

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, compliant to AS9000, and certified to MIL-PRF-38534 and MIL-STD-883.

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
- 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/in³
- 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

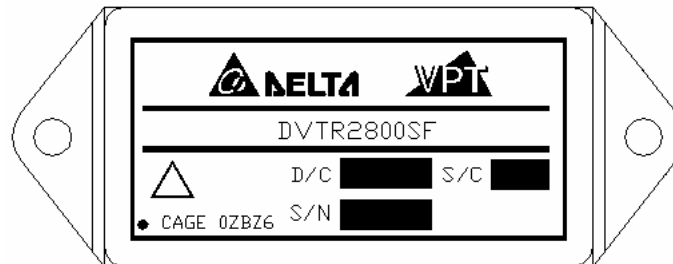


Figure 1 – DVTR2800S / DVTR2800SF DC-DC Converter
(Not To Scale)

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	50 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	-	-	75	-	-	75	mA
Ripple Current		Full Load, 20Hz to 20MHz	-	-	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	5.125	5.075	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 20MHz	-	-	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
THERMAL RESISTANCE		Case to Ambient (θCA)	-	19	-	-	19	-	°C/W
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 ²			-	-	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	50 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	-	-	75	-	-	75	mA
Ripple Current		Full Load, 20Hz to 20MHz	-	-	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 20MHz	-	-	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
THERMAL RESISTANCE		Case to Ambient (θCA)	-	19	-	-	19	-	°C/W
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 ²			-	-	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

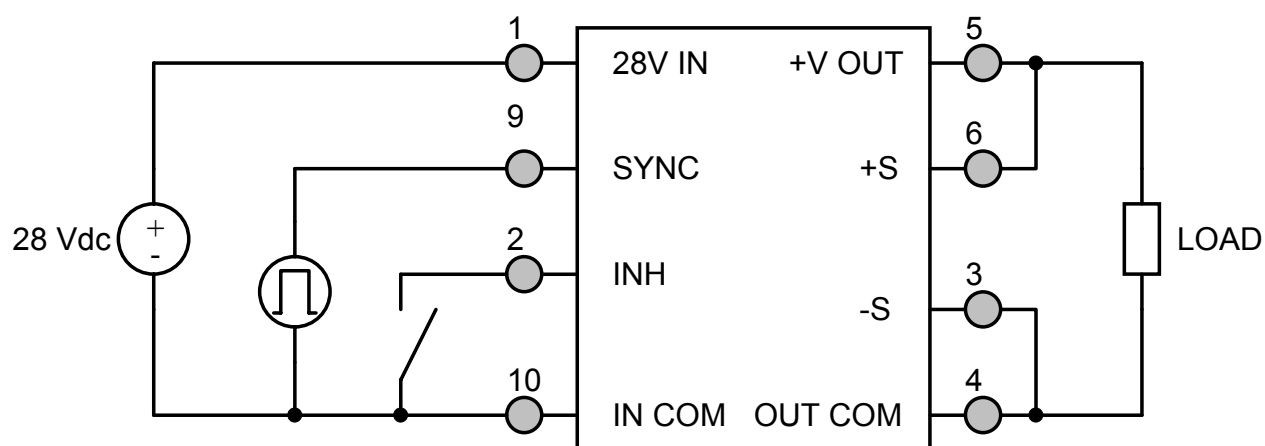
Input Voltage (Continuous)	50 V _{DC}	Junction Temperature Rise to Case	+15°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power ¹	40 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T _{CASE} = +125°C)	13 Watts	Weight	50 grams

Parameter		Conditions	DVTR285R2S			Units
			Min	Typ	Max	
STATIC						
INPUT Voltage ⁴		Continuous	15	28	50	V
		Transient, 1 sec	-	-	80	V
Current		Inhibited	-	-	6	mA
		No Load	-	-	75	mA
Ripple Current		Full Load, 20Hz to 20MHz	-	-	50	mA _{p-p}
Inhibit Pin Input ⁴			0	-	1.5	V
Inhibit Pin Open Circuit Voltage ⁴			9.0	11.0	13.0	V
UVLO Turn On			12.0	-	14.8	V
UVLO Turn Off ⁴			11.0	-	14.5	V
OUTPUT Voltage	V _{OUT}	T _{CASE} = 25°C	5.14	5.20	5.26	V
	V _{OUT}	T _{CASE} = -55°C to +125°C	5.07	5.20	5.33	V
Power ³			0	-	30	W
Current ³	V _{OUT}		0	-	6.0	A
Ripple Voltage	V _{OUT}	Full Load, 20Hz to 20MHz	-	-	50	mV _{p-p}
Line Regulation	V _{OUT}	V _{IN} = 15V to 50V	-	-	20	mV
Load Regulation	V _{OUT}	No Load to Full Load	-	-	50	mV
EFFICIENCY			72	-	-	%
LOAD FAULT POWER DISSIPATION		Overload ⁴	-	-	16	W
		Short Circuit	-	-	16	W
CAPACITIVE LOAD ⁴			-	-	1000	μF
SWITCHING FREQUENCY			400	475	550	kHz
SYNC FREQUENCY RANGE		V _H - V _L = 5V, DC = 20-80%	500	-	600	kHz
ISOLATION		500 V _{DC}	100	-	-	MΩ
THERMAL RESISTANCE		Case to Ambient (θCA)	-	19	-	°C/W
MTBF (MIL-HDBK-217F)		AIF @ T _C = 55°C	-	413	-	kHrs
DYNAMIC						
Load Step Output Transient	V _{OUT}	Half Load to Full Load	-	-	500	mV _{PK}
Load Step Recovery ²			-	-	500	μSec
Line Step Output Transient ⁴	V _{OUT}	V _{IN} = 16V to 40V	-	300	600	mV _{PK}
Line Step Recovery ^{2, 4}			-	300	500	μSec
Turn On Delay	V _{OUT}	V _{IN} = 0V to 28V	-	-	20	mSec
Turn On Overshoot ²			-	-	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.

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CONNECTION DIAGRAM



5

INHIBIT DRIVE CONNECTION DIAGRAMS

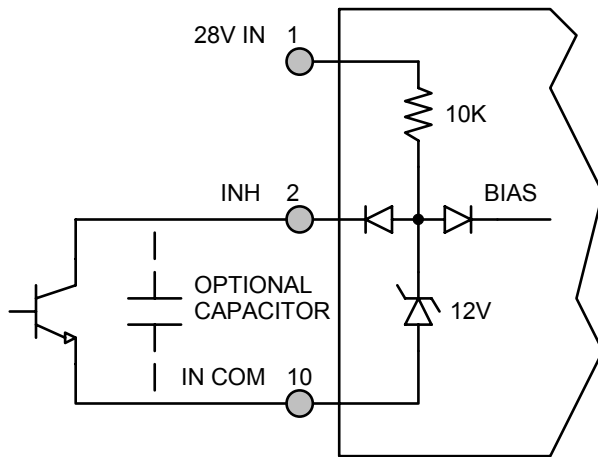


Figure 4 – Internal Inhibit Circuit and Recommended Drive
(Shown with optional capacitor for turn-on delay)

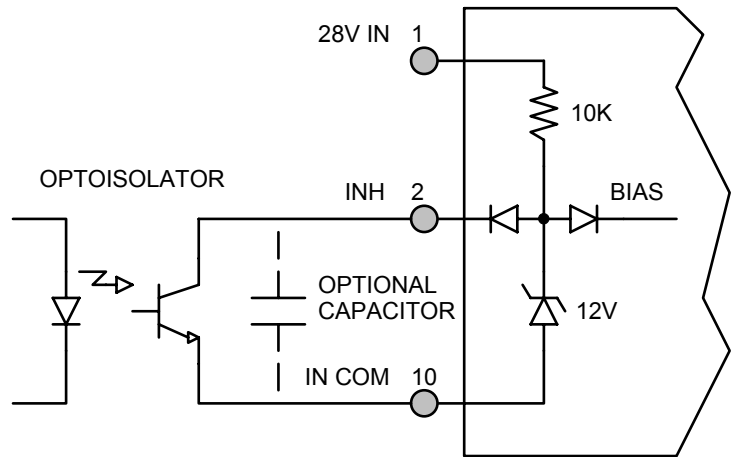


Figure 5 – Isolated Inhibit Drive
(Shown with optional capacitor for turn-on delay)

EMI FILTER HOOKUP DIAGRAM

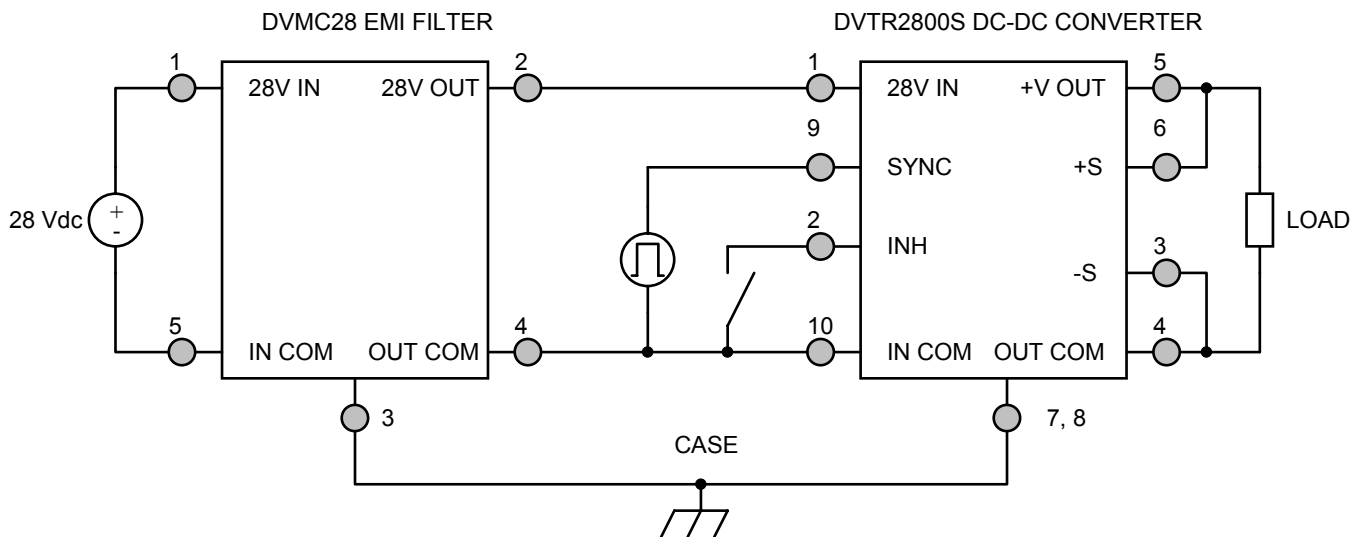
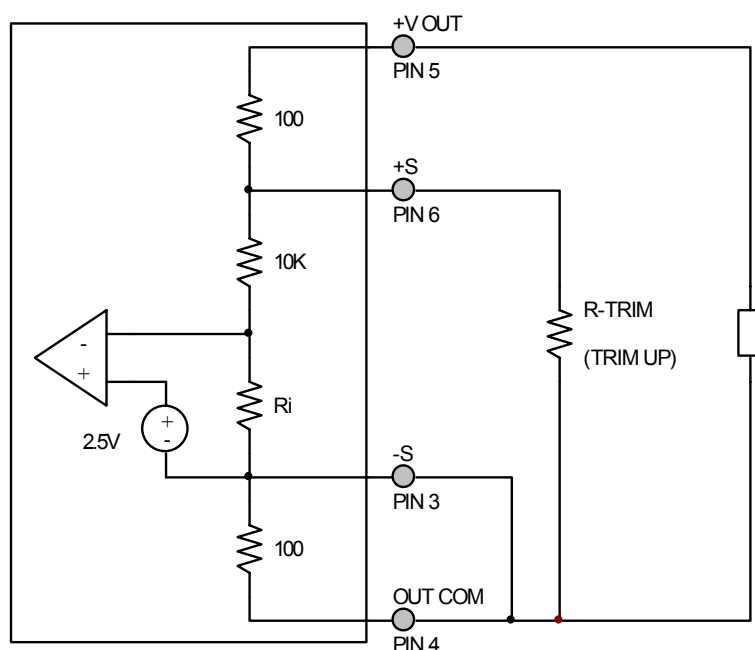


Figure 6 – Converter with EMI Filter

The diagram illustrates a 28Vdc power supply system. A 28Vdc source is connected to a DVMC28 EMI FILTER. The filter's output is connected to two DVTR2800S DC-DC CONVERTERS. Each converter has a 28V IN, +V OUT, SYNC, INH, IN COM, OUT COM, and CASE pins. The +V OUT pins are connected to a common output line that passes through a diode and a load. The INH pins are connected to a common input line that passes through a diode and a load. The OUT COM pins are connected to a common output line that passes through a diode and a load. The CASE pins are connected to ground.

12007DSB

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

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)
3.60	1.13k	5.50	1.05k	5.70	1.09k	13.2	1.09k	16.50	1.09k
3.55	1.36k	5.45	1.18k	5.65	1.22k	13.1	1.19k	16.40	1.18k
3.50	1.72k	5.40	1.33k	5.60	1.39k	13.0	1.33k	16.30	1.28k
3.45	2.32k	5.35	1.54k	5.55	1.60k	12.9	1.49k	16.20	1.4k
3.40	3.59k	5.30	1.82k	5.50	1.89k	12.8	1.7k	16.10	1.54k
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 RTRIM = 400Ω from +VOUT (PIN 5) to +S (PIN 6).

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

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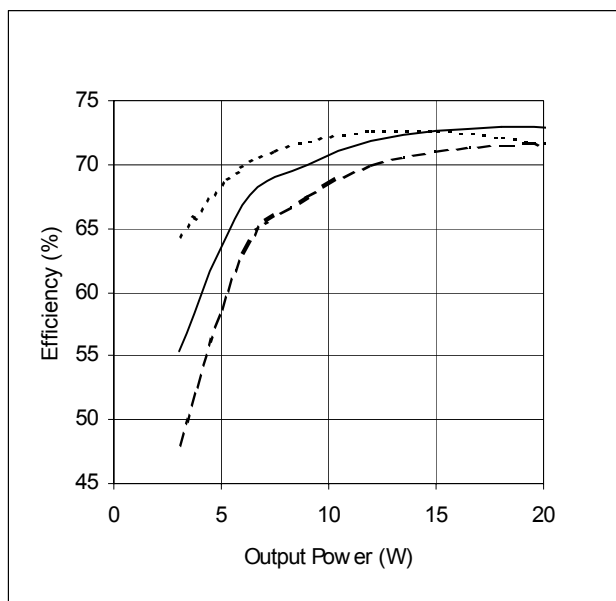


Figure 9 – DVTR283R3S
Efficiency (%) vs. Output Power (W)

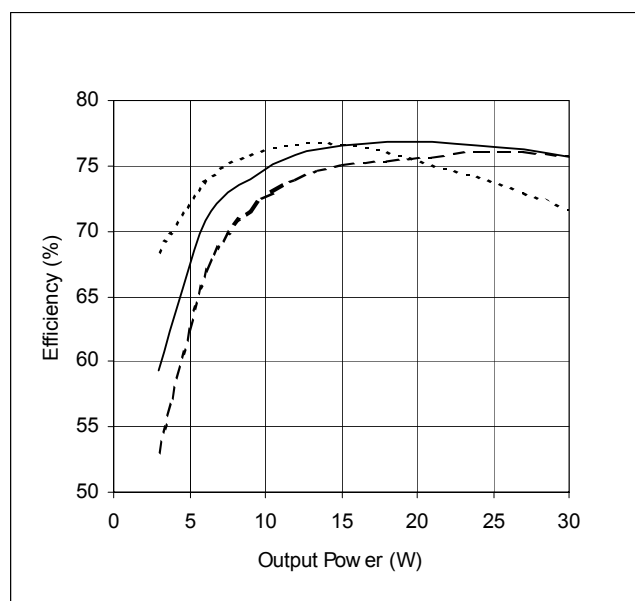


Figure 10 – DVTR2805S / DVTR285R2S
Efficiency (%) vs. Output Power (W)

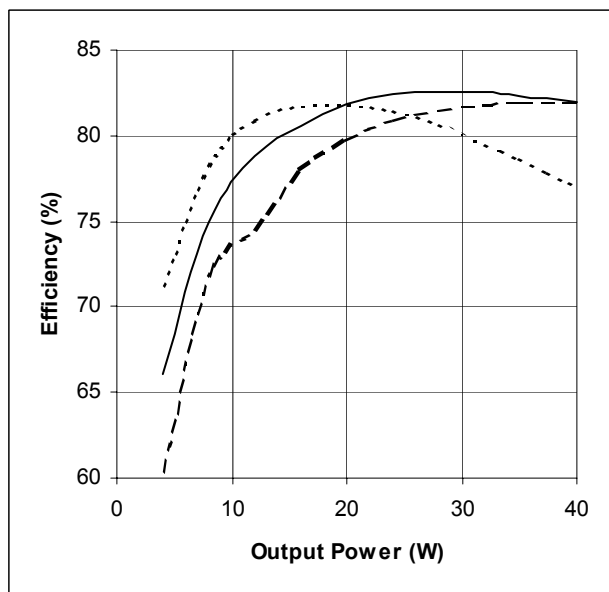


Figure 11 – DVTR2812S
Efficiency (%) vs. Output Power (W)

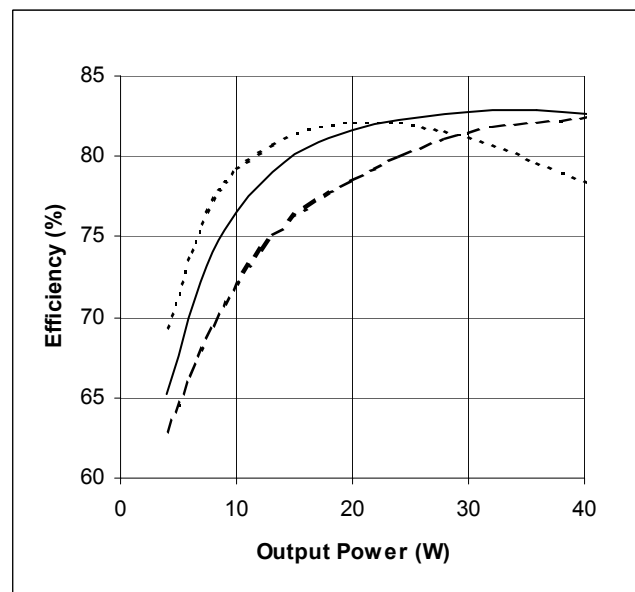


Figure 12 – DVTR2815S
Efficiency (%) vs. Output Power (W)

EMI PERFORMANCE CURVES

($T_{CASE} = 25^{\circ}\text{C}$, $V_{IN} = +28\text{V} \pm 5\%$, Full Load, Unless Otherwise Specified)

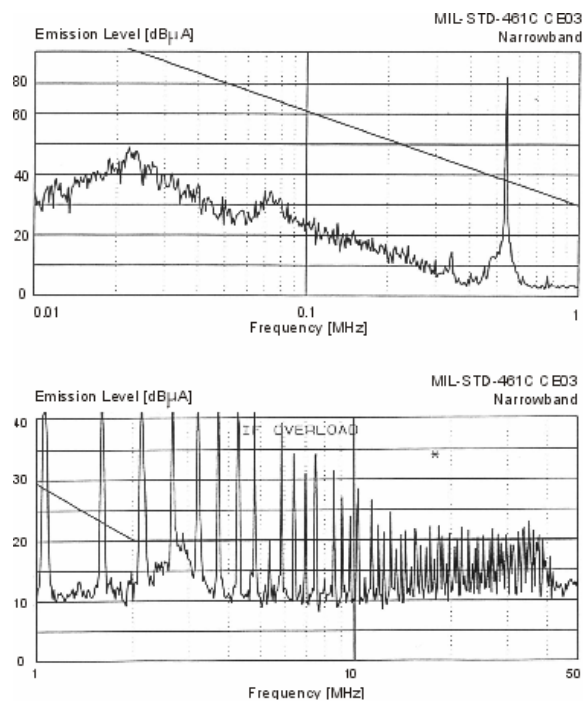


Figure 13 – DVTR2800S without EMI Filter

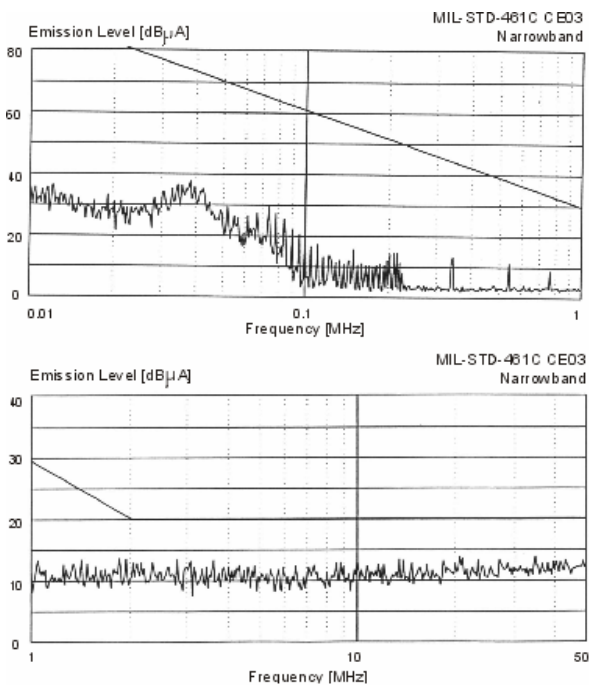


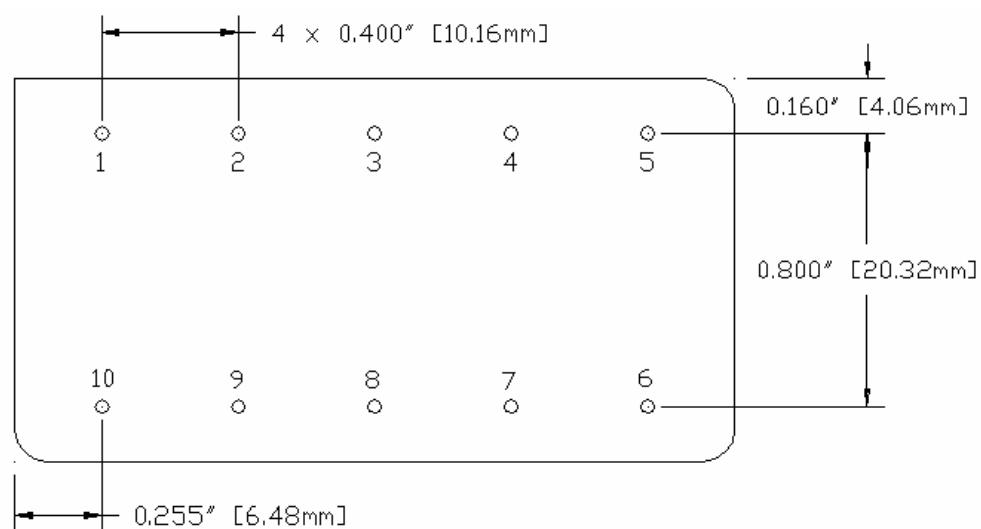
Figure 14 – DVTR2800S with EMI Filter

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

PACKAGE SPECIFICATIONS (NON-FLANGED, SEAM SEAL)

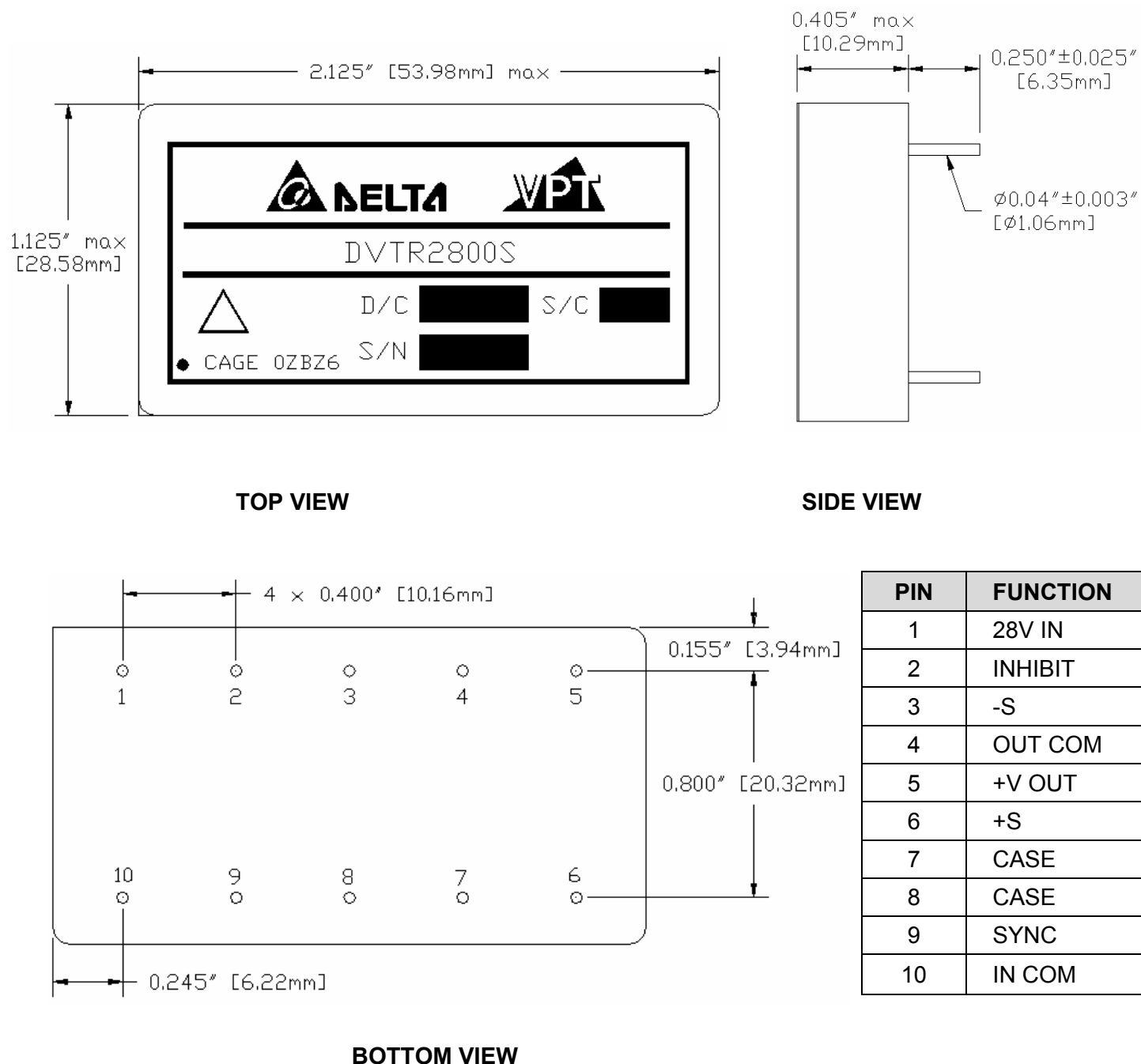
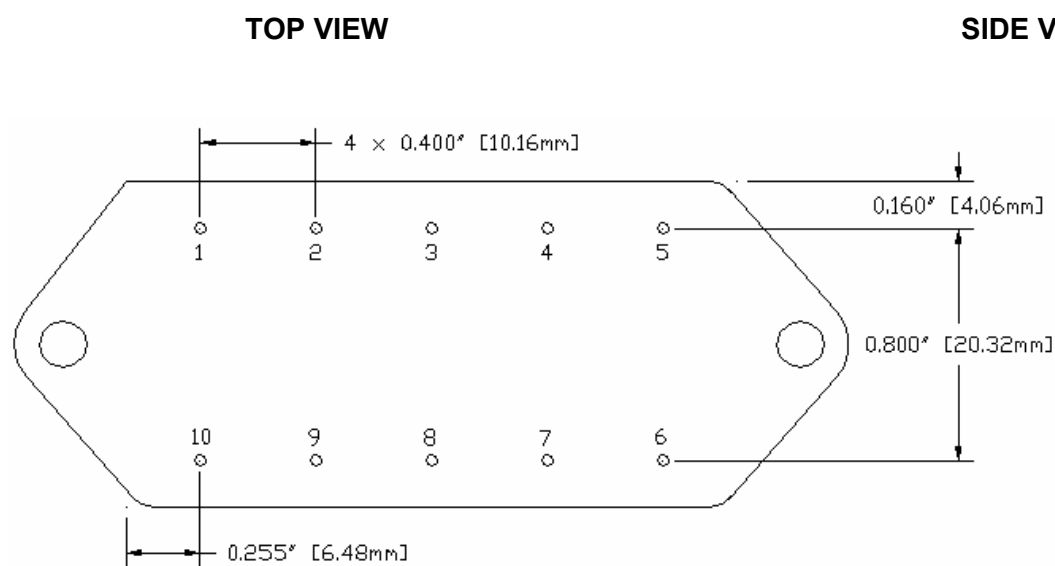
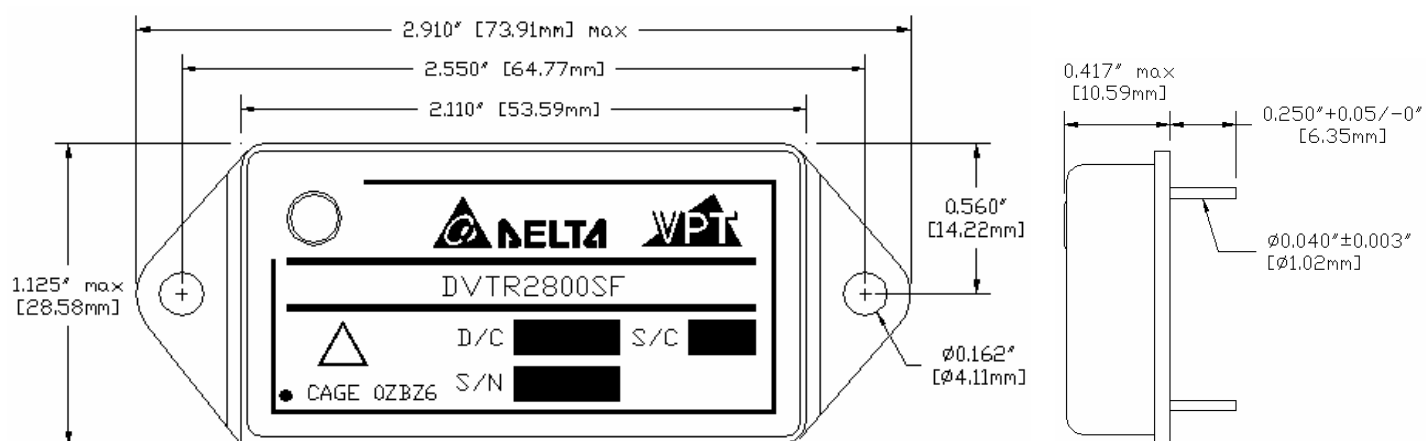


Figure 16 – Non-Flanged, Seam Seal Package and Pinout (/HB Screened Units Only)
(Dimensional Limits are ±0.005" Unless Otherwise Stated)

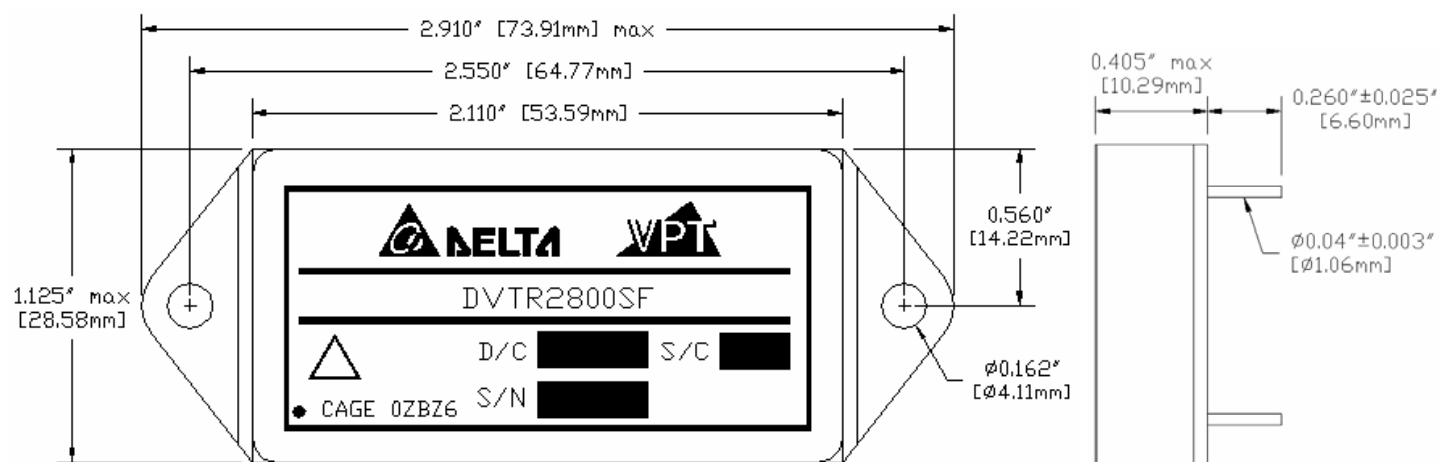
PACKAGE SPECIFICATIONS (FLANGED, SOLDER SEAL)



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

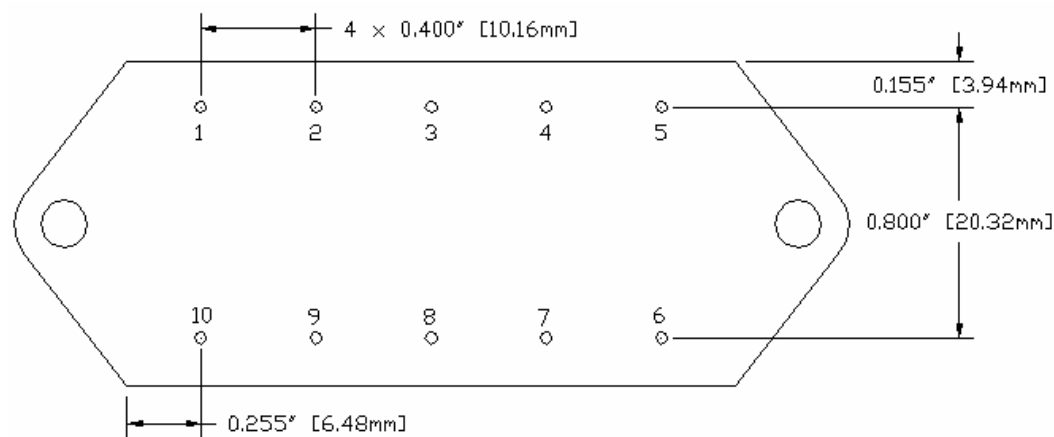
Figure 17 – Flanged, Solder Seal Package and Pinout
(Dimensional Limits are $\pm 0.005"$ Unless Otherwise Stated)

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 18 – Flanged, Seam Seal Package and Pinout (/HB Screened Units Only)
(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 (Per MIL-STD-883 as referenced to MIL-PRF-38534, Class H)

Screening	MIL-STD-883	Standard (No Suffix)	Extended /ES	HB /HB
Pre-Cap Inspection	Method 2017, 2032 Internal Procedure	•	•	•
Temperature Cycling	Method 1010, Condition C Method 1010, -55°C to 125°C		•	•
Constant Acceleration	Method 2001, Condition A Method 2001, 500g		•	•
Burn-In	Method 1015, 160 hours at +125°C 96 hours at +125°C 24 hours at +125°C	•	•	•
Hermeticity	Method 1014, Fine Leak, Condition A Method 1014, Gross Leak, Condition C Dip (1×10^{-3})	•	• •	• •
Final Electrical	MIL-PRF-38534, Group A ¹ 100% at 25°C	•	•	•
Final Inspection	Method 2009	•	•	•

Note: 1. 100% R&R testing at -55°C, +25°C, and +125°C with all test data included in product shipment.

ORDERING INFORMATION

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

(1) Product Series	(2) Nominal Input Voltage	(3) Output Voltage	(4) Number of Outputs
DVTR	28 28 Volts	3R3 05 5R2 12 15 3.3 Volts 5 Volts 5.2 Volts 12 Volts 15 Volts	S Single

(5) Package Option	(6) Rad-Hard Option	(7) Screening Code	(8) Additional Screening Code
None F Non-Flanged Flanged	None R Standard 100 kRad	None /ES /HB Standard Extended HB	Contact Sales

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.

CONTACT INFORMATION

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

Phone: (425) 487-4850
Fax: (425) 487-4802
E-mail: sales@vpt-inc.com

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