



SVGA0510S Series

ULTRA-HIGH RELIABILITY 100 krad (Si) RADIATION HARDENED HYBRID DC-DC CONVERTERS

DESCRIPTION

The SVGA series of high-reliability DC-DC converters is operable over the full military temperature range (-55°C to +125°C) with no power derating. Operating at a nominal fixed frequency of 250 kHz, these regulated non-isolated converters are optimized for low voltage point-of-load applications with high-efficiency synchronous rectification and fast transient response.

The SVGA series is specifically designed for the harsh radiation environment of space applications. Performance is guaranteed by design through extensive Worst Case Analysis, the use of hardened components, and Radiation Lot Acceptance Testing (RLAT) of semiconductor components. The SVGA series has been characterized for Total Ionizing Dose (TID) performance including Enhanced Low Dose Rate Sensitivity (ELDRS) and for Single Event Effects (SEE) according to VPT's DLA approved Radiation Hardness Assurance (RHA) plan per MIL-PRF-38534, Appendix G. Characterization is performed at both the component level and at the SVGA series hybrid converter level.

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

- Guaranteed TID Performance to 100 krad(Si) including ELDRS, per VPT's RHA plan specified per MIL-PRF-38534, Appendix G, Level R.
- SEE Characterized to 85 MeV-cm²/mg with minor transients only; no dropouts, shutdowns, latch up or burn out.
- High Reliability
- Operates from 5V input
- Adjustable Output Voltage from 0.8V to 3.4V
- Up to 10 Amps or 33 Watts Output Power
- High Efficiency, Up to 94%
- High Power Density, >100W/in³
- Output Inhibit Control
- Low Output Noise
- No Use of Opto-isolators
- Short Circuit Protection
- Precision Projection Welded Hermetic Package
- MIL-PRF-38534 Element Evaluated Components
- Compliant to MIL-HDBK-1547 Deratings
- Worst Case Analysis, Stress, Radiation and Reliability reports available¹



Figure 1 – SVGA0510S DC-DC Converter
(Exact marking may differ from that shown)

¹Subject to all export restrictions and export regulations including but not limited to the Export Administration and Foreign Assets Control Regulations. Further restrictions may apply contact VPT for details.

SPECIFICATIONS ($T_{CASE} = -55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$, $V_{IN} = +5\text{V} \pm 1\%$, Full Load, Unless Otherwise Specified)

ABSOLUTE MAXIMUM RATINGS

Input Voltage (Continuous)	7 V_{DC}	Junction Temperature Rise to Case	+11°C
Input Voltage Transient (1 second)	7.5 V_{DC}	Storage Temperature	-65°C to +150°C
Output Power ¹	33 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, $T_{CASE} = +125^{\circ}\text{C}$)	4.5 Watts	Weight (Maximum)	16 Grams
ESD Rating per MIL-PRF-38534	3B		

Parameter	Conditions	SVGA0510S			Units
		Min	Typ	Max	
STATIC					
INPUT Voltage ⁴	$V_{out} = 0.8\text{V}$ to 2.5V	3.5	-	7.0	V
	$V_{out} = 2.6\text{V}$ to 3.3V	4.1	-	7.0	
Current	Inhibited	-	30	35	mA
	No Load	-	100	150	mA
Inhibit Pin Input ⁴		0	-	1.5	V
Inhibit Pin Open Circuit Voltage ⁴		-	4.7	V_{in}	V
UVLO Turn On ^{4,6}		-	3.0	-	V
UVLO Turn Off ^{4,6}		-	2.7	-	V
OUTPUT Voltage	V_{OUT} $T_{CASE} = 25^{\circ}\text{C}$	-1.0	V_{out}	+1.0	%V
	V_{OUT} $T_{CASE} = -55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	-1.5	V_{out}	+1.5	%V
Power ^{1,3}		0	-	33	W
Current ³	I_{OUT}	0	-	10	A
Ripple Voltage	V_{OUT} Full Load, 20Hz to 10MHz	-	60	100	mV _{p-p}
Load Regulation	V_{OUT} No Load to Full Load	-	10	25	mV
EFFICIENCY ¹	$V_{out} = 3.3\text{V}$	88	93		%
FAULT POWER DISSIPATION	$V_{out} = 3.3\text{V}$		1.5	3	W
CAPACITIVE LOAD ⁴				5000	μF
SWITCHING FREQUENCY		200	250	350	kHz
MTBF (MIL-HDBK-217F)	SF @ $T_C = 55^{\circ}\text{C}$	-	6.90	-	MHrs
DYNAMIC					
Load Step Output Transient ⁵	V_{OUT} Half Load to Full Load	-	75	120	mV
Load Step Recovery ^{2,5}	$V_{out} = 3.3\text{V}$	-	25	60	μSec
Turn On Delay	V_{OUT} $V_{IN} = 0\text{V}$ to 5V	-	5	8	mSec
Turn On Overshoot		-	2	10	mV _{PK}
POST-RAD END-OF-LIFE LIMITS⁷					
OUTPUT Voltage	$T_{CASE} = -55^{\circ}\text{C}$ to $+125^{\circ}\text{C}$	-3.0	V_{out}	+3.0	%V

- Notes:
1. Dependent on output voltage.
 2. Time for output voltage to settle within 1% or 20mV of its nominal value, whichever is greater.
 3. Derate linearly to 0 at 135°C.
 4. Verified by qualification testing.
 5. With 100 μF capacitor from V_{in} to Ground
 6. V_{out} not necessarily in regulation
 7. All other specifications remain the same

BLOCK DIAGRAM

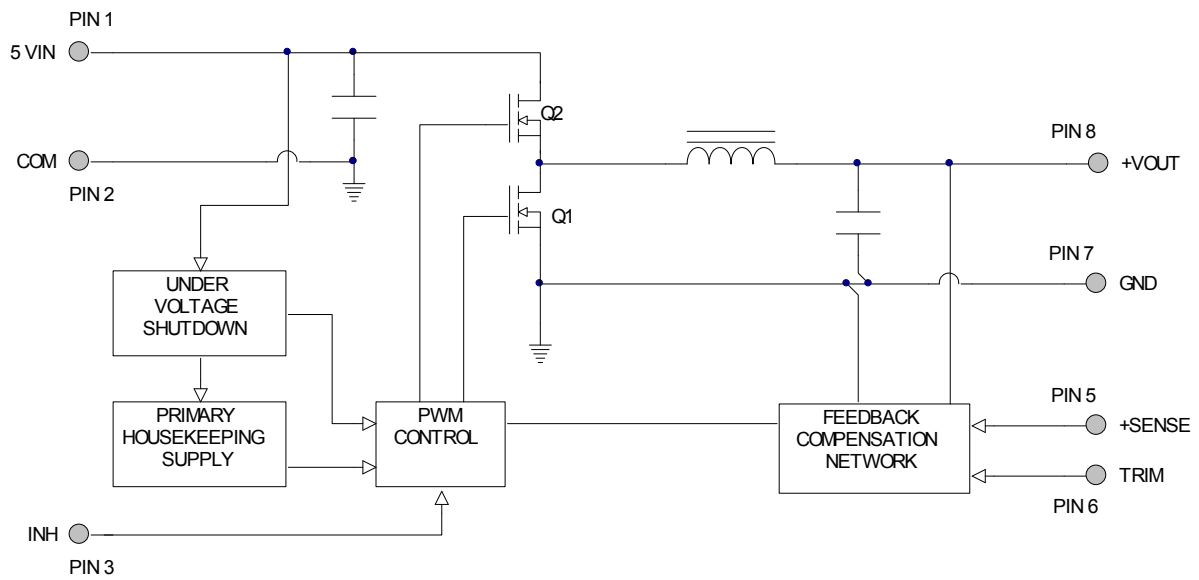


Figure 2

CONNECTION DIAGRAM

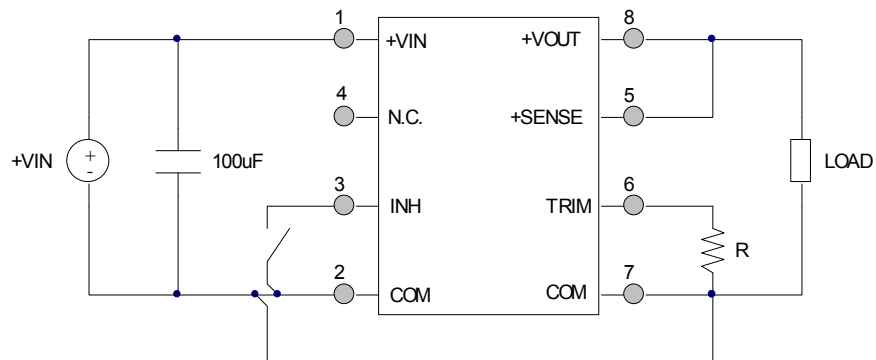


Figure 3

Shown with recommended 100uF capacitor on the input

INHIBIT DRIVE CONNECTION DIAGRAMS

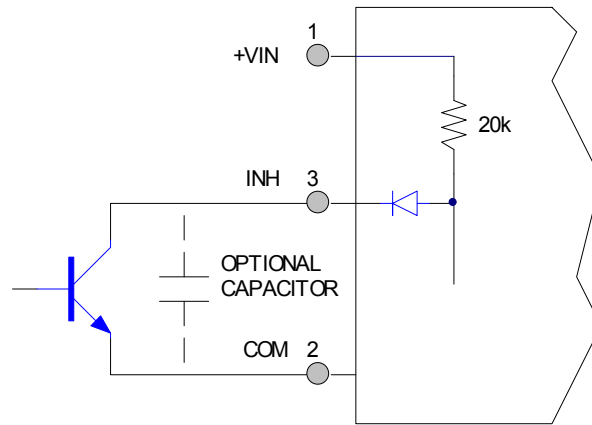
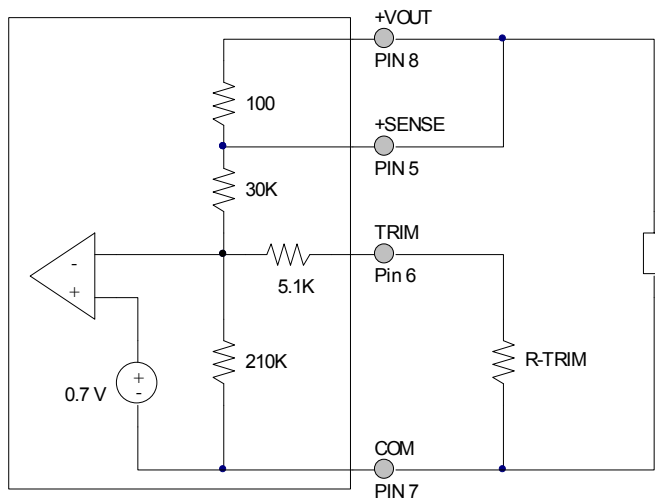


Figure 4 –Internal Inhibit Circuit and Recommended Drive
(Shown with optional capacitor for turn-on delay)

OUTPUT VOLTAGE TRIM



The output voltage is set with an external resistor connected from the TRIM pin to the GND pin 7. This resistor must have a tolerance of 1% or less to achieve an accurate output voltage.

The default output voltage with the TRIM pin left open is 0.80V.

SVGA0510S	
+V _{OUT} (V)	R _{TRIM} (Ω)
0.8	None
0.9	205k
1.0	99.9k
1.2	47.4k
1.5	24.9k
1.8	15.9k
1.9	13.9k
2.0	12.4k
2.5	7.25k
2.8	5.4k
3.0	4.44k
3.3	3.30k
3.4	2.98k

$$V_o = \frac{168R_{TRIM} + 5.267 * 10^6}{210R_{TRIM} + 1.071 * 10^6}$$

$$R_{TRIM} = \frac{5.267 * 10^6 - 1.071 * 10^6 * V_o}{210 * V_o - 168}$$

Figure 5 – Output voltage trim table

EFFICIENCY PERFORMANCE CURVES (T_{CASE} = 25°C, V_{in} = 5V)

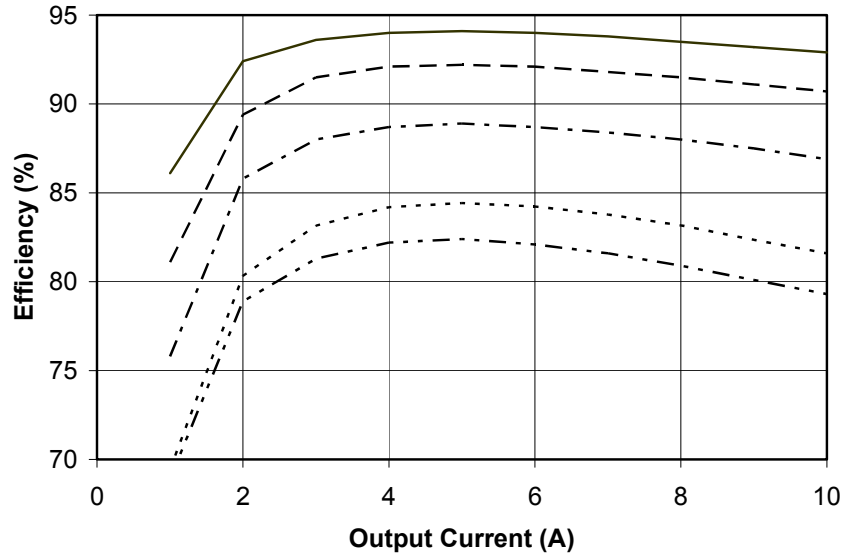
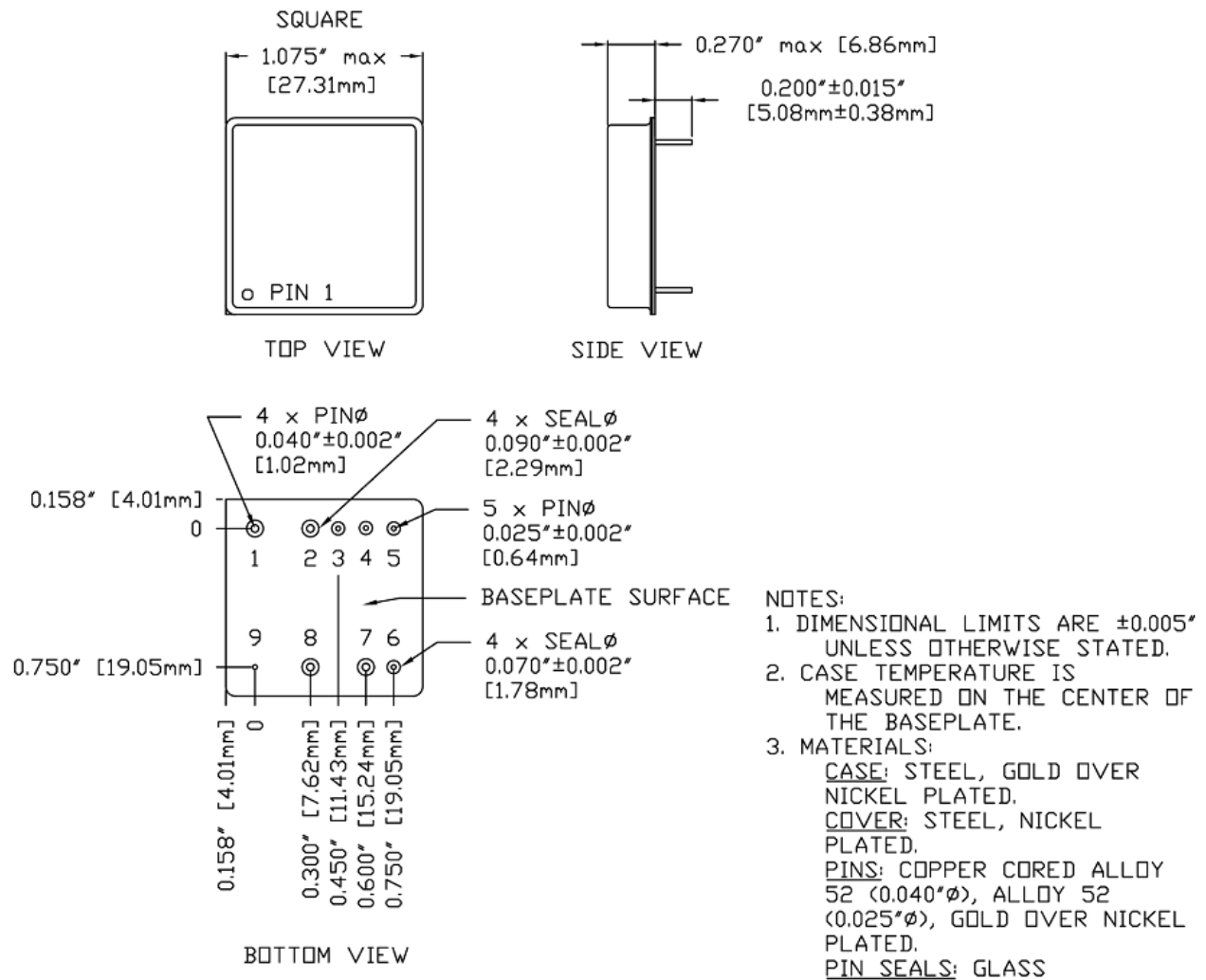


Figure 6 – Efficiency curves for typical output voltages.

PACKAGE SPECIFICATIONS



Pin	Function	Pin	Function	Pin	Function
1	+V IN	4	N/C	7	COM
2	COM	5	+SENSE	8	+V OUT
3	INHIBIT	6	TRIM	9	CASE

Figure 7 – Package and Pinout

PACKAGE PIN DESCRIPTION

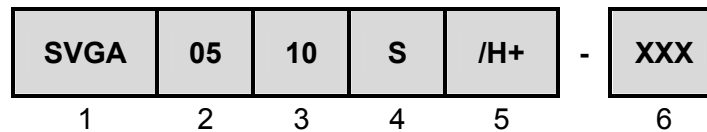
Pin	Function	Description
1	+VIN	Positive Input Voltage Connection
2	COM	Common Return Connection, Input Side
3	INHIBIT	Logic Low = Disabled Output. Connecting the inhibit pin to common causes converter shutdown. Logic High (open collector or open drain) = Enabled Output. Leave open if not used.
4	N/C	No Connection
5	+SENSE	Positive Sense
6	TRIM	Trim pin sets output voltage with a resistor to pin 7
7	COM	Common Return Connection, Output Side
8	+VOUT	Positive Output Voltage Connection
9	CASE	Case Connection

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

Test	MIL-STD-883 Test Method, Condition	/H+ (Class H + PIND)	/K (Class K)	/EM (Engineering Model) Non-QML ⑤⑥
Non-Destructive Bond Pull	TM2023	• ④	•	• ④
Internal Visual	TM2010, TM2017, TM2032 (MIL-STD-750, TM2072, TM2073)	•	•	•
Temperature Cycling	TM1010, Condition C -65°C to 150°C, Ambient	•	•	
Constant Acceleration	TM2001, 3000g, Y1 Direction	•	•	
PIND ⑦	TM2020, Condition A	• ④	•	
Pre Burn-In Electrical	25°C		•	
Burn-In	TM1015, 320 hrs, 125°C, Case Typ		•	
	TM1015, 160 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 ③	•	•	
	MIL-PRF-38534, Group A Subgroups 1 and 4 25°C			•
Hermeticity (Seal)	TM1014, Fine Leak, Condition A2	•	•	
	TM1014, Gross Leak, Condition C	•	•	
	Gross Leak, Dip (1 x 10 ⁻³)			•
Radiography ⑧	TM2012		•	
External Visual	TM2009	•	•	•

- Notes:
- ① Contact Sales for more information concerning additional environmental screening and testing options desired.
 - 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.
 - ③ 100% R&R testing with all test data included in product shipment.
 - ④ Not required per MIL-PRF-38534. Test is performed for additional product quality assurance.
 - ⑤ Non-QML products may not meet all requirements of MIL-PRF-38534.
 - ⑥ Engineering models utilize only the screening specified and are not considered compliant for flight use.
 - ⑦ PIND test Certificate of Compliance included in product shipment.
 - ⑧ Radiographic test Certificate of Compliance and film(s) or data CD included in product shipment.

ORDERING INFORMATION



(1) Product Series	(2) Nominal Input Voltage		(3) Output Current		(4) Number of Outputs	
SVGA	05	5 Volts	10	10 A	S	Single

(5) Screening Code	(6) Additional Screening Code
/EM /H+ /K	Engineering Model Class H + PIND Class K 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 only and have no guarantee regarding operation in a radiation environment. 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.

SMD (STANDARD MICROCIRCUIT DRAWING) NUMBERS

Standard Microcircuit Drawing (SMD)	SVGA0510S Part Number
5962R1221901HXC	SVGA0510S/H+
5962R1221901HXA	SVGA0510S/H+-E
5962R1221901KXC	SVGA0510S/K
5962R1221901KXA	SVGA0510S/K-E

Do not use the SVGA0510S part numbers 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 <http://www.dsccl.dla.mil/programs/smcr/>. The SMD number listed above is for standard gold-plated lead finish and "P" RHA (Radiation Hardness Assurance) level. 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@vpt-inc.com

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