



# DVTR2800T Series

## HIGH RELIABILITY HYBRID DC-DC CONVERTERS

### DESCRIPTION

The DVTR series of high-reliability DC-DC converters provide decades of successful critical mission support. Operable over the full military (-55 °C to +125 °C) temperature range with no power derating, the DVTR series unique input, and output filters dramatically reduce input and output noise performance. While operating at a nominal fixed frequency of 450 kHz, these regulated, isolated units utilize a high-speed magnetic feedback design and well-controlled under-voltage lockout circuitry to eliminate slow start-up problems.

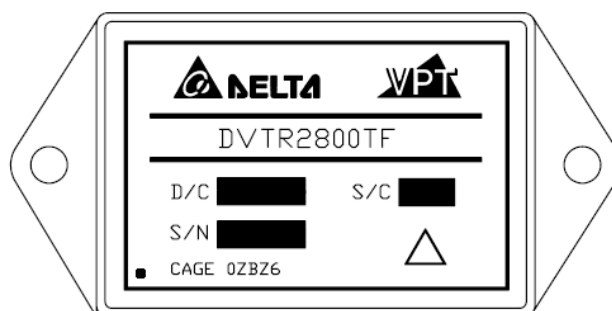
These converters are designed and manufactured in a facility qualified to ISO9001 and certified to MIL-PRF-38534 and MIL-STD-883.

This product may incorporate one or more of the following U.S. patents:

5,784,266  
5,790,389  
5,963,438  
5,999,433  
6,005,780  
6,084,792  
6,118,673

### FEATURES

- High Reliability
- Very Low Output Noise
- Wide Input Voltage Range: 15 to 50 Volts per MIL-STD-704
- Up to 30 Watts Output Power
- Fault Tolerant Magnetic Feedback Circuit
- NO Use of Optoisolators
- Undervoltage Lockout
- Indefinite Short Circuit Protection
- Current Limit Protection
- Industry Standard Pinout
- High Input Transient Voltage: 80 Volts for 1 sec per MIL-STD-704A
- Precision Seam Welded Hermetic Package
- High Power Density: > 28 W/in<sup>3</sup>
- Custom Versions Available
- Additional Environmental Screening Available
- Meets MIL-STD-461 Revisions C, D, E and F EMC Requirements When Used With VPT's EMI Filters
- Flanged and Non-flanged Versions Available.
- MIL-PRF-38534 Element Evaluated Components



**Figure 1** – DVTR2800T / DVTR2800TF DC-DC Converter  
(Exact marking may differ from that shown)

## SPECIFICATIONS (T<sub>CASE</sub> = -55°C to +125°C, V<sub>IN</sub> = +28V ± 5%, Full Load<sup>5</sup>, Unless Otherwise Specified)

### ABSOLUTE MAXIMUM RATINGS

Input Voltage (Continuous)	50 V <sub>DC</sub>	Junction Temperature Rise to Case	+15°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power	30 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T <sub>CASE</sub> = +125°C)	10 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(54 / 58) Grams
ESD Rating per MIL-PRF-38534	3B		

Parameter	Conditions	DVTR28512T			DVTR28515T			Units	
		Min	Typ	Max	Min	Typ	Max		
<b>STATIC</b>									
INPUT Voltage	Continuous	15	28	50	15	28	50	V	
	Transient, 1 sec <sup>4</sup>	-	-	80	-	-	80	V	
Current	Inhibited	-	2	5	-	2	5	mA	
	No Load	-	20	60	-	20	60	mA	
Ripple Current	Full Load <sup>5</sup> , 20Hz to 10MHz	-	15	50	-	15	50	mA <sub>p-p</sub>	
Inhibit Pin Input <sup>4</sup>		0	-	1.5	0	-	1.5	V	
Inhibit Pin Open Circuit Voltage <sup>4</sup>		13	15	17	13	15	17	V	
UVLO Turn On		10.5	-	14.5	10.5	-	14.5	V	
UVLO Turn Off <sup>4</sup>		10.0	-	14.5	10.0	-	14.5	V	
OUTPUT Voltage	V <sub>MAIN</sub>	T <sub>CASE</sub> = 25°C	4.95	5.0	5.05	4.95	5.0	5.05	V
	+V <sub>AUX</sub>		11.88	12.0	12.12	14.85	15.0	15.15	V
	-V <sub>AUX</sub>		11.76	12.0	12.24	14.70	15.0	15.30	V
	V <sub>MAIN</sub>	T <sub>CASE</sub> = -55°C to +125°C	4.85	5.0	5.15	4.85	5.0	5.15	V
	+V <sub>AUX</sub>		11.64	12.0	12.36	14.55	15.0	15.45	V
	-V <sub>AUX</sub>		11.52	12.0	12.48	14.40	15.0	15.60	V
Power <sup>4</sup>	Total		0	-	30	0	-	30	W
	V <sub>MAIN</sub>		0	-	15	0	-	15	W
	±V <sub>AUX</sub> <sup>6</sup>		0	-	15	0	-	15	W
Current <sup>3</sup>	V <sub>MAIN</sub>		0	-	3.0	0	-	3.0	A
	±V <sub>AUX</sub>	Either Output <sup>6</sup>	0	-	0.87	0	-	0.70	A
Ripple Voltage	V <sub>MAIN</sub>	Full Load <sup>5</sup> , 20Hz to 10MHz	-	15	60	-	15	60	mV <sub>p-p</sub>
	±V <sub>AUX</sub>		-	40	100	-	40	100	mV <sub>p-p</sub>
Line Regulation	V <sub>MAIN</sub>	V <sub>IN</sub> = 15V to 50V	-	2	25	-	2	25	mV
	+V <sub>AUX</sub>		-	2	50	-	2	50	mV
	-V <sub>AUX</sub>		-	15	100	-	15	100	mV
Load Regulation	V <sub>MAIN</sub>	No Load to Full Load <sup>5,8</sup>	-	10	25	-	10	25	mV
	+V <sub>AUX</sub>		-	5	50	-	5	50	mV
	-V <sub>AUX</sub>		-	60	250	-	60	250	mV
Cross Regulation	±V <sub>AUX</sub>	+V <sub>OUT</sub> = 30%, -V <sub>OUT</sub> = 70% +V <sub>OUT</sub> = 70%, -V <sub>OUT</sub> = 30%	-	200	550	-	200	550	mV
EFFICIENCY		Full Load <sup>5</sup>	74	81	-	75	82	-	%
LOAD FAULT POWER DISSIPATION		Overload <sup>4</sup>	-	-	15	-	-	15	W
		Short Circuit	-	-	10	-	-	10	W
CAPACITIVE LOAD <sup>4</sup>			-	-	500	-	-	500	μF
SWITCHING FREQUENCY			550	650	700	550	650	700	kHz
SYNCHRONIZATION FREQUENCY <sup>7</sup>			700	750	800	700	750	800	kHz
ISOLATION		500 V <sub>DC</sub> , T <sub>CASE</sub> = 25°C	100	-	-	100	-	-	MΩ
MTBF (MIL-HDBK-217F)		AIF @ T <sub>C</sub> = 55°C	-	307	-	-	307	-	kHrs

## SPECIFICATIONS (T<sub>CASE</sub> = -55°C to +125°C, V<sub>IN</sub> = +28V ± 5%, Full Load<sup>5</sup>, Unless Otherwise Specified)

### ABSOLUTE MAXIMUM RATINGS

Input Voltage (Continuous)	50 V <sub>DC</sub>	Junction Temperature Rise to Case	+15°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power	30 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T <sub>CASE</sub> = +125°C)	10 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(54 / 58) Grams
ESD Rating per MIL-PRF-38534	3B		

Parameter	Conditions	DVTR28512T			DVTR28515T			Units	
		Min	Typ	Max	Min	Typ	Max		
<b>DYNAMIC</b>									
Load Step Output Transient	V <sub>MAIN</sub>	Half Load to Full Load	-	250	400	-	250	400	mV <sub>PK</sub>
	±V <sub>AUX</sub>		-	340	700	-	330	700	mV <sub>PK</sub>
Load Step Recovery <sup>2</sup>	V <sub>MAIN</sub>		-	320	500	-	330	500	μSec
	±V <sub>AUX</sub>		-	310	500	-	300	500	μSec
Line Step Output Transient <sup>4</sup>	V <sub>MAIN</sub>	V <sub>IN</sub> = 16V to 40V	-	200	400	-	200	400	mV <sub>PK</sub>
	±V <sub>AUX</sub>		-	300	500	-	300	500	mV <sub>PK</sub>
Line Step Recovery <sup>2, 4</sup>	V <sub>MAIN</sub>		-	200	400	-	200	400	μSec
	±V <sub>AUX</sub>		-	200	400	-	200	400	μSec
Turn On Delay			-	14	20	-	14	20	mSec
Turn On Overshoot	V <sub>MAIN</sub>	V <sub>IN</sub> = 0V to 28V	-	0	25	-	0	25	mV <sub>PK</sub>
	±V <sub>AUX</sub>		-	0	50	-	0	50	mV <sub>PK</sub>

### Notes:

1. This note intentionally not used.
2. Time for output voltage to settle within 1% of its nominal value.
3. Derate linearly to 0 at 135°C.
4. Verified by initial electrical design verification. Post design verification, parameter shall be guaranteed to the limits specified.
5. 15W on V<sub>MAIN</sub> and 15W on ±V<sub>AUX</sub>.
6. Up to 70% of the total auxiliary power or current can be drawn from either of the auxiliary outputs.
7. Synchronization is TTL signal with V<sub>SYNC MAX</sub> = 6V.
8. -V<sub>AUX</sub> is 5% Load to Full Load at -55°C.

**BLOCK DIAGRAM**

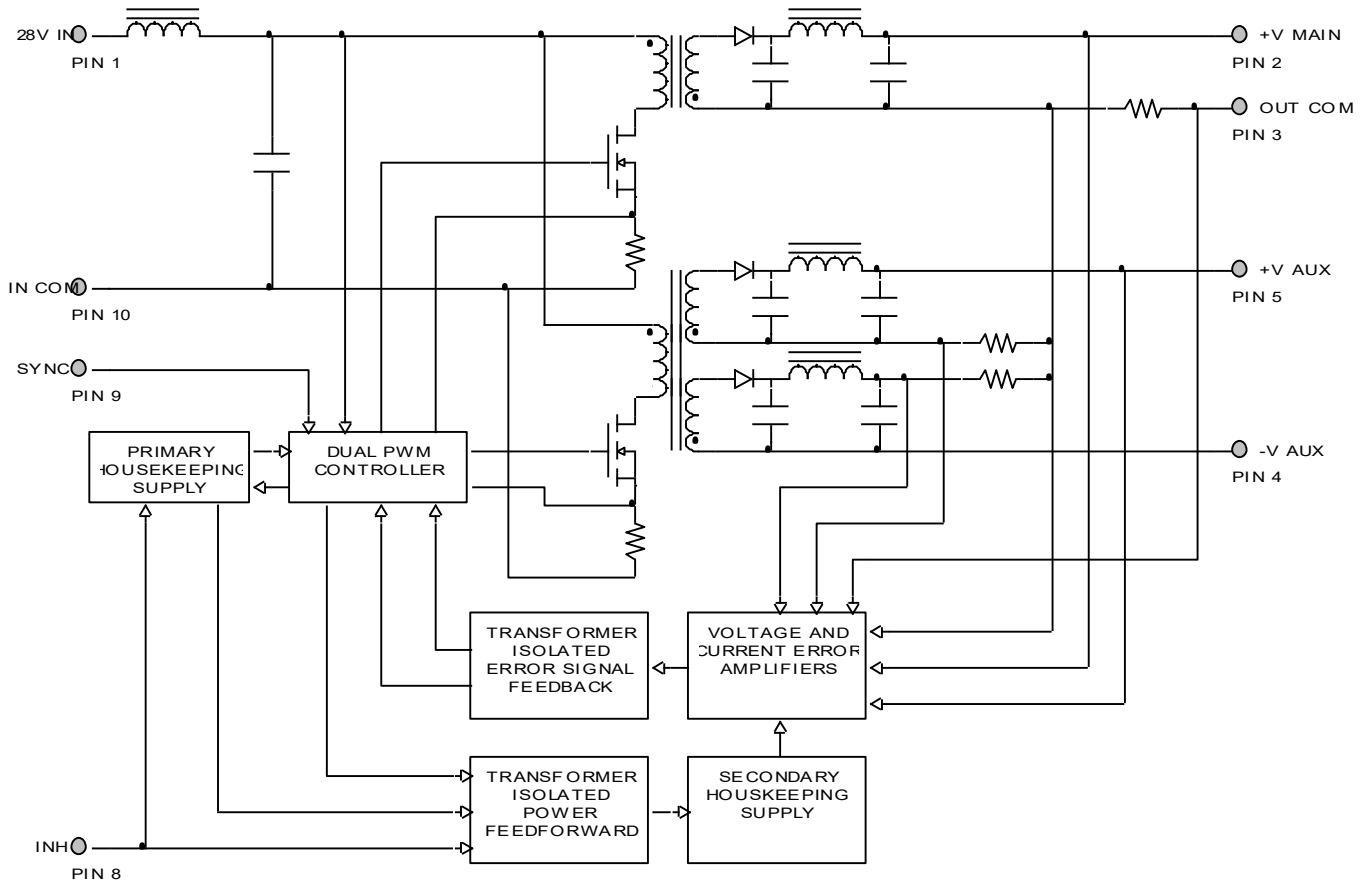


Figure 2

**CONNECTION DIAGRAM**

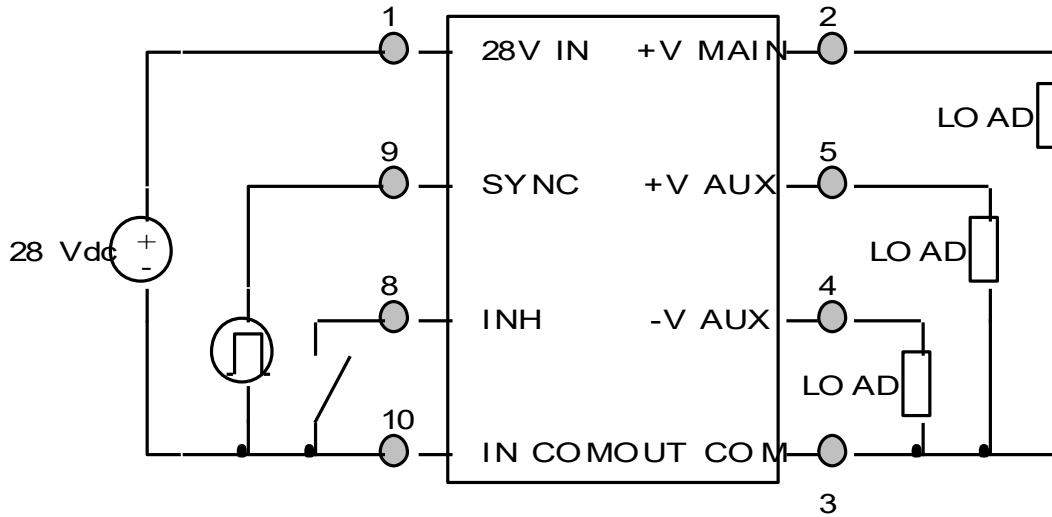


Figure 3

**INHIBIT DRIVE CONNECTION DIAGRAMS**

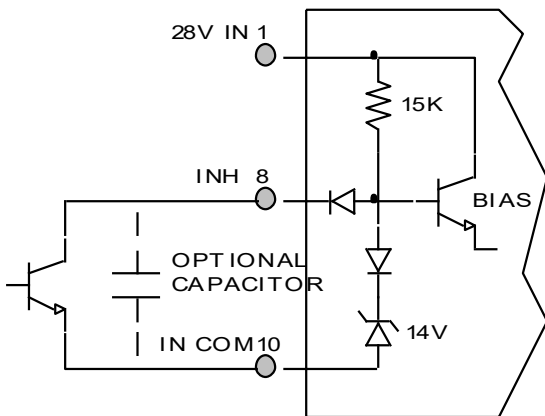


Figure 4 – Internal Inhibit Circuit and Recommended Drive  
(Shown with optional capacitor for turn-on delay)

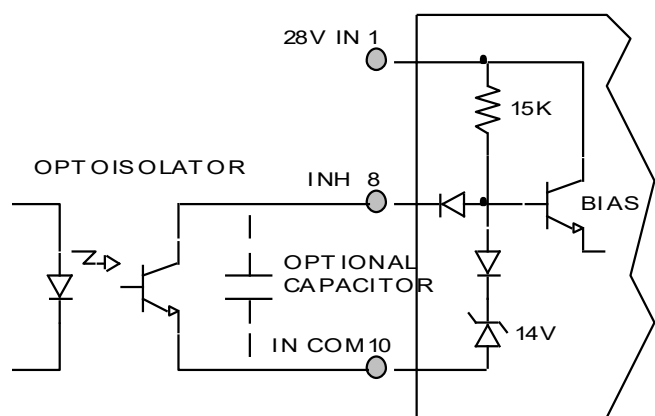
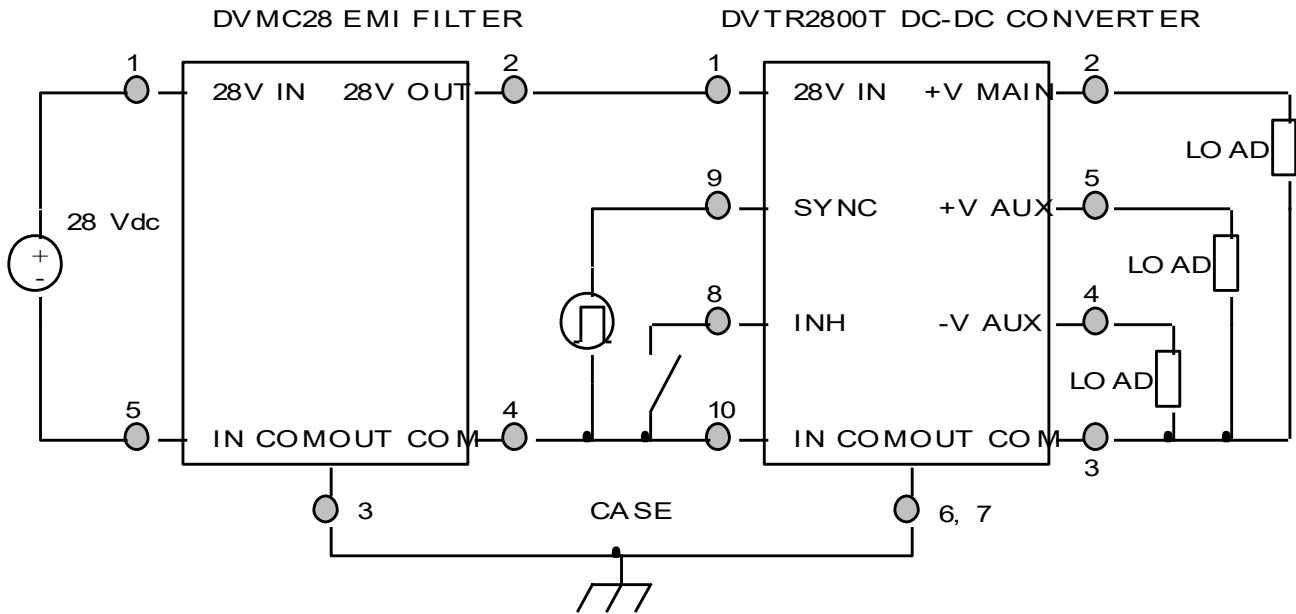


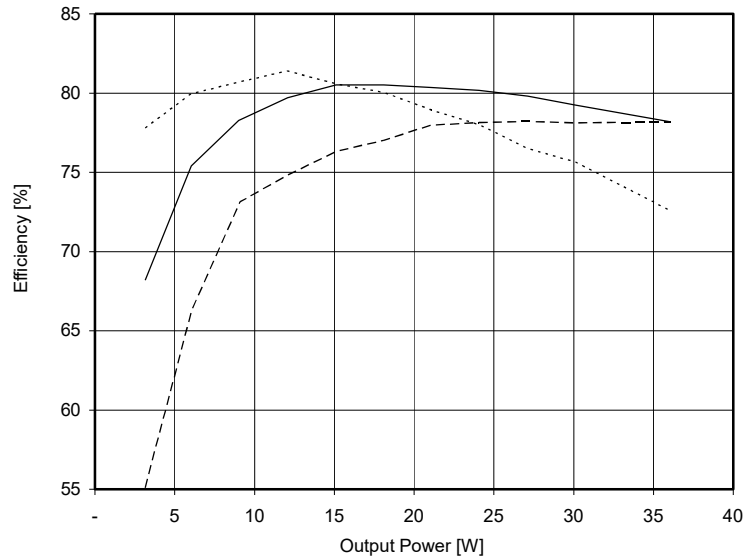
Figure 5 – Isolated Inhibit Drive  
(Shown with optional capacitor for turn-on delay)

**EMI FILTER HOOKUP DIAGRAM**

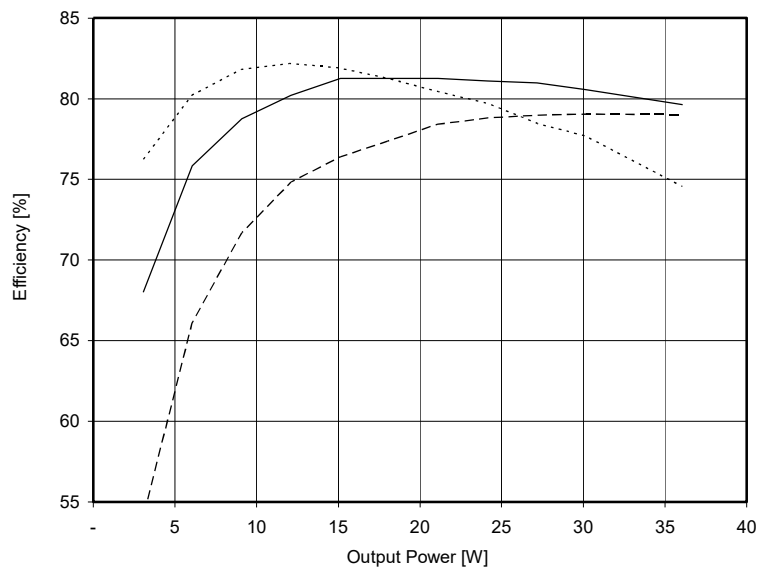


**Figure 6** – Converter with EMI Filter

**EFFICIENCY PERFORMANCE CURVES** ( $T_{CASE} = 25^{\circ}C$ )

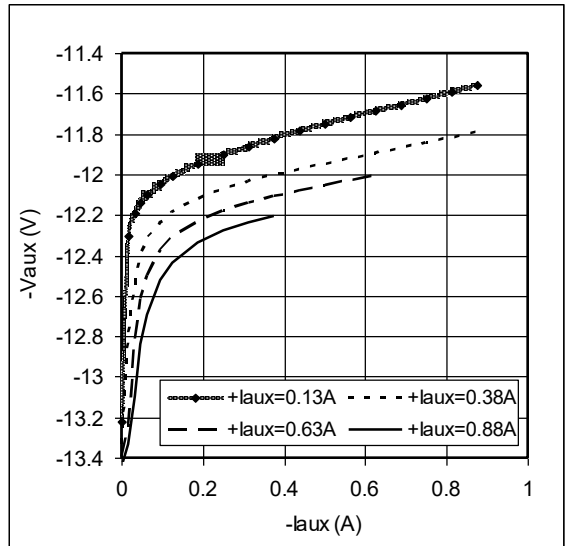
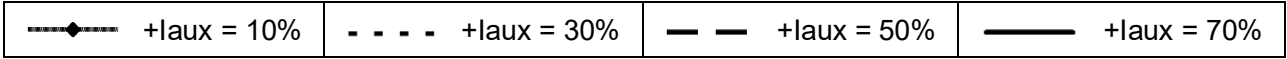


**Figure 7 – DVTR28512T**  
Efficiency (%) vs. Output Power (W)



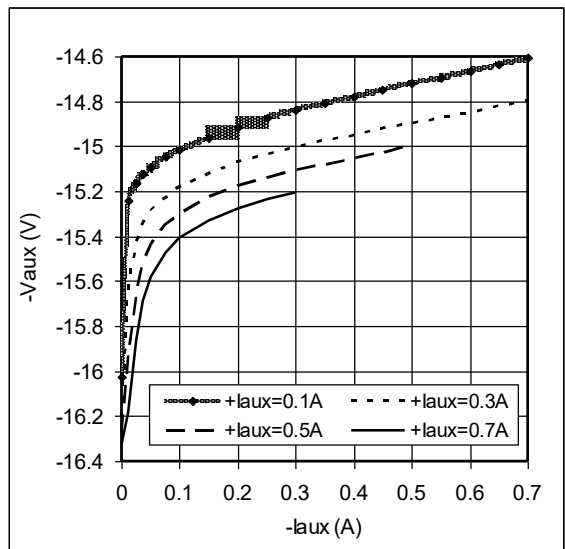
**Figure 8 – DVTR28515T**  
Efficiency (%) vs. Output Power (W)

**CROSS REGULATION CURVES** ( $T_{CASE} = 25^{\circ}C$ , Full Load, Unless Otherwise Specified)



**Figure 9 – DVTR28512T**

-Vaux (V) vs. -Iaux (A)



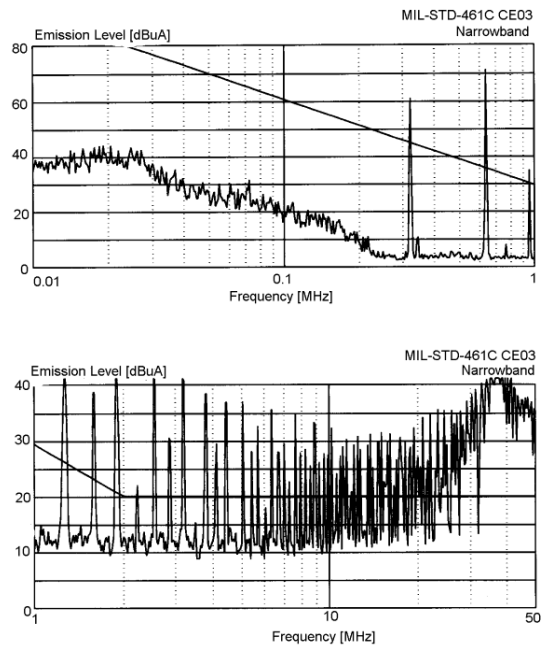
**Figure 10 – DVTR28515T**

-Vaux (V) vs. -Iaux (A)

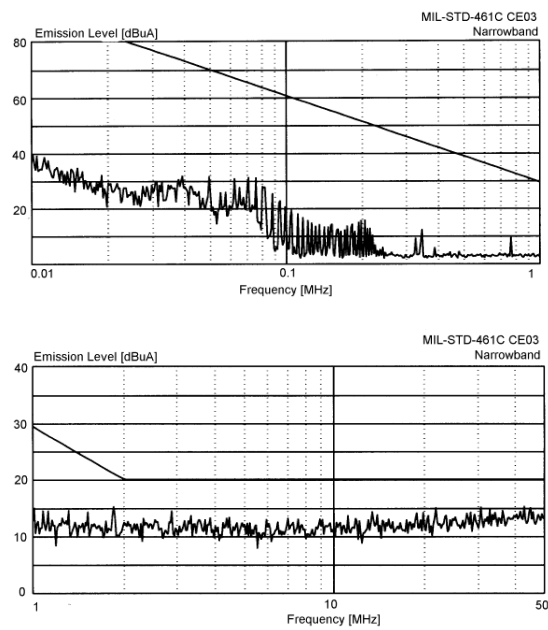


**EMI PERFORMANCE CURVES**

(T<sub>CASE</sub> = 25°C, V<sub>IN</sub> = +28V ± 5%, Full Load, Unless Otherwise Specified)

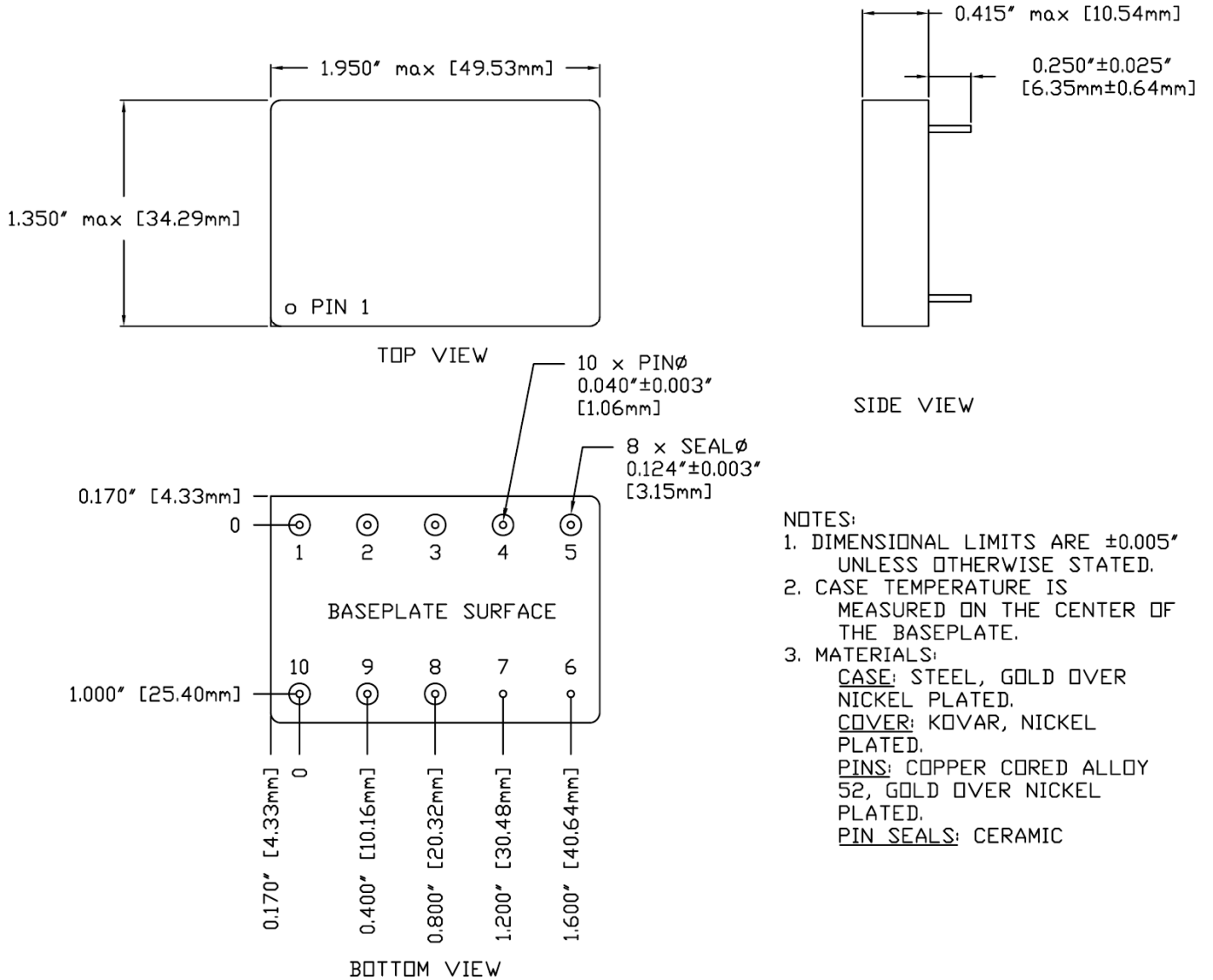


**Figure 11 – DVTR2800T without EMI Filter**



**Figure 12 – DVTR2800T with EMI Filter**

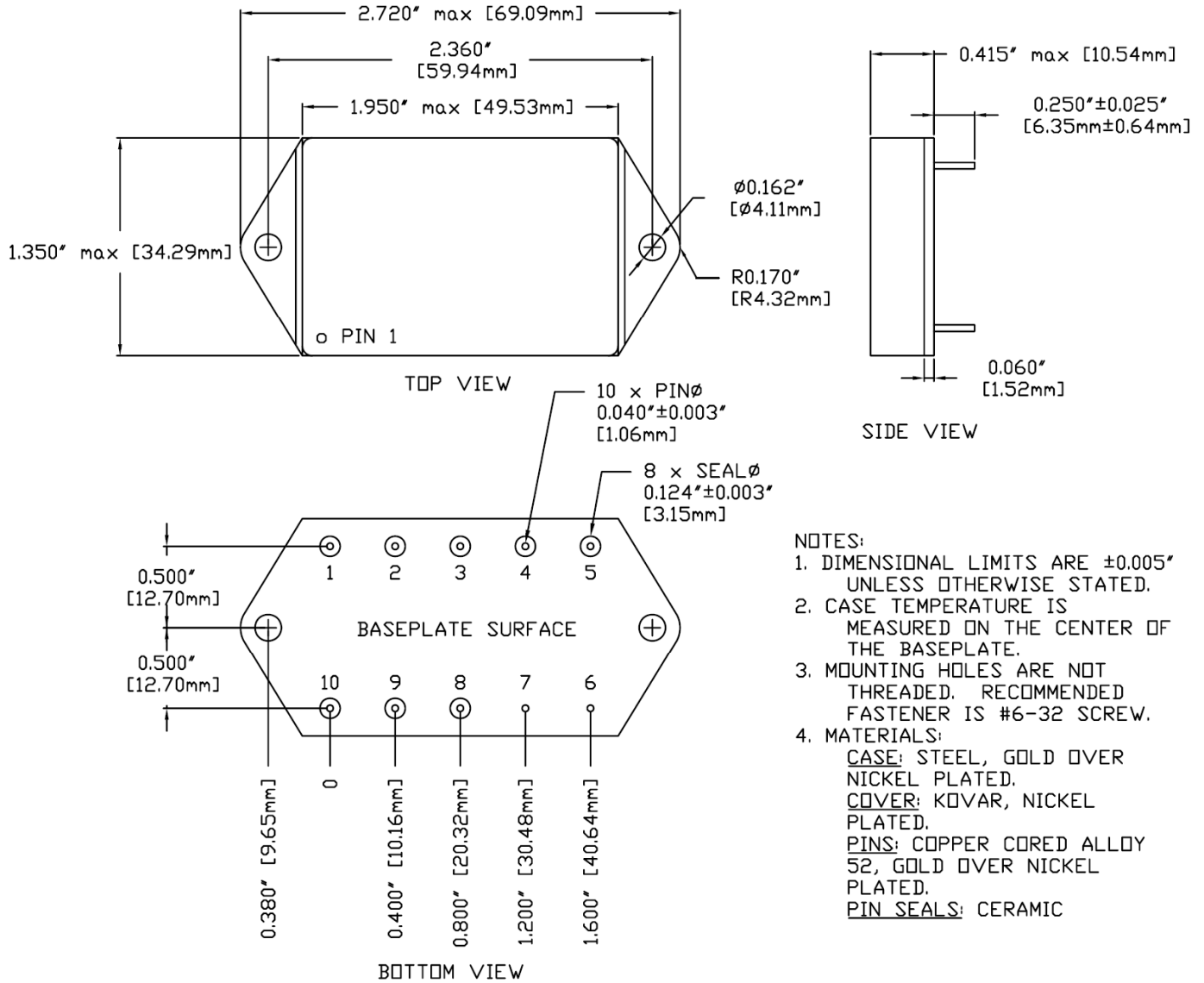
**PACKAGE SPECIFICATIONS (NON-FLANGED, SEAM SEAL)**



Pin	Function	Pin	Function
1	28V IN	6	CASE
2	+V MAIN	7	CASE
3	OUT COM	8	INHIBIT
4	-V AUX	9	SYNC
5	+V AUX	10	IN COM

**Figure 13** – Non-Flanged, Seam Seal Package and Pinout

**PACKAGE SPECIFICATIONS (FLANGED, SEAM SEAL)**



Pin	Function	Pin	Function
1	28V IN	6	CASE
2	+V MAIN	7	CASE
3	OUT COM	8	INHIBIT
4	-V AUX	9	SYNC
5	+V AUX	10	IN COM

**Figure 14 – Flanged, Seam Seal Package and Pinout**

## PACKAGE PIN DESCRIPTION

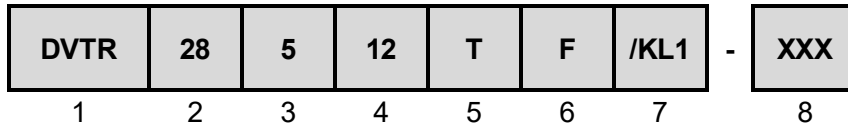
Pin	Function	Description
1	28V IN	Positive Input Voltage Connection
2	+V MAIN	Positive Main Output Voltage Connection
3	OUT COM	Output Common Connection
4	-V AUX	Negative Auxiliary Output Voltage Connection
5	+V AUX	Positive Auxiliary Output Voltage Connection
6	CASE	Case Connection
7	CASE	Case Connection
8	INHIBIT	Logic Low = Disabled Output. Connecting the inhibit pin to input common causes converter shutdown. Logic High = Enabled Output. Unconnected or open collector TTL.
9	SYNC	Synchronization Signal
10	IN COM	Input Common Connection

## ENVIRONMENTAL SCREENING (100% Tested Per MIL-STD-883 as referenced to MIL-PRF-38534)

Test	MIL-STD-883 Test Method, Condition	No Suffix (Standard) Non-QML <sup>5</sup>	/ES (Extended) Non-QML <sup>5</sup>	/H (Class H)	/KL1 Non-QML <sup>5,9</sup>
Non-Destructive Bond Pull	TM2023	• <sup>4</sup>	• <sup>4</sup>	• <sup>4</sup>	•
Internal Visual	TM2010, TM2017, TM2032 (MIL-STD-750, TM2072, TM2073)	•	•	•	•
Temperature Cycling	TM1010, Condition C -65°C to 150°C, Ambient			•	•
	TM1010, Condition B -55°C to 125°C, Ambient		•		
Constant Acceleration	TM2001, 3000g, Y1 Direction			•	•
	TM2001, 500g, Y1 Direction		•		
PIND <sup>7</sup>	TM2020, Condition A				•
Pre Burn-In Electrical	25°C				•
Burn-In	TM1015, 320 hrs, 125°C, Case Typ				•
	TM1015, 160 hrs, 125°C, Case Typ			•	
	96 hrs, 125°C, Case Typ		•		
	24 hrs, 125°C, Case Typ	•			
Final Electrical	MIL-PRF-38534, Group A Subgroups 1-6 -55°C, 25°C, 125°C <sup>3</sup>			•	•
	MIL-PRF-38534, Group A Subgroups 1 and 4 25°C	•	•		
Hermeticity (Seal)	TM1014, Fine Leak, Condition A2 or B1		•	•	•
	TM1014, Gross Leak, Condition C1 or B2		•	•	•
	Gross Leak, Dip (No Bomb), Visual Verification	•			
Radiography <sup>8</sup>	TM2012				•
External Visual	TM2009	•	•	•	•

- Notes:
- Contact Sales for more information concerning additional environmental screening and testing options desired.
  - VPT Inc. reserves the right to ship higher screened or SMD products to meet lower screened orders at our sole discretion unless specifically forbidden by customer contract.
  - 100% R&R testing with all test data included in product shipment.
  - Not required per MIL-PRF-38534. Test is performed for additional product quality assurance.
  - Non-QML products may not meet all requirements of MIL-PRF-38534.
  - Note intentionally not used.
  - PIND test Certificate of Compliance included in product shipment.
  - Radiographic test Certificate of Compliance and film(s) or data CD included in product shipment.
  - KL1 products are identical in every way with Class K products in compliance with MIL-PRF-38534 revision L and later revisions except they contain elements evaluated to the requirements of MIL-PRF-38534 revision K and previous revisions. These devices are not marked with an SMD number or MIL-PRF-38534 certification mark and are marked with -KL1 screening code in place of -K.

## ORDERING INFORMATION



(1)

(2)

(3)

(4)

Product Series	Nominal Input Voltage		Main Output Voltage		Auxiliary Output Voltages	
DVTR	28	28 Volts	5	+ 5 Volts	12 15	± 12 Volts ± 15 Volts

(5)

(6)

(7)

(8)

Number of Outputs		Package Option		Screening Code <sup>1,2</sup>		Additional Screening Code
T	Triple	None F	Non-Flanged Flanged	None /ES /H /KL1	Standard Extended Class H Class KL1	Contact Sales

- Notes:
1. Contact the VPT Inc. Sales Department for availability of Class H (/H) and KL1 (/KL1) qualified products.
  2. VPT Inc. reserves the right to ship higher screened or SMD products to meet lower screened orders at our sole discretion unless specifically forbidden by customer contract.
  3. -KL1 products are identical in every way with Class K products in compliance with MIL-PRF-38534 revision L and later revisions except they contain elements evaluated to the requirements of MIL-PRF-38534 revision K and previous revisions. These devices are not marked with an SMD number or MIL-PRF-38534 certification mark and are marked with -KL1 screening code in place of -K.

Please contact your sales representative or the VPT Inc. Sales Department for more information concerning additional environmental screening and testing, different input voltage, output voltage, power requirement, source inspection, and/or special element evaluation for space or other higher quality applications.

## SMD (STANDARD MICROCIRCUIT DRAWING) NUMBERS

Standard Microcircuit Drawing (SMD)	DVTR2800T Series Similar Part Number
5962-1620201HXC 5962-1620201HXA 5962-1620201HYC 5962-1620201HYA	DVTR28512T/H DVTR28512T/H-E DVTR28512TF/H DVTR28512TF/H-E
5962-1620202HXC 5962-1620202HXA 5962-1620202HYC 5962-1620202HYA	DVTR28515T/H DVTR28515T/H-E DVTR28515TF/H DVTR28515TF/H-E

Do not use the DVTR2800T Series similar part number for SMD product acquisition. It is listed for reference only. For exact specifications for the SMD product, refer to the SMD drawing. SMDs can be downloaded from the DLA Land and Maritime (Previously known as DSCC) website at <https://landandmaritimeapps.dla.mil/programs/defaultapps.asp>. The SMD number listed above represents the Federal Stock Class, Device Type, Device Class Designator, Case Outline, Lead Finish and RHA Designator (where applicable). Please reference the SMD for other screening levels, lead finishes, and radiation levels. All SMD products are marked with a "Q" on the cover as specified by the QML certification mark requirement of MIL-PRF-38534.

## CONTACT INFORMATION

To request a quotation or place orders please contact your sales representative or the VPT Inc. Sales Department at:

**Phone:** (425) 353-3010  
**Fax:** (425) 353-4030  
**E-mail:** [vptsales@vptpower.com](mailto:vptsales@vptpower.com)

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