient = +25°C		TBD		Hours x 10^6
DYNAMIC CHARACTERISTICS					
Fixed Switching Frequency		225	250	275	KHz
Startup Time	Power on to Vout regulated		50	75	mS
Startup Time	Remote on to Vout regulated		130	150	mS
Dynamic Load Response	50-75-50% load step, settling time to within 3% of Vout		75	150	µSec
Dynamic Load Peak Deviation	same as above		±275	±375	mV
FEATURES and OPTIONS					
Remote On/Off Control ④					
"N" suffix:					
Negative Logic, ON state	ON = Ground pin or external voltage	0		1	Vdc
Negative Logic, OFF state	OFF = Pin open or external voltage	3.5		13.5	Vdc
Control Current	Open collector/drain		1		mA
"P" suffix:					
Positive Logic, ON state	ON = Pin open or external voltage	3.5		13.5	Vdc
Positive Logic, OFF state	OFF = Ground pin or external voltage	0		1	Vdc
Control Current	Open collector/drain		1		mA

FUNCTIONAL SPECIFICATIONS, (CONT.)

OUTPUT	Conditions ① /Comments	Minimum	Typical/Nominal	Maximum	Units
Total Output Power		0	98.34	99.32	W
Voltage					
Nominal Output Voltage	No trim	29.502	29.8	30.098	Vdc
Setting Accuracy	At 50% load, no trim	-1		1	% of Vnom
Output Voltage Range	User-adjustable	-20		10	% of Vnom
Overvoltage Protection			39		Vdc
Current					
Output Current Range		0	3.3	3.3	A
Current Limit Inception	97% of Vnom., after warmup	3.8	4.8	5.8	A
Short Circuit					
Short Circuit Current	Hiccup technique, autorecovery within 2% of Vout		0.8	1.5	A
Short Circuit Duration (remove short for recovery)	Output shorted to ground, no damage		Continuous		
Short circuit protection method	Current limiting				
Regulation ⑤					
Total Accuracy:	Over line, load(0-3.3A), and temp.	28.906		30.69	Vdc
Line Regulation	Vin = min. to max., Vout = nom., Iout = nom.			±0.1	% of Vout
Load Regulation	Iout = min. to max., Vin = 48V			±0.1	% of Vout
Ripple and Noise	5 Hz- 20 MHz BW		65	100	mV pk-pk
Remote Sense			10		%
Case to Ground pin option	("3" Suffix)				
Baseplate option	("B" Suffix)				
Temperature Coefficient	At all outputs		±0.02		% of Vout./°C
Maximum Capacitive Loading	Low ESR		1	2.2	mF
MECHANICAL					
Outline Dimensions (open frame)			2.3 x 0.90 x 0.44		Inches
For outline dimensions with baseplate, please refer to mechanical drawing			58.4 x 22.9 x 11.1		mm
Weight	Open frame		0.94		Ounces
			26.6		Grams
	With baseplate		1.4		Ounces
			45		Grams
Through Hole Pin Diameter	pins (1-4, 6-8) & (5, 9)		0.04 & 0.06		Inches
			1.016 & 1.52		mm
Through Hole Pin Material			Copper alloy		
TH Pin Plating Metal and Thickness	Nickel subplate		50		µ-inches
	Gold overplate		5		µ-inches
ENVIRONMENTAL					
Operating Ambient Temperature Range	With Derating	-40		85	°C
Operating Baseplate Temperature	No derating,	-40		100	°C
Storage Temperature	Vin = Zero (no power)	-55		125	°C
Thermal Protection/Shutdown	Measured in center	115	125	135	°C
Electromagnetic Interference	External filter is required				
Conducted, EN55022/CISPR22			B		Class
RoHS rating			RoHS-6		

Notes

① Unless otherwise noted, all specifications apply at Vin = nominal, nominal output voltage and full output load. General conditions are near sea level altitude, no base plate installed and natural convection airflow unless otherwise specified. All models are tested and specified with external parallel 1 µF and 10 µF output capacitors and a 22µf external input capacitor (see Technical Notes). All capacitors are low-ESR types wired close to the converter. These capacitors are necessary for our test equipment and may not be needed in the user's application.

② Input (back) ripple current is tested and specified over 5 Hz to 20 MHz bandwidth. Input filtering is Cin = 33 µF/100V, Cbus = 220µF/100V and Lbus = 12 µH.

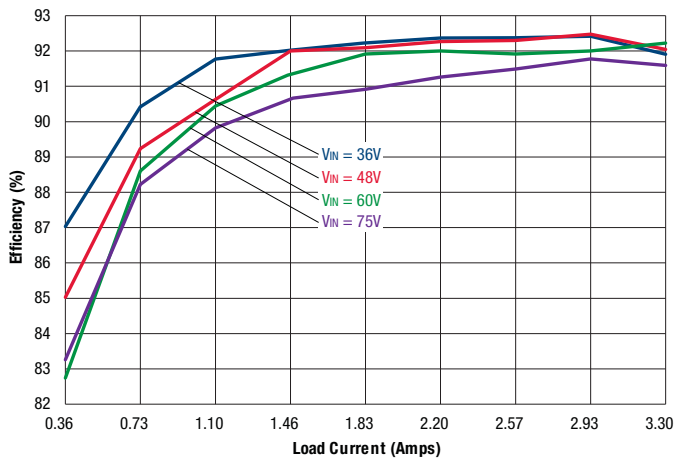
③ All models are stable and regulate to specification under no load.

④ The Remote On/Off Control is referred to -Vin.

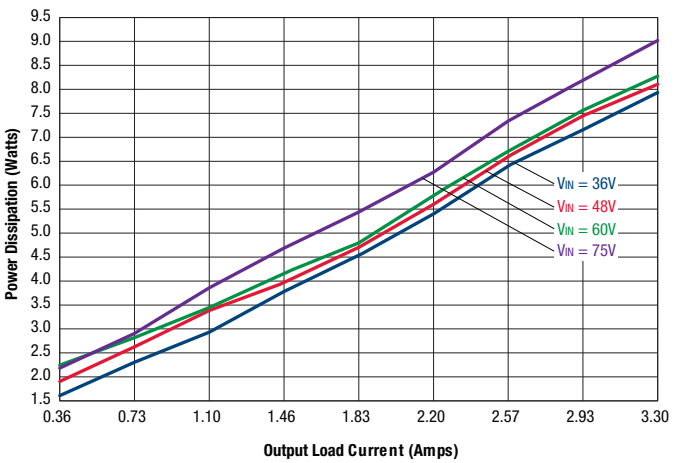
⑤ Regulation specifications describe the output voltage changes as the line voltage or load current is varied from its nominal or midpoint value to either extreme. The load step is ±25% of full load current.

PERFORMANCE DATA

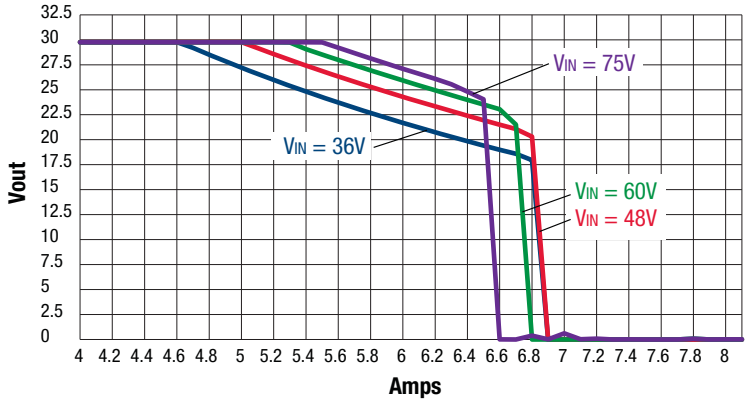
Efficiency vs. Line Voltage and Load Current @ +25°C



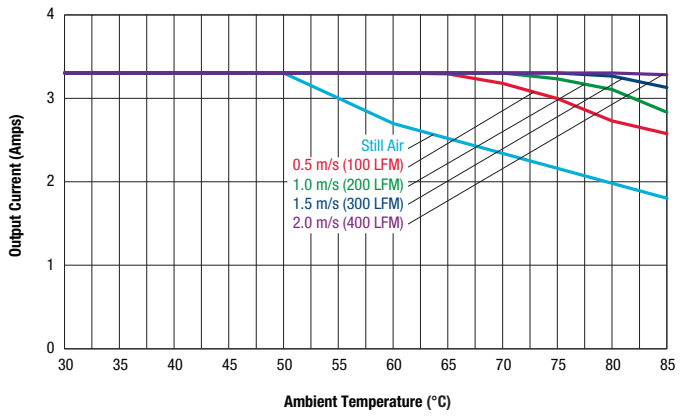
Power Dissipation vs. Load Current @ +25°C



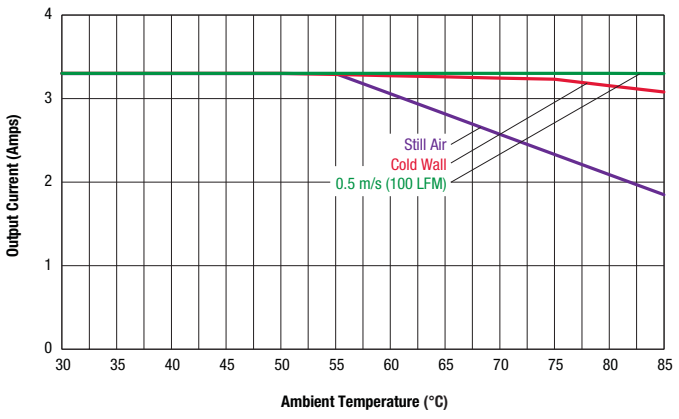
Output Current Limit vs. Output Voltage (at various input line voltages)



Maximum Current Temperature Derating at sea level
(Vin = 36V, airflow from pin 1 to pin 4, without baseplate)

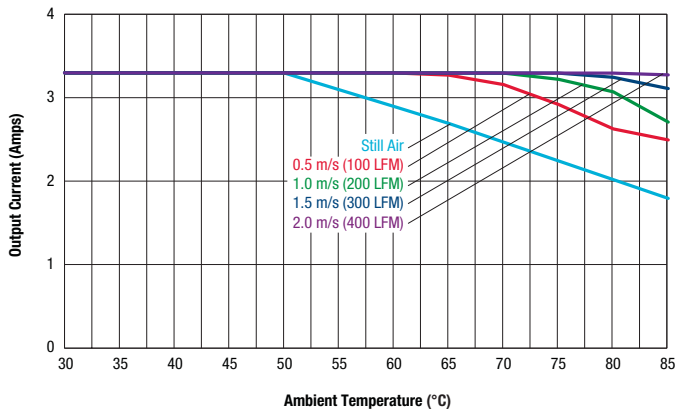


Maximum Current Temperature Derating at sea level
(Vin = 36V, airflow from pin 1 to pin 4, with baseplate)

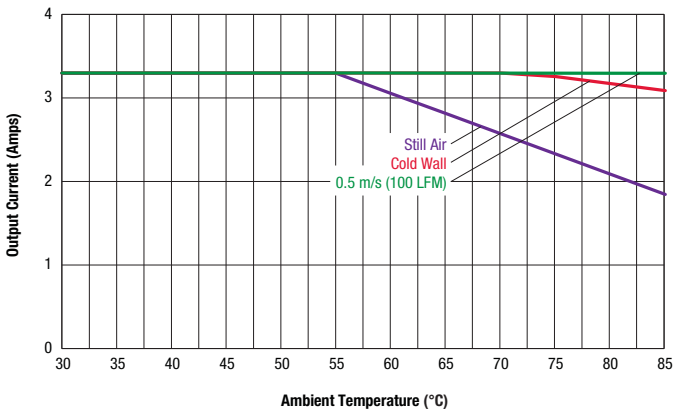


PERFORMANCE DATA

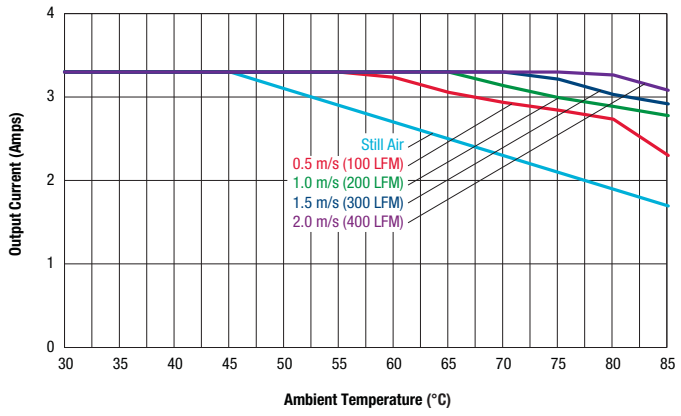
Maximum Current Temperature Derating at sea level
(Vin = 48V, airflow from pin 1 to pin 4, without baseplate)



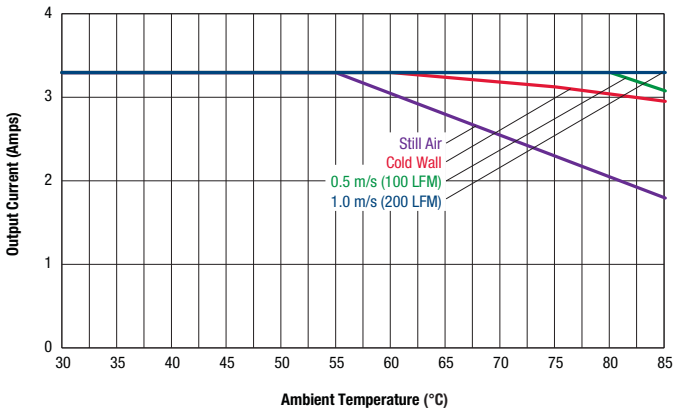
Maximum Current Temperature Derating at sea level
(Vin = 48V, airflow from pin 1 to pin 4, with baseplate)



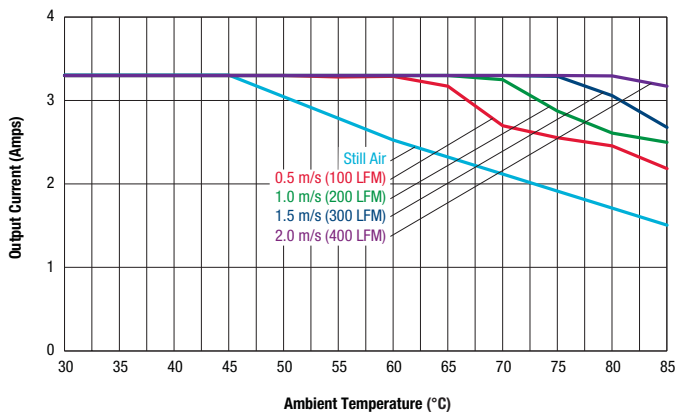
Maximum Current Temperature Derating at sea level
(Vin = 60V, airflow from pin 1 to pin 4, without baseplate)



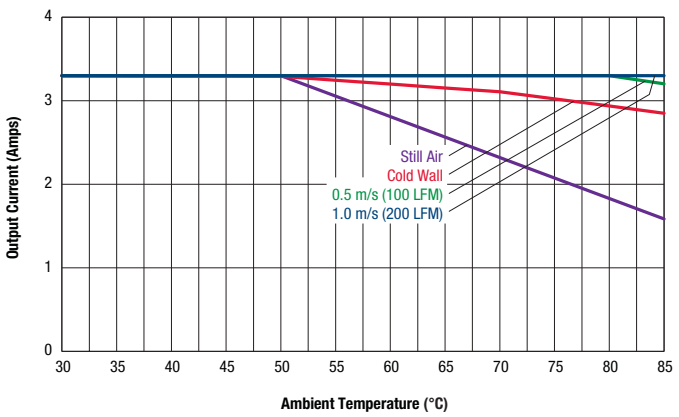
Maximum Current Temperature Derating at sea level
(Vin = 60V, airflow from pin 1 to pin 4, with baseplate)



Maximum Current Temperature Derating at sea level
(Vin = 75V, airflow from pin 1 to pin 4, without baseplate)

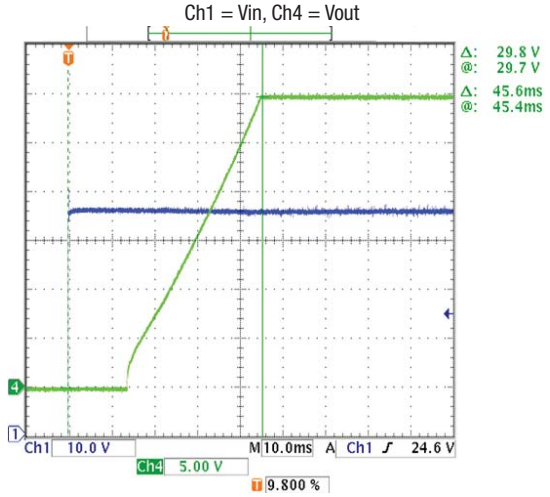


Maximum Current Temperature Derating at sea level
(Vin = 75V, airflow from pin 1 to pin 4, with baseplate)

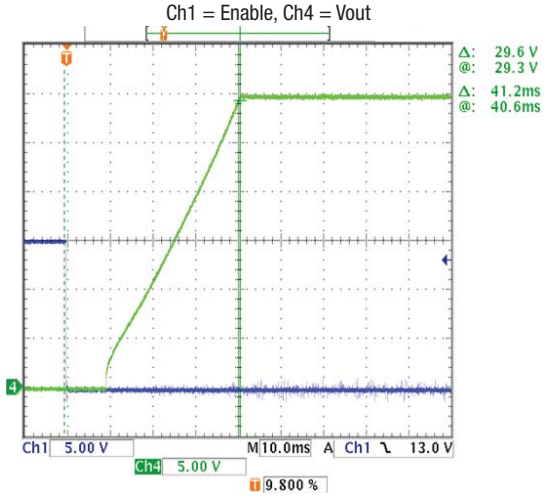


PERFORMANCE DATA

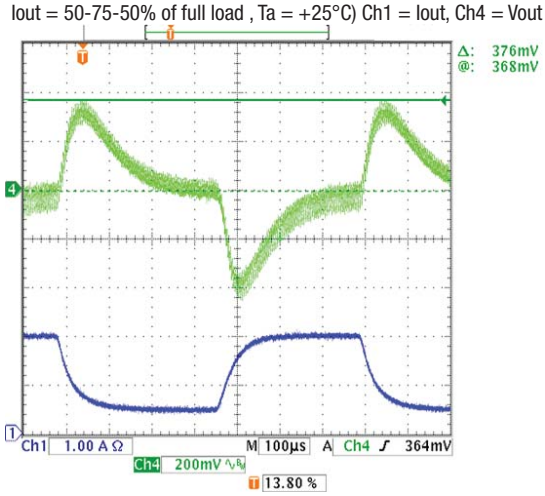
Start up Delay (Vin = 48V, Vout = nom, Iout = full load, Ta = +25°C)
Ch1 = Vin, Ch4 = Vout



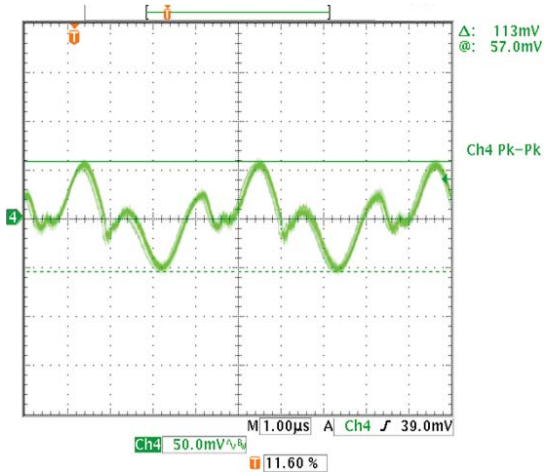
Enable Start up Delay (Vin = 48V, Vout = nom, Iout = full load, Ta = +25°C)
Ch1 = Enable, Ch4 = Vout



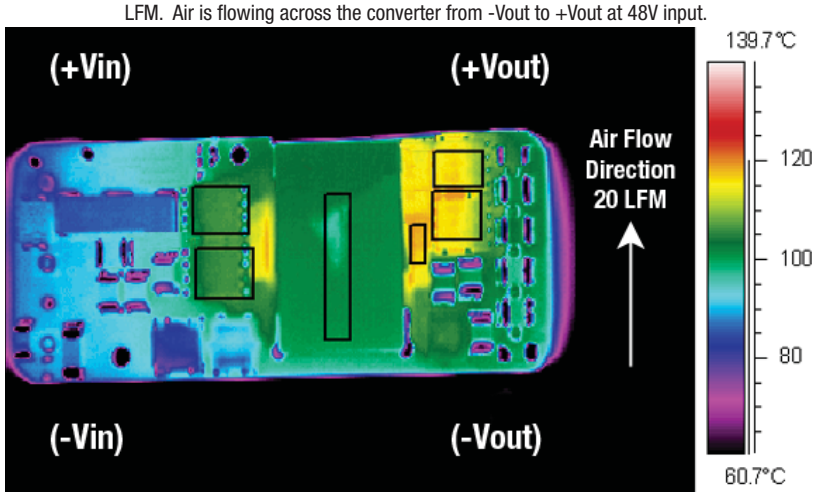
Step load Transient Response (Vin = 48V, Vout = nom, Cload = 10µf || 1µf,
Iout = 50-75-50% of full load , Ta = +25°C) Ch1 = Iout, Ch4 = Vout



Output Ripple and Noise (Vin = 48V, Iout = 3.3A, Cload = 1µf||10µf, Ta = +25°C)



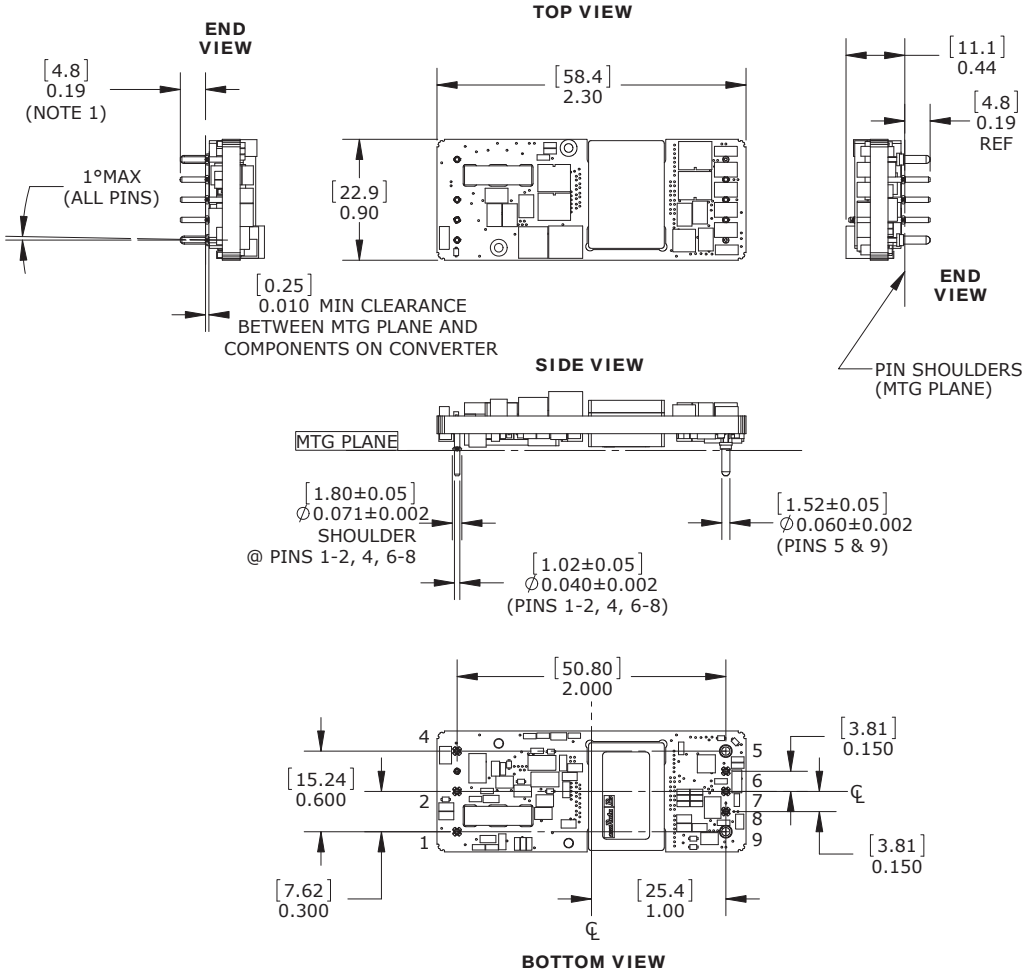
Thermal image with hot spot at full load current with +25°C ambient; air is flowing at 20
LFM. Air is flowing across the converter from -Vout to +Vout at 48V input.



MECHANICAL SPECIFICATIONS: OPEN FRAME

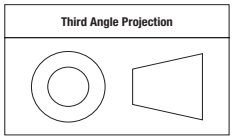
MATERIAL:
0.040 PINS: COPPER ALLOY
0.060 PINS: COPPER ALLOY

FINISH: (ALL PINS)
GOLD (5µ"MIN) OVER NICKEL (50µ" MIN)



1. ALTERNATE PIN LENGTHS AVAILABLE (CONTACT MURATA-PS FOR INFORMATION)
2. COMPONENTS SHOWN FOR REF ONLY
3. DIMENSIONS ARE IN INCHES [mm]
4. PIN LOCATION DIMENSIONS APPLY AT CIRCUIT BOARD LEVEL

Dimensions are in inches (mm shown for ref. only).



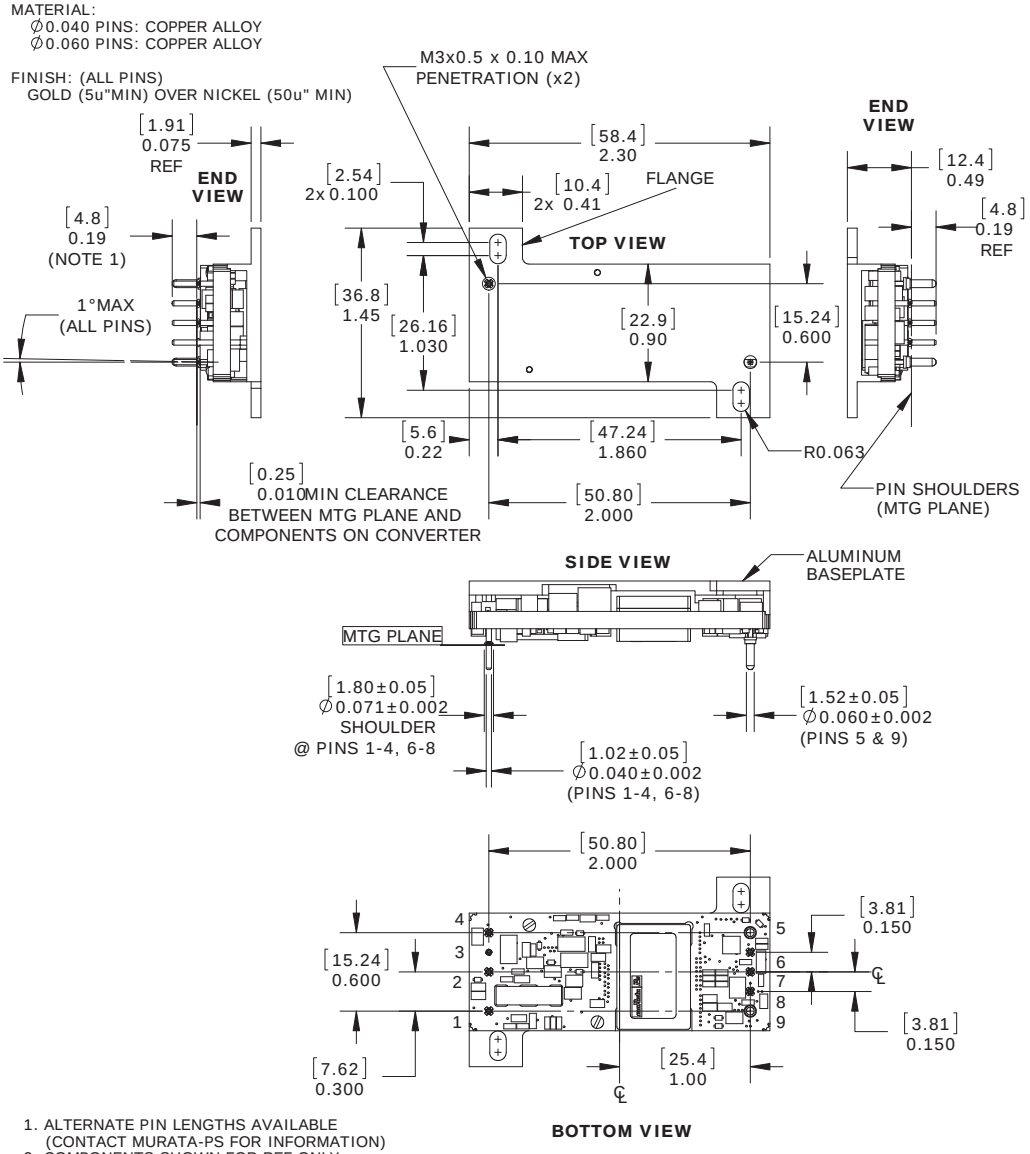
Tolerances (unless otherwise specified):
.XX ± 0.02 (0.5)
.XXX ± 0.010 (0.25)
Angles ± 2°

Components are shown for reference only.

INPUT/OUTPUT CONNECTIONS	
Pin	Function
1	+ Vin
2	Remote On/Off *
3	No pin
4	– Vin
5	– Vout
6	– Sense
7	Trim
8	+ Sense
9	+ Vout

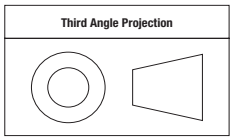
*The Remote On/Off can be provided with either positive (P suffix) or negative (N suffix) logic.

MECHANICAL SPECIFICATIONS: WITH BASEPLATE, WITH FLANGE



1. ALTERNATE PIN LENGTHS AVAILABLE (CONTACT MURATA-PS FOR INFORMATION)
2. COMPONENTS SHOWN FOR REF ONLY
3. DIMENSIONS ARE IN INCHES [mm]
4. PIN LOCATION DIMENSIONS APPLY AT CIRCUIT BOARD LEVEL

Dimensions are in inches (mm shown for ref. only).



Tolerances (unless otherwise specified):
.XX ± 0.02 (0.5)
.XXX ± 0.010 (0.25)
Angles ± 2°

Components are shown for reference only.

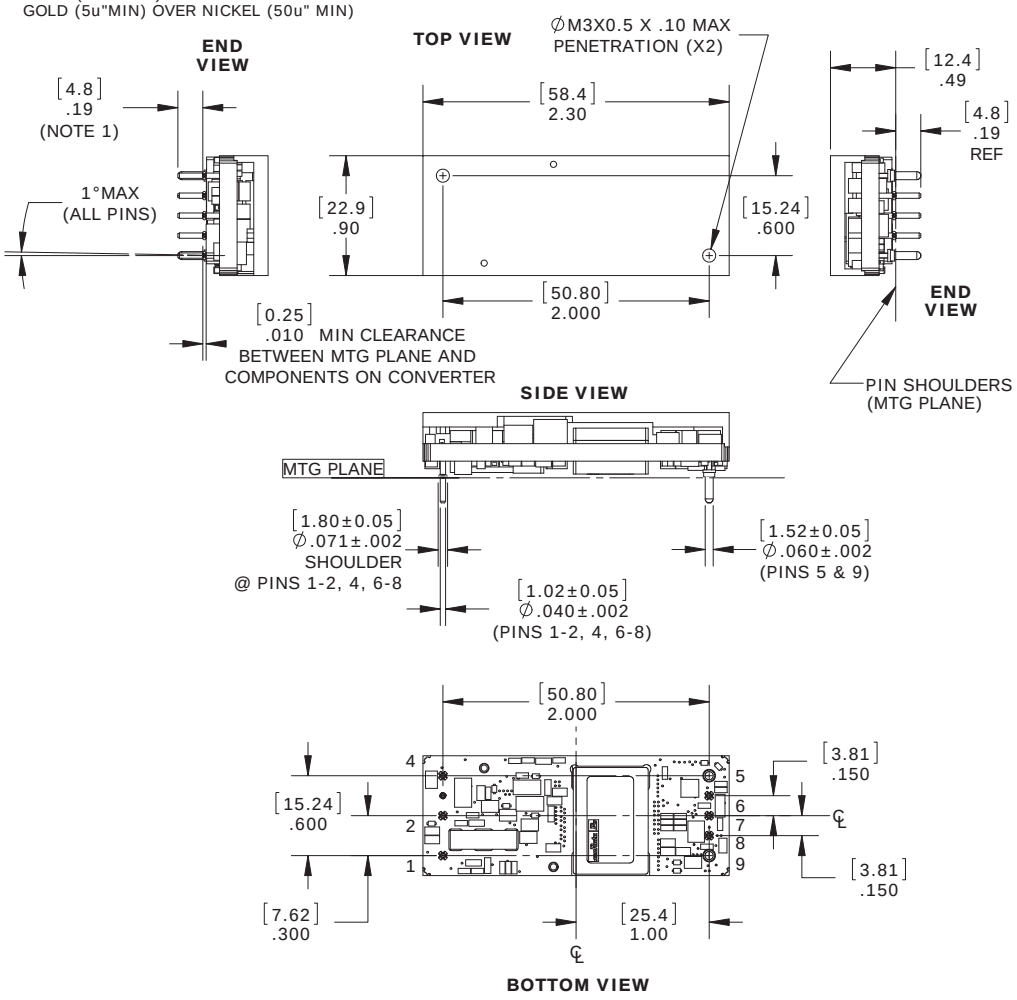
INPUT/OUTPUT CONNECTIONS	
Pin	**Function**
1	+ Vin
2	Remote On/Off *
3	Baseplate Gnd (when applicable)
4	– Vin
5	– Vout
6	– Sense
7	Trim
8	+ Sense
9	+ Vout

*The Remote On/Off can be provided with either positive (P suffix) or negative (N suffix) logic.

MECHANICAL SPECIFICATIONS: WITH BASEPLATE, WITHOUT FLANGE

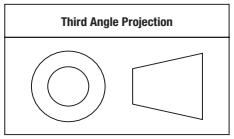
MATERIAL:
Ø.040 PINS: COPPER ALLOY
Ø.060 PINS: COPPER ALLOY

FINISH: (ALL PINS)
GOLD (5u"MIN) OVER NICKEL (50u" MIN)



1. ALTERNATE PIN LENGTHS AVAILABLE (CONTACT MURATA-PS FOR INFORMATION)
2. COMPONENTS SHOWN FOR REF ONLY
3. DIMENSIONS ARE IN INCHES [mm]
4. PIN LOCATION DIMENSIONS APPLY AT CIRCUIT BOARD LEVEL

Dimensions are in inches (mm shown for ref. only).



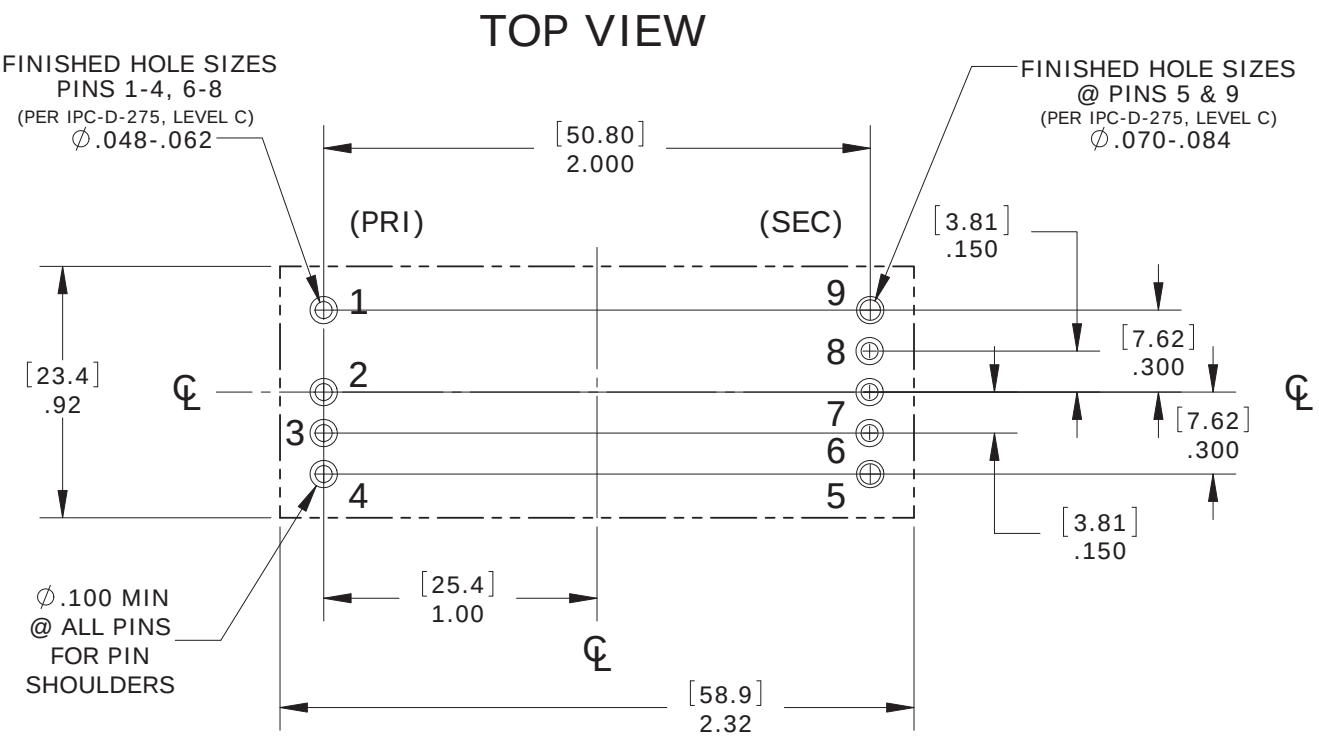
Tolerances (unless otherwise specified):
.XX ± 0.02 (0.5)
.XXX ± 0.010 (0.25)
Angles ± 2°

Components are shown for reference only.

INPUT/OUTPUT CONNECTIONS	
Pin	**Function**
1	+ Vin
2	Remote On/Off *
3	Baseplate Gnd (when applicable)
4	– Vin
5	– Vout
6	– Sense
7	Trim
8	+ Sense
9	+ Vout

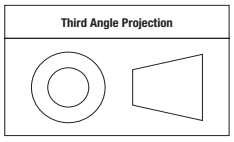
*The Remote On/Off can be provided with either positive (P suffix) or negative (N suffix) logic.

MECHANICAL SPECIFICATIONS: RECOMMENDED FOOTPRINT (VIEW THROUGH CONVERTER)



IT IS RECOMMENDED THAT NO PARTS
BE PLACED BENEATH CONVERTER
(HATCHED AREA)

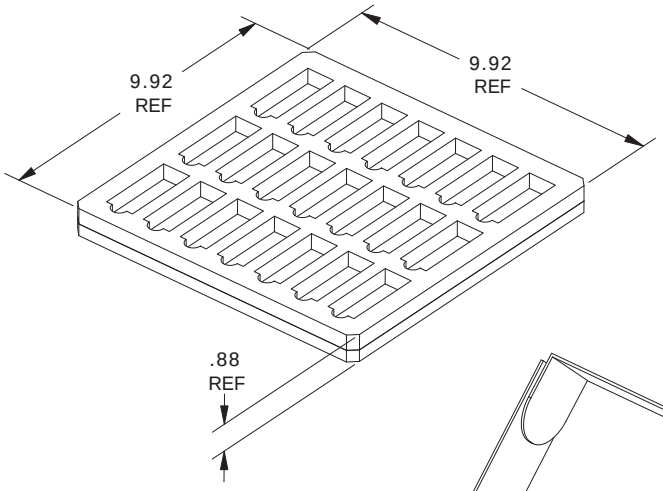
Dimensions are in inches (mm shown for ref. only).



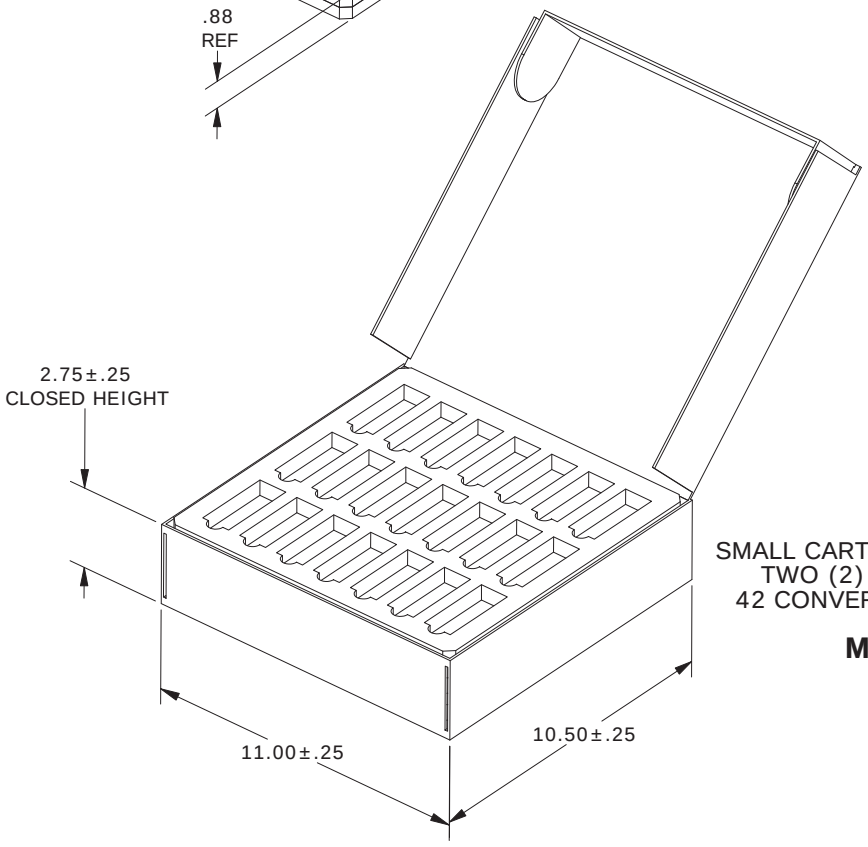
Tolerances (unless otherwise specified):
.XX ± 0.02 (0.5)
.XXX ± 0.010 (0.25)
Angles ± 2°

Components are shown for reference only.

STANDARD PACKAGING: OPEN FRAME AND BASEPLATE WITHOUT FLANGE



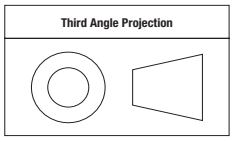
EACH STATIC DISSIPATIVE
POLYETHYLENE FOAM TRAY
ACCOMMODATES 21 CONVERTERS
IN A 3 X 7 ARRAY



SMALL CARTON ACCOMMODATES
TWO (2) TRAYS YIELDING
42 CONVERTERS PER CARTON

MPQ=42

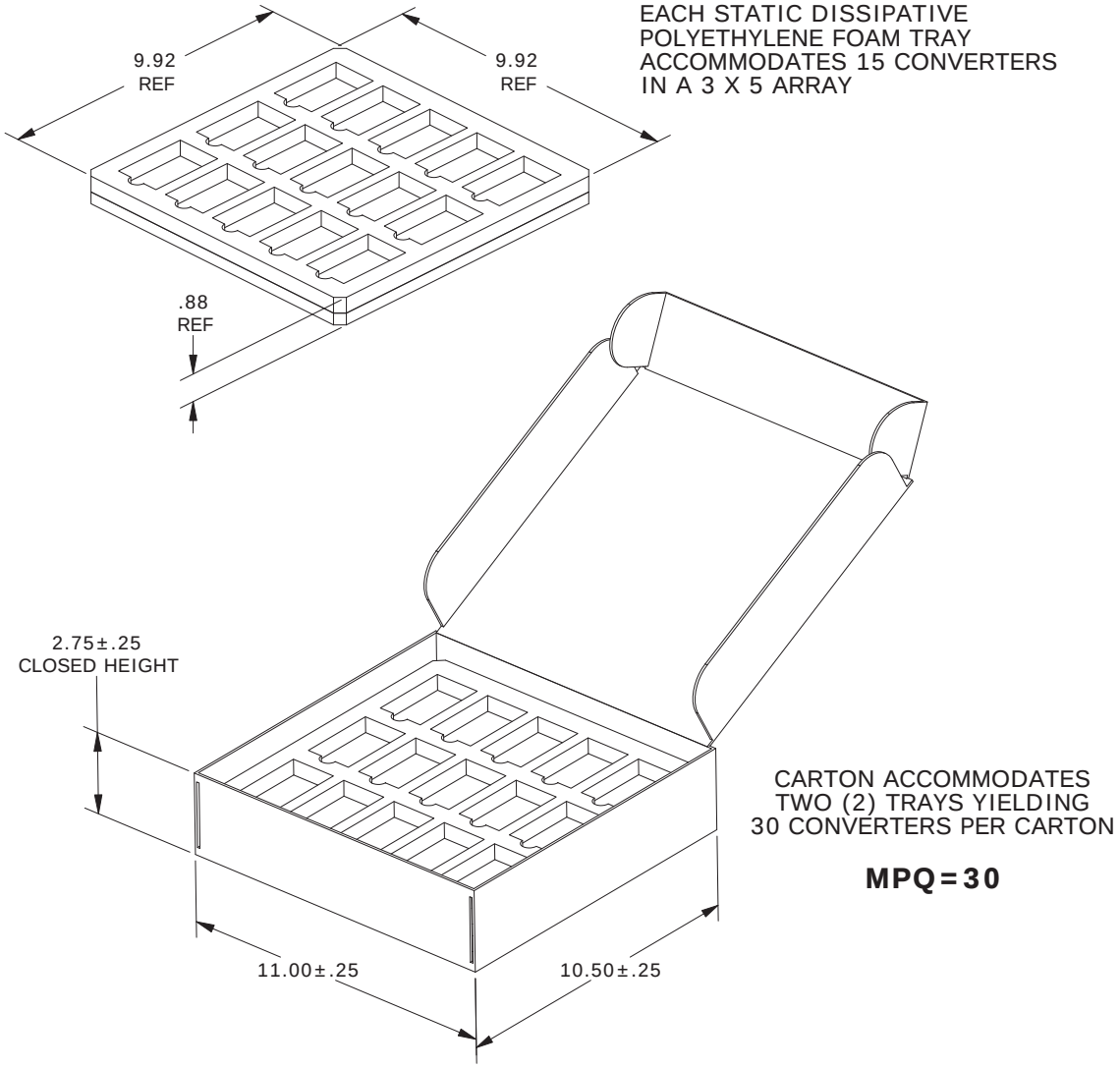
Dimensions are in inches (mm shown for ref. only).



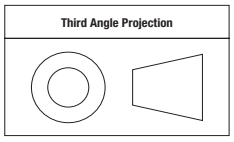
Tolerances (unless otherwise specified):
.XX ± 0.02 (0.5)
.XXX ± 0.010 (0.25)
Angles ± 2°

Components are shown for reference only.

STANDARD PACKAGING: WITH BASEPLATE, WITH FLANGE



Dimensions are in inches (mm shown for ref. only).



Tolerances (unless otherwise specified):
.XX ± 0.02 (0.5)
.XXX ± 0.010 (0.25)
Angles ± 2°

Components are shown for reference only.

TECHNICAL NOTES

Input Fusing

Certain applications and/or safety agencies may 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 current-limited. For greatest safety, we recommend a fast blow fuse installed in the +Vin input supply line.

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, make sure the operating input voltage is well 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 Delay (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 V_{OUT} 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

These converters will operate to specifications without external components, assuming that the source voltage has very low impedance. Since real-world voltage sources have finite impedance, performance is improved by adding external filter components. Sometimes only a small ceramic capacitor is sufficient. Since it is difficult to totally characterize all applications, some experimentation may be needed. Note that external input capacitors must accept high speed switching currents.

Because of the switching nature of DC/DC converters, the input of these converters must be driven from a source with both low AC impedance and adequate DC input regulation. Performance will degrade with increasing input inductance. Excessive input inductance may inhibit operation. The DC input regulation specifies that the input voltage, once operating, must never degrade below the Shut-Down Threshold under all load conditions. Be sure to use adequate trace sizes and mount components close to the converter.

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 (C_{IN} 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 C_{BUS} and L_{BUS} components simulate a typical DC voltage bus. Specific system configurations may require additional considerations. Please note that the values of C_{IN}, L_{BUS} and C_{BUS} may vary according to the specific converter model.

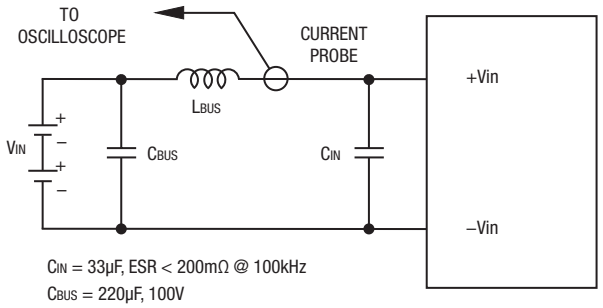


Figure 2. Measuring Input Ripple Current

In critical applications, output ripple and noise (also referred to as periodic and random deviations or PARD) may be reduced by adding filter elements such as multiple external capacitors. Be sure to calculate component temperature rise from reflected AC current dissipated inside capacitor ESR. In figure 3, the two copper strips simulate real-world printed circuit impedances between the power supply and its load. In order to minimize circuit errors and standardize tests between units, scope measurements should be made using BNC connectors or the probe ground should not exceed one half inch and soldered directly to the fixture.

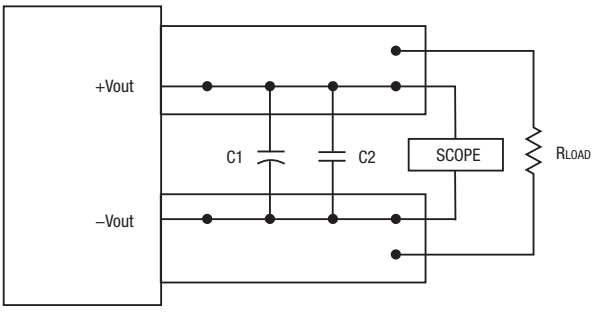


Figure 3. Measuring Output Ripple and Noise (PARD)

Floating Outputs

Since these are isolated DC/DC converters, their outputs are "floating" with respect to their input. The essential feature of such isolation is ideal ZERO CURRENT FLOW between input and output. Real-world converters however do exhibit tiny leakage currents between input and output (see Specifications). These leakages consist of both an AC stray capacitance coupling component and a DC leakage resistance. When using the isolation feature, do not allow the isolation voltage to exceed specifications. Otherwise the converter may be damaged. Designers will normally use the negative output (-Output) as the ground return of the load circuit. You can however use the positive output (+Output) as the ground return to effectively reverse the output polarity.

Minimum Output Loading Requirements

These converters employ a flyback design topology. All models regulate within specification and are stable under no load to full load conditions. Operation under no load might however slightly increase output ripple and noise.

Thermal Shutdown

To protect against thermal over-stress, these converters include thermal shutdown circuitry. If environmental conditions cause the temperature of the DC/DC's to rise above the Operating Temperature Range up to the shutdown temperature, an on-board electronic temperature sensor will power down the unit. When the temperature decreases below the turn-on threshold, the converter will automatically restart. There is a small amount of hysteresis to prevent rapid on/off cycling. CAUTION: If you operate too close to the thermal limits, the converter may shut down suddenly without warning. Be sure to thoroughly test your application to avoid unplanned thermal shutdown.

Temperature Derating Curves

The graphs in this data sheet illustrate 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 will accept brief increases in temperature and/or current or reduced airflow as long as the average is not exceeded.

Note that the temperatures are of the ambient airflow, not the converter itself which is obviously running at higher temperature than the outside air. Also note that "natural convection" is defined as very low flow rates which are not using fan-forced airflow. Depending on the application, "natural convection" is usually about 30-65 LFM but is not equal to still air (0 LFM).

Murata Power Solutions makes Characterization measurements in a closed cycle wind tunnel with calibrated airflow. Both thermocouples and an infrared camera system are used to observe thermal performance. Sometimes it is possible to estimate the effective airflow if you thoroughly understand the enclosure geometry, entry/exit orifice areas and the fan flowrate specifications.

CAUTION: If these Derating guidelines are exceeded, the converter may have an unplanned Over Temperature shut down. Also, these graphs are all collected near Sea Level altitude. Be sure to reduce the derating for higher altitude.

Output Overvoltage Protection (OVP)

This converter monitors its output voltage for an over-voltage condition using an on-board electronic comparator. If the output exceeds OVP limits, the sensing circuit will power down the unit, and the output voltage will decrease. After a time-out period, the PWM will automatically attempt to restart, causing the output voltage to ramp up to its rated value. It is not necessary to power down and reset the converter for this automatic OVP-recovery restart.

If the fault condition persists and the output voltage climbs to excessive levels, the OVP circuitry will initiate another shutdown cycle. This on/off cycling is referred to as "hiccup" mode.

Current Limiting (Power limit with current mode control)

As power demand increases on the output and enters the specified "limit inception range" limiting circuitry activates in the DC-DC converter to limit/restrict the maximum current or total power available. Once the current reaches a certain range the output voltage will start to decrease while the output current continues to increase, thereby maintaining constant power, until a minimum voltage set is reached and the converter enters a "hiccup" (on off cycling) mode of operation until the load is reduced below the threshold level, whereupon it will return to a normal mode of operation. Current limit inception is defined as the point where the output voltage has decreased by a pre-specified percentage (usually a 2% decrease from nominal).

Short Circuit Condition (Current mode control)

The short circuit condition is an extension of the "Current Limiting" condition. When the monitored peak current signal reaches a certain range, the PWM controller's outputs are shut off thereby turning the converter "off." This is followed by an extended time out period. This period can vary depending on other conditions such as the input voltage level. Following this time out period, the PWM controller will attempt to re-start the converter by initiating a "normal start cycle" which includes softstart. If the "fault condition" persists, another "hiccup" cycle is initiated. This "cycle" can and will continue indefinitely until such time as the "fault condition" is removed, at which time the converter will resume "normal operation." Operating in the "hiccup" mode during a fault condition is advantageous in that average input and output power levels are held low preventing excessive internal increases in temperature.

Trimming Output Voltage

PAE converters have a trim capability that enables users to adjust the output voltage from +10% to –20% (refer to the trim equations). Adjustments to the output voltage can be accomplished with a single fixed resistor as shown in Figures 4 and 5. A single fixed resistor can increase or decrease the output voltage depending on its connection. Resistors should be located close to the converter and have TCR's less than 100ppm/°C to minimize sensitivity to changes in temperature. If the trim function is not used, leave the trim pin open.

Standard PAE's have a "positive trim" where a single resistor connected from the Trim pin to the +Sense will increase the output voltage. A resistor connected from the Trim Pin to the –Sense will decrease the output voltage.

Trim adjustments greater than the specified +10%/–20% can have an adverse affect on the converter's performance and are not recommended. Excessive voltage differences between V_{OUT} and Sense, in conjunction with trim adjustment of the output voltage, can cause the overvoltage protection circuitry to activate (see Performance Specifications for overvoltage limits).

Temperature/power derating is based on maximum output current and voltage at the converter's output pins. Use of the trim and sense functions can cause output voltages to increase, thereby increasing output power beyond the PAE's specified rating, or cause output voltages to climb into the output overvoltage region. Therefore:

(V_{OUT} at pins) x (I_{OUT}) ≤ rated output power

The Trim pin (pin 6) is a relatively high impedance node that can be susceptible to noise pickup when connected to long conductors in noisy environments.

Trim Equations

Trim Down

Connect trim resistor between trim pin and –Sense

$$R_{TrimDn}\,(k\,\Omega) = \frac{5.11}{\Delta} - 10.22$$

Trim Up

Connect trim resistor between trim pin and +Sense

$$R_{TrimUp}\,(k\,\Omega) = \frac{5.11 \times V_{NOM} \times (1+\Delta)}{1.225 \times \Delta} - \frac{5.11}{\Delta} - 10.22$$

Where,

$\Delta = |\,(V_{NOM} - V_{OUT}) / V_{NOM}\,|$

V_{NOM} is the nominal, untrimmed output voltage.

V_{OUT} is the desired new output voltage.

Do not exceed the specified trim range or maximum power ratings when adjusting trim. Use 1% precision resistors mounted close to the converter on short leads.

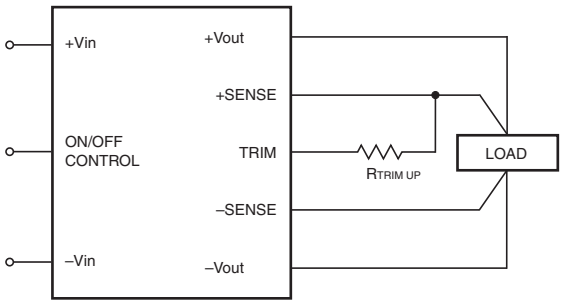


Figure 4. Trim Connections To Increase Output Voltages Using Fixed Resistors

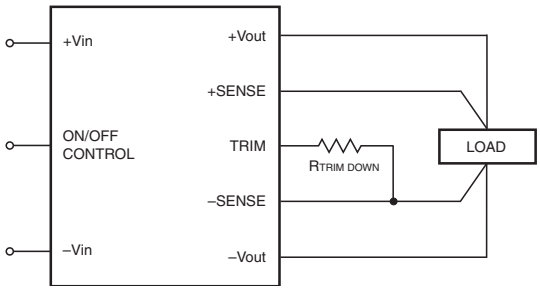


Figure 5. Trim Connections To Decrease Output Voltages Using Fixed Resistors

Remote Sense Input

Use the Sense inputs with caution. Sense is normally connected ***at the load***. Sense inputs compensate for output voltage inaccuracy delivered at the load. This is done by correcting IR voltage drops along the output wiring and the current carrying capacity of PC board etch. This output drop (the difference between Sense and Vout when measured at the converter) should not exceed 0.5V. Consider using heavier wire if this drop is excessive. Sense inputs also improve the stability of the converter and load system by optimizing the control loop phase margin.

Note: The Sense input and power Vout lines are internally connected through low value resistors to their respective polarities so that the converter can operate without external connection to the Sense. Nevertheless, if the Sense function is not used for remote regulation, the user should connect +Sense to +Vout and –Sense to –Vout at the converter pins.

The remote Sense lines carry very little current. They are also capacitively coupled to the output lines and therefore are in the feedback control loop to regulate and stabilize the output. As such, they are not low impedance inputs and must be treated with care in PC board layouts. Sense lines on the PCB should run adjacent to DC signals, preferably Ground. In cables and discrete wiring, use twisted pair, shielded tubing or similar techniques.

Any long, distributed wiring and/or significant inductance introduced into the Sense control loop can adversely affect overall system stability. If in doubt, test

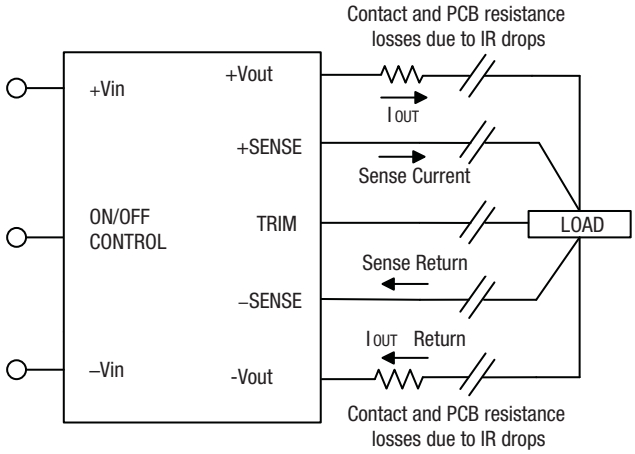


Figure 6. Remote Sense Circuit Configuration

your applications by observing the converter's output transient response during step loads. There should not be any appreciable ringing or oscillation. You may also adjust the output trim slightly to compensate for voltage loss in any external filter elements. Do not exceed maximum power ratings.

Please observe Sense inputs tolerance to avoid improper operation:

[Vout(+) –Vout(-)] – [Sense(+) –Sense(-)] ≤ 10% of Vout

Output overvoltage protection is monitored at the output voltage pin, not the Sense pin. Therefore excessive voltage differences between Vout and Sense together with trim adjustment of the output can cause the overvoltage protection circuit to activate and shut down the output.

Power derating of the converter is based on the combination of maximum output current and the highest output voltage. Therefore the designer must ensure:

(Vout at pins) x (Iout) ≤ (Max. rated output power)

Remote On/Off Control

On the input side, a remote On/Off Control can be specified with either positive or negative logic as follows:

Models are on (enabled) when the On/Off is grounded or brought to within a low voltage (see Specifications) with respect to $-V_{IN}$. The device is off (disabled) when the On/Off is left open or is pulled high to $+13.5V_{DC}$ Max. with respect to $-V_{IN}$.

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

There are two CAUTIONs for the On/Off Control:

CAUTION: While it is possible to control the On/Off with external logic if you carefully observe the voltage levels, the preferred circuit is either an open drain/open collector transistor or a relay (which can thereupon be controlled by logic). The On/Off prefers to be set at approx. +13.5V (open pin) for the ON state, assuming positive logic.

CAUTION: Do not apply voltages to the On/Off pin when there is no input power voltage. Otherwise the converter may be permanently damaged.

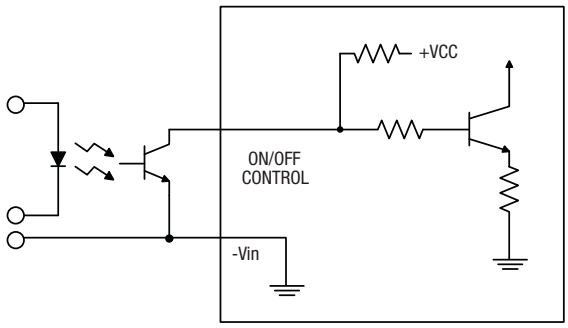


Figure 7. Driving the On/Off Control Pin (suggested circuit)

Cold Wall Cooling Test Method (cold baseplate applications)

Murata Power Solutions' cold wall cooling test is implemented with the baseplate of the UUT (unit under test) mounted to the large aluminum block (see figure 8). Thermocouples are attached to the known hot spots on the UUT as well as the aluminum block and still air space. The environment chamber regulates the aluminum block and baseplate temperature at a fixed value up to 100°C. The still air chamber is manually regulated to 85°C by the attached heaters. Output load is applied to the UUT and it is monitored to ensure safe operating limits at all input voltages.

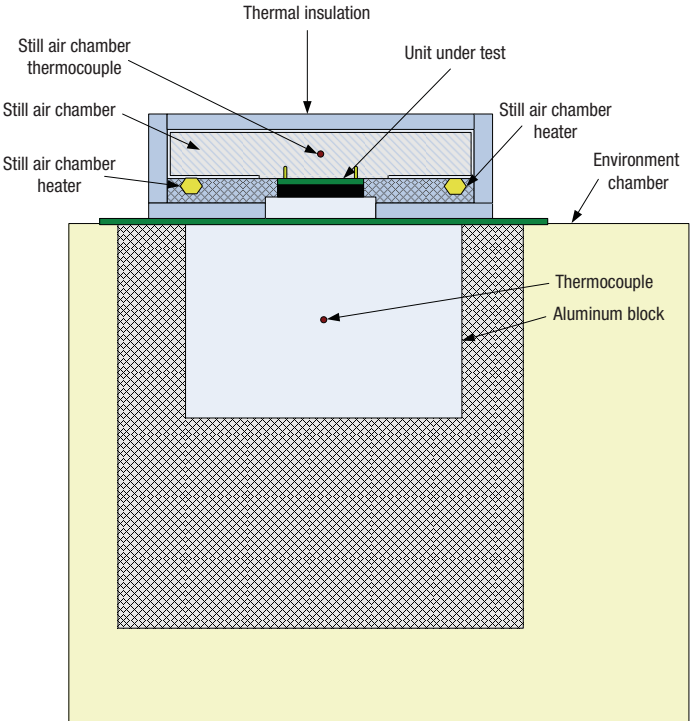


Figure 8. Cold Wall Test Fixture Equipment

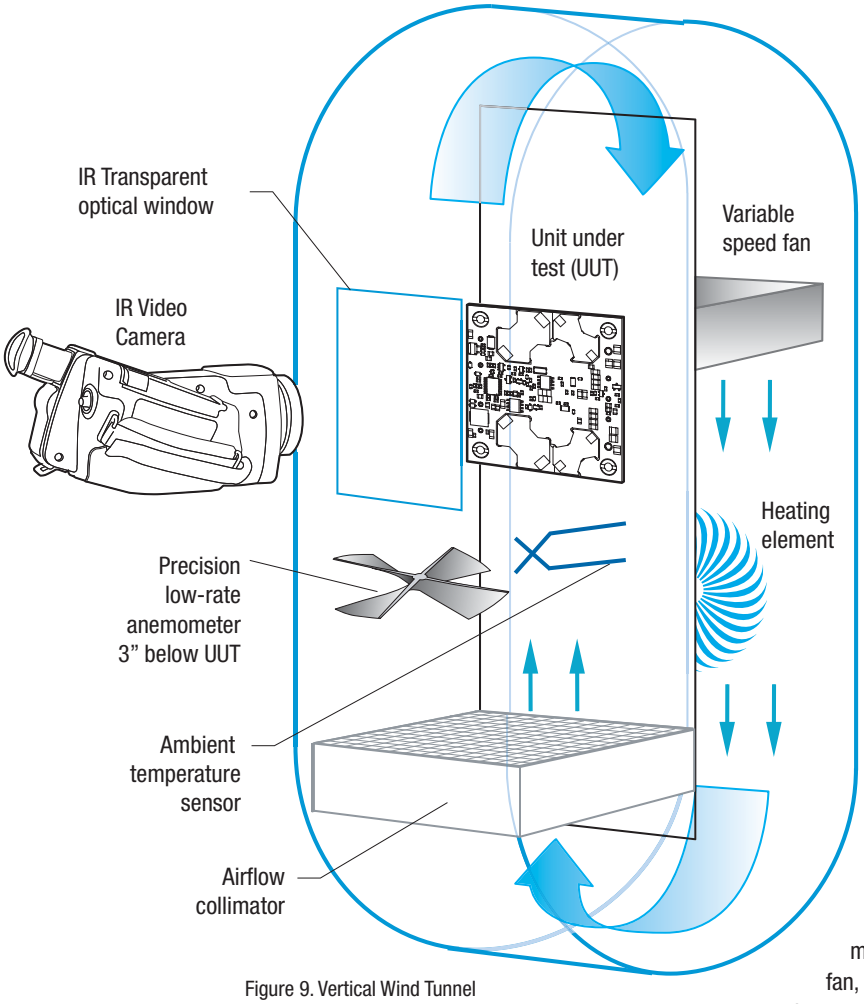


Figure 9. Vertical Wind Tunnel

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" by 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 by minimizing airflow turbulence. 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.

Soldering Guidelines

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

Wave Solder Operations for through-hole mounted products (THMT)			
For Sn/Ag/Cu based solders:		**For Sn/Pb based solders:**	
Maximum Preheat Temperature	115° C.	Maximum Preheat Temperature	105° C.
Maximum Pot Temperature	270° C.	Maximum Pot Temperature	250° C.
Maximum Solder Dwell Time	7 seconds	Maximum Solder Dwell Time	6 seconds

Murata Power Solutions, Inc.
129 Flanders Road, Westborough, MA 01581 U.S.A.
ISO 9001 and 14001 REGISTERED

This product is subject to the following operating requirements and the Life and Safety Critical Application Sales Policy:
Refer to: http://www.murata-ps.com/requirements/

Murata Power Solutions, Inc. makes no representation that the use of its products in the circuits described herein, or the use of other technical information contained herein, will not infringe upon existing or future patent rights. The descriptions contained herein do not imply the granting of licenses to make, use, or sell equipment constructed in accordance therewith. Specifi cations are subject to change without notice.
© 2018 Murata Power Solutions, Inc.