

### HIGH RELIABILITY HYBRID DC-DC CONVERTERS

#### **DESCRIPTION**

The DVCH 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 DVCH series is a magnetic feedback circuit that is radiation immune. Operating at a nominal fixed frequency of 400 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 and certified to MIL-PRF-38534 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: 12 to 50 Volts per MIL-STD-704
- Up to 1.5 Watts Output Power
- Radiation Immune Magnetic Feedback Circuit
- NO Use of Optoisolators
- Undervoltage Lockout
- Indefinite Short Circuit Protection
- Current Limit Protection
- Industry Standard Pinout
- High Input Transient Voltage: 80 Volts for 1 sec per MIL-STD-704A
- Precision Projection Welded Hermetic Package
- High Power Density: > 7 W/in<sup>3</sup>
- Custom Versions Available
- Additional Environmental Screening Available
- Meets MIL-STD-461C and MIL-STD-461E EMC Requirements When Used With a DVMSA28 EMI Filter
- MIL-PRF-38534 Element Evaluated Components



Figure 1 – DVCH2800S 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 +5°C Input Voltage (Transient, 1 second) 80 Volts Storage Temperature -65°C to +150°C Output Power<sup>1</sup> 1.5 Watts Lead Solder Temperature (10 seconds) 270°C Power Dissipation (Full Load,  $T_{CASE} = +125^{\circ}C$ ) 0.6 Watts Weight (Maximum) 11 Grams

Parameter		Conditions	D'	VCH283R	3S	С	VCH2805	S	Units
Parameter		Conditions	Min	Тур	Max	Min	Тур	Max	Units
STATIC									
INPUT _		Continuous	12	28	50	12	28	50	V
Voltage <sup>4</sup>		Transient, 1 sec	-	-	80	-	-	80	V
Current		Inhibited	-	-	3.5	-	-	3.5	mA
Current		No Load	-	-	10	-	-	10	mA
Ripple Current		Full Load, 20Hz to 10MHz	-	-	30	-	-	30	mA <sub>p-p</sub>
Inhibit Pin Input⁴			0	-	1.5	0	-	1.5	V
Inhibit Pin Open Circuit Volt	tage <sup>4</sup>		8.0	9.0	11.0	8.0	9.0	11.0	V
UVLO Turn On			6.5	-	11.5	6.5	-	11.5	V
OUTPUT	$V_{OUT}$	T <sub>CASE</sub> = 25°C	3.267	3.30	3.333	4.95	5.00	5.05	V
Voltage	$V_{\text{OUT}}$	T <sub>CASE</sub> = -55°C to +125°C	3.17	3.30	3.43	4.80	5.00	5.20	V
Power <sup>3</sup>			0	-	1.0	0	-	1.5	W
Current <sup>3</sup>	I <sub>OUT</sub>		0	-	0.3	0	-	0.3	Α
Ripple Voltage	$V_{\text{OUT}}$	Full Load, 20Hz to 10MHz	-	-	50	-	-	50	$mV_{p-p}$
Line Regulation	V <sub>OUT</sub>	V <sub>IN</sub> = 12V to 50V	-	-	150	-	-	150	mV
Load Regulation	$V_{\text{OUT}}$	10% Load to Full Load	-	-	400	-	-	400	mV
Load Regulation	$V_{OUT}$	50% Load to Full Load	-	-	250	-	-	250	mV
EFFICIENCY			69	75	-	72	79	-	%
LOAD FAULT POWER DISSIPA	ATION	Overload <sup>4</sup>	-	-	3	-	-	3	W
LOAD FAULT POWER DISSIPA	ATION	Short Circuit	-	-	4	-	-	4	W
CAPACITIVE LOAD <sup>4</sup>			-	-	500	-	-	500	μF
SWITCHING FREQUENCY			325	400	475	325	400	475	kHz
ISOLATION		500 V <sub>DC</sub>	100	-	-	100	-	-	МΩ
MTBF (MIL-HDBK-217F)		AIF @ T <sub>C</sub> = 55°C	-	841	-	-	841	-	kHrs
DYNAMIC									
Load Step Output Transient⁵	$V_{\text{OUT}}$	Holf Lood to Full Lood	-	150	300	-	150	500	$mV_{PK}$
Load Step Recovery <sup>2</sup>		Half Load to Full Load	-	200	500	-	400	600	μSec
Line Step Output Transient <sup>4,5</sup>	$V_{\text{OUT}}$	\/ = 10\/ to F0\/	-	150	300	-	250	400	$mV_{PK}$
Line Step Recovery <sup>2, 4</sup>		V <sub>IN</sub> = 12V to 50V	-	200	500	-	400	600	μSec
Turn On Delay	V <sub>OUT</sub>	)/ 0)//- 00)/	-	15	20	-	15	20	mSec
Turn On Overshoot		$V_{IN} = 0V \text{ to } 28V$	-	0	15	-	0	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. regulation.
- 4. Verified by qualification testing.
- 5. Does not include changes due to static



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 +5°C Input Voltage (Transient, 1 second) 80 Volts Storage Temperature -65°C to +150°C Output Power<sup>1</sup> 1.5 Watts Lead Solder Temperature (10 seconds) 270°C Power Dissipation (Full Load,  $T_{CASE} = +125^{\circ}C$ ) 0.6 Watts Weight (Maximum) 11 Grams

Parameter		Conditions	DVCH2812S			DVCH2815S			Units
Parameter		Conditions	Min	Тур	Max	Min	Тур	Max	Units
STATIC									
INPUT _		Continuous	12	28	50	12	28	50	V
Voltage⁴		Transient, 1 sec	-	-	80	-	-	80	V
Current		Inhibited	-	-	3.5	-	-	3.5	mA
Current		No Load	-	-	10	-	-	10	mA
Ripple Current		Full Load, 20Hz to 10MHz	-	-	30	-	-	30	mA <sub>p-p</sub>
Inhibit Pin Input⁴			0	-	1.5	0	-	1.5	V
Inhibit Pin Open Circuit Vo	oltage <sup>4</sup>		8.0	9.0	11.0	8.0	9.0	11.0	V
UVLO Turn On			6.5	-	11.5	6.5	-	11.5	V
OUTPUT	$V_{\text{OUT}}$	T <sub>CASE</sub> = 25°C	11.88	12.0	12.12	14.85	15.0	15.15	V
Voltage	$V_{\text{OUT}}$	T <sub>CASE</sub> = -55°C to +125°C	11.52	12.0	12.48	14.40	15.0	15.60	V
Power <sup>3</sup>			0	-	1.5	0	-	1.5	W
Current <sup>3</sup>	I <sub>out</sub>		0	-	0.125	0	-	0.1	Α
Ripple Voltage	$V_{\text{OUT}}$	Full Load, 20Hz to 10MHz	-	-	50	-	-	50	$mV_{p-p}$
Line Regulation	$V_{\text{OUT}}$	V <sub>IN</sub> = 12V to 50V	-	-	60	-	-	60	mV
Load Regulation	$V_{\text{OUT}}$	10% Load to Full Load	-	-	700	-	-	700	mV
Load Regulation	$V_{\text{OUT}}$	50% Load to Full Load	-	-	250	-	-	250	mV
EFFICIENCY			76	81	-	77	81	-	%
LOAD FAULT POWER DISSI	DATION	Overload <sup>4</sup>	-	-	3	-	-	3	W
LOAD FAULT POWER DISSI	PATION	Short Circuit	-	-	4.5	-	-	4.5	W
CAPACITIVE LOAD <sup>4</sup>			-	-	200	-	-	200	μF
SWITCHING FREQUENCY			325	400	475	325	400	475	kHz
ISOLATION		500 V <sub>DC</sub>	100	-	-	100	-	-	ΜΩ
MTBF (MIL-HDBK-217F)		AIF @ T <sub>C</sub> = 55°C	-	841	-	-	841	-	kHrs
DYNAMIC									
Load Step Output Transient <sup>5</sup>	$V_{OUT}$	- Half Load to Full Load	-	100	300	-	100	300	$mV_{PK}$
Load Step Recovery <sup>2</sup>		TIAN LUAU IU FUN LUAU	-	50	400	-	50	400	μSec
Line Step Output Transient <sup>4,5</sup>	$V_{OUT}$	\/ - 40\/ to 50\/	-	150	400	-	150	400	$mV_{PK}$
Line Step Recovery <sup>2, 4</sup>		$V_{IN} = 12V \text{ to } 50V$	-	100	400	-	100	400	μSec
Turn On Delay	V <sub>OUT</sub>	\/ - 0\/ t= 00\/	-	10	20	-	10	20	mSec
Turn On Overshoot		$V_{IN} = 0V \text{ to } 28V$	-	0	50	-	0	50	$mV_{PK}$

Notes:

- 1. Dependant on output voltage.
- 3. Derate linearly to 0 at 135°C. regulation.
- 2. Time for output voltage to settle within 1% of its nominal value.
- 4. Verified by qualification testing. 5. Does not include changes due to static



 $SPECIFICATIONS \ (T_{CASE} = -55^{\circ}C \ to \ +125^{\circ}C, \ V_{IN} = +28V \pm 5\%, \ Full \ Load, \ Unless \ Otherwise \ Specified)$ 

ABSOLUTE MAXIMUM RATINGS			
Input Voltage (Continuous)	50 V <sub>DC</sub>	Junction Temperature Rise to Case	+5°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power <sup>1</sup>	1.5 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T <sub>CASE</sub> = +125°C)	0.6 Watts	Weight (Maximum)	11 Grams

Conditions  Continuous  Transient, 1 sec  Inhibited  Io Load  Tull Load, 20Hz to 10MHz	12 0 8.0	28	50 80 3.5 10 30	V V mA mA
ransient, 1 sec nhibited lo Load	- - - 0 8.0		80 3.5 10 30	V mA mA
ransient, 1 sec nhibited lo Load	- - - 0 8.0		80 3.5 10 30	V mA mA
nhibited Io Load	- 0 8.0	-	3.5 10 30	mA mA
lo Load	- 0 8.0	-	10	mA
	- 0 8.0	-	30	
full Load, 20Hz to 10MHz	0.8	-		A
	8.0	-		$mA_{p-p}$
			1.5	V
		9.0	11.0	V
	6.5	-	11.5	V
CASE = 25°C	5.15	5.20	5.25	V
<sub>CASE</sub> = -55°C to +125°C	5.00	5.20	5.40	V
	0	-	1.5	W
	0	-	0.288	Α
ull Load, 20Hz to 10MHz	-	-	50	$mV_{p-p}$
<sub>IN</sub> = 12V to 50V	-	-	150	mV
0% Load to Full Load	-	-	400	mV
0% Load to Full Load	-	-	250	mV
	72	79	-	%
Overload <sup>4</sup>	-	-	3	W
Short Circuit	-	-	4	W
	-	-	500	μF
	325	400	475	kHz
00 V <sub>DC</sub>	100	-	-	ΜΩ
IF @ T <sub>C</sub> = 55°C	-	841	-	kHrs
		•		
lelf Lead to Full Lead	-	150	300	$mV_{PK}$
iait load to full load	-	400	600	μSec
	-	250	400	mV <sub>PK</sub>
T <sub>IN</sub> = 12V to 50V	-	400	600	μSec
	-	15	20	mSec
' <sub>IN</sub> = 0V to 28V	_	0	25	mV <sub>PK</sub>
i c c c c c c c c c c c c c c c c c c c	CASE = -55°C to +125°C  Ull Load, 20Hz to 10MHz  N = 12V to 50V  O% Load to Full Load  O% Load to Full Load  verload <sup>4</sup> hort Circuit	CASE = -55°C to +125°C  0  0  0  0  0  0  0  0  0  0  0  0  0	CASE = -55°C to +125°C  0	CASE = -55°C to +125°C  0

Notes:

- Dependant on output voltage.
   Derate linearly to 0 at 135°C. regulation.
- Time for output voltage to settle within 1% of its nominal value.
   Verified by qualification testing.
   Does not include changes due to static



#### **BLOCK DIAGRAM**

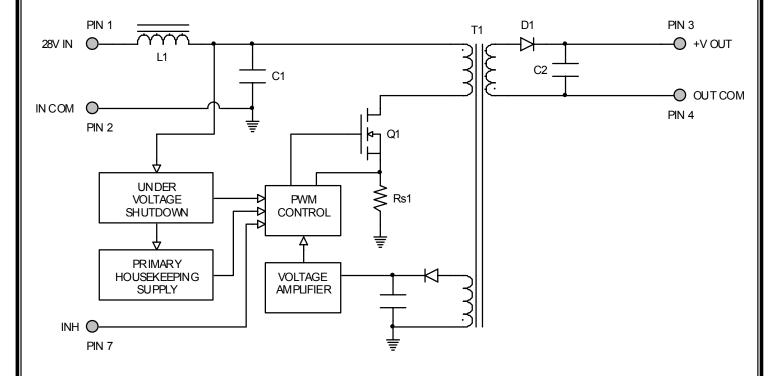


Figure 2

#### **CONNECTION DIAGRAM**

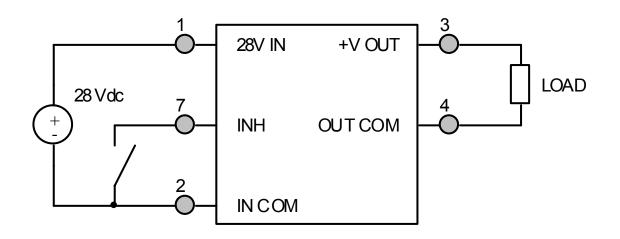
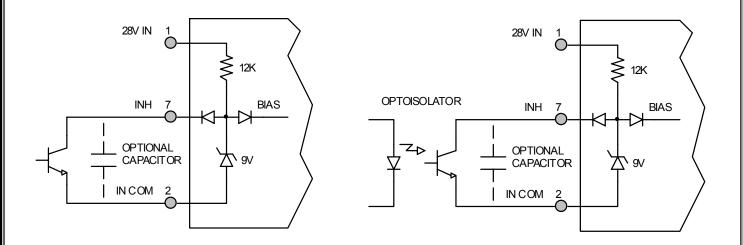


Figure 3



#### 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

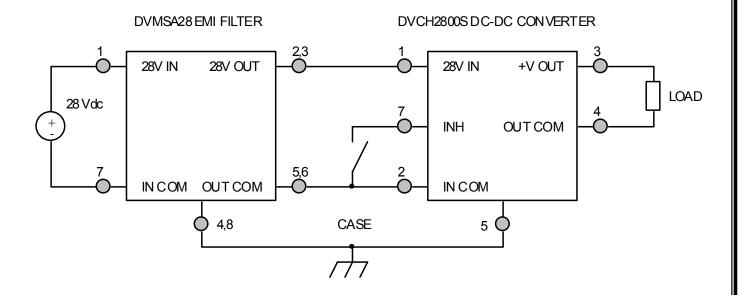


Figure 6 – Converter with EMI Filter



EFFICIENCY PERFORMANCE CURVES (T<sub>CASE</sub> = 25°C, Full Load, Unless Otherwise Specified)

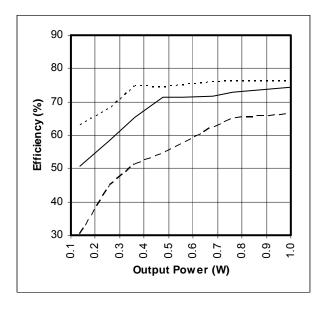


Figure 7 – DVCH283R3S Efficiency (%) vs. Output Power (W)

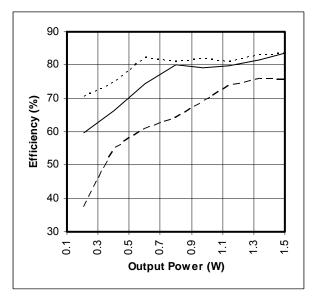


Figure 9 – DVCH2812S Efficiency (%) vs. Output Power (W)

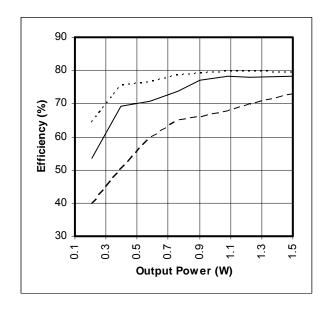


Figure 8 – DVCH2805S / DVCH285R2S Efficiency (%) vs. Output Power (W)

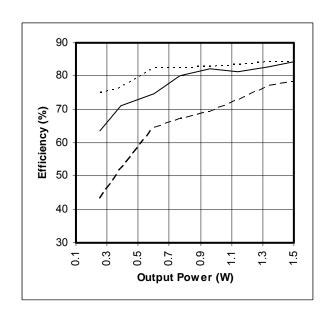
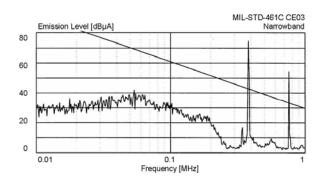


Figure 10 – DVCH2815S Efficiency (%) vs. Output Power (W)



#### **EMI PERFORMANCE CURVES**

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



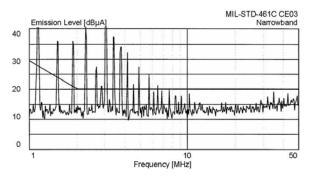


Figure 11 - DVCH2800S without EMI Filter

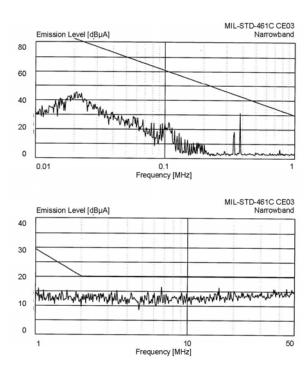
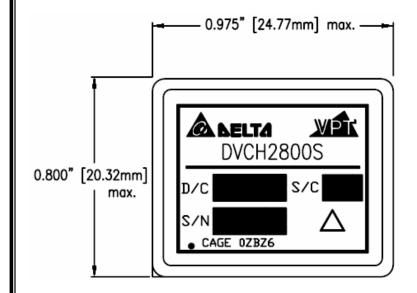
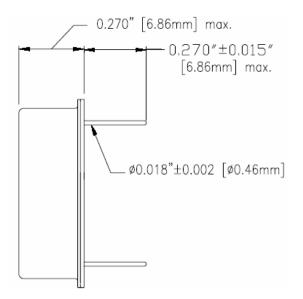


Figure 12 - DVCH2800S with EMI Filter



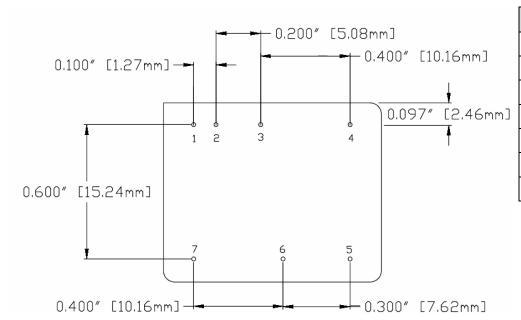
#### PACKAGE SPECIFICATIONS





#### **TOP VIEW**

SIDE VIEW



PIN	FUNCTION
1	28V IN
2	IN COM
3	+V OUT
4	OUT COM
5	CASE
6	N/C
7	INHIBIT

#### **BOTTOM VIEW**

Figure 13 – Package and Pinout (Dimensional Limits are ±0.005" Unless Otherwise Stated)



### PACKAGE PIN DESCRIPTION

Pin	Function	Description
1	28V IN	Positive Input Voltage Connection
2	IN COM	Input Common Connection
3	+V OUT	Positive Output Voltage Connection
4	OUT COM	Output Common Connection
5	CASE	Case Connection
6	N/C	No Connection
7	INHIBIT	Logic Low = Disabled Output. Connecting the inhibit pin to input common causes converter shutdown.  Logic High = Enabled Output. Unconnected or open collector TTL.



ENVIRONMENTAL SCREENING (100% Tested Per MIL-STD-883 as referenced to MIL-PRF-38534)

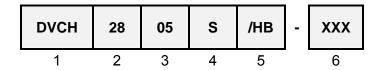
Screening	MIL-STD-883	Standard (No Suffix)	Extended /ES	HB /HB	Class H /H	Class K /K
Non- Destructive Bond Pull	Method 2023	•	•	•	•	•
Internal Visual	Method 2017, 2032 Internal Procedure	•	•	•	•	•
Temperature Cycling	Method 1010, Condition C Method 1010, -55°C to 125°C		•	•	•	•
Constant Acceleration	Method 2001, 3000g, Y1 Direction Method 2001, 500g, Y1 Direction		•	•	•	•
PIND	Method 2020, Condition A <sup>2</sup>					•
Pre Burn-In Electrical	100% at 25°C					•
Burn-In	Method 1015, 320 hours at +125°C Method 1015, 160 hours at +125°C 96 hours at +125°C 24 hours at +125°C	•	•	•	•	•
Final Electrical	MIL-PRF-38534, Group A <sup>1</sup> 100% at 25°C	•	•	•	•	•
Hermeticity	Method 1014, Fine Leak, Condition A Method 1014, Gross Leak, Condition C Dip (1 x 10 <sup>-3</sup> )	•	•	•	•	•
Radiography	Method 2012 <sup>3</sup>					•
External Visual	Method 2009	•	•	•	•	•

Notes:

- 100% R&R testing at  $-55^{\circ}$ C,  $+25^{\circ}$ C, and  $+125^{\circ}$ C with all test data included in product shipment. PIND test Certificate of Compliance included in product shipment. 1.
- 2.
- Radiographic test Certificate of Compliance and film(s) included in product shipment. 3.



#### ORDERING INFORMATION



(1) (2)

Product Series		al Input tage	Output	Voltage
DVCH	28	28 Volts	3R3 05 5R2 12 15	3.3 Volts 5 Volts 5.2 Volts 12 Volts 15 Volts

(4) (5)

Number of Outputs		Screenin	g Code <sup>1, 2</sup>	Additional Screening Code		
S	Single	None /ES /HB /H /K	Standard Extended HB Class H Class K	Contact Sales		

Notes:

- 1. Contact the VPT Inc. Sales Department for availability of Class H (/H) or Class K (/K) qualified products.
- 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.

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)	DVCH2800S Series Similar Part Number
*T.B.D.	DVCH283R3S/H
*T.B.D.	DVCH2805S/H
*T.B.D.	DVCH285R2S/H
*T.B.D.	DVCH2812S/H
*T.B.D.	DVCH2815S/H

Do not use the DVCH2800S Series similar part number for SMD product acquisition. It is listed for reference only. For exact specifications for the SMD product, refer to the SMD drawing. SMD's can be downloaded from the DSCC website at <a href="http://www.dscc.dla.mil/programs/smcr/">http://www.dscc.dla.mil/programs/smcr/</a>. The SMD number listed above is for MIL-PRF-38534 Class H screening, standard gold plated lead finish, and no RHA (Radiation Hardness Assurance) level. Please reference the SMD for other screening levels, lead finishes, and radiation levels.

#### **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

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.