SVTR2800S Series

HIGH RELIABILITY HYBRID RADIATION TOLERANT DC-DC CONVERTERS

DESCRIPTION

The SVTR series of high reliability DC-DC converters is operable over the full military (-55 °C to +125 °C) temperature range with no power derating. Paramount to the SVTR 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. The SVTR series has been characterized and tested for TID (Total Ionizing Dose) at HDR (High Dose Rate) and LDR (Low Dose Rate – ELDRS) per VPT's RHA plan. The SVTR series has also been characterized for SEE (Single Event Effects). VPT's certified radiation program per MIL-PRF-38534, Appendix G is currently under review by DSCC. Please contact DSCC at 614-692-0585 for details. This characterization and testing is performed at the critical semiconductor component piece-part level (RLAT) from traceable semiconductor lots as well as on the SVTR series hybrid converter level produced from the same traceable semiconductor lots evaluated during RLAT.

These converters are designed and manufactured in a facility qualified to ISO9001 and certified to MIL-PRF-38534 Class H and Class K 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
- High Input Transient Voltage: 80 Volts for 1 sec per MIL-STD-704A
- Precision Seam Seal Hermetic Package
- High Power Density: > 40 W/in^3
- Custom Modified Versions May Be 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 Utilized
- Characterized and assured to 30krads(Si), per VPT's RHA plan specified per MIL-PRF-38534, Appendix G, Level P with 2X margin. After radiation exposure, converter testing is performed at 25°C per standard datasheet limits.
- Characterized to 44 MeV-cm2/mg with minor transients only; no dropouts, shutdowns, latch up or burn out.
- Critical semiconductor component piece-parts and assured converter products tested at an HDR of 80 rads(Si)/sec and an LDR of 8 mrads(Si)/sec.

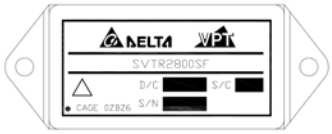

Figure 1 – SVTR2800S / SVTR2800SF DC-DC Converter (Exact marking may differ from that shown)

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Everett, WA 98204
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Sales Information:
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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	SVTR283R3S			SVTR2805S			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			65	-	-	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)		SF @ T_C = 55°C	-	752	-	-	752	-	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	SVTR2812S			SVTR2815S			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)		SF @ T_C = 55°C	-	752	-	-	752	-	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	SVTR285R2S			SVTR282R5S			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)		SF @ T_C = 55°C	-	752	-	-	752	-	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

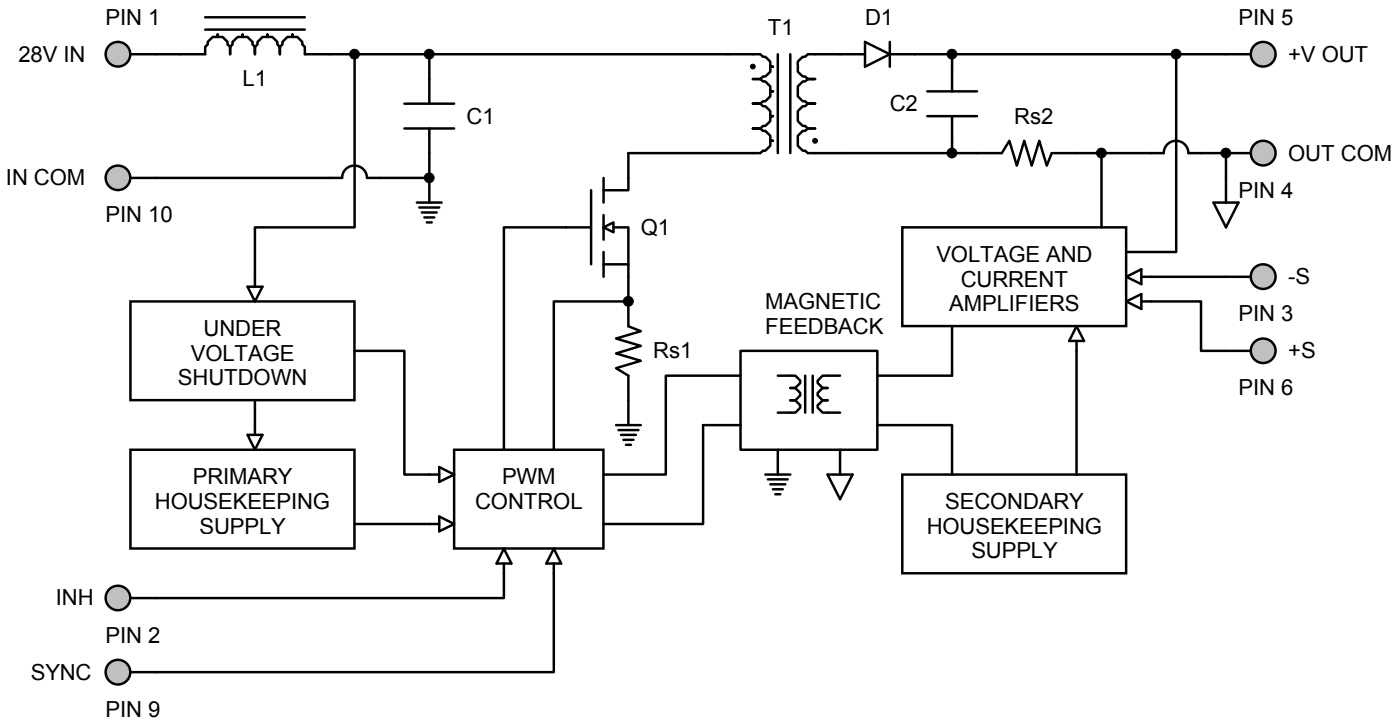


Figure 2

CONNECTION DIAGRAM

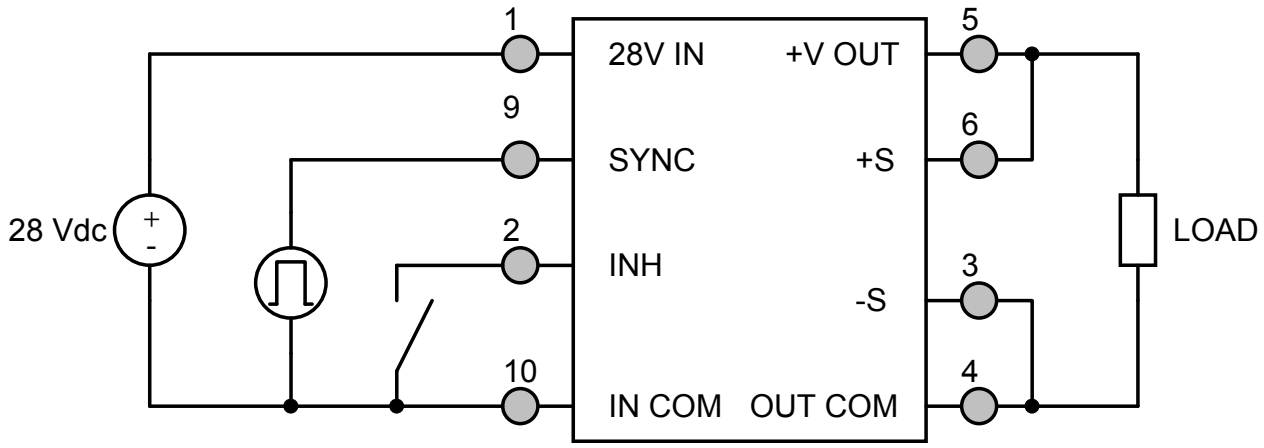


Figure 3

INHIBIT DRIVE CONNECTION DIAGRAMS

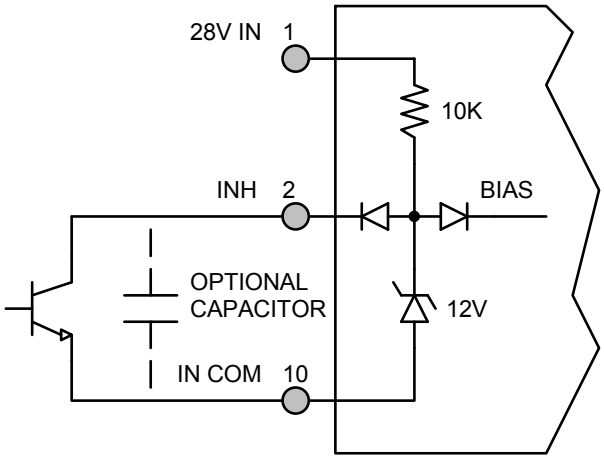


Figure 4 – Internal Inhibit Circuit and Recommended Drive
(Shown with optional capacitor for turn-on delay)

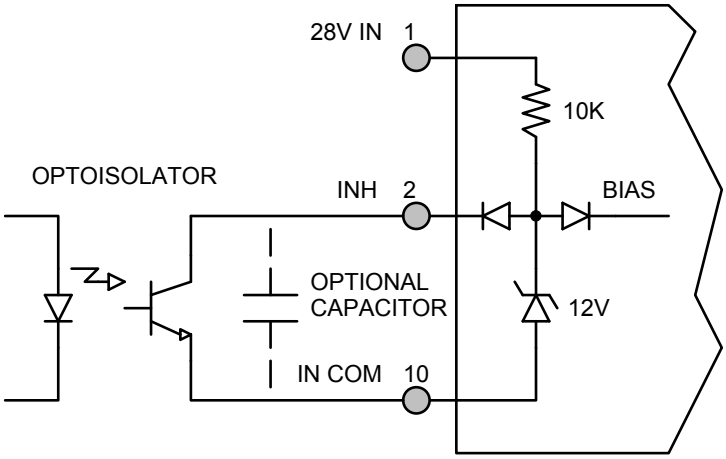


Figure 5 – Isolated Inhibit Drive
(Shown with optional capacitor for turn-on delay)

EMI FILTER HOOKUP DIAGRAM

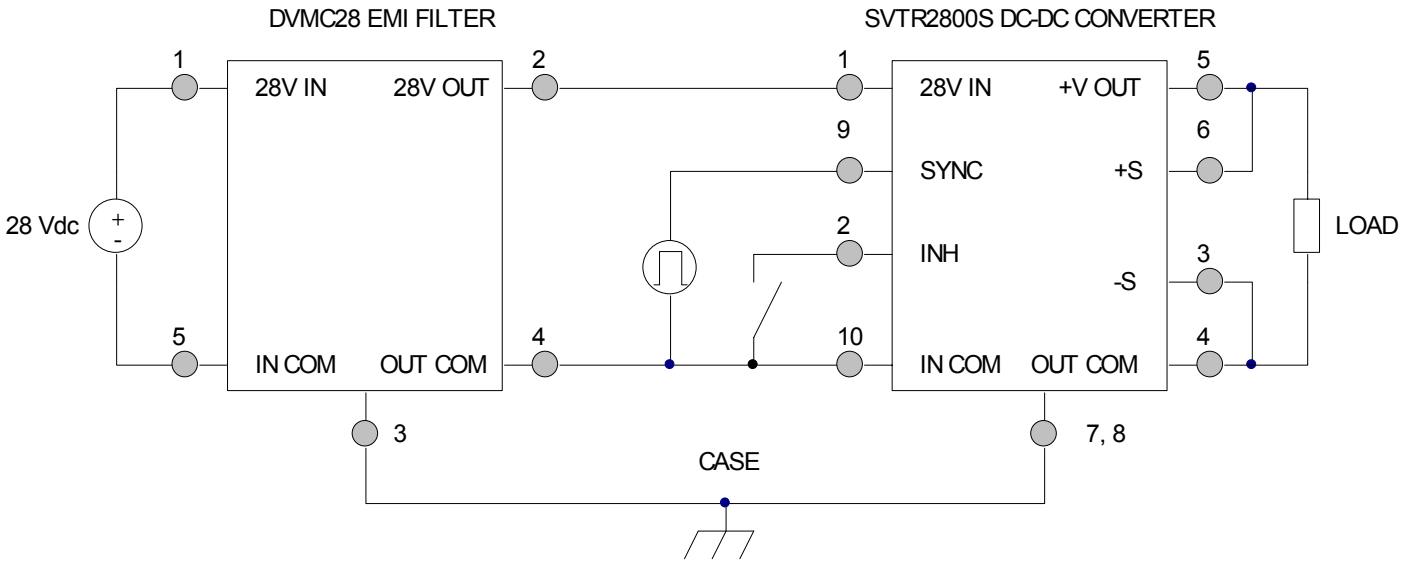
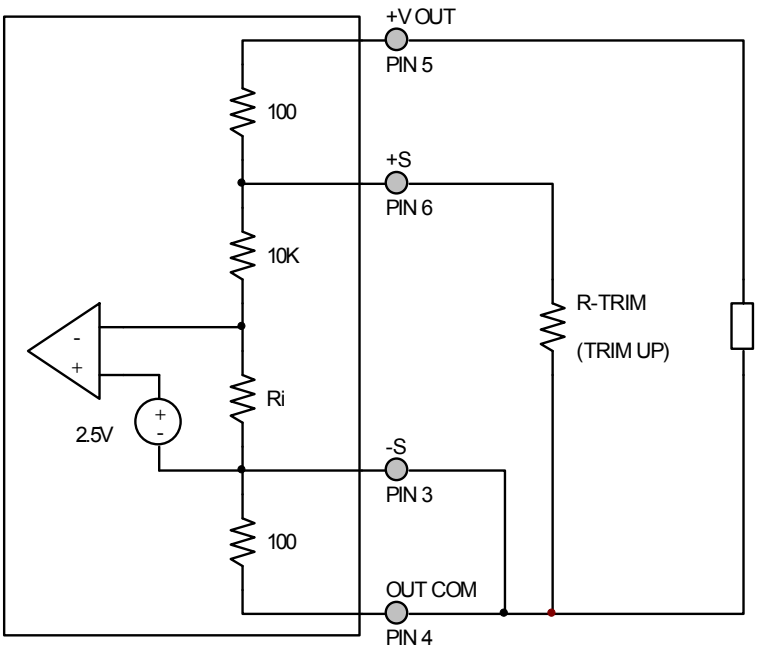


Figure 6 – Converter with EMI Filter

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 7 – Output Voltage Trim

SVTR282R5S		SVTR283R3S		SVTR2805S		SVTR285R2S		SVTR2812S		SVTR2815S	
$+V_{OUT}$ (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).

RHA TEST CIRCUIT DIAGRAM

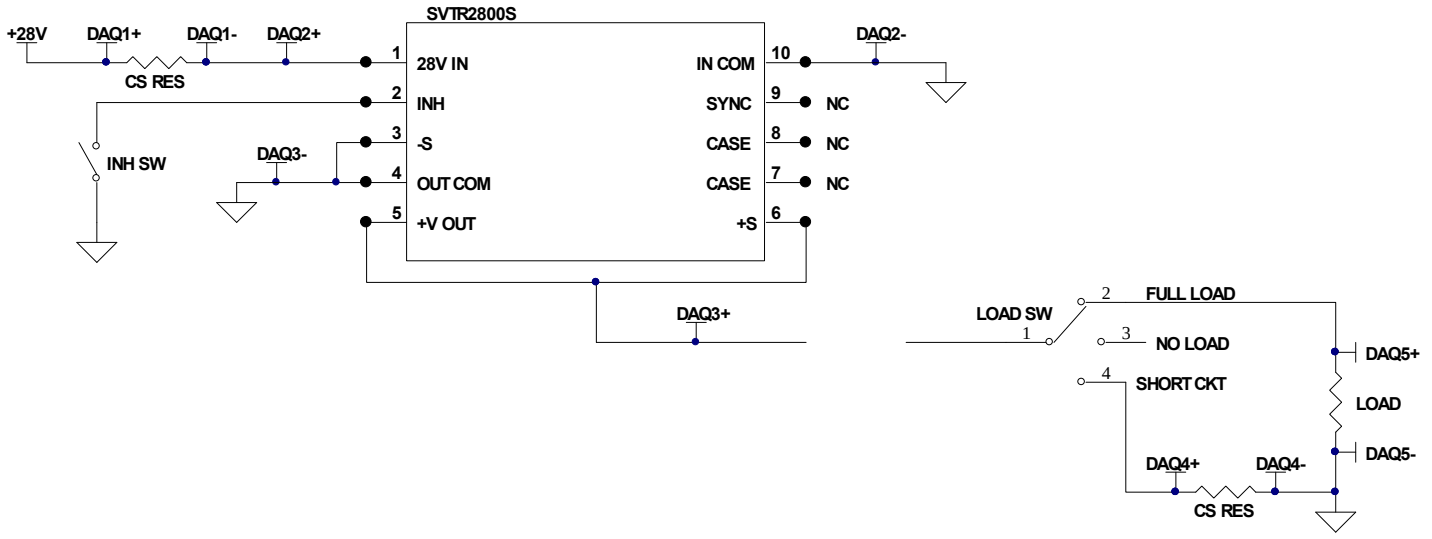


Figure 8

FREQUENCY OF RHA TESTING

Every initial wafer lot of critical semiconductor components has been characterized and tested at HDR as well as at LDR to determine if there is ELDRS sensitivity. If a specific component type is determined to have ELDRS sensitivity, all future wafer lots of that specific component will be tested at LDR. If no ELDRS sensitivity is shown in the initial wafer lot testing, future wafer lots of those specific components will not be tested at LDR. All future critical semiconductor component wafer lots are tested at HDR. If the components test to the same level (within 15% of the previous 99/90 RLAT level) or better as the wafer lot used to characterize the converter family, the converter family is not re-characterized. If the components test to a worse level, one of the following actions is performed (depending on the test level passed):

1. Component lot is not used in VPT RHA assured product.
2. Component lot is used if WCA (Worst Case Analysis) performed on the new lot against the original characterization WCA determines the component level characterized will not negatively impact the assured product characterization level.
3. The assured product is re-characterized using the new component lot.

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

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

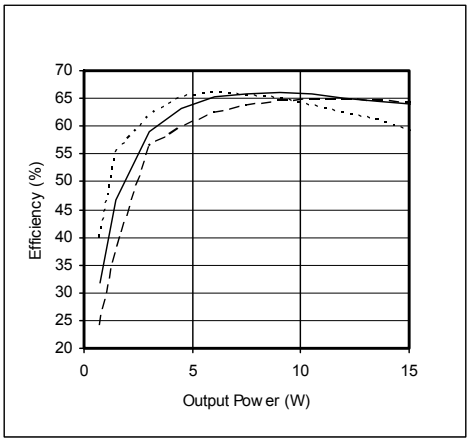


Figure 9 – SVTR282R5S
Efficiency (%) vs. Output Power (W)

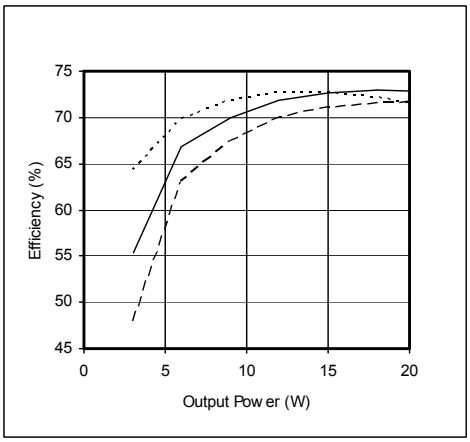


Figure 10 – SVTR283R3S
Efficiency (%) vs. Output Power (W)

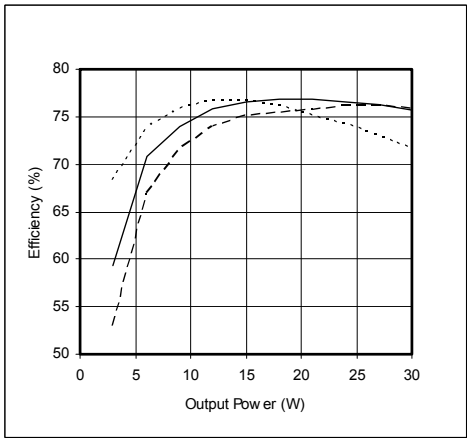


Figure 11 – SVTR2805S / SVTR285R2S
Efficiency (%) vs. Output Power (W)

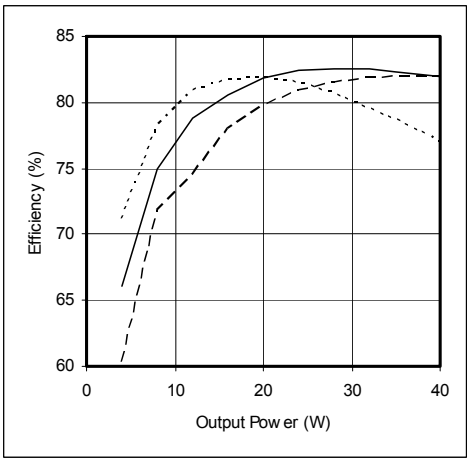


Figure 12 – SVTR2812S
Efficiency (%) vs. Output Power (W)

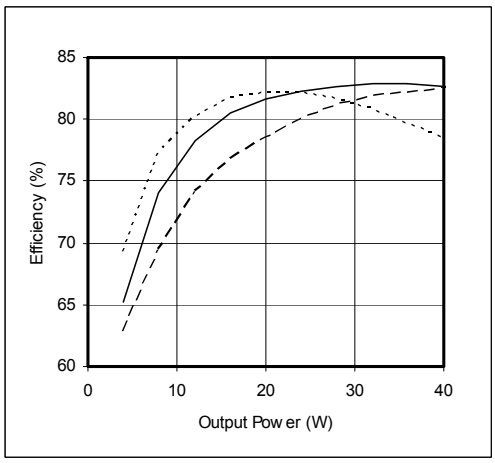


Figure 13 – SVTR2815S
Efficiency (%) vs. Output Power (W)

EMI PERFORMANCE CURVES

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

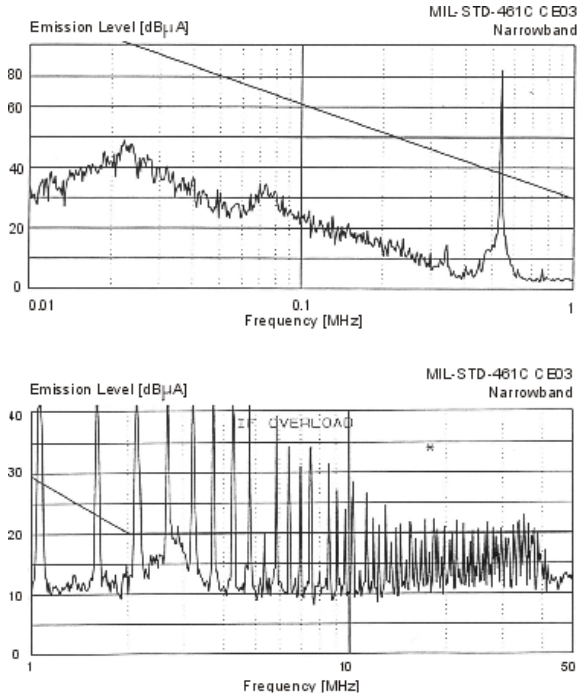


Figure 14 – SVTR2800S without EMI Filter

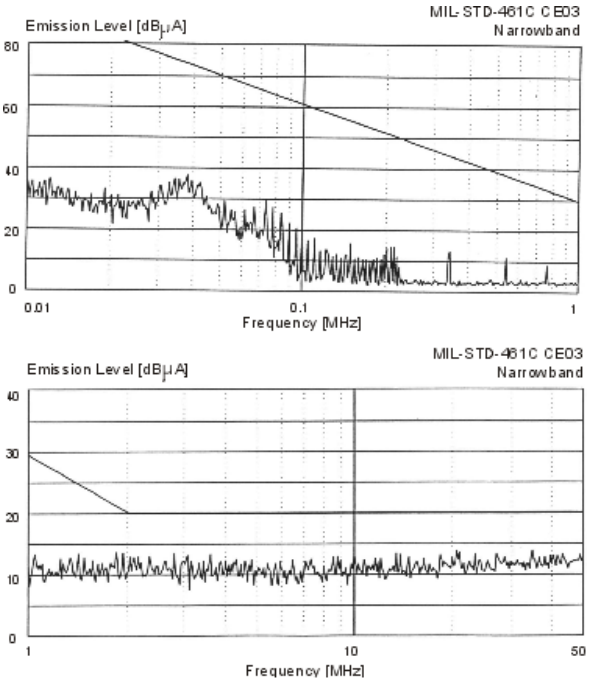
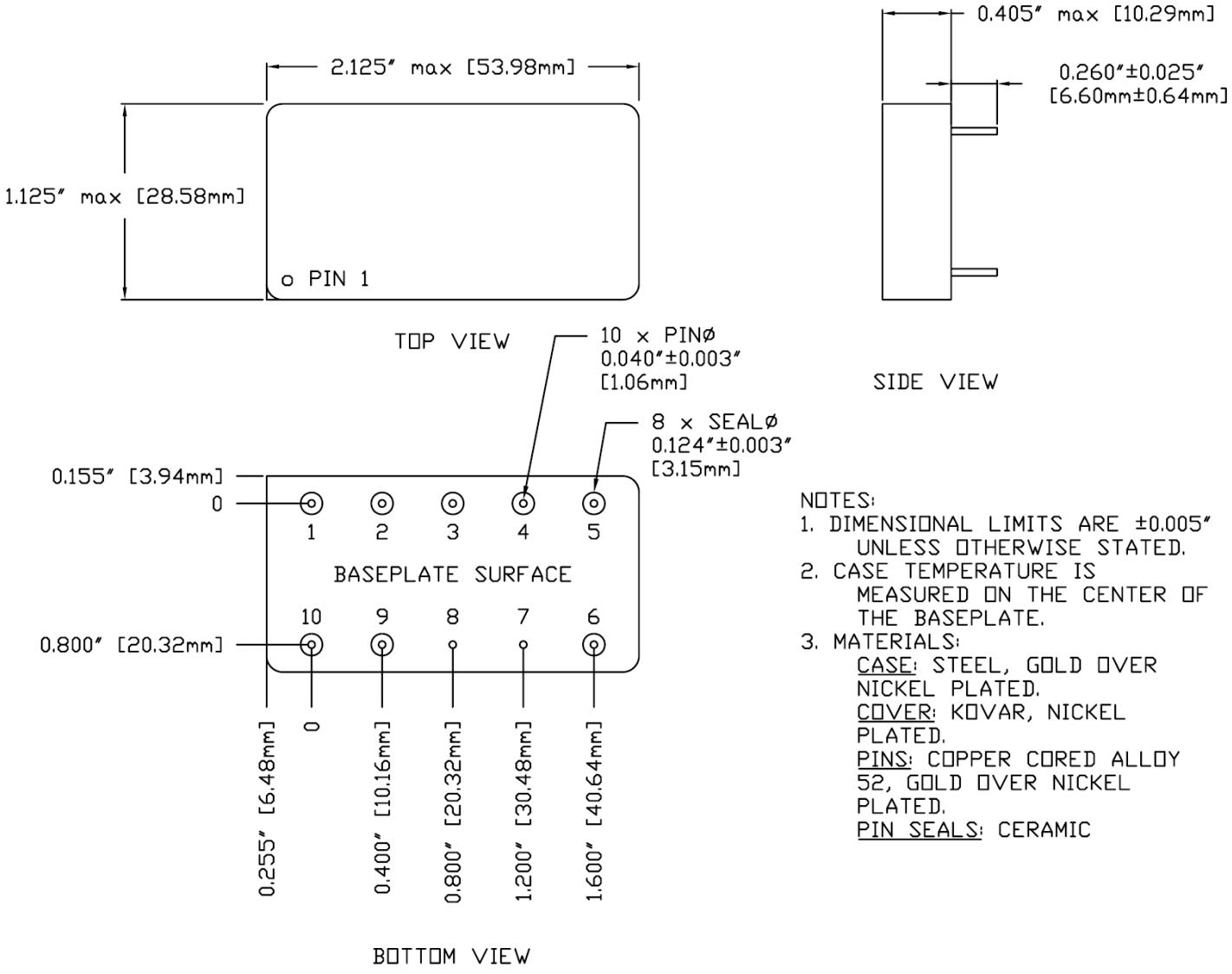


Figure 15 – SVTR2800S with EMI Filter

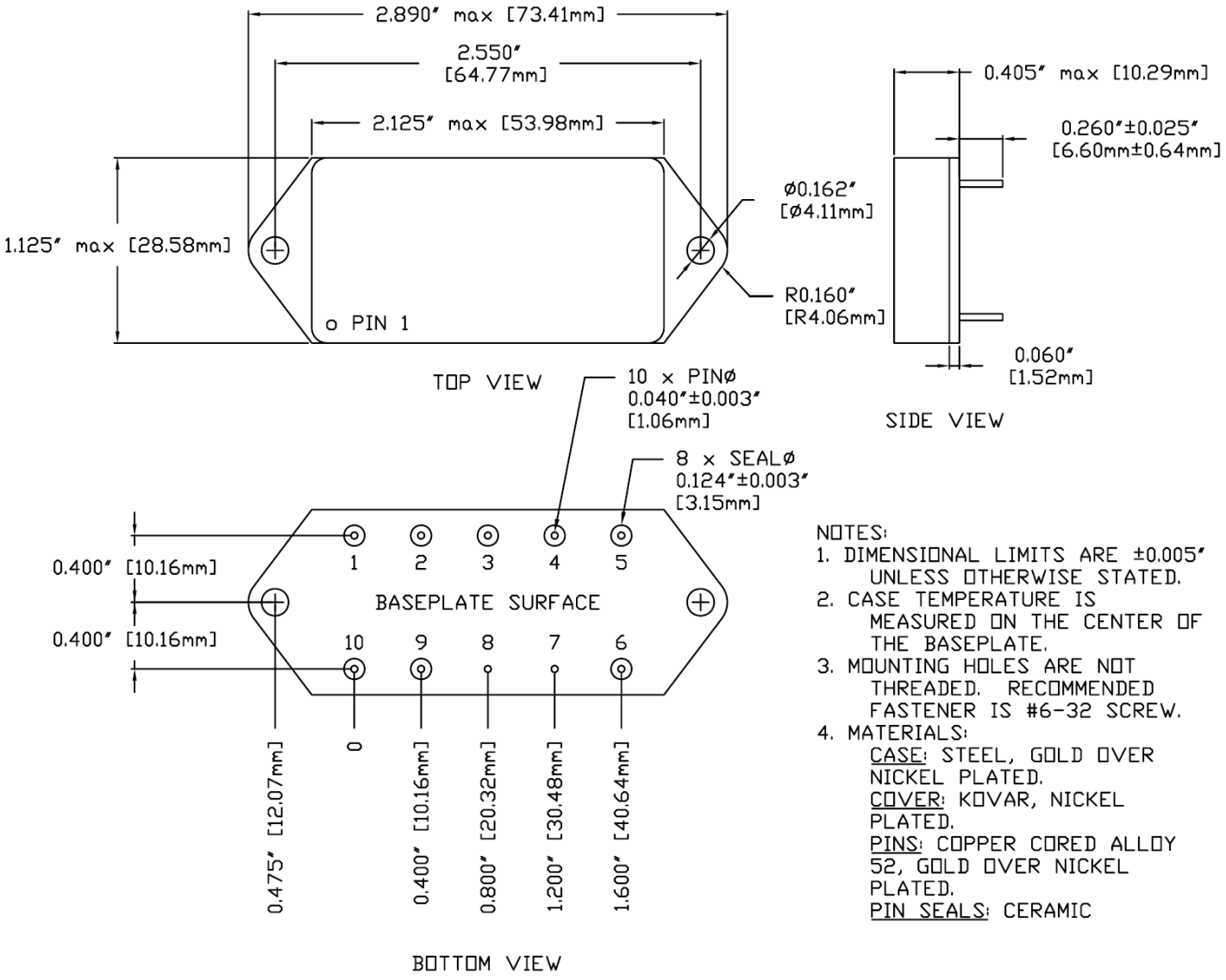
PACKAGE SPECIFICATIONS (NON-FLANGED)



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

Figure 16 – Non-Flanged Package and Pinout

PACKAGE SPECIFICATIONS (FLANGED)



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

Figure 17 – Flanged Package and Pinout

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	Class HB+ /HB+	Engineering Model[5] /EM
Non-Destructive Bond Pull	Method 2023	•	•
Internal Visual	Method 2017, 2032 Internal Procedure	•	•
Temperature Cycling	Method 1010, Condition C	•	
Constant Acceleration	Method 2001, 3000g, Y1 Direction	•	
PIND	Method 2020, Condition A[2]	•	
Burn-In	Method 1015, 160 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})	• •	•
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. Non-Destructive bond pull per Method 2023 performed.
4. Please contact your sales representative or the VPT Inc. Sales Department for more information concerning additional environmental screening and testing options desired.
5. Engineering models utilize only the standard screening specified and are not considered compliant for flight use.

ORDERING INFORMATION

SVTR	28	05	S	F	/HB+	-	XXX
1	2	3	4	5	6		7

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

Product Series	Nominal Input Voltage		Output Voltage		Number of Outputs	
SVTR	**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)

Package Option		Screening Code		Additional Screening Code
None **F**	Non-Flanged Flanged	**/HB+** **/EM**	HB+ Engineering Model	Contact Sales

Note: Engineering models utilize only the standard screening specified and are not considered compliant for flight use. These models are intended for low volume engineering characterization. The customer must place the following statement on each line item of their purchase order(s) for /EM units when ordering engineering models:

"(Customer Name) acknowledges that the /EM unit listed in this line item is not permitted for flight use and will be used for Engineering characterization only."

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 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