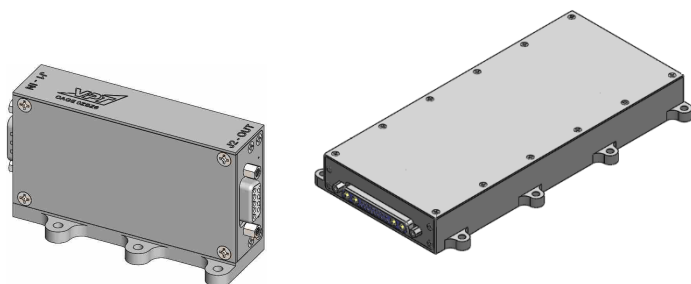




Power Your Critical Mission Today

FLX SERIES

CONFIGURABLE DC-DC CONVERTER BOX SOLUTIONS



FLX Series Overview

Standard 28 V, 50 V and 270 V bus voltages

15 W – 5,000 W

Up to 90% efficiency

Modified versions available to meet customer-specific requirements

1.0 SERIES DESCRIPTION

The FLX Series provides a highly reliable, configurable power solution by integrating any of VPT's standard EMI filters and DC-DC converter modules into a robust housing.

This turnkey solution is deliverable as a screened and qualified unit, ready for seamless integration into your system. Designed to perform in extreme environments, the FLX can endure high shock and vibration, supporting military, avionics, and space applications. Radiation capabilities for space applications can range from radiation-tolerant (30 krad (Si) / 42 MeV) to radiation-hardened (100 krad(Si) / 85 MeV). With power levels ranging from watts to kilowatts, the form factor is scalable and configurable for vertical, horizontal, or stacked/sharable orientations.

Engineered for the harshest conditions, the FLX is ideal for mission-critical applications in space, avionics, and military systems, delivering reliable power when it is most needed.

1.1 FEATURES

- Scalable up to 5,000 W output power
- Military, avionics, and space (up to 100 krad(Si))
- Integrated EMI filter (MIL-STD-461 C-G)
- 1 – 6 output voltage rails
- Integrates any of VPT's standard converter modules
- DC bus standards: MIL-STD-704, MIL-STD-1275, DO-160

1.1 FEATURES (CONTINUED)

- Continuous operation over a temperature range of -55 °C to +85 °C with no power derating
- Undervoltage lockout
- Current limit protection / short circuit protection
- Fixed frequency
- No use of optocouplers

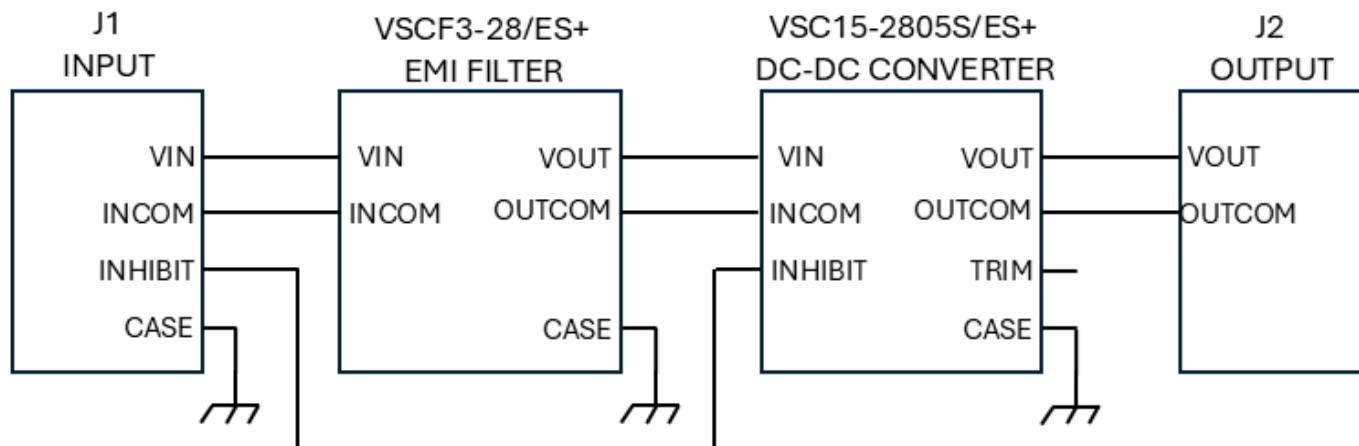
1.2 MANUFACTURING AND COMPLIANCE

- Manufactured in a facility certified to SAE AS9100, J-STD-001 (Space Addendum) and IPC-A-610
- MIL-STD-461 C-G
- Low outgassing for space environments

1.3 PACKAGING

- Configurable options
- Vertical and horizontal mounting configurations
- Stacked configurations available for higher power
- Scalable to minimize size and weight
- Aluminum case and cover with nickel plating

2.0 BLOCK DIAGRAM, EXAMPLE FLX15-28VSC-002



Throughout this document, performance and operation details are based on a FLX15-28VSC-002, a box of one VSCF3-28 filter and one VSC15-2805S converter. For other configurations contact vp.sales@vptpower.com.

3.0 SPECIFICATIONS, EXAMPLE FLX15-28VSC-002

3.1 ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings, EXAMPLE FLX15-28VSC-002

Input Voltage (Continuous):	-0.5 V to 50 V	Operating Temperature (Full Load):	-55 °C to +85 °C
Input Voltage (Transient, 1 second):	-0.5 V to 80 V	Storage Temperature:	-55 °C to +125 °C

3.2 PERFORMANCE SPECIFICATIONS

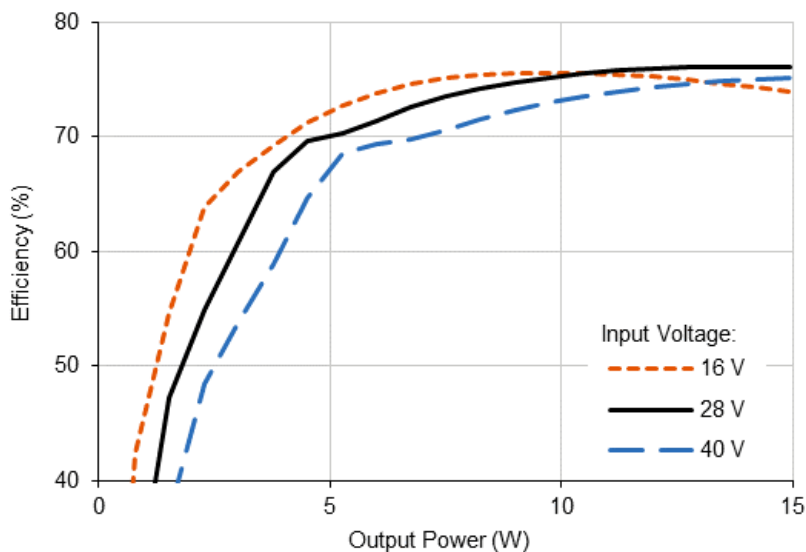
T_{case} = -55 °C to +85 °C, V_{in} = +28 V ± 5%, Full Load, Unless Otherwise Specified

Example FLX15-28VSC-002					
Parameter	Conditions	Min	Typ	Max	Units
INPUT					
Voltage	Continuous	15	28	50	V
	Transient, 1 sec ²	-	-	80	V
Current	INH < 1.5 V	-	4	6	mA
	No Load	-	50	65	mA
Ripple Current	20 Hz to 10 MHz	-	50	85	mApp
Undervoltage Lockout	Turn-On	12	-	14.8	V
	Turn-Off ²	11	-	14.5	V
OUTPUT STATIC					
Voltage	T _{case} = 25 °C	4.92	5	5.08	V
	T _{case} = -55 °C to +85 °C	4.87	5	5.13	V
Power ³		0	-	15	W
Current ³		0	-	3	A
Ripple Voltage	20 Hz to 10 MHz	-	10	40	mVpp
Line Regulation	V _{in} = 15 V to 50 V	-	1	20	mV
Load Regulation	No Load to Full Load	-	1	20	mV
Load Fault Power Dissipation	Overload ²	-	-	9.5	W
	Short Circuit ²	-	-	8	W
OUTPUT DYNAMIC					
Load Step, Half to Full Load	Output Transient	-	170	250	mVpk
	Recovery ¹	-	300	450	μs
Line Step ² , V _{in} = 16 V to 40 V	Output Transient	-	350	550	mVpk
	Recovery ¹	-	400	550	μs
Turn-On, V _{in} = 0 V to 28 V	Delay	-	10	20	ms
	Overshoot	-	0	25	mVpk
FUNCTION					
INH Pin Input ²	Output Inhibited	0	-	1.5	V
INH Pin Open Circuit Voltage ²	Output Enabled	9	-	13	V
GENERAL					
Efficiency		72	76	-	%
Capacitive Load ²		-	-	1000	μF
Switching Frequency		400	500	550	kHz
Isolation	500 V DC, T _{case} = 25 °C	100	-	-	MΩ
Weight		-	215	237	g
MTBF (MIL-HDBK-217F)	SF @ T _{case} = 40 °C	-	9.8	-	MHr
POST-RAD LIMITS⁴					
Output Voltage	T _{case} = -55 °C to +85 °C	4.77	5	5.22	V
Line Regulation	V _{in} = 15 V to 50 V	-	1	25	mV
Load Regulation	No Load to Full Load	-	1	25	mV

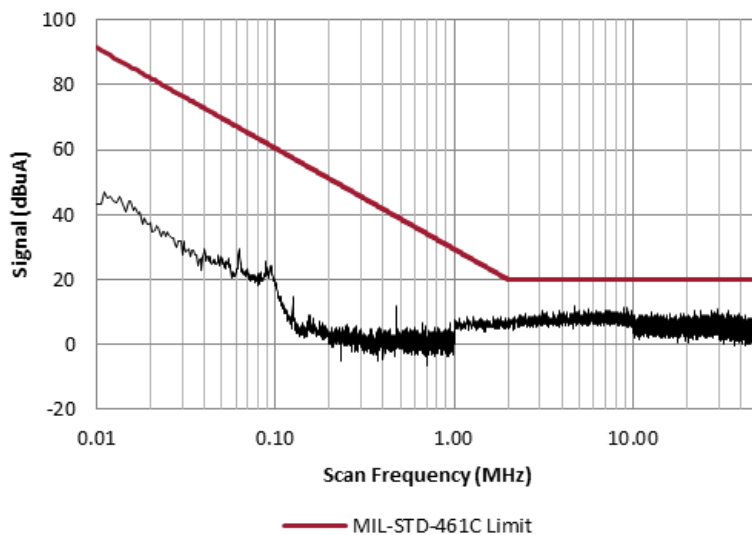
1. Time for output voltage to settle within 1% of steady-state value.
2. Verified by initial electrical design verification. Post design verification, parameter shall be guaranteed to the limits specified.
3. Derate linearly to 0 at 95°C.
4. Post-RAD limits are within standard limits except where noted.

4.0 PERFORMANCE CURVES, EXAMPLE FLX15-28VSC-002

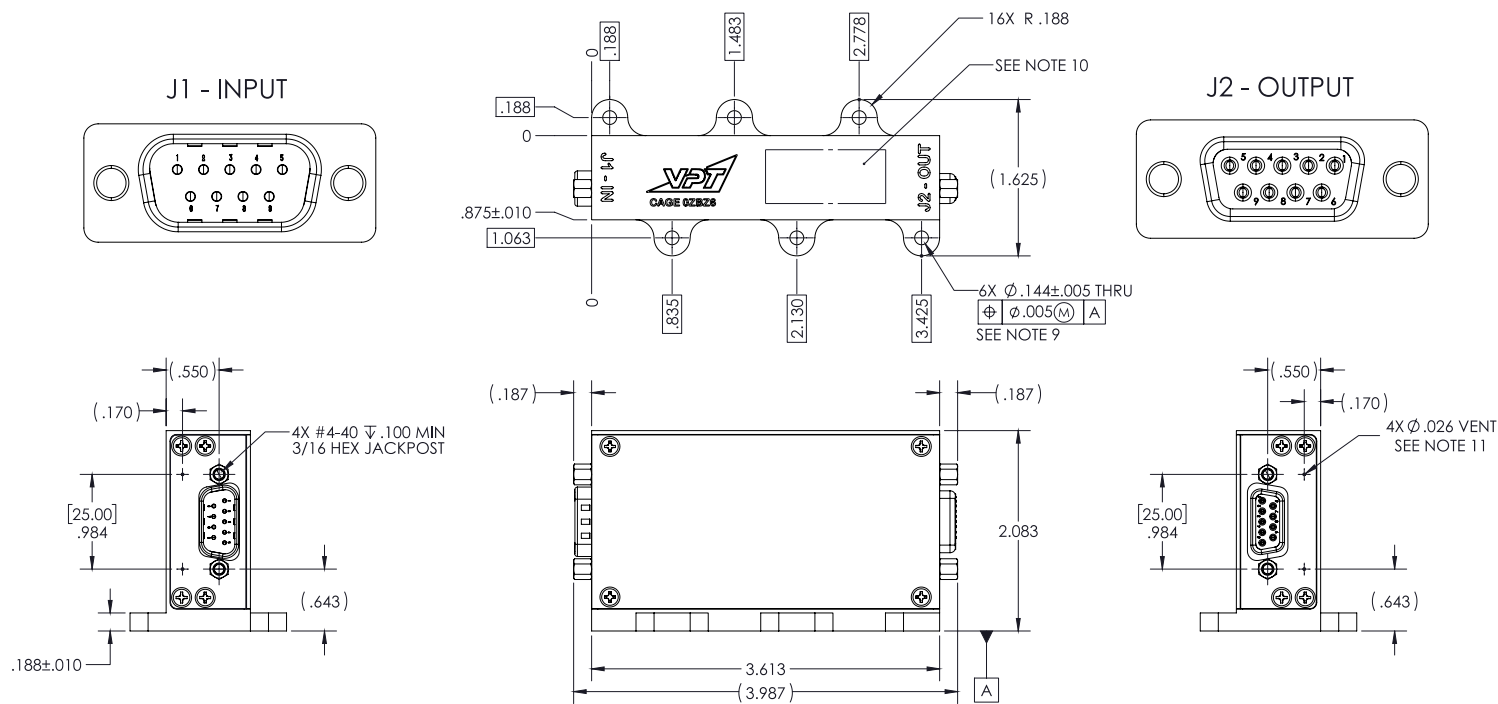
4.1 Efficiency, $V_o = 5\text{ V}$ (Typical, 25°C)



4.2 Conducted Emissions on $V_{in} = 28\text{V}$, $V_o = 5\text{ V}$ (Typical, 25°C)



5.0 MECHANICAL OUTLINE AND PINOUT, EXAMPLE FLX15-28VSC-002



1. Example package configuration shown above.
2. Interpret per ASME Y14.5.
3. Dimensions are in inches, bracketed dimensions are in mm.
4. Tolerances are $\pm .005$ " unless otherwise specified.
5. Material: aluminum 6061-T6 IAW SAE AMS4027 or ASTM B209.
6. Finish: electroless nickel, 100-300 μ in thick, per ASTM B733, type V, class 4.
7. Surface finish: RA32.
8. Connectors:
 - a. J1 – 9-pin standard density d-sub, male
 - b. J2 – 9-pin standard density d-sub, female
9. Use #6 mounting hardware.
10. Area reserved for serialization, part number, and date code marking.
11. (2x) vent holes on each side, (4x) total, do not obstruct.
12. Temperature is specified at the baseplate (mounting surface shown above).

J1		J2	
Pin	Function	Pin	Function
1	VIN	1	VOU
2	INCOM	2	VOU
3	NO CONNECT	3	NO CONNECT
4	INHIBIT	4	OUTCOM
5	CASE (CHASSIS)	5	OUTCOM
6	NO CONNECT	6	NO CONNECT
7	NO CONNECT	7	NO CONNECT
8	NO CONNECT	8	NO CONNECT
9	NO CONNECT	9	NO CONNECT

6.0 TECHNICAL NOTES, EXAMPLE FLX15-28VSC-002

Please note that many of these functions are also demonstrated in detail on the VPT website in the form of technical video labs.

6.1 GENERAL INFORMATION, EXAMPLE FLX15-28VSC-002

6.1.1 Topology Description

The FLX15-28VSC-002 integrates an EMI filter, and a 15 W DC-DC converter. The DC-DC converter is an isolated single-output flyback converter. It operates over a wide input voltage range and provides a regulated positive output voltage with respect to the OUTCOM pin. Feedback isolation is accomplished using VPT's proprietary magnetic feedback technology.

6.1.2 External Components

The FLX15-28VSC-002 is designed to operate stand-alone in most applications. It does not require any external components for proper operation or to meet the datasheet specifications. Input and output passive filters are provided internally for low ripple and noise. To further reduce output ripple and noise, a small ceramic capacitor, 1 μ F to 10 μ F, can be added at the output. Most application specific ripple requirements can be met with the addition of output capacitors alone. External output capacitance can be added up to the maximum listed in Section 3.2. For applications requiring additional capacitance please contact VPT for assistance.

6.1.3 Output Configurations

Since the converter is isolated, the output can be configured as a positive or negative voltage. For example, the FLX15-28VSC-002 can provide +5 V DC referenced to OUTCOM or -5 V referenced to VOUT.

The outputs of multiple units can be stacked in series to provide higher voltages. When the outputs of multiple units are stacked, they naturally share the load. For example, two FLX15-28VSC-002 units can be stacked to provide a 10 V output at 30 W.

6.2 FUNCTION DESCRIPTIONS, EXAMPLE FLX15-28VSC-002

6.2.1 On/Off Control (INHIBIT)

The INHIBIT pin is a primary-side control pin referenced to INCOM. The INHIBIT pin must be driven by using a switch, relay, open collector, or open drain configuration. Pulling the INH pin low disables the output, removes bias voltage from internal control circuitry, and puts the unit in a state of minimum input current draw. Leaving INH open enables the output, allowing the unit to operate normally. The pin must be pulled below 1.5 V to disable the output. An optional capacitor from INH to INCOM may be used to delay turn-on. The INH pin should be left open if not used.

6.3 PROTECTION FEATURES, EXAMPLE FLX15-28VSC-002

6.3.1 Input Undervoltage Lockout

The FLX15-28VSC-002 provides input undervoltage lockout protection. For input voltages below the turn-on voltage, the unit will remain off, drawing minimal current from the source. When the input voltage exceeds the turn-on voltage, the unit will start. The lockout circuit is designed to tolerate slow ramping input voltage waveforms.

6.3.2 Output Soft Start

The FLX15-28VSC-002 utilizes an output soft-start function to ramp the output in a controlled manner, eliminating output voltage overshoot and limiting inrush current at turn on. A closed-loop soft-start ensures the output waveform remains consistent regardless of changes in the load current. The output rise time is approximately 8 ms. The soft-start function is active whether the module is turned on with an application of input voltage or from release of the inhibit pin. Under normal conditions, current drawn from the source during turn-on will not exceed the full-load input current. The turn-on delay time is specified from the application of input voltage (or release of the inhibit pin) until the output reaches 90% of its final value.

6.3.3 Output Overcurrent Protection

The FLX15-28VSC-002 provides output overcurrent and output short circuit protection. During a load fault condition, a constant output current control circuit reduces the operating duty cycle to limit the output current to approximately 145% of its rated value. The unit will continue to provide constant current into any overload or short circuit condition. This feature allows the unit to start into any capacitive load. Recovery is automatic and immediate upon removal of the fault condition. Sustained short circuit or overload operation can cause excessive power dissipation. Care should be taken to control the operating temperature of the unit in this condition.

6.4 THERMAL CONSIDERATIONS, EXAMPLE FLX15-28VSC-002

The FLX15-28VSC-002 is rated for full power operation at 85 °C. Operation above 85 °C is allowed at reduced power. Specifically, the output power should be derated linearly from full power at 85 °C to half power at 90 °C and to zero power at 95 °C. The operating temperature of the unit is specified on the baseplate (mounting surface) of the unit. The unit is designed to be conduction-cooled, with the baseplate mounted to a heat sink, chassis, heat pipe, or other thermal surface.

The DC-DC converter contains many semiconductor components. The maximum temperature rise from junction to the case is 24 °C at full load.

6.5 RADIATION HARDNESS ASSURANCE, EXAMPLE FLX15-28VSC-002

VPT takes a conservative approach to radiation testing to ensure product performance in a space environment. VPT's internal Space COTS Radiation Hardness Assurance (RHA) plan documents VPT's processes and procedures for assuring the performance of VPT Space COTS products under various environmental conditions in space including Total Ionizing Dose (TID) and Single-Event Effects (SEE). Additionally, the converter was characterized for Enhanced Low Dose Rate Sensitivity (ELDRS) by testing samples at 50 mrad(Si)/s to 30 krad(Si). Radiation tolerance is assured by a combination of both module-level characterization and sample HDR TID testing of sequestered lots of all sensitive semiconductor piece-parts used within the module.

6.5.1 Radiation Test and Performance Levels

Radiation Environment		Piece Part RLAT	Module-Level Characterization
Total Ionizing Dose (TID)	High Dose Rate (HDR)	30 krad(Si)	30 krad(Si)
	Low Dose Rate (LDR)	---	30 krad(Si)
Single-Event Effects (SEE)	Destructive (SEB, SEGR, SEL)	Not applicable	≥ 42 MeV/mg/cm ²
	Non-Destructive (SET, SEU, SEFI)	Not applicable	≥ 30 MeV/mg/cm ²

6.5.2 RHA Plan Summary

Test	RHA Plan for VSC Series Isolated DC-DC Converters
Total Ionizing Dose (TID):	Sensitive semiconductor components undergo RLAT to 40 krad(Si) per MIL-STD-883 Method 1019. Converters are characterized to 30 krad(Si).
Enhanced Low Dose Rate Sensitivity (ELDRS):	Converters were tested at 50 mrad(Si)/s up to 30 krad(Si).
Single Event Effects (SEE):	Converters are characterized to LET ≥ 42 MeV/mg/cm ² for catastrophic events (SEL, SEB, SEGR) and to LET ≥ 30 MeV/mg/cm ² for transients (SET) and functional interrupts (SEFI) under heavy ion exposure.
Radiation Lot Acceptance Testing (RLAT):	All production lots of sensitive semiconductor components undergo a sample test for TID at HDR.

7.0 ENVIRONMENTAL SCREENING, EXAMPLE FLX15-28VSC-002

Test	Test Method and/or Condition	Flight	/EM (Engineering Model) ²
Internal Visual	IPC-A-610, Class 3 J-STD-001 (Space Addendum)	•	•
Random Vibration	7.3 Grms XYZ Axis Duration: 60 seconds/axis (See Table Below)	•	
Powered Temperature Cycling, no load	Temp: -55 °C to 105 °C Cycles: 10 Dwell: 15 minutes Ramp: 5 °C/min (max) 48 hour dwell at 105 °C after cycling	•	
Final Electrical ¹	100% at -55 °C, 25 °C, and 85 °C	•	
	100% at 25 °C		•
External Visual	Internal Procedure	•	•

1. 100% R&R testing with all test data included in product shipment.
2. Engineering models utilize only the screening specified and are not considered compliant for flight use.

8.0 QUALIFICATION, EXAMPLE FLX15-28VSC-002

Test	Test Method and/or Condition
Random Vibration	14.71 Grms XYZ Axis Duration: 180 seconds/axis (See Table Below)
Shock	XYZ Axis 3 shocks per axis (2 in each direction) 1,750 g, 0.3 msec, half-sine
Thermal Vacuum	Temp: -35 °C to 85 °C Cycles: 10 Dwell: 30 minutes Ramp: 5 °C/min (max)
Final Electrical	-55 °C, 25 °C, and 85 °C

Vibration Environment

Frequency (Hz)	Screening ASD (G ² /Hz)	Qualification ASD (G ² /Hz)
20	0.010	0.040
50	0.040	0.160
800	0.040	0.160
2000	0.010	0.040

9.0 ORDERING INFORMATION, EXAMPLE FLX15-28VSC-002

FLX	15	-	28	VSC	-	002	/EM
1	2		3	4		5	6

(1) Product Series	(2) Output Power	(3) Nominal Input Voltage	(4) Internal Modules Series	(5) Series Number ¹	(6) Screening Code
FLX	15 15 Watts	28 28 Volts	VSC VSC modules	002	/EM

1. This series number is unique to your configuration and will be provided by VPT Inc. prior to your order placement.
2. 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(s) 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 VPT Inc. Sales Department for more information concerning additional environmental screening and testing, different input voltage, output voltage, power requirements, source inspection, and/or special element evaluation for space or other higher-quality applications.

10.0 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

All information contained in this datasheet is believed to be accurate; however, no responsibility is assumed for possible errors or omissions. The products or specifications contained herein are subject to change without notice.

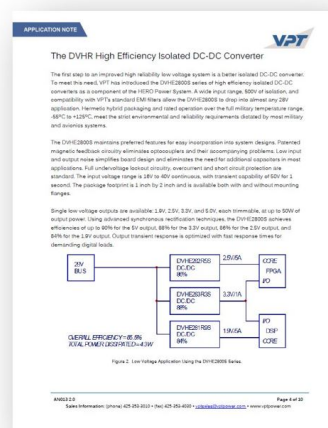
11.0 ADDITIONAL INFORMATION

Visit the VPT website for additional technical resources, including:

[Product Catalogs](#)



[Application Notes and White Papers](#)



[Technical Video Labs](#)



[Additional Products For Avionics/Military, Hi-Rel COTS, and Space Applications](#)

