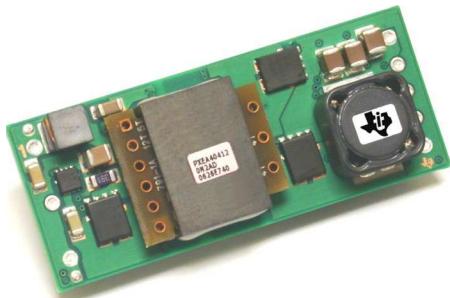


15-A, 48-V INPUT, 5-V OUTPUT, ISOLATED, 1/8th BRICK DC/DC CONVERTER

Check for Samples: [PTEA415050](#)

FEATURES

- 15-A Output Current Rating
- Input Voltage Range: 36 V to 75 V
- 91% Efficiency
- 1500 V_{DC} Isolation
- On/Off Control
- Overcurrent Protection
- Differential Remote Sense
- Adjustable Output Voltage
- Output Overvoltage Protection
- Over-Temperature Shutdown
- Undervoltage Lockout
- Standard 1/8-Brick Footprint
- UL Safety Agency Approval



DESCRIPTION

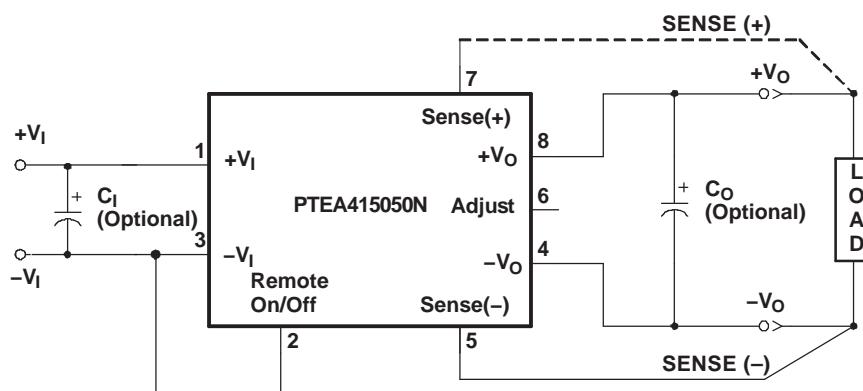
The PTEA415050 power module is a 5-V, single-output, isolated DC/DC converter, housed in an industry standard one-eighth brick package. This module is rated up to 75 W with a maximum load current of 15 A.

The PTEA415050 operates from a standard 48-V telecom central office (CO) supply and occupies less than 2.0 in² of PCB area. The modules offer OEMs a compact and flexible high-output power source in an industry standard footprint. They are suitable for distributed power applications in both telecom and computing environments, and may be used for intermediate bus converter architectures.

Features include a remote On/Off control with optional logic polarity, an undervoltage lockout (UVLO), a differential remote sense, and an industry standard output voltage adjustment using an external resistor. Protection features include output overcurrent protection (OCP), overvoltage protection (OVP), and thermal shutdown (OTP).

The module is fully integrated for stand-alone operation, and requires no additional components.

STANDARD APPLICATION



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

ORDERING INFORMATION

For the most current package and ordering information, see the Package Option Addendum at the end of this datasheet, or see the TI website at www.ti.com.

Table 1. PART NUMBERING SCHEME

	Input Voltage	Output Current	Output Voltage	Enable	Electrical Options		Pin Style
PTEA	4	15	050	N	2	A	D
	4 = 48 V	15 = 15A	050 = 5 V	N = Negative P = Positive	2 = V_O Adjust		D = Through-hole, Pb-free

ABSOLUTE MAXIMUM RATING

				UNIT
T_A	Operating Temperature Range			–40°C to 85°C ⁽¹⁾
V_I , MAX	Maximum Input Voltage			75 V 100 V
P_O , MAX	Maximum Output Power			75 W
T_S	Storage Temperature			–40°C to 125°C
Mechanical Shock	Per Mil-STD-883, Method 2002.3 1 ms, 1/2 Sine, mounted		AD Suffix	250 G
Mechanical Vibrarion	Per Mil-STD-883, Method 2007.2 20- 2000 Hz, PCB mounted		AD Suffix	15 G
Weight				18 grams
Flammability	Meets UL 94V-O			

(1) See SOA curves or consult factory for appropriate derating.

ELECTRICAL CHARACTERISTICS PTEA415050

(Unless otherwise stated, $T_A = 25^\circ\text{C}$, $V_I = 48\text{ V}$, $V_O = 5\text{ V}$, $C_O = 0\text{ }\mu\text{F}$, and $I_O = I_{O\text{max}}$)

PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNIT
I_O Output Current	Over V_I range		0		15	A
V_I Input Voltage Range	Over I_O Range		35	48	75	V
V_O tol Set Point Voltage Tolerance				$\pm 1^{(1)}$		% V_O
			4.95	5	5.05	V
Reg_{temp} Temperature Variation	–40°C > T_A > 85°C			± 1		% V_O
Reg_{line} Line Regulation	Over V_I range			± 1		mV
Reg_{load} Load Regulation	Over I_O range			± 1		mV
$\Delta V_O\text{tot}$ Total Output Voltage Variation	Includes set-point, line, load, –40°C > T_A > 85°C			± 1.5	± 3	% V_O
ΔV_{ADJ} Output Adjust Range	$P_O \leq 75\text{ W}$		–20		10	% V_O
η Efficiency	$I_O = I_{O\text{max}}$			91%		
V_R V_O Ripple (pk-pk)	20 MHz bandwidth			40		mV _{pp}
t_{tr}	Transient Response		0.1 A/ μs slew rate, 50% to 75% $I_{O\text{max}}$		100	μs
ΔV_{tr}			V_O over/undershoot		200	mV
I_{TRIP} Overcurrent Threshold	Shutdown, followed by auto-recovery			19		A
OVP Output Overvoltage Protection	Output shutdown and latch off			120		% V_O
OTP Over Temperature Protection	Temperature Measurement at thermal sensor. Hysteresis = 10°C nominal.			115		° C
f_s Switching Frequency	Over V_I range			290		kHz
UVLO Undervoltage Lockout	V_{OFF}	V_I decreasing, $I_O = 5\text{ A}$	29.4			V
	V_{HYS}	Hysteresis	3.3			
On/Off Input: Negative Enable	Referenced to $-V_I$					
V_{IH} Input High Voltage			2.4	Open ⁽²⁾		V
V_{IL} Input Low Voltage			–0.2	0.8		
I_{IL} Input Low Current				–0.2		mA
On/Off Input: Positive Enable	Referenced to $-V_I$					
V_{IH} Input High Voltage			4.5	Open ⁽²⁾		V
V_{IL} Input Low Voltage			–0.2	0.8		
I_{IL} Input Low Current				–0.2		mA
I_{SB} Standby Input Current	Output disabled (pin 2 status set to Off)			0.5		mA
C_I External Input Capacitance	Between $+V_I$ and $-V_I$		0	100		μF
C_O External Output Capacitance	$+V_O$ and $-V_O$		0		1000	μF
	Equivalent Series Resistance			10		$\text{m}\Omega$
Isolation Voltage	Input-to-output and input-to-case			1500		Vdc
Isolation Capacitance	Input-to-output			1200		pF
Isolation Resistance	Input-to-output			10		$\text{M}\Omega$

(1) If Sense(–) is not used, pin 5 must be connected to pin 4 for optimum output voltage accuracy.

(2) The Remote On/Off input has an internal pull-up and may be controlled with an open collector (or open drain) interface. An open circuit correlates to a logic high. Consult the application notes for interface considerations.

PIN DESCRIPTIONS

+V_I: The positive input for the module with respect to $-V_I$. When powering the module from a -48-V telecom central office supply, this input is connected to the primary system ground.

$-V_I$: The negative input supply for the module, and the 0 VDC reference for the Remote On/Off input. When powering the module from a $+48\text{-V}$ supply, this input is connected to the 48-V return.

Remote On/Off: This input controls the On/Off status of the output voltage. It is either driven low ($-V_I$ potential), or left open-circuit. For units identified with the NEN option, applying a logic low to this pin will enable the output. And for units identified with the PEN option, the output will be disabled.

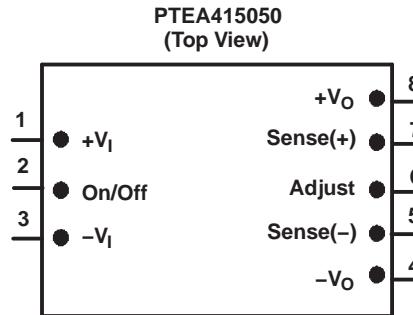
V_O Adjust: Allows the output voltage to be trimmed by up or down between $+10\%$ and -20% of its nominal value. The adjustment method uses a single external resistor. Connecting the resistor between V_O Adjust and $-V_O$ adjusts the output voltage lower, and placing it between V_O Adjust and +V_O adjusts the output higher. The calculations for the resistance value follows industry standard formulas. For further information consult the application note on output voltage adjustment.

+V_O: The positive power output with respect to $-V_O$, which is DC isolated from the input supply pins. If a negative output voltage is desired, +V_O should be connected to the secondary circuit common and the output taken from $-V_O$.

$-V_O$: The negative power output with respect to +V_O, which is DC isolated from the input supply pins. This output is normally connected to the secondary circuit common when a positive output voltage is desired.

Sense(+): Provides the converter with an output sense capability to regulate the set-point voltage directly at the load. When used with Sense(-), the regulation circuitry will compensate for voltage drop between the converter and the load. The pin may be left open circuit, but connecting it to +V_O will improve load regulation. If a series inductor is used for filtering between the module output and load, this pin must be connected directly to the module output to ensure good control design stability.

Sense(-): Provides the converter with an output sense capability when used in conjunction with Sense(+) input. For optimum output voltage accuracy this pin should always be connected to $-V_O$.



TYPICAL CHARACTERISTICS

PTEA415050, $V_O = 5$ V ⁽¹⁾ ⁽²⁾

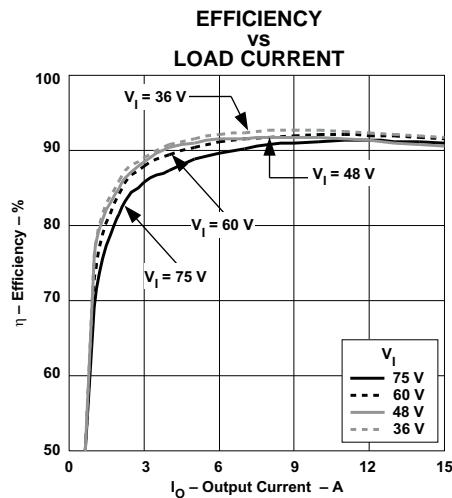


Figure 1.

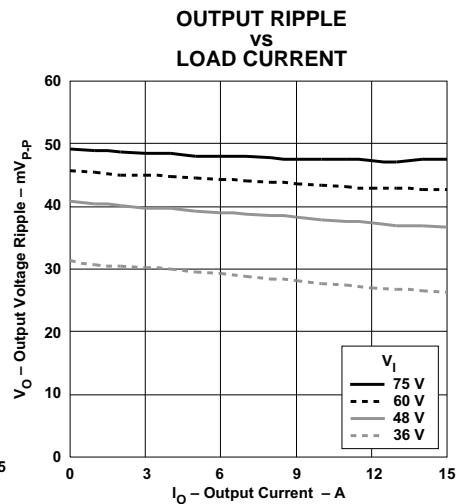


Figure 2.

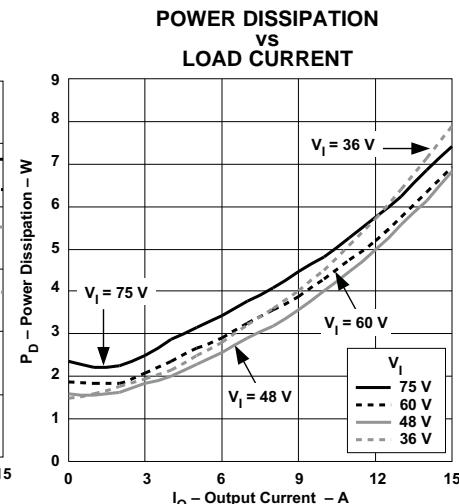


Figure 3.

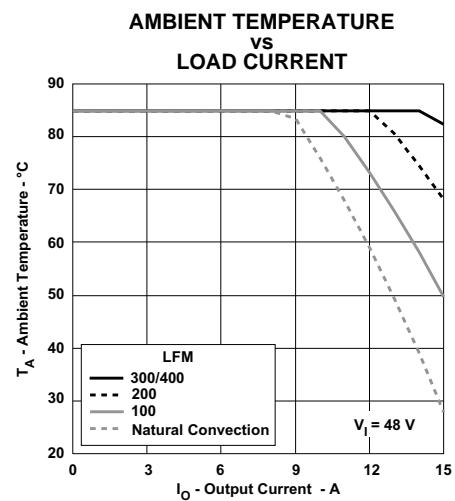


Figure 4.

- (1) All data listed in [Figure 1](#), [Figure 2](#), and [Figure 3](#) have been developed from actual products tested at 25°C. This data is considered typical data for the dc-dc converter.
- (2) The temperature derating curves represent operating conditions at which internal components are at or below manufacturer's maximum rated operating temperature. Derating limits apply to modules soldered directly to a 100-mm x 100-mm, double-sided PCB with 2 oz. copper. For surface mount packages, multiple vias (plated through holes) are required to add thermal paths around the power pins. Please refer to the mechanical specification for more information. Applies to [Figure 4](#).

APPLICATION INFORMATION

Operating Features and System Considerations for the PTEA415050 DC/DC Converter

Overcurrent Protection

To protect against load faults, these converters incorporate output overcurrent protection. Applying a load to the output that exceeds the converter's overcurrent threshold (see applicable specification) will cause the output voltage to momentarily fold back, and then shut down. Following shutdown the module will periodically attempt to automatically recover by initiating a soft-start power-up. This is often described as a *hiccup* mode of operation, whereby the module continues in the cycle of successive shutdown and power up until the load fault is removed. Once the fault is removed, the converter automatically recovers and returns to normal operation.

Output Overvoltage Protection

Each converter incorporates protection circuitry that continually senses for an output overvoltage (OV) condition. The OV threshold is set approximately 20% higher than the nominal output voltage. If the converter output voltage exceeds this threshold, the converter is immediately shut down and remains in a latched-off state. To resume normal operation the converter must be actively reset. This can only be done by momentarily removing the input power to the converter. For fail-safe operation and redundancy, the OV protection uses circuitry that is independent of the converter's internal feedback loop.

Overtemperature Protection

Overtemperature protection is provided by an internal temperature sensor, which closely monitors the temperature of the converter's printed circuit board (PCB). If the sensor exceeds a temperature of approximately 115°C, the converter will shut down. The converter will then automatically restart when the sensed temperature drops back to approximately 105°C. When operated outside its recommended thermal derating envelope (see data sheet SOA curves), the converter will typically cycle on and off at intervals from a few seconds to one or two minutes. This is to ensure that the internal components are not permanently damaged from excessive thermal stress.

Undervoltage Lockout

The Undervoltage lockout (UVLO) is designed to prevent the operation of the converter until the input voltage is at the minimum input voltage. This prevents high start-up current during normal power-up of the converter, and minimizes the current drain from the input source during low input voltage conditions. The UVLO circuitry also overrides the operation of the *Remote On/Off* control.

Primary-Secondary Isolation

These converters incorporate electrical isolation between the input terminals (primary) and the output terminals (secondary). All converters are production tested to a withstand voltage of 1500 VDC. This specification complies with UL60950 and EN60950 requirements. This allows the converter to be configured for either a positive or negative input voltage source. The data sheet *Pin Descriptions* section provides guidance as to the correct reference that must be used for the external control signals.

Input Current Limiting

The converter is not internally fused. For safety and overall system protection, the maximum input current to the converter must be limited. Active or passive current limiting can be used. Passive current limiting can be a fast acting fuse. A 125-V fuse, rated no more than 10 A, is recommended. Active current limiting can be implemented with a current limited *Hot-Swap* controller.

Thermal Considerations

Airflow may be necessary to ensure that the module can supply the desired load current in environments with elevated ambient temperatures. The required airflow rate may be determined from the Safe Operating Area (SOA) thermal derating chart (see typical characteristics).

Differential Remote Sense

The remote sense pins allows the converter to precisely regulate the DC output voltage at a remote location. This might be a power plane on an inner layer of the host PCB. Connecting Sense(+) directly to $+V_O$, and Sense(–) to $-V_O$ will improve output voltage accuracy. In the event that the sense pins are left open-circuit, an internal $10\text{-}\Omega$ resistor between each sense pin and its corresponding output prevents an excessive rise in the output voltage. For practical reasons, the amount of IR voltage compensation should be limited to 0.5 V maximum.

The remote sense feature is designed to compensate for limited amounts of IR voltage drop. It is **not** intended to compensate for the forward drop of a non-linear or frequency dependent components that may be placed in series with the converter output. Examples of such components include OR-ing diodes, filter inductors, ferrite beads, and fuses. Enclosing these components with the remote sense connections effectively places them inside the regulation control loop, which can affect the stability of the regulator.

Using the Remote On/Off Function on the PTEA415050 DC/DC Converter

For applications requiring output voltage On/Off control, the PTEA415050 DC/DC converter incorporate a *Remote On/Off* control (pin 2). This feature can be used to switch the module off without removing the applied input source voltage. When placed in the *Off* state, the standby current drawn from the input source is typically reduced to 3 mA.

Negative Output Enable (NEN)

Models using the negative enable option, the *Remote On/Off* (pin 2) control must be driven to a logic low voltage for the converter to produce an output. This is accomplished by either permanently connecting pin 2 to $-V_L$ (pin 3), or driving it low with an external control signal. [Table 2](#) shows the input requirements of pin 2 for those modules with the *NEN* option.

Table 2. On/Off Control Requirements for Negative Enable

PARAMETER		MIN	TYP	MAX	UNITS
V_{IH}	Disable	2.4	20		V
V_{IL}	Enable	-0.2	0.8		
$V_{o/c}$	Open-Circuit		9	15	
I_L	Pin 2 at $-V_L$			-0.75	mA

Positive Output Enable (PEN)

For those models with the positive enable (PEN) option, leaving pin 2 open circuit, (or driving it to an equivalent logic high voltage), will enable the converter output. This allows the module to produce an output voltage whenever a valid input source voltage is applied to $+V_L$ with respect to $-V_L$. If a logic-low signal is then applied to pin 2 the converter output is disabled. [Table 3](#) gives the input requirements of pin 2 for modules with the *PEN* option.

Table 3. On/Off Control Requirements for Positive Enable

PARAMETER		MIN	TYP	MAX	UNITS
V_{IH}	Enable	4.5	20		V
V_{IL}	Disable	-0.2	0.8		
$V_{o/c}$	Open-Circuit		5	7	
I_L	Pin 2 at $-V_L$			-0.5	mA

Notes:

1. The *Remote On/Off* control uses $-V_L$ (pin 3) as its ground reference. All voltages are with respect to $-V_L$.
2. An open-collector device (preferably a discrete transistor) is recommended. A pull-up resistor is not required. If one is added the pull-up voltage should not exceed 20 V.

Caution: Do not use a pull-resistor to $+V_L$ (pin 1). The remote On/Off control has a maximum input voltage of 20 V. Exceeding this voltage will overstress, and possibly damage, the converter.

3. The *Remote On/Off* pin may be controlled with devices that have a totem-pole output. This is provided the output high level voltage (V_{OH}) meets the module's minimum V_{IH} specified in [Table 2](#). If a TTL gate is used, a pull-up resistor may be required to the logic supply voltage.
4. The converter incorporates an *undervoltage lockout* (UVLO). The UVLO keeps the converter off until the input voltage is close to the minimum specified operating voltage. This is regardless of the state of the *Remote On/Off* control. Consult the product specification for the UVLO input voltage thresholds.

Turn-On: With a valid input source voltage applied, the converter produces a regulated output voltage within 10 ms of the output being enabled. Figure 6 shows the output response of the PTEA following the removal of the logic-low signal from the *Remote On/Off* (pin 2); see Figure 5. This corresponds to the rise in V_{EN} in Figure 6. Although the rise-time of the output voltage is short (<5 ms), the indicated delay time will vary depending upon the input voltage and the module's internal timing. The waveforms were measured with 48 VDC input voltage, and a 15-A resistive load.

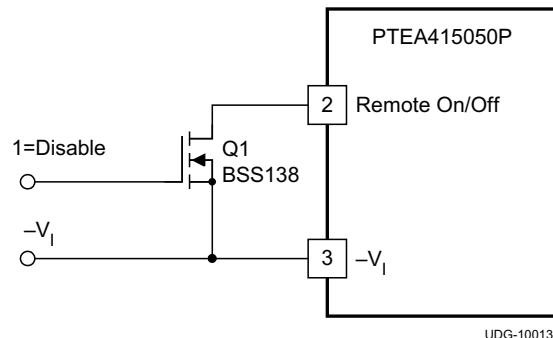


Figure 5. Recommended Remote On/Off Control

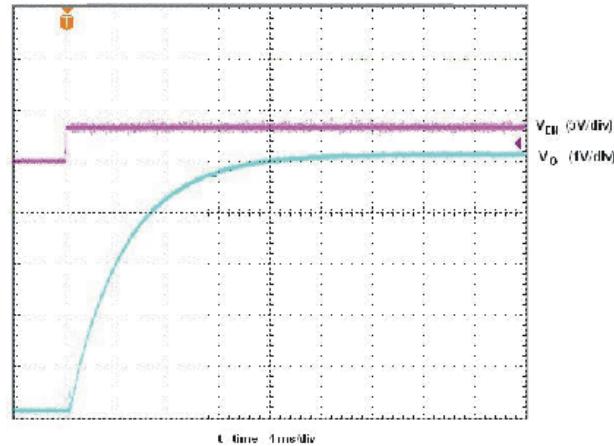


Figure 6. Power Up

Adjusting the Output Voltage of the PTEA415050 Isolated DC/DC Converter

The output voltage adjustment of the PTEA415050 isolated DC/DC converter follows the standard adopted by popular 1/8-brick DC/DC converters. Adjustment is accomplished with a single external resistor that can adjust the output voltage from -20% to $+10\%$ of the nominal set-point voltage. The placement of the resistor determines the direction of adjustment, up or down, and the value of the magnitude of adjustment. To ensure good V_O set-point accuracy, a 1% maximum tolerance resistor is recommended.

Adjust Up: To increase the output voltage add a resistor, R1, between V_O Adjust (pin 6) and Sense(+) (pin 7).

Adjust Down: Add a resistor, (R2), between V_O Adjust (pin 6) and Sense(–) (pin 5).

Refer to [Figure 7](#) for the placement of the required resistor, R1 or (R2).

The values of R1 [adjust up], and (R2) [adjust down], can be calculated using the following formulas.

$$R1 = \frac{5.11 V_O (100 + \Delta\%)}{1.225 \Delta\%} - \frac{511}{\Delta\%} - 10.22 \text{ (k}\Omega\text{)} \quad (1)$$

$$(R2) = 5.11 \frac{100}{\Delta\%} - 10.22 \text{ (k}\Omega\text{)} \quad (2)$$

Where:

$\Delta\%$ = Amount of adjustment in %

V_O = Original set-point voltage

Notes:

1. Use a 1% resistor for either the R1 or (R2). Place the resistor as close to the converter as possible.
2. If V_O is increased, the maximum load current must be derated according to the following equation.

$$I_O(\max) = \frac{V_O \times I_O(\text{rated})}{V_A}$$

where

- V_O is the original set-point voltage
- V_A is the adjusted output voltage (measured between pin 8 and pin 4)

In any instance, the load current must not exceed the converter's maximum rated output current of 15 A.

3. The overvoltage threshold is fixed, and is set approximately 20% above the nominal output voltage. Adjusting the output voltage higher reduces the voltage margin between the adjusted output voltage and the overvoltage (OV) protection threshold. This could make the module sensitive to OV fault detection, as a result of random noise and load transients.

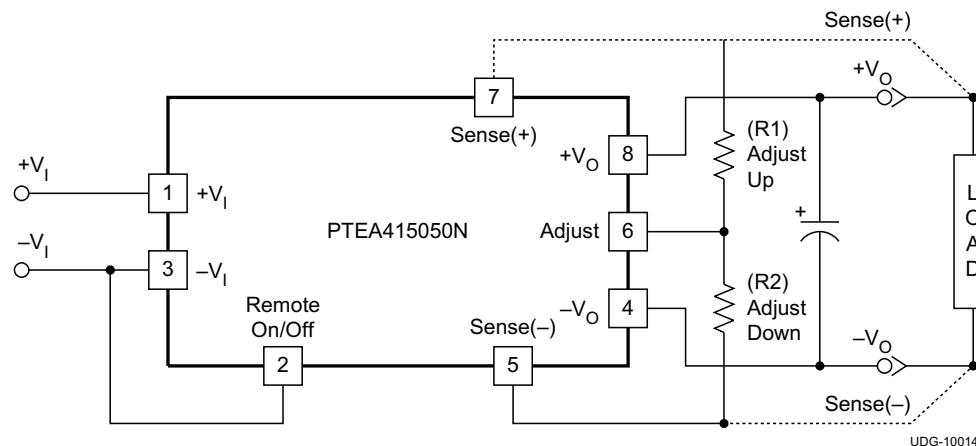


Figure 7.

Table 4. Adjustment Resistor Values

V_O (nom) % Adjust (V)	Adjusted Output Voltage (V)	Trim-Up R_{ADJ} $R1$ (k Ω)	Trim-Down R_{ADJ} $R2$ (k Ω)
+10	5.50	169	Open
+ 9	5.45	187	Open
+ 8	5.40	205	Open
+ 7	5.35	237	Open
+ 6	5.30	274	Open
+ 5	5.25	324	Open
+ 4	5.20	402	Open
+ 3	5.15	536	Open
+ 2	5.10	806	Open
+ 1	5.05	1580	Open
0	5.00	Open	Open
-1	4.95	Open	499
-2	4.90	Open	243
-3	4.85	Open	158
-4	4.80	Open	118
-5	4.75	Open	90.9
-6	4.70	Open	75.0
-7	4.65	Open	63.4
-8	4.60	Open	53.6
-9	4.55	Open	46.4
-10	4.50	Open	41.2
-11	4.45	Open	36.5
-12	4.40	Open	32.4
-13	4.35	Open	28.7
-14	4.30	Open	26.1
-15	4.25	Open	23.7
-16	4.20	Open	21.5
-17	4.15	Open	19.6
-18	4.10	Open	18.2
-19	4.05	Open	16.5
-20	4.00	Open	15.4

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
PTEA415050N2AD	NRND	Production	Through-Hole Module (EAW) 8	15 TIW TRAY	In-Work	SN	N/A for Pkg Type	-40 to 85	
PTEA415050N2AD.B	NRND	Production	Through-Hole Module (EAW) 8	15 TIW TRAY	In-Work	SN	N/A for Pkg Type	-40 to 85	
PTEA415050P2AD	NRND	Production	Through-Hole Module (EAW) 8	15 TIW TRAY	In-Work	SN	N/A for Pkg Type	-40 to 85	

⁽¹⁾ **Status:** For more details on status, see our [product life cycle](#).

⁽²⁾ **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

⁽³⁾ **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

⁽⁴⁾ **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

⁽⁵⁾ **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

⁽⁶⁾ **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

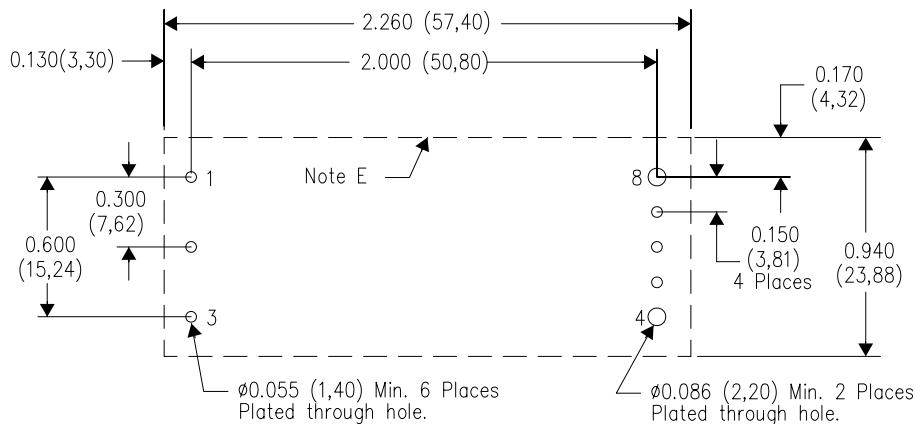
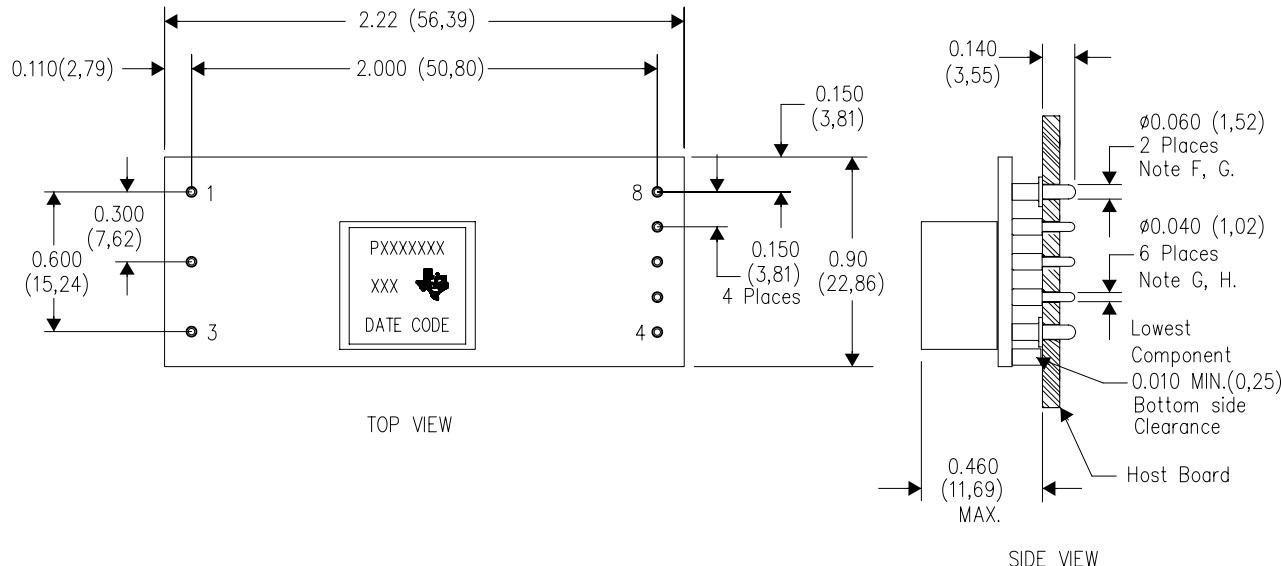
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MECHANICAL DATA

EAW (R-PDSS-T8)

DOUBLE SIDED MODULE



4208117/B 10/10

NOTES:

- A. All linear dimensions are in inches (mm).
- B. This drawing is subject to change without notice.
- C. 2 place decimals are ± 0.020 ($\pm 0,51\text{mm}$).
- D. 3 place decimals are ± 0.010 ($\pm 0,25\text{mm}$).
- E. Recommended keep out area for user components.

- F. Pins are 0.040" (1,02) diameter with 0.070" (1,78) diameter standoff shoulder.
- G. All pins: Material – Copper Alloy Finish – Tin (100%) over Nickel plate

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