DVTR2800S Series

HIGH RELIABILITY HYBRID DC-DC CONVERTERS

DESCRIPTION

The DVTR series of high reliability DC-DC converters is operable over the full military (-55 °C to +125 °C) temperature range with no power derating. Unique to the DVTR series is a magnetic feedback circuit that is radiation immune. Operating at a nominal fixed frequency of 475 kHz, these regulated, isolated units utilize well controlled undervoltage 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 40 Watts Output Power
- Output Voltage Trim Up +10%
- Radiation Immune 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
- Radiation Hardened Version Available
- Precision Seam Seal or Solder Seal Hermetic Package
- High Power Density: > 40 W/in^3
- Custom Versions Available
- Additional Environmental Screening Available
- Meets MIL-STD-461C and MIL-STD-461D EMC Requirements When Used With a DVMC28 EMI Filter
- Flanged and Non-flanged Versions Available.
- MIL-PRF-38534 Element Evaluated Components

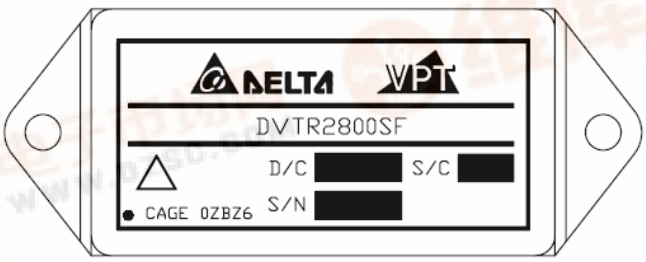


Figure 1 – DVTR2800S / DVTR2800SF DC-DC Converter
(Not To Scale)

11314 4th Avenue
West, Suite 206

Sales Information:
Phone: (425) 353-3010

SPECIFICATIONS (T_{CASE} = -55°C to +125°C, V_{IN} = +28V ± 5%, Full Load, Unless Otherwise Specified)

ABSOLUTE MAXIMUM RATINGS			
Input Voltage (Continuous)	50 V_{DC}	Junction Temperature Rise to Case	+15°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power[1]	40 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T_{CASE} = +125°C)	13 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(49 / 52) Grams

Parameter		Conditions	DVTR283R3S			DVTR2805S			Units
			Min	Typ	Max	Min	Typ	Max	
STATIC									
INPUT Voltage[4]		Continuous	15	28	50	15	28	50	V
		Transient, 1 sec	-	-	80	-	-	80	V
Current		Inhibited	-	-	6	-	-	6	mA
		No Load	-	-	90	-	-	90	mA
Ripple Current		Full Load, 20Hz to 10MHz	-	-	50	-	-	50	mA_{p-p}
Inhibit Pin Input[4]			0	-	1.5	0	-	1.5	V
Inhibit Pin Open Circuit Voltage[4]			9.0	11.0	13.0	9.0	11.0	13.0	V
UVLO Turn On			12.0	-	14.8	12.0	-	14.8	V
UVLO Turn Off[4]			11.0	-	14.5	11.0	-	14.5	V
OUTPUT Voltage	V_{OUT}	T_{CASE} = 25°C	3.25	3.30	3.35	4.95	5.00	5.05	V
	V_{OUT}	T_{CASE} = -55°C to +125°C	3.20	3.30	3.40	4.875	5.00	5.125	V
Power[3]			0	-	20	0	-	30	W
Current[3]	V_{OUT}		0	-	6.06	0	-	6.0	A
Ripple Voltage	V_{OUT}	Full Load, 20Hz to 10MHz	-	-	50	-	-	50	mV_{p-p}
Line Regulation	V_{OUT}	V_{IN} = 15V to 50V	-	-	20	-	-	20	mV
Load Regulation	V_{OUT}	No Load to Full Load	-	-	50	-	-	50	mV
EFFICIENCY			67	-	-	72	-	-	%
LOAD FAULT POWER DISSIPATION		Overload[4]	-	-	16	-	-	16	W
		Short Circuit	-	-	16	-	-	16	W
CAPACITIVE LOAD[4]			-	-	1000	-	-	1000	µF
SWITCHING FREQUENCY			400	475	550	400	475	550	kHz
SYNC FREQUENCY RANGE		V_H - V_L = 5V, DC = 20-80%	500	-	600	500	-	600	kHz
ISOLATION		500 V_{DC}	100	-	-	100	-	-	MΩ
MTBF (MIL-HDBK-217F)		AIF @ T_C = 55°C	-	413	-	-	413	-	kHrs
DYNAMIC									
Load Step Output Transient	V_{OUT}	Half Load to Full Load	-	-	400	-	-	500	mV_{PK}
Load Step Recovery[2]			-	-	500	-	-	500	µSec
Line Step Output Transient[4]	V_{OUT}	V_{IN} = 16V to 40V	-	300	600	-	300	600	mV_{PK}
Line Step Recovery[2, 4]			-	300	500	-	300	500	µSec
Turn On Delay	V_{OUT}	V_{IN} = 0V to 28V	-	-	20	-	-	20	mSec
Turn On Overshoot			-	-	15	-	-	25	mV_{PK}

Notes: 1. Dependant on output voltage. 2. Time for output voltage to settle within 1% of its nominal value.
3. Derate linearly to 0 at 135°C. 4. Verified by qualification testing.

SPECIFICATIONS (T_{CASE} = -55°C to +125°C, V_{IN} = +28V ± 5%, Full Load, Unless Otherwise Specified)

ABSOLUTE MAXIMUM RATINGS			
Input Voltage (Continuous)	50 V_{DC}	Junction Temperature Rise to Case	+15°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power[1]	40 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T_{CASE} = +125°C)	13 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(49 / 52) Grams

Parameter		Conditions	DVTR2812S			DVTR2815S			Units
			Min	Typ	Max	Min	Typ	Max	
STATIC									
INPUT Voltage[4]		Continuous	15	28	50	15	28	50	V
		Transient, 1 sec	-	-	80	-	-	80	V
Current		Inhibited	-	-	6	-	-	6	mA
		No Load	-	-	90	-	-	90	mA
Ripple Current		Full Load, 20Hz to 10MHz	-	-	50	-	-	50	mA_{p-p}
Inhibit Pin Input[4]			0	-	1.5	0	-	1.5	V
Inhibit Pin Open Circuit Voltage[4]			9.0	11.0	13.0	9.0	11.0	13.0	V
UVLO Turn On			12.0	-	14.8	12.0	-	14.8	V
UVLO Turn Off[4]			11.0	-	14.5	11.0	-	14.5	V
OUTPUT Voltage	V_{OUT}	T_{CASE} = 25°C	11.88	12.0	12.12	14.85	15.0	15.15	V
	V_{OUT}	T_{CASE} = -55°C to +125°C	11.70	12.0	12.30	14.625	15.0	15.375	V
Power[3]			0	-	40	0	-	40	W
Current[3]	V_{OUT}		0	-	3.33	0	-	2.67	A
Ripple Voltage	V_{OUT}	Full Load, 20Hz to 10MHz	-	-	50	-	-	50	mV_{p-p}
Line Regulation	V_{OUT}	V_{IN} = 15V to 50V	-	-	20	-	-	20	mV
Load Regulation	V_{OUT}	No Load to Full Load	-	-	50	-	-	50	mV
EFFICIENCY			76	-	-	77	-	-	%
LOAD FAULT POWER DISSIPATION		Overload[4]	-	-	14	-	-	14	W
		Short Circuit	-	-	14	-	-	14	W
CAPACITIVE LOAD[4]			-	-	500	-	-	500	µF
SWITCHING FREQUENCY			400	475	550	400	475	550	kHz
SYNC FREQUENCY RANGE		V_H - V_L = 5V, DC = 20-80%	500	-	600	500	-	600	kHz
ISOLATION		500 V_{DC}	100	-	-	100	-	-	MΩ
MTBF (MIL-HDBK-217F)		AIF @ T_C = 55°C	-	413	-	-	413	-	kHrs
DYNAMIC									
Load Step Output Transient	V_{OUT}	Half Load to Full Load	-	-	700	-	-	700	mV_{PK}
Load Step Recovery[2]			-	-	500	-	-	500	µSec
Line Step Output Transient[4]	V_{OUT}	V_{IN} = 16V to 40V	-	500	900	-	500	900	mV_{PK}
Line Step Recovery[2, 4]			-	300	500	-	300	500	µSec
Turn On Delay	V_{OUT}	V_{IN} = 0V to 28V	-	-	20	-	-	20	mSec
Turn On Overshoot			-	-	50	-	-	50	mV_{PK}

Notes: 1. Dependant on output voltage. 2. Time for output voltage to settle within 1% of its nominal value.
3. Derate linearly to 0 at 135°C. 4. Verified by qualification testing.

SPECIFICATIONS (T_{CASE} = -55°C to +125°C, V_{IN} = +28V ± 5%, Full Load, Unless Otherwise Specified)

ABSOLUTE MAXIMUM RATINGS			
Input Voltage (Continuous)	50 V_{DC}	Junction Temperature Rise to Case	+15°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power[1]	40 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T_{CASE} = +125°C)	13 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(49 / 52) Grams

Parameter		Conditions	DVTR285R2S			DVTR282R5S			Units
			Min	Typ	Max	Min	Typ	Max	
STATIC									
INPUT Voltage[4]		Continuous	15	28	50	15	28	50	V
		Transient, 1 sec	-	-	80	-	-	80	V
Current		Inhibited	-	-	6	-	-	6	mA
		No Load	-	-	90	-	-	90	mA
Ripple Current		Full Load, 20Hz to 10MHz	-	-	50	-	-	50	mA_{p-p}
Inhibit Pin Input[4]			0	-	1.5	0	-	1.5	V
Inhibit Pin Open Circuit Voltage[4]			9.0	11.0	13.0	9.0	11.0	13.0	V
UVLO Turn On			12.0	-	14.8	12.0	-	14.8	V
UVLO Turn Off[4]			11.0	-	14.5	11.0	-	14.5	V
OUTPUT Voltage	V_{OUT}	T_{CASE} = 25°C	5.14	5.20	5.26	2.47	2.50	2.53	V
	V_{OUT}	T_{CASE} = -55°C to +125°C	5.07	5.20	5.33	2.46	2.50	2.54	V
Power[3]			0	-	30	0	-	15	W
Current[3]	V_{OUT}		0	-	6.0	0	-	6.0	A
Ripple Voltage	V_{OUT}	Full Load, 20Hz to 10MHz	-	-	50	-	-	50	mV_{p-p}
Line Regulation	V_{OUT}	V_{IN} = 15V to 50V	-	-	20	-	-	20	mV
Load Regulation	V_{OUT}	No Load to Full Load	-	-	50	-	-	50	mV
EFFICIENCY			72	-	-	63	-	-	%
LOAD FAULT POWER DISSIPATION		Overload[4]	-	-	16	-	-	18	W
		Short Circuit	-	-	16	-	-	18	W
CAPACITIVE LOAD[4]			-	-	1000	-	-	1000	µF
SWITCHING FREQUENCY			400	475	550	400	475	550	kHz
SYNC FREQUENCY RANGE		V_H - V_L = 5V, DC = 20-80%	500	-	600	500	-	600	kHz
ISOLATION		500 V_{DC}	100	-	-	100	-	-	MΩ
MTBF (MIL-HDBK-217F)		AIF @ T_C = 55°C	-	413	-	-	413	-	kHrs
DYNAMIC									
Load Step Output Transient	V_{OUT}	Half Load to Full Load	-	-	500	-	-	400	mV_{PK}
Load Step Recovery[2]			-	-	500	-	-	500	µSec
Line Step Output Transient[4]	V_{OUT}	V_{IN} = 16V to 40V	-	300	600	-	250	450	mV_{PK}
Line Step Recovery[2, 4]			-	300	500	-	300	450	µSec
Turn On Delay	V_{OUT}	V_{IN} = 0V to 28V	-	-	20	-	-	20	mSec
Turn On Overshoot			-	-	25	-	-	15	mV_{PK}

Notes: 1. Dependant on output voltage. 2. Time for output voltage to settle within 1% of its nominal value.
3. Derate linearly to 0 at 135°C. 4. Verified by qualification testing.

BLOCK DIAGRAM

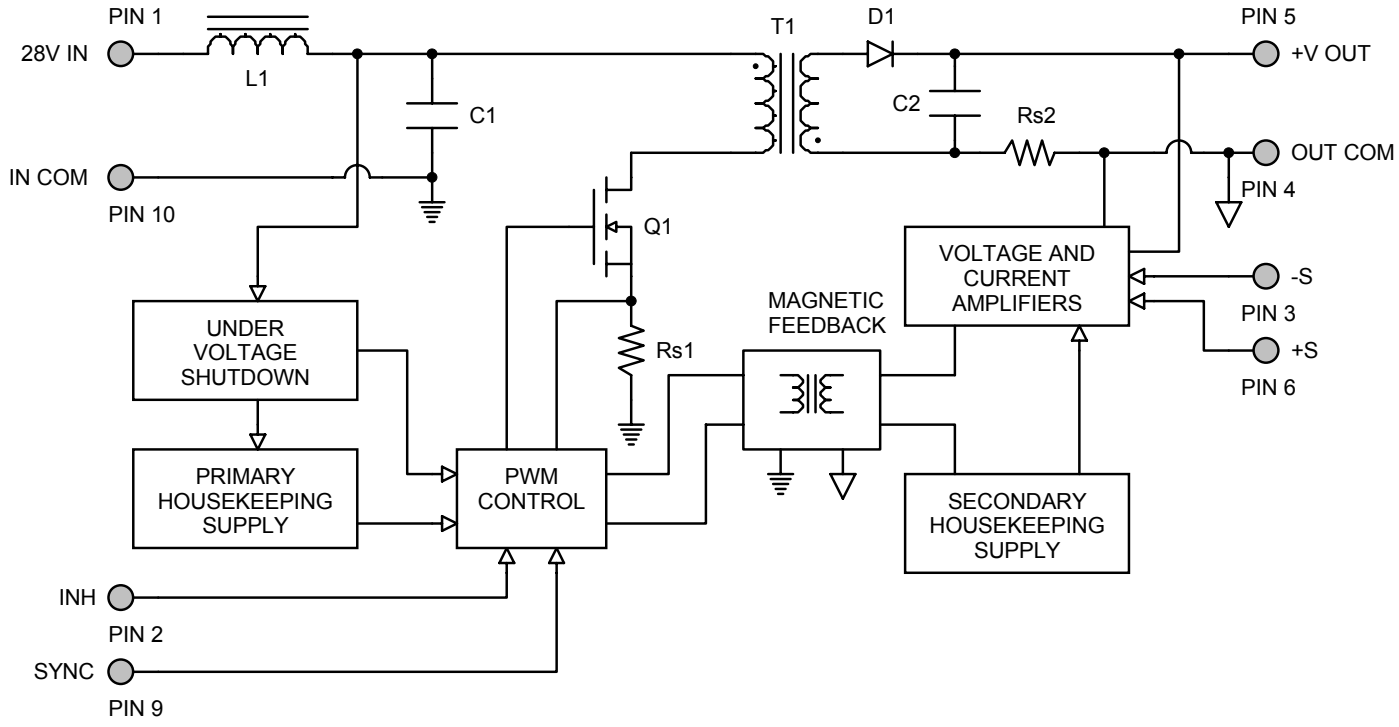


Figure 2

CONNECTION DIAGRAM

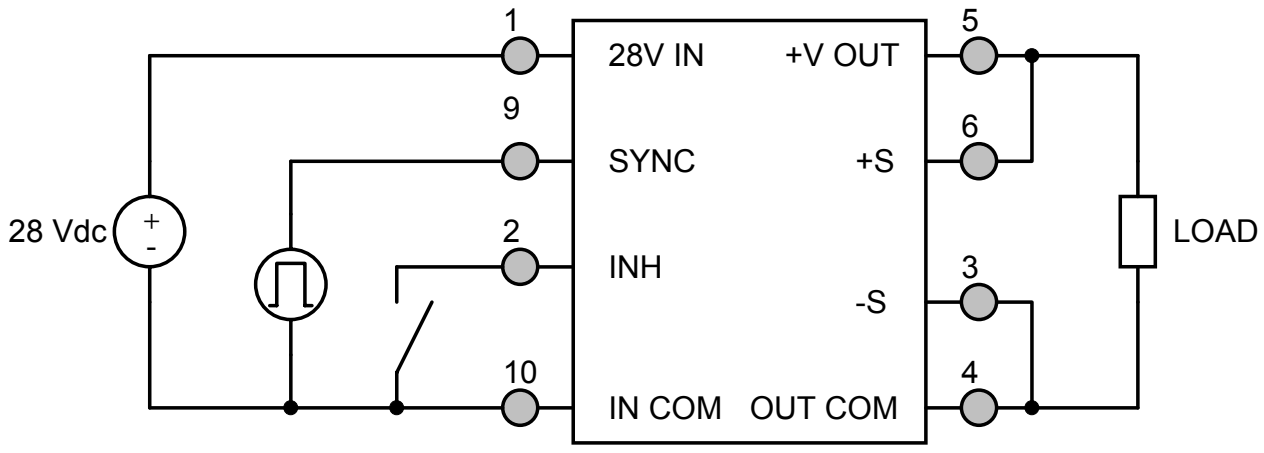


Figure 3

INHIBIT DRIVE CONNECTION DIAGRAMS

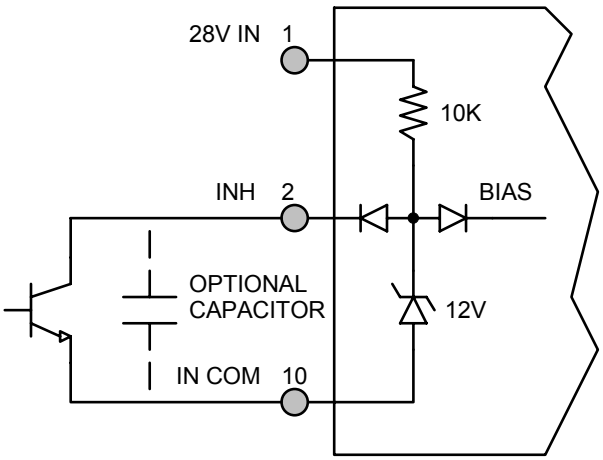


Figure 4 – Internal Inhibit Circuit and Recommended Drive
(Shown with optional capacitor for turn-on delay)

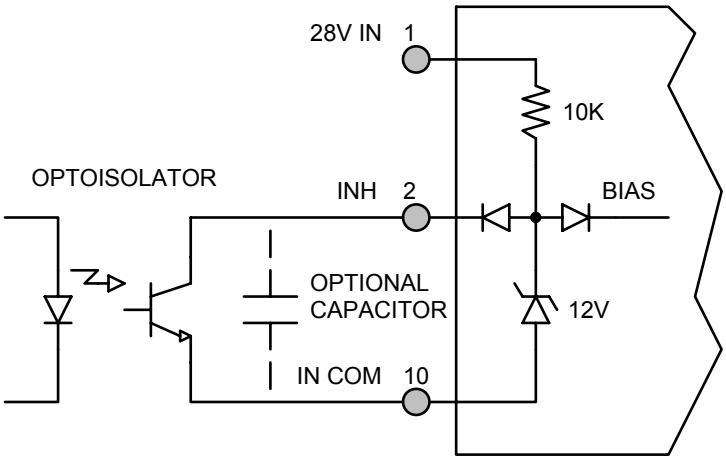


Figure 5 – Isolated Inhibit Drive
(Shown with optional capacitor for turn-on delay)

EMI FILTER HOOKUP DIAGRAM

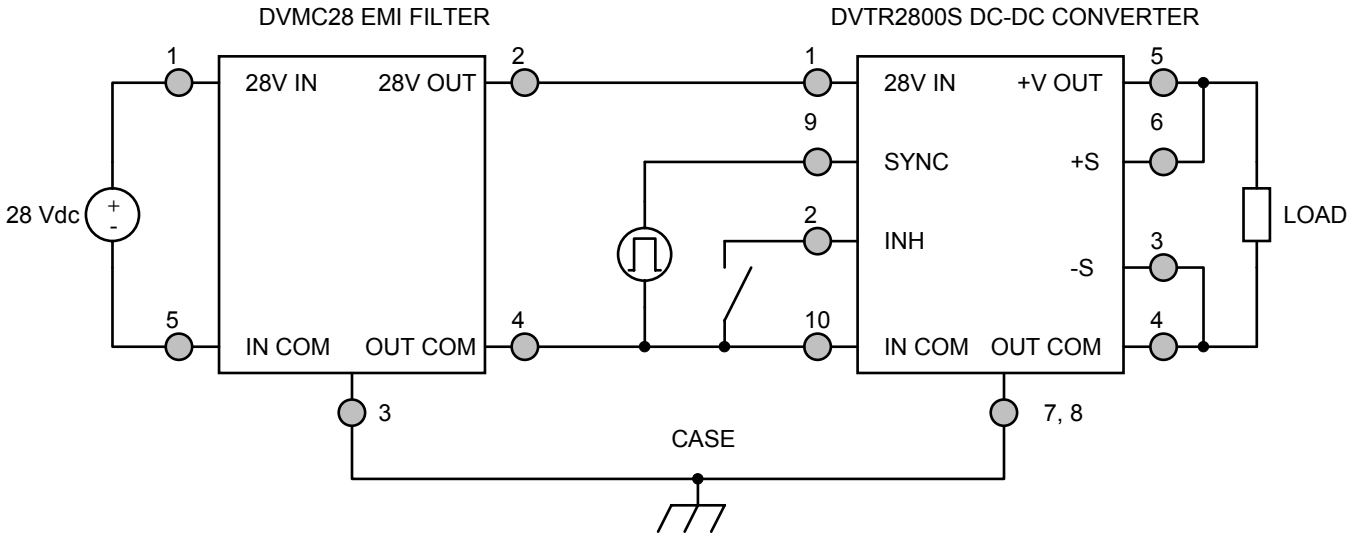


Figure 6 – Converter with EMI Filter

PARALLEL CONNECTION DIAGRAM

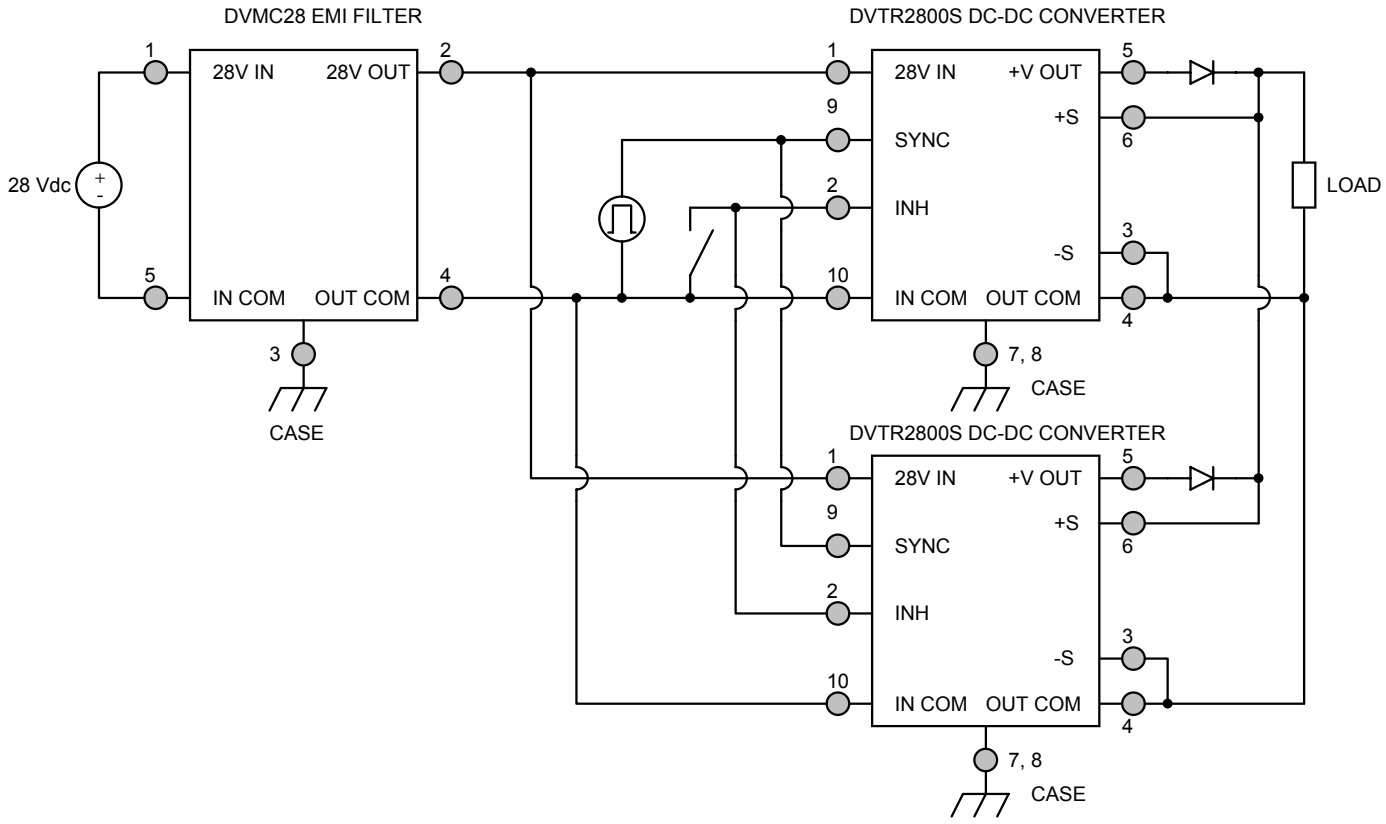
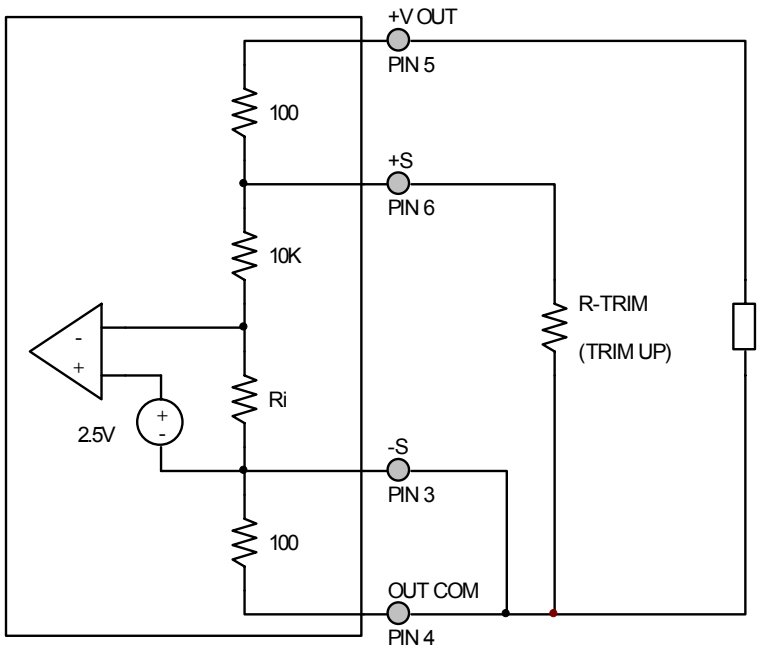


Figure 7

OUTPUT VOLTAGE TRIM



The output voltage can be trimmed up by connecting a resistor between the +S pin (PIN 6) and the OUT COM pin (PIN 4). The maximum trim range is +10%. The appropriate resistor values versus the output voltage are given in the trim table below. The –S pin should be connected to the OUT COM pin.

Figure 8 – Output Voltage Trim

DVTR282R5S		DVTR283R3S		DVTR2805S		DVTR285R2S		DVTR2812S		DVTR2815S	
$+V_{OUT}$ (V)	R_{TRIM} (Ω)	$+V_{OUT}$ (V)	R_{TRIM} (Ω)	$+V_{OUT}$ (V)	R_{TRIM} (Ω)	$+V_{OUT}$ (V)	R_{TRIM} (Ω)	$+V_{OUT}$ (V)	R_{TRIM} (Ω)	$+V_{OUT}$ (V)	R_{TRIM} (Ω)
2.75	1.05k	3.60	1.13k	5.50	1.05k	5.70	1.09k	13.2	1.09k	16.50	1.09k
2.70	1.33k	3.55	1.36k	5.45	1.18k	5.65	1.22k	13.1	1.19k	16.40	1.18k
2.65	1.82k	3.50	1.72k	5.40	1.33k	5.60	1.39k	13.0	1.33k	16.30	1.28k
2.60	2.86k	3.45	2.32k	5.35	1.54k	5.55	1.60k	12.9	1.49k	16.20	1.4k
2.55	6.67k	3.40	3.59k	5.30	1.82k	5.50	1.89k	12.8	1.7k	16.10	1.54k
2.50	-	3.35	7.87k	5.25	2.22k	5.45	2.31k	12.7	1.98k	16.00	1.71k
		3.30	-	5.20	2.86k	5.40	2.97k	12.6	2.38k	15.90	1.94k
				5.15	4k	5.35	4.16k	12.5	2.96k	15.80	2.22k
				5.10	6.67k	5.30	6.93k	12.4	3.94k	15.70	2.61k
				5.05	20k	5.25	20.8k	12.3	5.86k	15.60	3.16k
				5.00	-	5.20	-	12.2	11.4k	15.50	4k
								12.1	242k	15.40	5.46k
								12.0	-	15.30	8.57k
										15.20	20k
										15.10	Note 1
										15.00	-

Notes: 1. Connect R-TRIM = 400Ω from +VOUT (PIN 5) to +S (PIN 6).

EFFICIENCY PERFORMANCE CURVES (T_{CASE} = 25°C, Full Load, Unless Otherwise Specified)

------- V_{IN} = 16V	——— V_{IN} = 28V	– – – – – V_{IN} = 40V

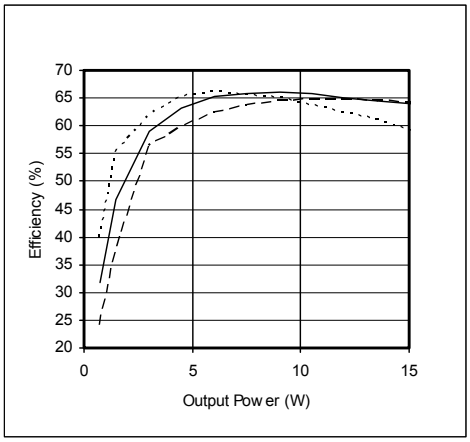


Figure 9 – DVTR282R5S
Efficiency (%) vs. Output Power (W)

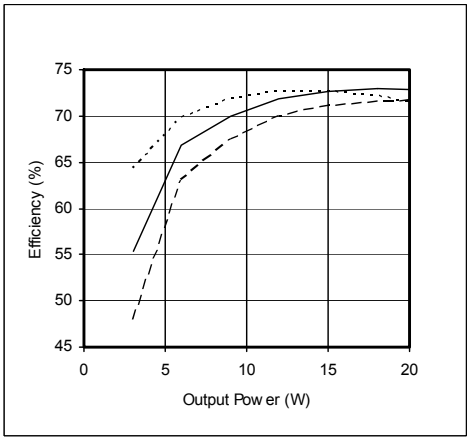


Figure 10 – DVTR283R3S
Efficiency (%) vs. Output Power (W)

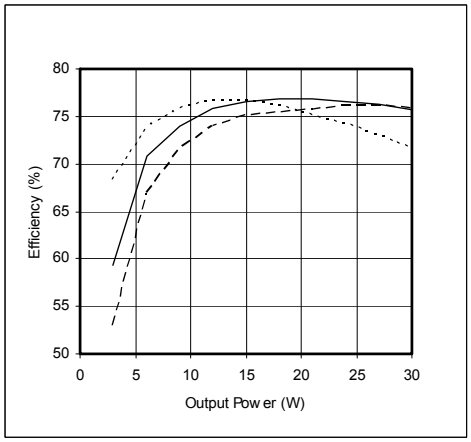


Figure 11 – DVTR2805S / DVTR285R2S
Efficiency (%) vs. Output Power (W)

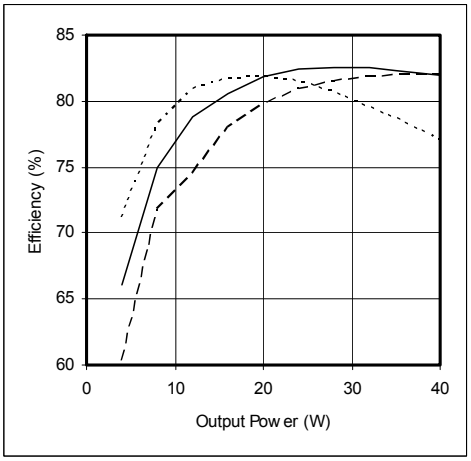


Figure 12 – DVTR2812S
Efficiency (%) vs. Output Power (W)

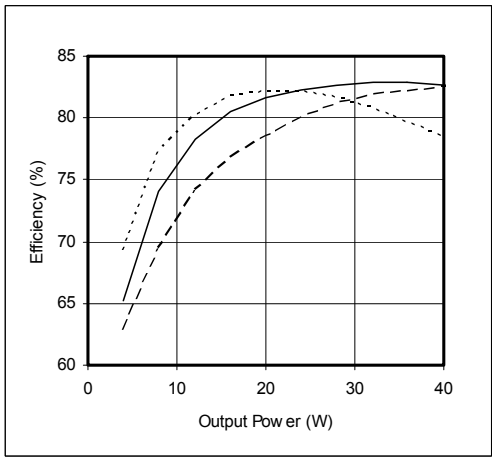


Figure 13 – DVTR2815S
Efficiency (%) vs. Output Power (W)

EMI PERFORMANCE CURVES

(T_{CASE} = 25°C, V_{IN} = +28V ± 5%, Full Load, Unless Otherwise Specified)

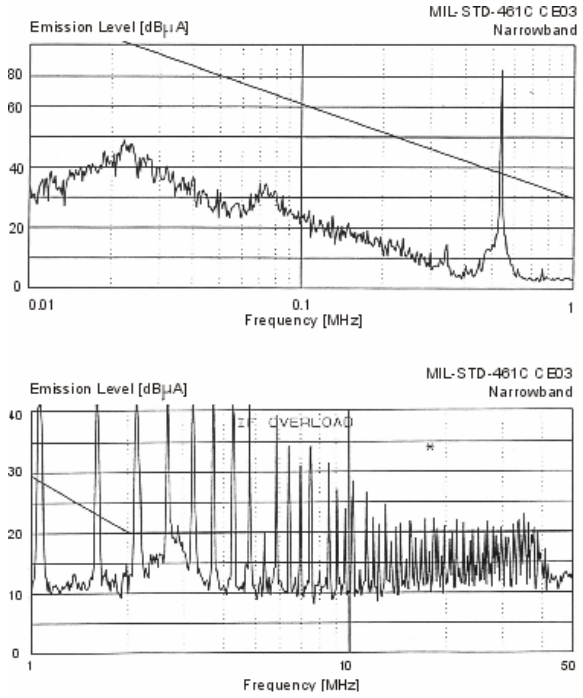


Figure 14 – DVTR2800S <u>without</u> EMI Filter

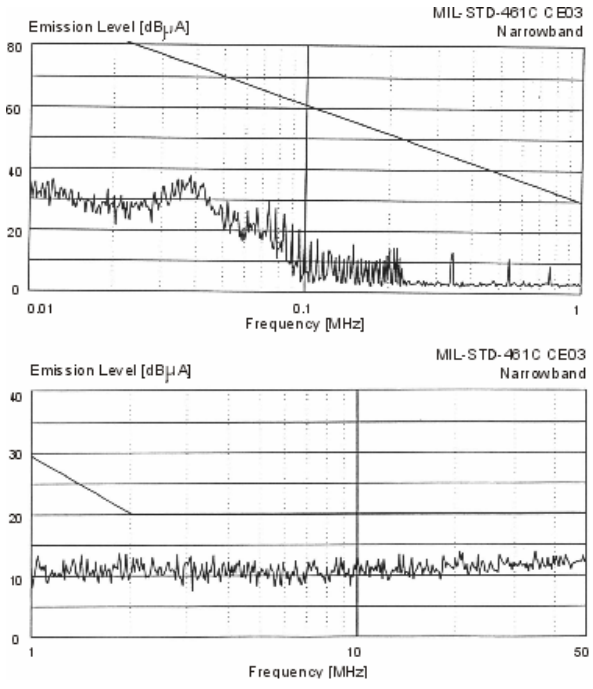
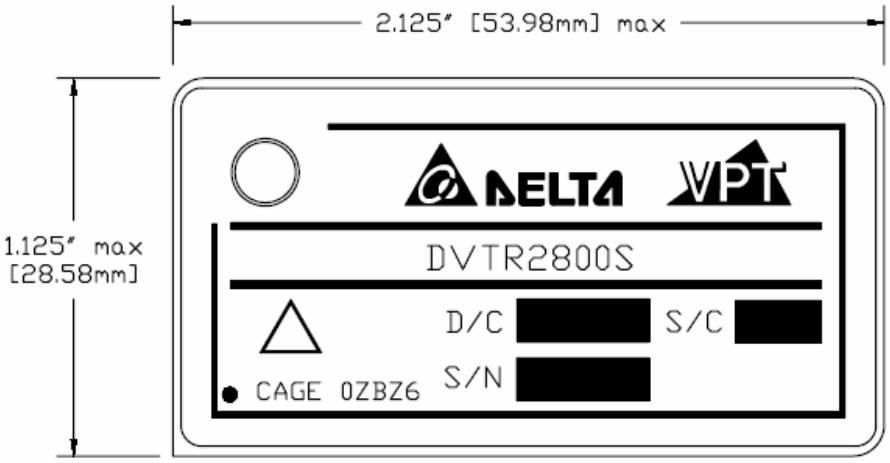
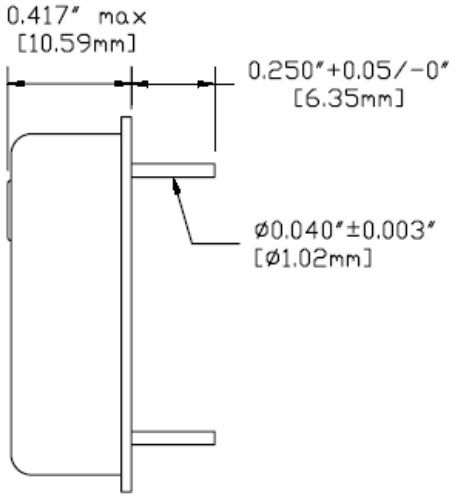


Figure 15 – DVTR2800S <u>with</u> EMI Filter

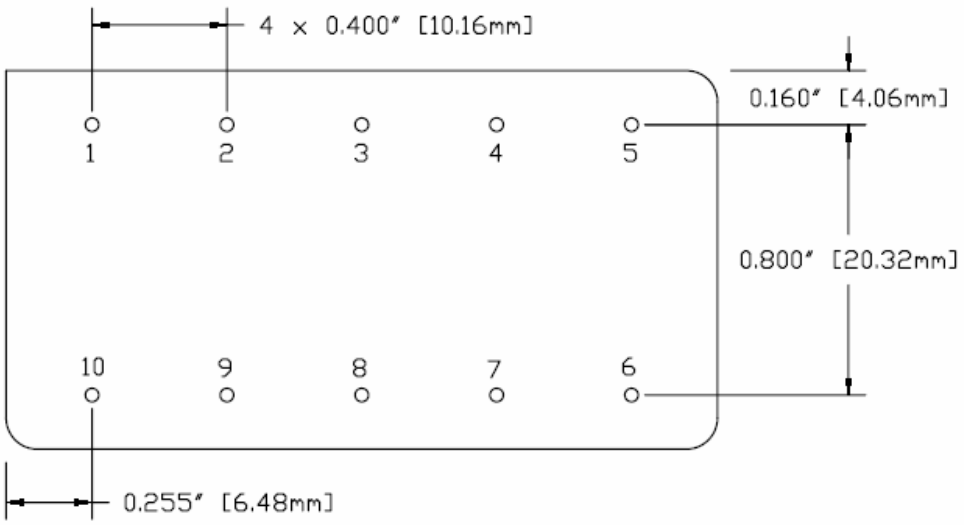
PACKAGE SPECIFICATIONS (NON-FLANGED, SOLDER SEAL)



TOP VIEW



SIDE VIEW

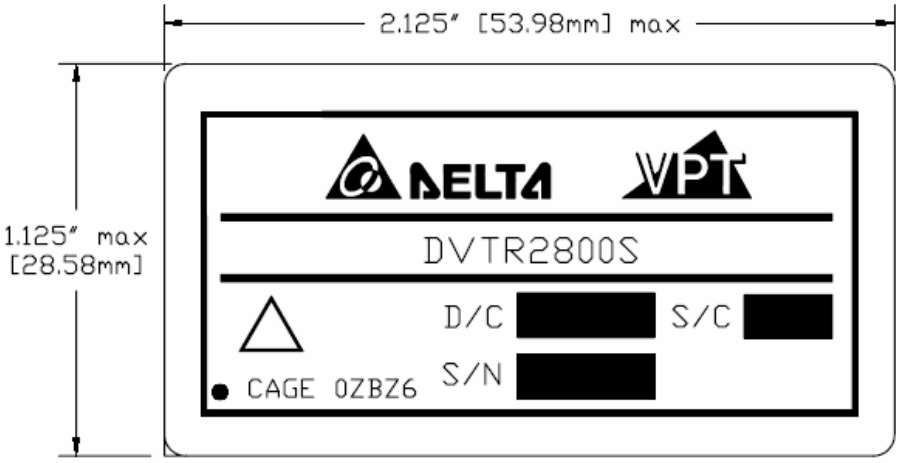


BOTTOM VIEW

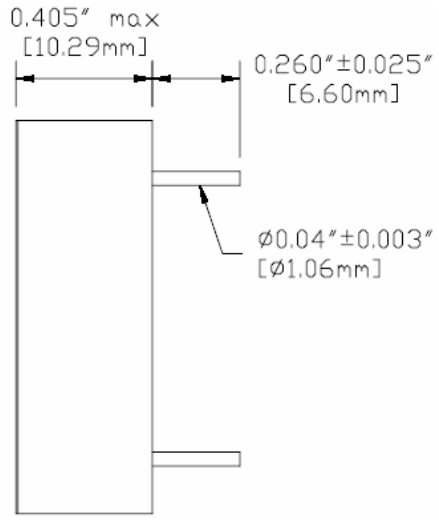
PIN	FUNCTION
1	28V IN
2	INHIBIT
3	-S
4	OUT COM
5	+V OUT
6	+S
7	CASE
8	CASE
9	SYNC
10	IN COM

Figure 16 – Non-Flanged, Solder Seal Tin Plated Package and Pinout (Not Used for /HB or Higher Screened Products)
(Dimensional Limits are ±0.005" Unless Otherwise Stated)

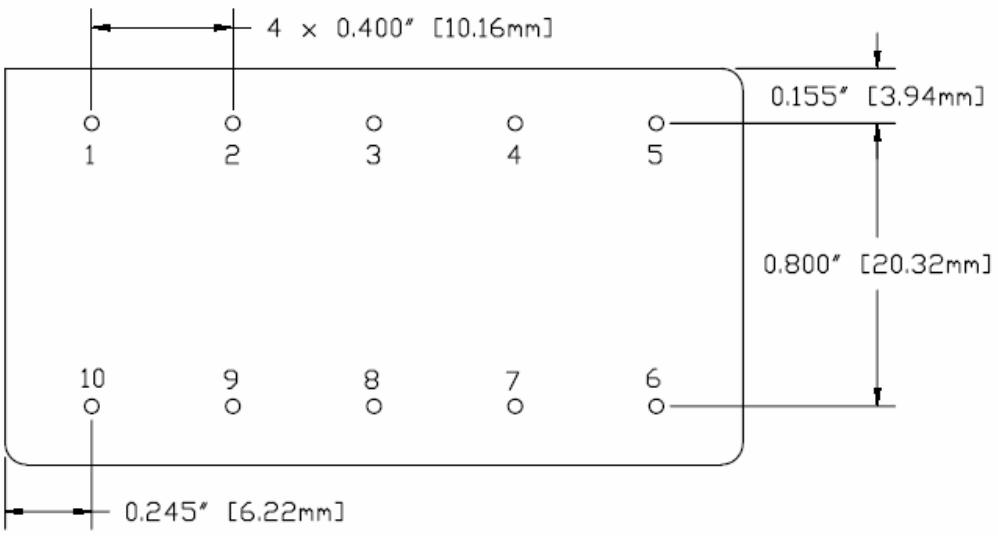
PACKAGE SPECIFICATIONS (NON-FLANGED, SEAM SEAL)



TOP VIEW



SIDE VIEW

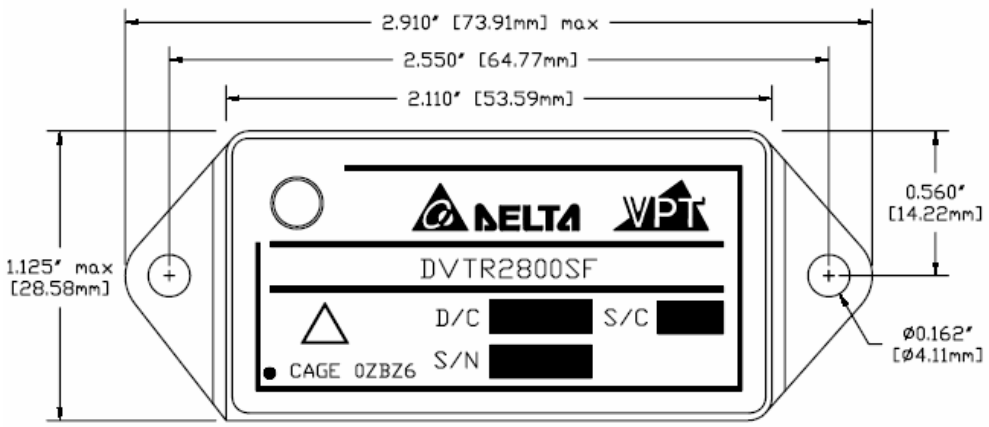


BOTTOM VIEW

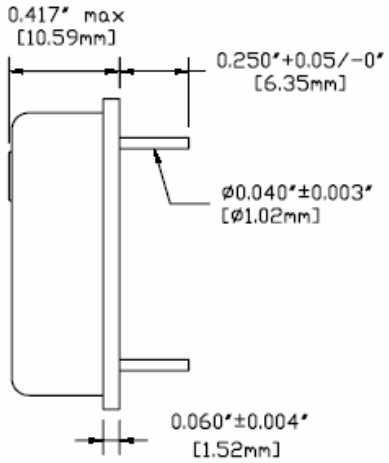
PIN	FUNCTION
1	28V IN
2	INHIBIT
3	-S
4	OUT COM
5	+V OUT
6	+S
7	CASE
8	CASE
9	SYNC
10	IN COM

Figure 17 – Non-Flanged, Seam Seal Package and Pinout
(Dimensional Limits are ±0.005" Unless Otherwise Stated)

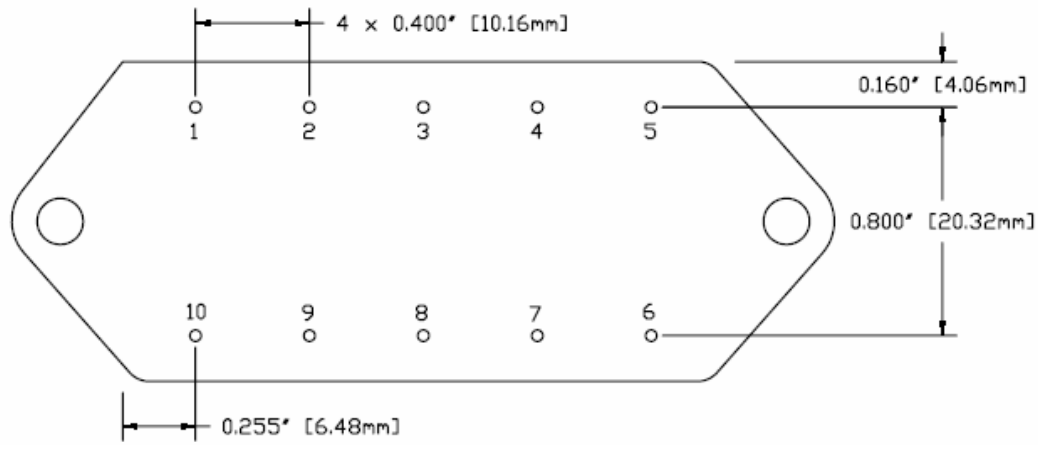
PACKAGE SPECIFICATIONS (FLANGED, SOLDER SEAL)



TOP VIEW



SIDE VIEW

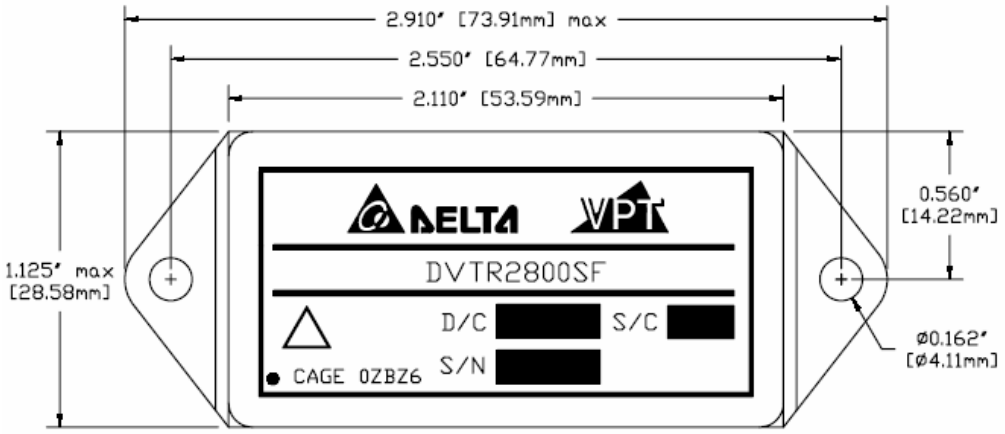


BOTTOM VIEW

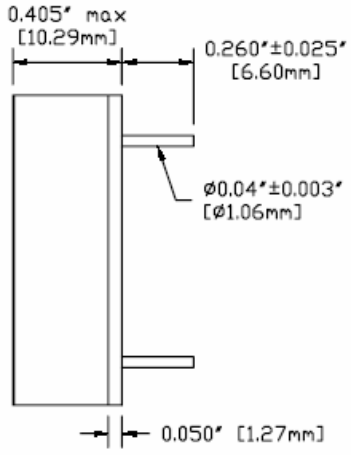
PIN	FUNCTION
1	28V IN
2	INHIBIT
3	-S
4	OUT COM
5	+V OUT
6	+S
7	CASE
8	CASE
9	SYNC
10	IN COM

Figure 18 – Flanged, Solder Seal Tin Plated Package and Pinout (Not Used for /HB or Higher Screened Products)
(Dimensional Limits are ±0.005" Unless Otherwise Stated)

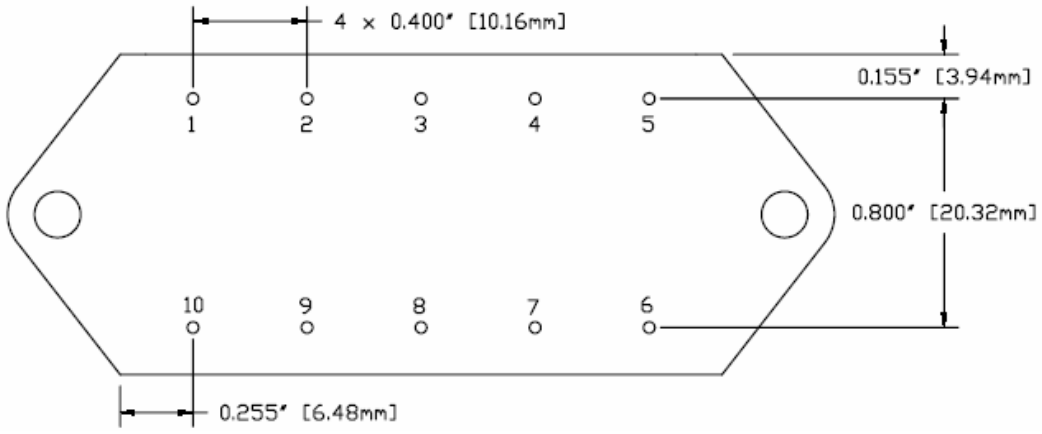
PACKAGE SPECIFICATIONS (FLANGED, SEAM SEAL)



TOP VIEW



SIDE VIEW



BOTTOM VIEW

PIN	FUNCTION
1	28V IN
2	INHIBIT
3	-S
4	OUT COM
5	+V OUT
6	+S
7	CASE
8	CASE
9	SYNC
10	IN COM

Figure 19 – Flanged, Seam Seal Package and Pinout
(Dimensional Limits are ±0.005" Unless Otherwise Stated)

PACKAGE PIN DESCRIPTION

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

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

Screening	MIL-STD-883	Standard (No Suffix)	Extended /ES	HB /HB	Class H /H	Class K /K
Non-Destructive Bond Pull	Method 2023	•	•	•	•	•
Internal Visual	Method 2017, 2032 Internal Procedure	•	•	•	•	•
Temperature Cycling	Method 1010, Condition C Method 1010, -55°C to 125°C		•	•	•	•
Constant Acceleration	Method 2001, 3000g, Y1 Direction Method 2001, 500g, Y1 Direction		•	•	•	•
PIND	Method 2020, Condition A[2]					•
Pre Burn-In Electrical	100% at 25°C					•
Burn-In	Method 1015, 320 hours at +125°C Method 1015, 160 hours at +125°C 96 hours at +125°C 24 hours at +125°C	•	•	•	•	•
Final Electrical	MIL-PRF-38534, Group A[1] 100% at 25°C	•	•	•	•	•
Hermeticity	Method 1014, Fine Leak, Condition A Method 1014, Gross Leak, Condition C Dip (1×10^{-3})	•	• •	• •	• •	• •
Radiography	Method 2012[3]					•
External Visual	Method 2009	•	•	•	•	•

Notes:
1. 100% R&R testing at –55°C, +25°C, and +125°C with all test data included in product shipment.
2. PIND test Certificate of Compliance included in product shipment.
3. Radiographic test Certificate of Compliance and film(s) included in product shipment.

ORDERING INFORMATION

DVTR	28	05	S	F	R	/HB	-	XXX
1	2	3	4	5	6	7		8

(1) (2) (3) (4)

Product Series	Nominal Input Voltage		Output Voltage		Number of Outputs	
DVTR	**28**	28 Volts	**2R5** **3R3** **05** **5R2** **12** **15**	2.5 Volts 3.3 Volts 5 Volts 5.2 Volts 12 Volts 15 Volts	**S**	Single

(5) (6) (7) (8)

Package Option		Rad-Hard Option[2]		Screening Code[1,3]		Additional Screening Code
None **F**	Non-Flanged Flanged	**None** **R**	Standard 100 kRad	**None** **/ES** **/HB** **/H** **/K**	Standard Extended HB Class H Class K	Contact Sales

Notes:
1. Contact the VPT Inc. Sales Department for availability of Class H (/H) or Class K (/K) qualified products.
2. VPT Inc. is not currently qualified to a DSCC certified radiation hardness assurance program.
3. 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.

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)	DVTR2800S Series Similar Part Number
*T.B.D.	DVTR282R5S/H DVTR282R5SF/H
*T.B.D.	DVTR283R3S/H DVTR283R3SF/H
*T.B.D.	DVTR2805S/H DVTR2805SF/H
*T.B.D.	DVTR285R2S/H DVTR285R2SF/H
*T.B.D.	DVTR2812S/H DVTR2812SF/H
*T.B.D.	DVTR2815S/H DVTR2815SF/H

Do not use the DVTR2800S 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. SMD's can be downloaded from the DSCC website at http://www.dscc.dla.mil/programs/smcr/. The SMD number listed above is for MIL-PRF-38534 Class H screening, standard gold plated lead finish, and no RHA (Radiation Hardness Assurance) level. Please reference the SMD for other screening levels, lead finishes, and radiation levels.

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@vpt-inc.com