



## VXR7-2800D SERIES

HIGH RELIABILITY COTS DC-DC CONVERTERS

### Models Available

Input: 9 V to 60 V continuous, 6 V to 100 V transient  
7 W, dual output of 3.3 V, 5 V, 12 V, 15 V  
-55 °C to 105 °C Operation



## 1.0 DESCRIPTION

The VXR series of isolated DC-DC converters is the latest and most advanced offering in VPT's extensive line of high reliability COTS products. Building on a proven design heritage, the VXR series features high efficiency, an ultra-wide input voltage range, and next-generation packaging. Providing a wide 9 V to 60 V input, along with VPT's standard full feature set and industry-leading performance, the VXR family is optimized for a broad range of applications from military ground vehicles to commercial and military aircraft.

The VXR7 utilizes a low noise, fixed frequency, wide input voltage range two stage topology with extended high and low input transient capability to simplify the overall power system design and compliance. Two switching post regulators achieve high efficiency over a wide input range, reducing power dissipation and minimizing external heatsink requirements. The two stage design provides fast transient response without the use of optoisolators. Two independent fully isolated outputs provide zero cross regulation and allow for multiple standard output voltage combinations.

The VXR Series patent-pending epoxy-encapsulated V-SHIELD® packaging is highly resistant to chemical, solvent and salt environments and is fully compatible with high volume manufacturing processes including wave solder, cleaning solvents, high pressure sprays and aqueous wash processes. A unique integral six-sided metalized shield improves system EMI compatibility. Dual sided conduction cooling coupled with reduced power dissipation simplifies system thermal design.

The VXR series is intended for harsh environments including severe vibration, shock and temperature cycling. Testing is to JESD22, MIL-STD-810, and MIL-STD-883.

## 1.1 FEATURES

- Wide input voltage range: 9 V to 60 V
- 6 V to 80 V transient for 1 second, 100 V for 200 milliseconds
- High Efficiency up to 79%
- Rugged Epoxy Encapsulated V-SHIELD® Package
- Fully compatible with aqueous cleaning processes
- Integral Six-sided Metalized EMI shield
- Dual-Sided Thermal Conduction
- 2000 V Isolation
- Fixed frequency
- Low noise
- Multiple standard output voltage combinations
- Short Circuit Protection
- Two independent fully isolated outputs
- Zero cross regulation

## 1.2 COMPLIANCE

- MIL-STD-1275 A-E
- RTCA / DO-160-Section 16
- MIL-STD-704 A-F
- MIL-STD-461 C-F when used with an appropriate VXR EMI filter
- RTCA / DO-160-section 18 and 21 when used with an appropriate VXR EMI filter

## 1.3 PACKAGING

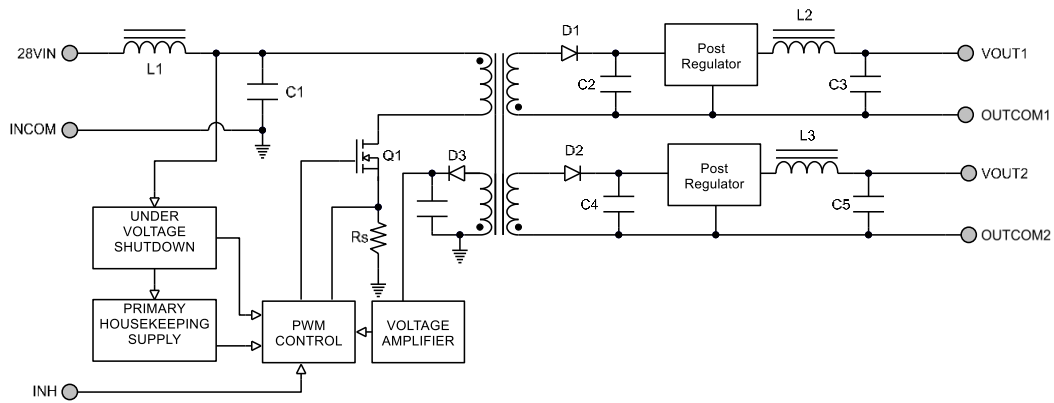
- Low-profile: 1.100" x 1.100" x 0.350"
- Max weight: 21 g

## 1.4 SIMILAR PRODUCTS AND ACCESSORIES

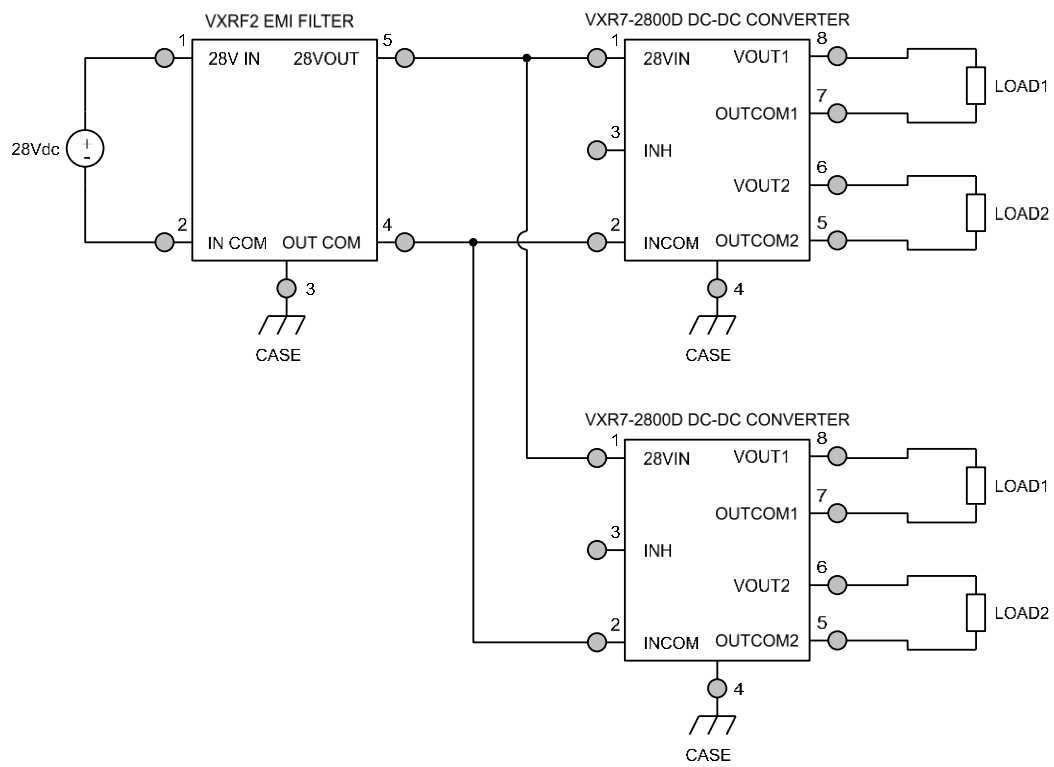
- [DVSA](#) 5 W dual output Military Qualified DC-DC Converter
- [VPT5](#) 5 W dual output metal package COTS DC-DC Converter
- [VHR5](#) 5 W dual output metal package COTS DC-DC Converter
- [EMI filters, Thermal Pads, Front-End Modules and Accessories](#)

2.0 DESCRIPTION

2.1 BLOCK DIAGRAM



2.2 CONNECTION DIAGRAM



### 3.0 SPECIFICATIONS

#### 3.1 ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings			
Input Voltage (Continuous):	60 V	Operating Temperature (Full Load):	-55 °C to + 105 °C
Input Voltage (Transient, 200 ms):	100 V	Storage Temperature:	-55 °C to + 125 °C
		Lead Solder Temperature (10 seconds):	300 °C

#### 3.2 PERFORMANCE SPECIFICATIONS

Tcase = -55 °C to +105 °C, Vin = +28 V ± 5%, Full Load, Vout Conditions/Specifications for either VOUT1 or VOUT2, Unless Otherwise Specified

Parameter	Conditions	VXR7-283R33R3D			VXR7-280505D			Units
		Min	Typ	Max	Min	Typ	Max	
<b>INPUT</b>								
Voltage	Continuous	9	28	60	9	28	60	V
	Transient, 200 ms <sup>3</sup>	6	-	100	6	-	100	V
	Transient, 1 sec <sup>3</sup>	6	-	80	6	-	80	V
Current	INH < 1.5 V	-	1	5	-	1	5	mA
	No Load	-	25	40	-	25	40	mA
Ripple Current	20 Hz to 10 MHz	-	20	40	-	20	40	mApp
Undervoltage Lockout	Turn-On	-	-	8.9	-	-	8.9	V
	Turn-Off <sup>3</sup>	-	-	5.9	-	-	5.9	V
<b>OUTPUT STATIC</b>								
Voltage <sup>4</sup>	Tcase = 25 °C	3.25	3.3	3.35	4.92	5	5.08	V
	Tcase = -55 °C to +105 °C	3.22	3.3	3.38	4.87	5	5.13	V
Total Power <sup>2</sup>		0	-	7	0	-	7	W
Power <sup>2,4</sup>		0	-	4.9	0	-	4.9	W
Current <sup>2,4</sup>		0	-	1.48	0	-	0.98	A
Ripple Voltage <sup>4</sup>	20 Hz to 10 MHz	-	15	30	-	15	30	mVpp
Line Regulation <sup>4</sup>	VIN = 9 V to 60 V	-	1	10	-	1	10	mV
Load Regulation <sup>4</sup>	No Load to Full Load	-	1	10	-	1	10	mV
Load Fault Power Dissipation <sup>4,5</sup>	Short Circuit <sup>3</sup>	-	1	3	-	1	3	W
<b>OUTPUT DYNAMIC</b>								
Load Step <sup>4</sup> , Half to Full Load	Output Transient	-	45	70	-	40	70	mVpk
	Recovery <sup>1</sup>	-	20	60	-	-	50	µs
Line Step <sup>3,4</sup> , Vin = 16 V to 40 V	Output Transient	-	10	33	-	10	50	mVpk
	Recovery <sup>1</sup>	-	-	40	-	-	40	µs
Turn-On, Vin = 0 to 28 V	Delay	-	9	12	-	9	12	ms
	Overshoot	-	0	15	-	0	25	mVpk
<b>FUNCTION</b>								
INH Pin Input <sup>3</sup>	Output Inhibited	0	-	1.5	0	-	1.5	V
INH Pin Open Circuit Voltage <sup>3</sup>	Output Enabled	-	8	12	-	8	12	V
<b>GENERAL</b>								
Efficiency		72	77	-	72	79	-	%
Capacitive Load <sup>3,4</sup>		-	-	1000	-	-	1000	µF
Switching Frequency	Input	450	500	550	450	500	550	kHz
	Output	600	650	700	600	650	700	kHz
Isolation Input / Output / Case	2000 V DC, Tcase = 25 °C	100	-	-	100	-	-	MΩ
Isolation Output / Output	500 V DC, Tcase = 25 °C	100	-	-	100	-	-	MΩ
Weight		-	-	21	-	-	21	g
MTBF (MIL-HDBK-217F)	GM @ Tcase = 55 °C	-	1.1	-	-	1.1	-	MHr

1. Time for output voltage to settle within 1% of steady-state value

2. Derate linearly to 0 at 115 °C

3. Verified by qualification testing

4. Each output

5. Other output at no load

### 3.2 PERFORMANCE SPECIFICATIONS (CONTINUED)

T<sub>case</sub> = -55 °C to +105 °C, V<sub>in</sub> = +28 V ± 5%, Full Load, V<sub>out</sub> Conditions/Specifications for either V<sub>OUT1</sub> or V<sub>OUT2</sub>, Unless Otherwise Specified

Parameter	Conditions	VXR7-281212D			VXR7-281515D			Units
		Min	Typ	Max	Min	Typ	Max	
<b>INPUT</b>								
Voltage	Continuous	9	28	60	9	28	60	V
	Transient, 200 ms <sup>3</sup>	6	-	100	6	-	100	V
	Transient, 1 sec <sup>3</sup>	6	-	80	6	-	80	V
Current	INH < 1.5 V	-	1	5	-	1	5	mA
	No Load	-	50	65	-	45	60	mA
Ripple Current	20 Hz to 10 MHz	-	20	40	-	20	40	mApp
Undervoltage Lockout	Turn-On	-	-	8.9	-	-	8.9	V
	Turn-Off <sup>3</sup>	-	-	5.9	-	-	5.9	V
<b>OUTPUT STATIC</b>								
Voltage <sup>4</sup>	T <sub>case</sub> = 25 °C	11.82	12	12.18	14.77	15	15.23	V
	T <sub>case</sub> = -55 °C to +105 °C	11.7	12	12.3	14.62	15	15.38	V
Total Power <sup>2</sup>		0	-	7	0	-	7	W
Power <sup>2,4</sup>		0	-	4.9	0	-	4.9	W
Current <sup>2,4</sup>		0	-	0.4	0	-	0.33	A
Ripple Voltage <sup>4</sup>	20 Hz to 10 MHz	-	20	40	-	20	40	mVpp
Line Regulation <sup>4</sup>	V <sub>IN</sub> = 9 V to 60 V	-	1	10	-	1	10	mV
Load Regulation <sup>4</sup>	No Load to Full Load	-	1	10	-	1	10	mV
Load Fault Power Dissipation <sup>4,5</sup>	Short Circuit <sup>3</sup>	-	1	3	-	1	3	W
<b>OUTPUT DYNAMIC</b>								
Load Step <sup>4</sup> , Half to Full Load	Output Transient	-	30	60	-	30	60	mVpk
	Recovery <sup>1</sup>	-	-	80	-	-	80	μs
Line Step <sup>3,4</sup> , V <sub>in</sub> = 16 V to 40 V	Output Transient	-	40	80	-	40	80	mVpk
	Recovery <sup>1</sup>	-	-	80	-	-	80	μs
Turn-On, V <sub>in</sub> = 0 to 28 V	Delay	-	9	12	-	9	12	ms
	Overshoot	-	0	50	-	0	50	mVpk
<b>FUNCTION</b>								
INH Pin Input <sup>3</sup>	Output Inhibited	0	-	1.5	0	-	1.5	V
INH Pin Open Circuit Voltage <sup>3</sup>	Output Enabled	-	8	12	-	8	12	V
<b>GENERAL</b>								
Efficiency		69	76	-	70	77	-	%
Capacitive Load <sup>3,4</sup>		-	-	200	-	-	200	μF
Switching Frequency	Input	450	500	550	450	500	550	kHz
	Output	600	650	700	600	650	700	kHz
Isolation Input / Output / Case	2000 V DC, T <sub>case</sub> = 25 °C	100	-	-	100	-	-	MΩ
Isolation Output / Output	500 V DC, T <sub>case</sub> = 25 °C	100	-	-	100	-	-	MΩ
Weight		-	-	21	-	-	21	g
MTBF (MIL-HDBK-217F)	GM @ T <sub>case</sub> = 55 °C	-	1.1	-	-	1.1	-	MHr

1. Time for output voltage to settle within 1% of steady-state value

2. Derate linearly to 0 at 115 °C

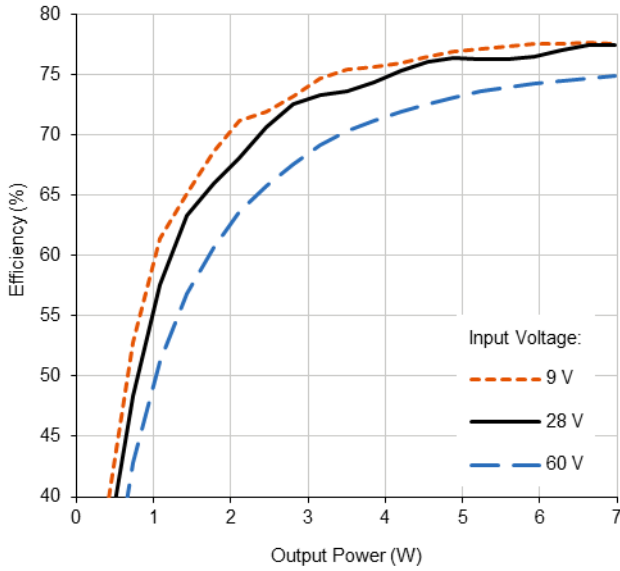
3. Verified by qualification testing

4. Each output

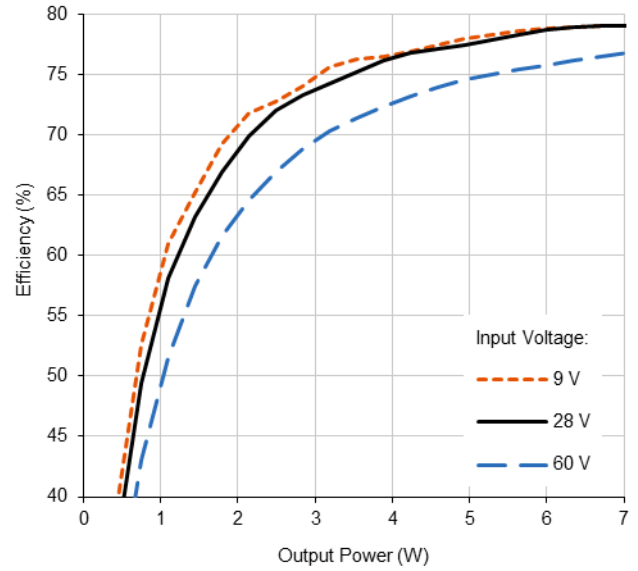
5. Other output at no load

4.0 PERFORMANCE CURVES

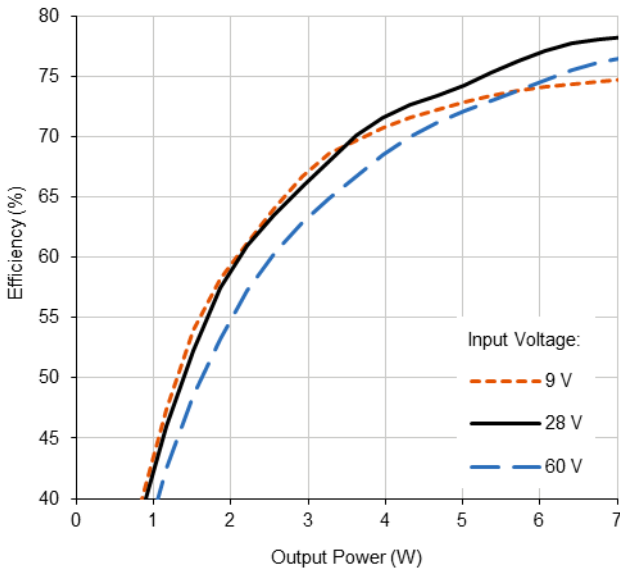
4.1.1 VXR7-283R33R3D Efficiency (Typical, 25 °C)



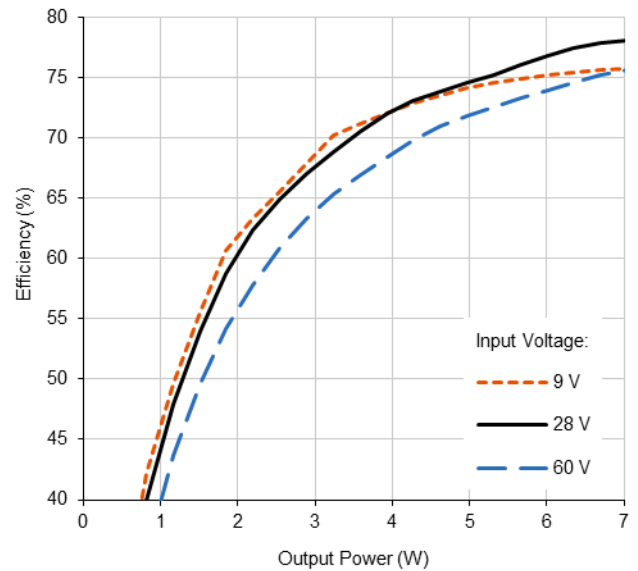
4.1.2 VXR7-280505D Efficiency (Typical, 25 °C)



4.1.3 VXR7-281212D Efficiency (Typical, 25 °C)

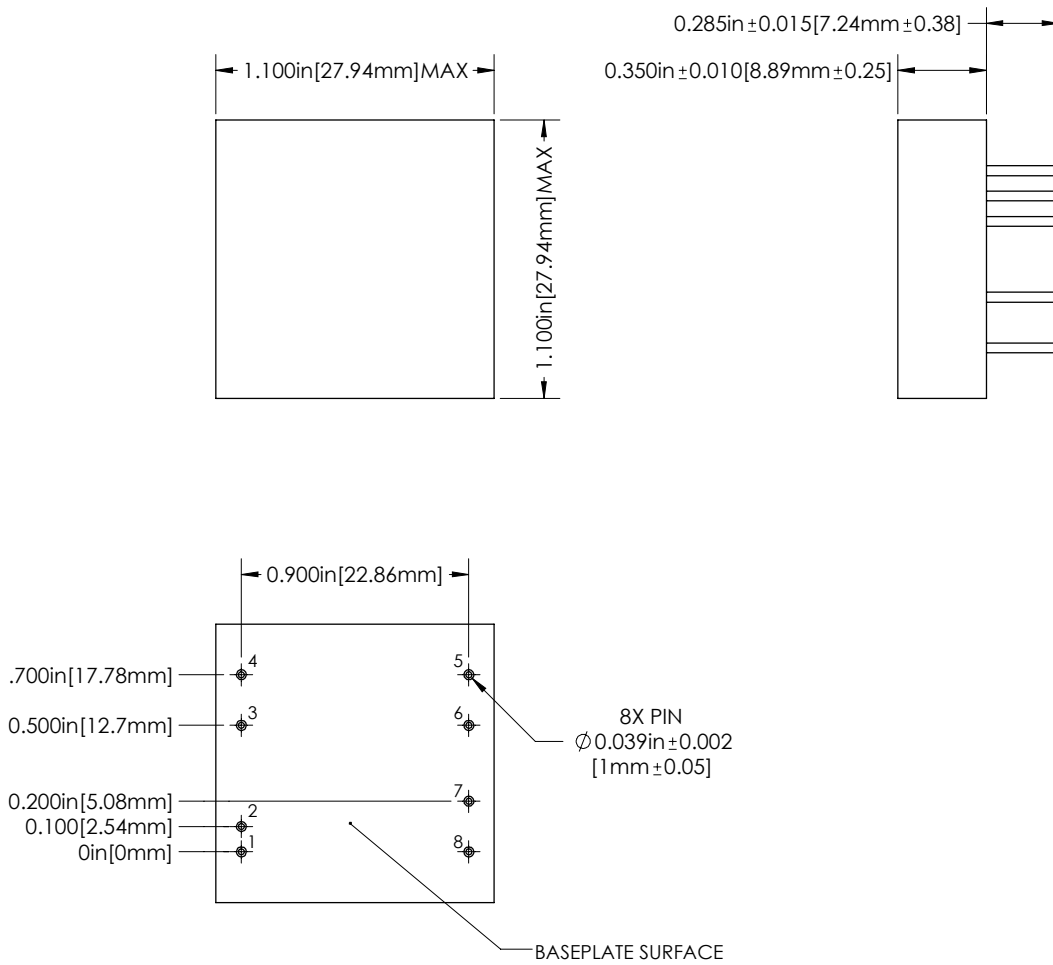


4.1.4 VXR7-281515D Efficiency (Typical, 25 °C)



5.0 MECHANICAL OUTLINES AND PINOUT

Standard Package:



1. Tolerances are ±0.005" unless otherwise stated
2. Case temperature is measured on the center of the baseplate surface
3. Materials: Body (Epoxy with integral metalized EMI shield); Pin (Tellurim Copper, alloy 145, gold over nickel plating)

Pin	Function	Pin	Function
1	28VIN	5	OUTCOM2
2	INCOM	6	VOUT2
3	INH	7	OUTCOM1
4	CASE	8	VOUT1

6.0 TECHNICAL NOTES



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

6.1.1 Topology Description

The VXR7-2800D Series is an isolated dual-output DC-DC converter. Providing two separately controlled isolated outputs either of which can be configured as positive or negative, the fixed frequency primary regulated flyback followed by a synchronous rectified buck converter provides high efficiency over a wide input voltage range. The two stage topology provides tightly regulated output voltages with fast transient response while eliminating analog feedback isolation. Implementing two independently controlled outputs eliminates any cross regulation error caused by unbalanced load conditions.

6.1.2 External Components

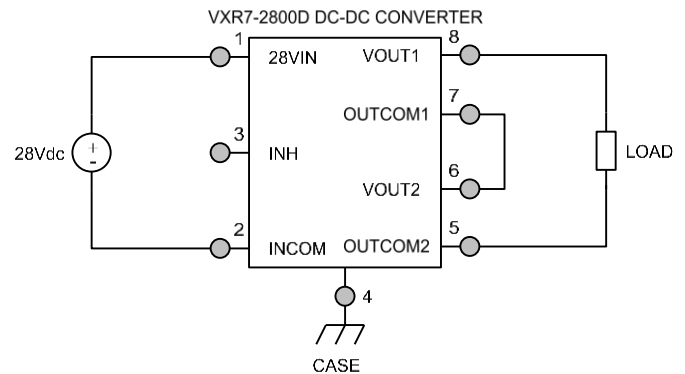
The VXR7-2800D Series is designed to operate stand-alone and does not require external components for proper operation in meeting the datasheet specifications. Input and output L-C filters are provided internally for low ripple and noise. To further reduce output ripple and noise for more sensitive applications, a small ceramic capacitor, 1  $\mu$ F to 10  $\mu$ F, can be added to 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.

6.1.3 Source Impedance

The impedance of the 28 V input source can interact with the DC-DC converter and may affect performance. High source impedance is often caused by a long input cable or components added in series with the input. Source resistance will cause a DC voltage drop as the converter draws DC input current. This voltage drop is determined by multiplying the cable resistance by the input current at low line. The voltage drop and the actual voltage at the input to the converter will determine the minimum source voltage at which the converter will operate. A high source inductance can interact with the feedback control loop of the converter. VPT's EMI filters will typically isolate the source and eliminate this problem. In some cases, additional input capacitance may be needed to stabilize the system.

6.1.4 Output Configurations

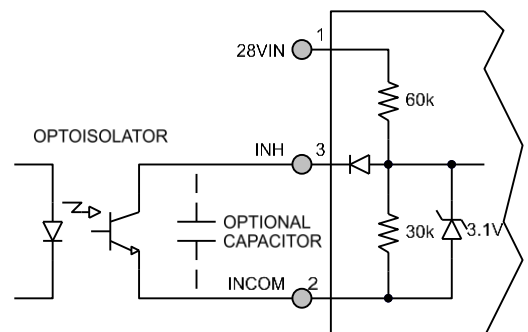
As each output of the converter is isolated both from the input and from each other, either output can be configured as a positive or negative voltage. The two outputs can also be stacked to create a single high voltage output. For example the VXR7-281212D model can output +12V from VOUT1 to OUTCOM1 and -12V from OUTCOM2 to VOUT2. Connecting OUTCOM1 to VOUT2 will provide +24V from VOUT1 to OUTCOM2. The mutually isolated outputs also allow for multiple standard output voltage combinations as shown in Section 8.0. For example, VXR7-283R312D provides VOUT1 at 3.3 V and VOUT2 at 12 V.



6.2 FUNCTION DESCRIPTIONS

6.2.1 On/Off Control (Inhibit)

The INH (Inhibit) pin is a primary-side control pin referenced to INCOM. The INH pin must be driven using an open collector or open drain configuration. Pulling the INH pin low disables the converter output, removes bias voltage from internal control circuitry and puts the converter in a state of minimum input current draw. Leaving INH open enables the output, allowing the converter 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

### 6.3.1 Input Undervoltage Lockout

The VXR7-2800D Series provides input undervoltage lockout protection. For input voltages below the turn-on voltage, the converter will remain off, drawing minimal current from the source. When the input voltage exceeds the turn-on voltage, the converter will start. The lockout circuit is designed to accept slow ramping input voltage waveforms.

### 6.3.2 Output Soft Start

The VXR7-2800D Series 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 voltage-mode soft-start ensures the output waveform remains consistent regardless of changes in the load current. The output rise time is approximately 6 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 Short Circuit Protection

The VXR7-2800D Series provides output short circuit protection independently to either output. During a short circuit condition, the shorted output will turn on and off to allow for low power dissipation during a short circuit condition. The non-shorter output will continue normal operation during this time. During a short circuit on either output,  $V_o$  on the shorted output will drop and turn off the switching for approximately 40 ms. After the 40 ms timeout the unit will turn back on and the output will slowly ramp up the output voltage. If the short circuit is still present at that time, the switching will turn off again and repeat the cycle. If the load has returned to normal, the shorted output voltage will soft start back to normal regulation automatically.

## 6.4 PACKAGE

### 6.4.1 Package Description

The VXR7-2800D is constructed with an epoxy encapsulated V-SHIELD® package that includes integral metallization for enhanced EMI shielding. The ruggedized package is highly resistant to chemical, solvent and salt environments and is fully compatible with high volume manufacturing processes including wave solder, cleaning solvents, high pressure sprays and aqueous wash processes. The encapsulated converter allows for superior shock and vibration performance in a low-weight package.

### 6.4.2 Thermal Performance

The VXR7-2800D Series is rated for full power operation up to 105 °C. Operation above 105 °C is allowed at reduced power. Specifically, the output power should be derated linearly from full power at 105 °C to half power at 110 °C and to zero power at 115 °C. The operating temperature of the converter is specified on the baseplate or top plate of the converter. The converter is designed to be conduction-cooled, with either the baseplate or top plate mounted to a heat sink, chassis, PCB or other thermal surface.

The DC-DC converter contains many semiconductor components. The maximum temperature rise from junction to case is 10 °C at full load.





## 7.0 ENVIRONMENTAL SCREENING

Test	Condition
Internal Visual	IPC-A-610, Class 3
Stabilization Bake	MIL-STD-883, Method 1008, Condition B, 125 °C, 24 hours
Temperature Cycling	MIL-STD-883, Method 1010, Condition B, -55 °C to +125 °C, 10 Cycles
Burn In	96 hours at +105 °C
Final Electrical	100% at 25 °C
External Visual	Internal Procedure

## 8.0 ORDERING INFORMATION

This commercially available product series was specifically designed to accommodate factory configurable output voltage combinations in addition to those defined per the product ordering information table. Please note that in a mixed output voltage configuration, the lowest output must be located in Output Voltage 1.

VXR7-	28	05	05	D
1	2	3	4	5

(1) Product Series	(2) Nominal Input Voltage	(3) Output Voltage 1	(4) Output Voltage 2	(5) Number of Outputs
VXR7-	28 28 Volts	3R3 3.3 Volts	3R3 3.3 Volts	D Dual
		05 05 Volts	05 05 Volts	
		12 12 Volts	12 12 Volts	
		15 15 Volts	15 15 Volts	

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 requirements, and source inspection.

## 9.0 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

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## 10.0 ADDITIONAL INFORMATION

Visit the [VPT website](http://www.vptpower.com) for additional technical resources, including:

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