



DVHF2800D Series

HIGH RELIABILITY HYBRID DC-DC CONVERTERS

DESCRIPTION

The DVHF series of high-reliability DC-DC converters provide decades of successful critical mission support. Operable over the full military (-55 °C to +125 °C) temperature range with no power derating, the DVHF series unique input, and output filters dramatically reduce input and output noise performance. While operating at a nominal fixed frequency of 450 kHz, these regulated, isolated units utilize a high-speed magnetic feedback design and well-controlled under-voltage 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: 15 to 50 Volts per MIL-STD-704
- Up to 20 Watts Output Power
- Fault Tolerant 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: > 37 W/in³
- Custom Versions Available
- Additional Environmental Screening Available
- Meets MIL-STD-461 Revisions C, D, E and F EMC Requirements When Used With VPT's EMI Filters
- Flanged and Non-flanged Versions Available.
- MIL-PRF-38534 Element Evaluated Components
- Space Applications should consider VPT's "S" Series of Radiation Tolerant Power Conversion Devices. Contact VPT for details.

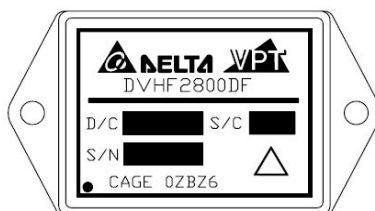


Figure 1 – DVHF2800D / DVHF2800DF DC-DC Converter
(Exact marking may differ from that shown)

SPECIFICATIONS (T_{CASE} = -55°C to +125°C, V_{IN} = +28V ± 5%, Full Load⁵, Unless Otherwise Specified)

ABSOLUTE MAXIMUM RATINGS

Input Voltage (Continuous)	50 V _{DC}	Junction Temperature Rise to Case	+12°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power ¹	20 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T _{CASE} = +125°C)	6 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(24 / 28) Grams
ESD Rating per MIL-PRF-38534	3A		

Parameter		Conditions	DVHF2805D			DVHF2807D			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	-	4	6	-	4	6	mA
		No Load	-	45	65	-	45	65	mA
Ripple Current		Full Load ⁵ , 20Hz to 10MHz	-	35	60	-	25	60	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 ⁵		+V _{OUT} T _{CASE} = 25°C	4.95	5.0	5.05	6.93	7	7.07	V
		+V _{OUT} T _{CASE} = -55°C to +125°C	4.925	5.0	5.075	6.895	7	7.105	V
		-V _{OUT} T _{CASE} = 25°C	4.80	5.0	5.20	6.72	7	7.28	V
		-V _{OUT} T _{CASE} = -55°C to +125°C	4.75	5.0	5.25	6.65	7	7.35	V
Power ^{3,6}		Total	0	-	15	0	-	15	W
		±V _{OUT} Either Output	0	-	10.5	0	-	10.5	W
Current ^{3,6}		±V _{OUT} Either Output	0	-	2.1	0	-	1.5	A
Ripple Voltage		±V _{OUT} Full Load ⁵ , 20Hz to 10MHz	-	35	60	-	25	60	mV _{p-p}
Line Regulation		+V _{OUT} V _{IN} = 16V to 40V	-	2	20	-	2	20	mV
		-V _{OUT} V _{IN} = 16V to 40V	-	20	200	-	25	200	mV
Load Regulation		+V _{OUT} No Load to Full Load ⁵	-	5	50	-	5	50	mV
		-V _{OUT} No Load to Full Load ^{5,7}	-	25	200	-	25	200	mV
Cross Regulation		-V _{OUT} +V _{OUT} = 70%, -V _{OUT} = 30% +V _{OUT} = 30%, -V _{OUT} = 70%	-	370	500	-	370	500	mV
EFFICIENCY		Full Load ⁵	73	78	-	73	78	-	%
LOAD FAULT POWER DISSIPATION		Overload ⁴	-	-	8	-	-	8	W
		Short Circuit	-	-	8	-	-	8	W
CAPACITIVE LOAD ⁴		Either Output	-	-	500	-	-	500	μF
SWITCHING FREQUENCY			350	450	500	350	450	500	kHz
ISOLATION		500 V _{DC} , T _{CASE} = 25°C	100	-	-	100	-	-	MΩ
MTBF (MIL-HDBK-217F) ⁸		AIF @ T _C = 55°C	-	712	-	-	712	-	kHrs

See notes next page.

SPECIFICATIONS (T_{CASE} = -55°C to +125°C, V_{IN} = +28V ± 5%, Full Load⁵, Unless Otherwise Specified)

ABSOLUTE MAXIMUM RATINGS

Input Voltage (Continuous)	50 V _{DC}	Junction Temperature Rise to Case	+12°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power ¹	20 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T _{CASE} = +125°C)	6 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(24 / 28) Grams
ESD Rating Per MIL-PRF-38534	3A		

Parameter		Conditions	DVHF2805D			DVHF2807D			Units
			Min	Typ	Max	Min	Typ	Max	
DYNAMIC									
Load Step Output Transient	±V _{OUT}	Half Load to Full Load	-	200	400	-	200	400	mV _{PK}
Load Step Recovery ²			-	300	500	-	300	500	μSec
Line Step Output Transient ⁴	±V _{OUT}	V _{IN} = 16V to 40V	-	400	800	-	450	800	mV _{PK}
Line Step Recovery ^{2, 4}			-	300	700	-	350	700	μSec
Turn On Delay	±V _{OUT}	V _{IN} = 0V to 28V	-	10	20	-	10	20	mSec
Turn On Overshoot			-	0	25	-	0	25	mV _{PK}

Notes:

1. Dependent 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 initial electrical design verification. Post design verification, parameter shall be guaranteed to the limits specified.
5. Half load at +V_{OUT} and half load at -V_{OUT}.
6. Up to 70% of the total power or current can be drawn from any one of the two outputs.
7. 5% Load to Full Load at -55°C.
8. Correction factor of 0.12 added to ceramic capacitors.

SPECIFICATIONS (T_{CASE} = -55°C to +125°C, V_{IN} = +28V ± 5%, Full Load⁵, Unless Otherwise Specified)

ABSOLUTE MAXIMUM RATINGS

Input Voltage (Continuous)	50 V _{DC}	Junction Temperature Rise to Case	+12°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power ¹	20 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T _{CASE} = +125°C)	6 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(24 / 28) Grams
ESD Rating per MIL-PRF-38534	3A		

Parameter	Conditions	DVHF2812D			DVHF2815D			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	-	4	6	-	4	6	mA
	No Load	-	45	65	-	50	65	mA
Ripple Current	Full Load ⁵ , 20Hz to 10MHz	-	45	90	-	40	90	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 ⁵	+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	11.82	12.0	12.18	14.775	15.0	15.225	V
	-V _{OUT} T _{CASE} = 25°C	11.80	12.0	12.20	14.80	15.0	15.20	V
	-V _{OUT} T _{CASE} = -55°C to +125°C	11.52	12.0	12.48	14.40	15.0	15.60	V
Power ^{3,6}	Total	0	-	20	-	-	20	W
	±V _{OUT} Either Output	0	-	14	-	-	14	W
Current ^{3,6}	±V _{OUT} Either Output	0	-	1.17	-	-	0.93	A
Ripple Voltage	±V _{OUT} Full Load ⁵ , 20Hz to 10MHz	-	30	50	-	30	60	mV _{p-p}
Line Regulation	+V _{OUT} V _{IN} = 16V to 40V	-	2	20	-	2	20	mV
	-V _{OUT} V _{IN} = 16V to 40V	-	20	200	-	40	200	mV
Load Regulation	+V _{OUT} No Load to Full Load ⁵	-	5	50	-	5	50	mV
	-V _{OUT} No Load to Full Load ^{5,7}	-	20	200	-	25	200	mV
Cross Regulation	-V _{OUT} +V _{OUT} = 70%, -V _{OUT} = 30% +V _{OUT} = 30%, -V _{OUT} = 70%	-	400	500	-	400	500	mV
EFFICIENCY	Full Load ⁵	78	84	-	79	85	-	%
LOAD FAULT POWER DISSIPATION	Overload ⁴	-	-	8	-	-	8	W
	Short Circuit	-	-	8	-	-	8	W
CAPACITIVE LOAD ⁴	Either Output	-	-	500	-	-	500	μF
SWITCHING FREQUENCY		350	450	500	350	450	500	kHz
ISOLATION	500 V _{DC} , T _{CASE} = 25°C	100	-	-	100	-	-	MΩ
MTBF (MIL-HDBK-217F) ⁸	AIF @ T _C = 55°C	-	712	-	-	712	-	kHrs

See notes next page.

SPECIFICATIONS (T_{CASE} = -55°C to +125°C, V_{IN} = +28V ± 5%, Full Load⁵, Unless Otherwise Specified)

ABSOLUTE MAXIMUM RATINGS

Input Voltage (Continuous)	50 V _{DC}	Junction Temperature Rise to Case	+12°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power ¹	20 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T _{CASE} = +125°C)	6 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(24 / 28) Grams
ESD Rating per MIL-PRF-38534	3A		

Parameter		Conditions	DVHF2812D			DVHF2815D			Units
			Min	Typ	Max	Min	Typ	Max	
DYNAMIC									
Load Step Output Transient	±V _{OUT}	Half Load to Full Load	-	220	400	-	200	400	mV _{PK}
Load Step Recovery ²			-	200	500	-	100	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	-	10	20	-	10	20	mSec
Turn On Overshoot			-	0	50	-	0	50	mV _{PK}

Notes:

1. Dependent 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 initial electrical design verification. Post design verification, parameter shall be guaranteed to the limits specified.
5. Half load at +V_{OUT} and half load at -V_{OUT}.
6. Up to 70% of the total power or current can be drawn from any one of the two outputs.
7. 5% Load to Full Load at -55°C.
8. Correction factor of 0.12 added to ceramic capacitors.

BLOCK DIAGRAM

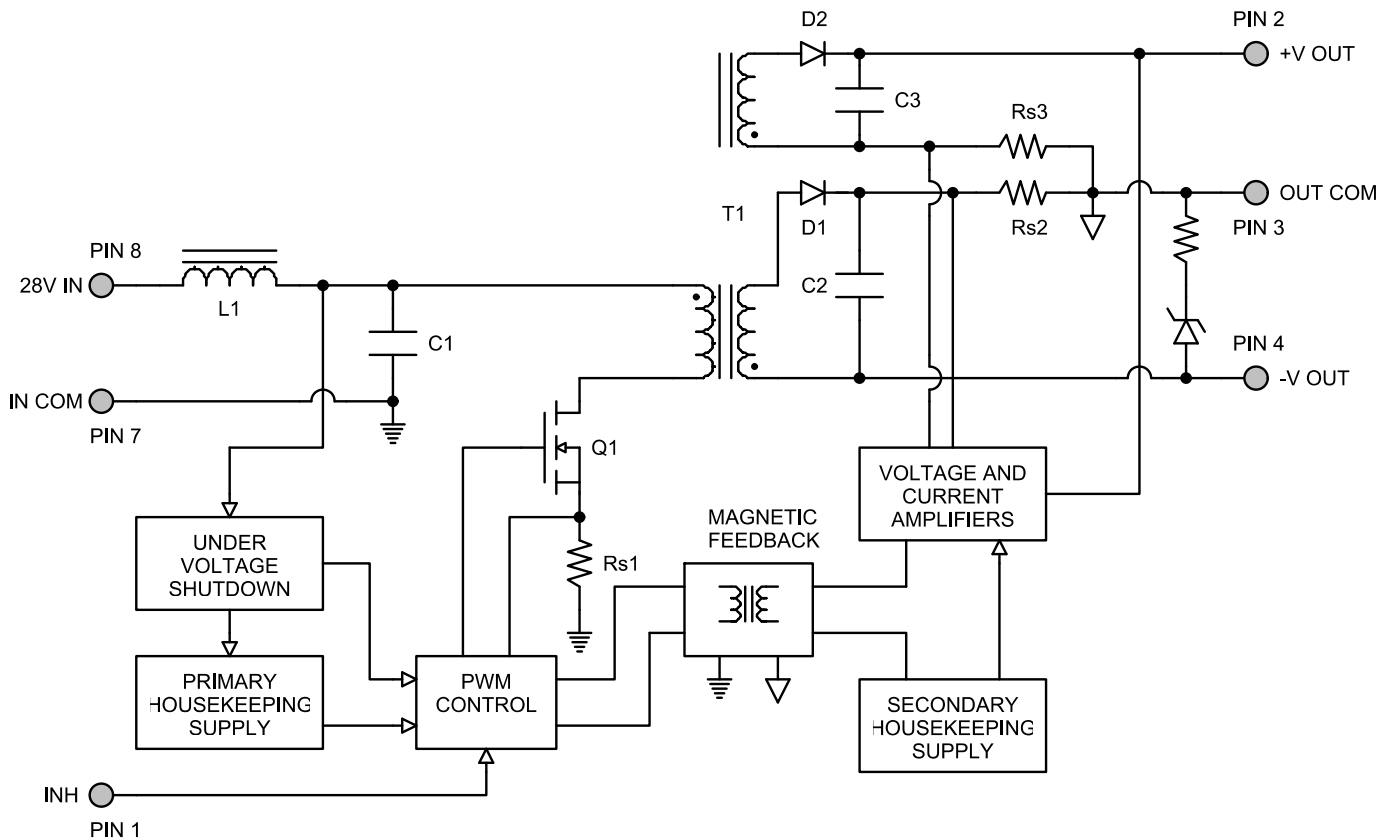


Figure 2

CONNECTION DIAGRAM

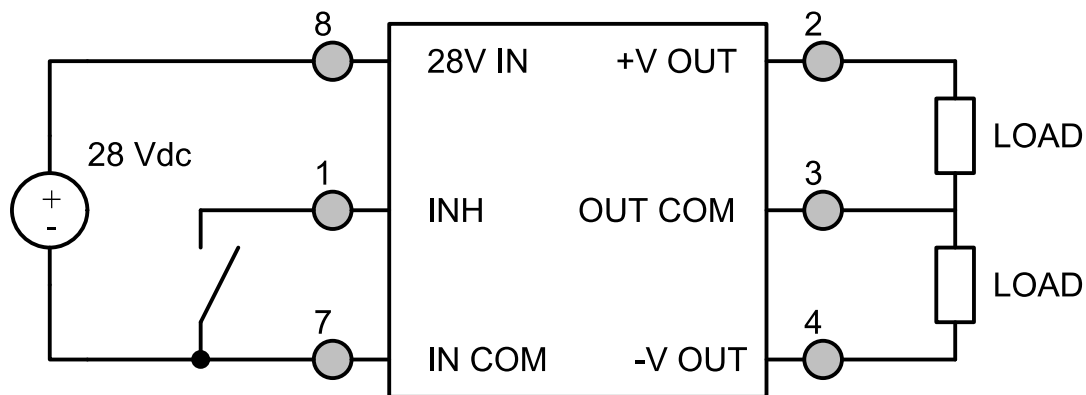


Figure 3

INHIBIT DRIVE CONNECTION DIAGRAMS

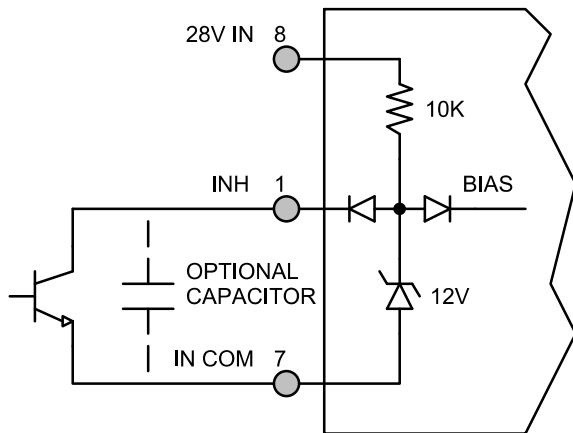


Figure 4 – Internal Inhibit Circuit and Recommended Drive
(Shown with optional capacitor for turn-on delay)

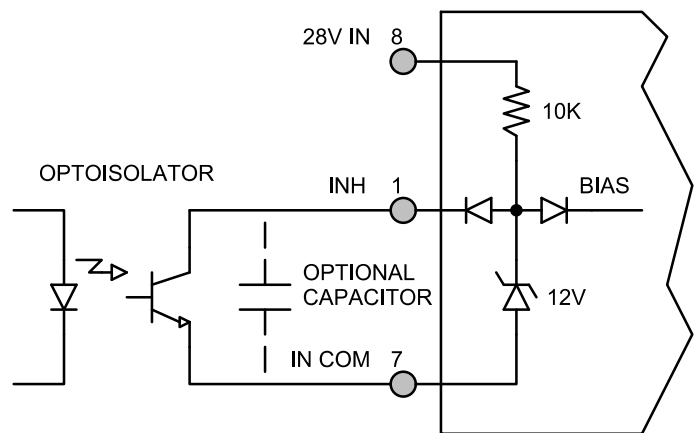


Figure 5 – Isolated Inhibit Drive
(Shown with optional capacitor for turn-on delay)

EMI FILTER HOOKUP DIAGRAM

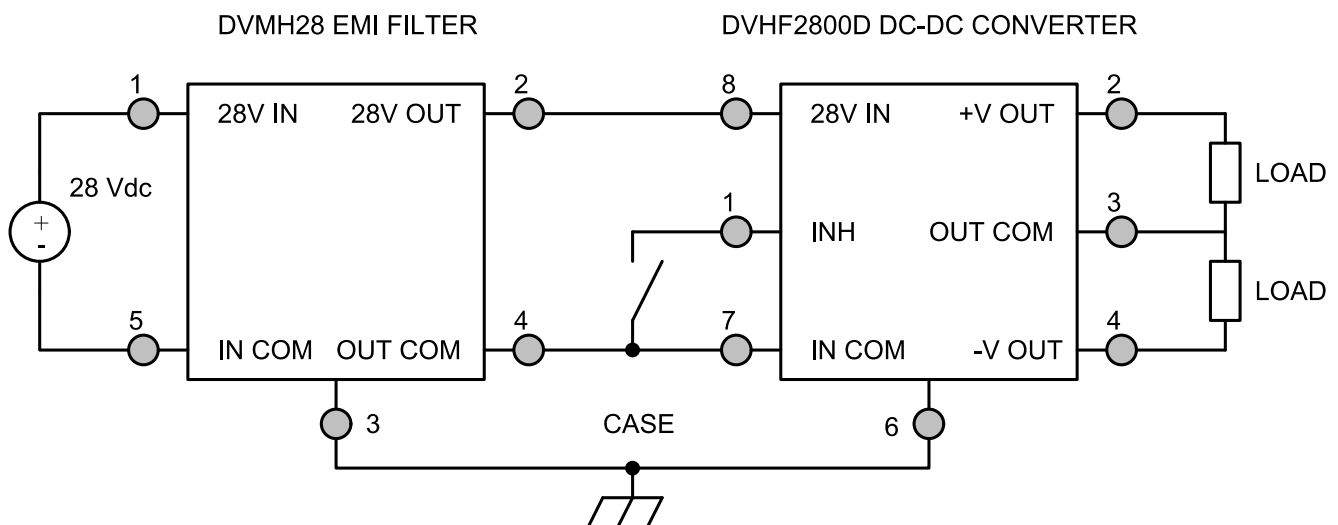


Figure 6 – Converter with EMI Filter

EFFICIENCY PERFORMANCE CURVES ($T_{CASE} = 25^{\circ}C$, Full Load, Unless Otherwise Specified)

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

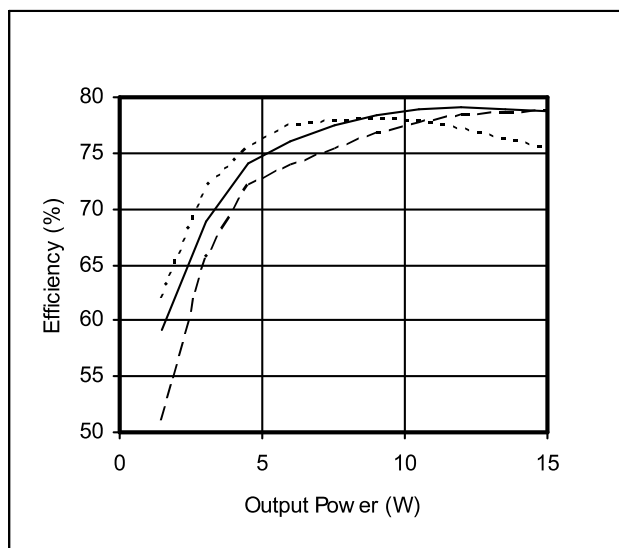


Figure 7 – DVHF2805D

Efficiency (%) vs. Output Power (W)

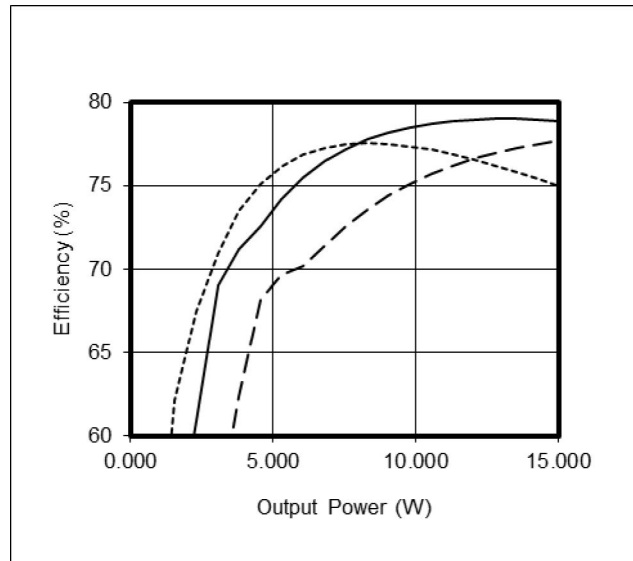


Figure 8 – DVHF2807D

Efficiency (%) vs. Output Power (W)

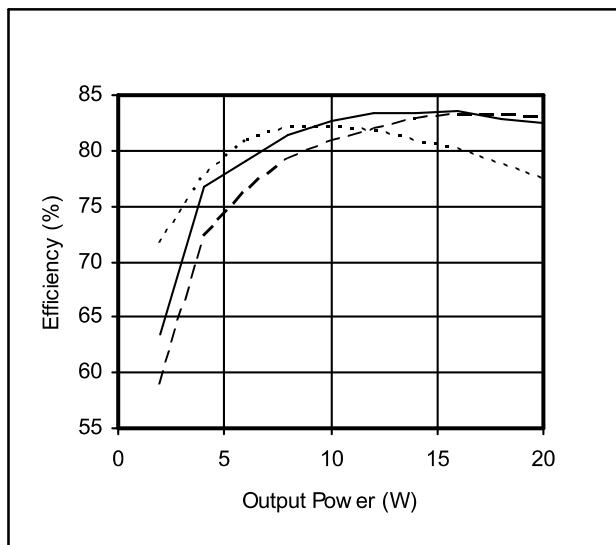


Figure 9 – DVHF2812D

Efficiency (%) vs. Output Power (W)

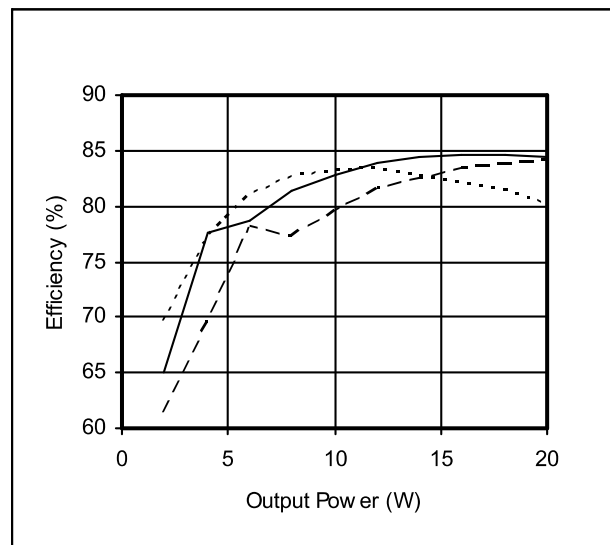


Figure 10 – DVHF2815D

Efficiency (%) vs. Output Power (W)

CROSS REGULATION CURVES ($T_{CASE} = 25^{\circ}C$, Full Load, Unless Otherwise Specified)

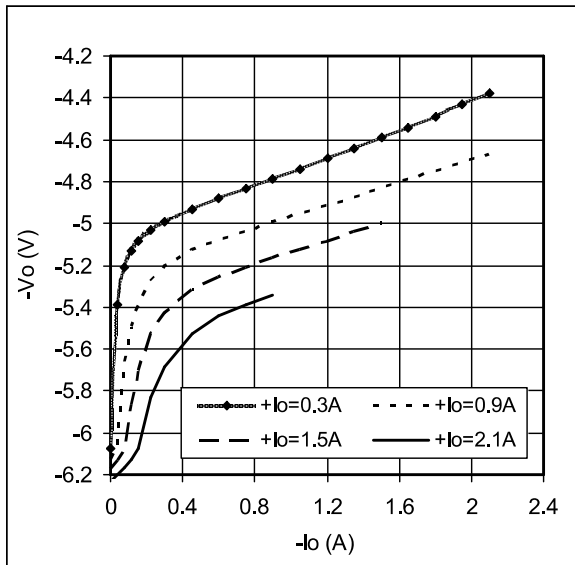
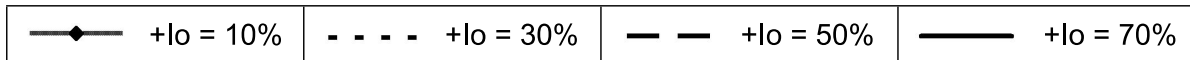


Figure 11 – DVHF2805D

-Vout (V) vs. -Iout (A)

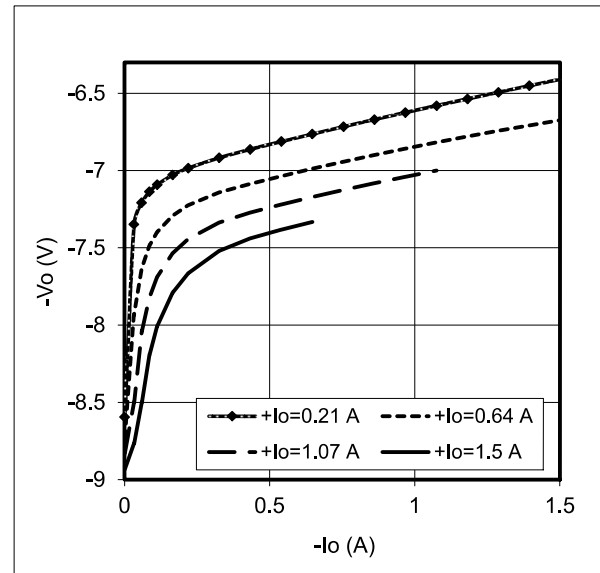


Figure 12 – DVHF2807D

-Vout (V) vs. -Iout (A)

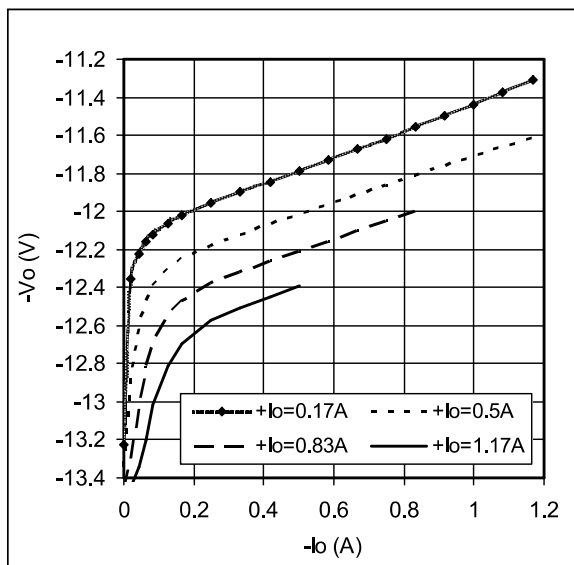


Figure 13 – DVHF2812D

-Vout (V) vs. -Iout (A)

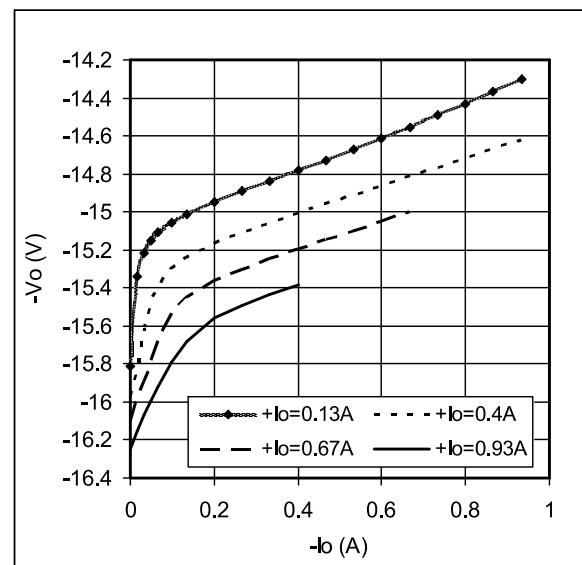


Figure 14 – DVHF2815D

-Vout (V) vs. -Iout (A)

EMI PERFORMANCE CURVES

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

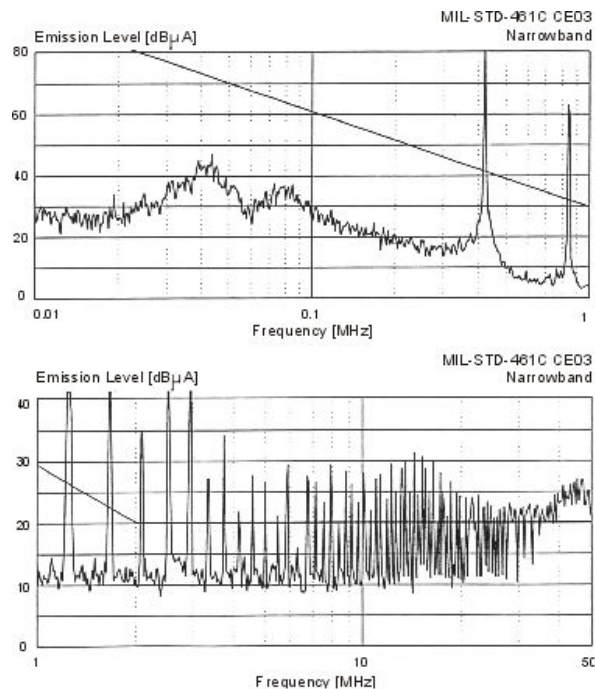


Figure 15 – DVHF2800D without EMI Filter

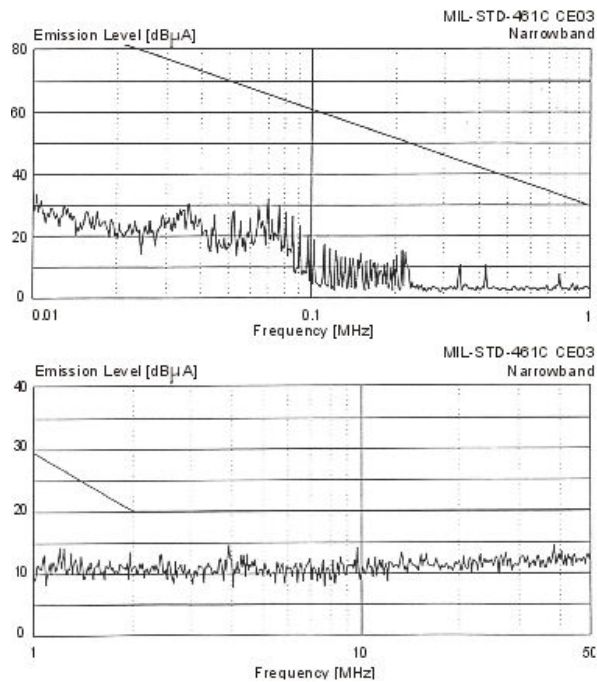
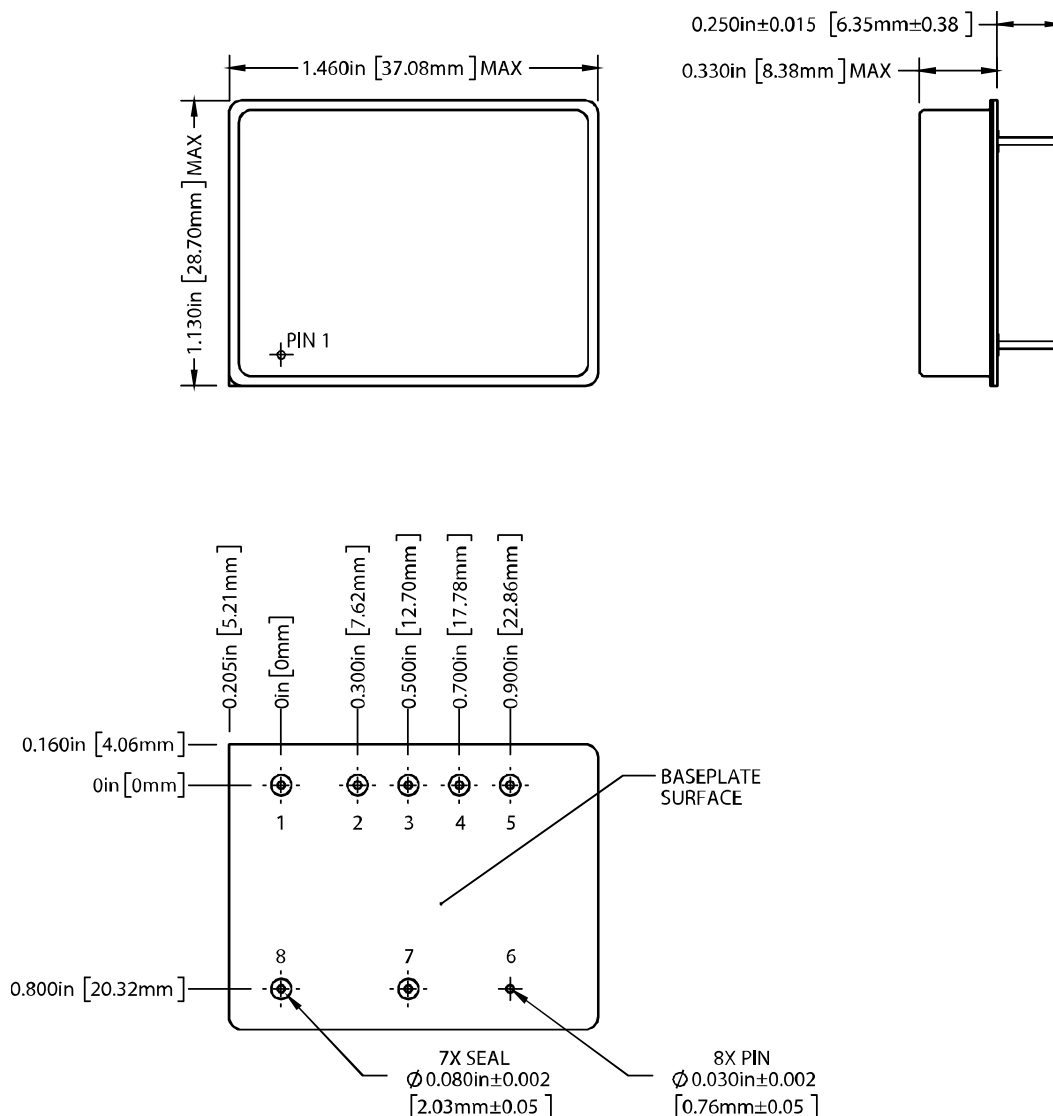


Figure 16 – DVHF2800D with EMI Filter

PACKAGE SPECIFICATIONS (NON-FLANGED)



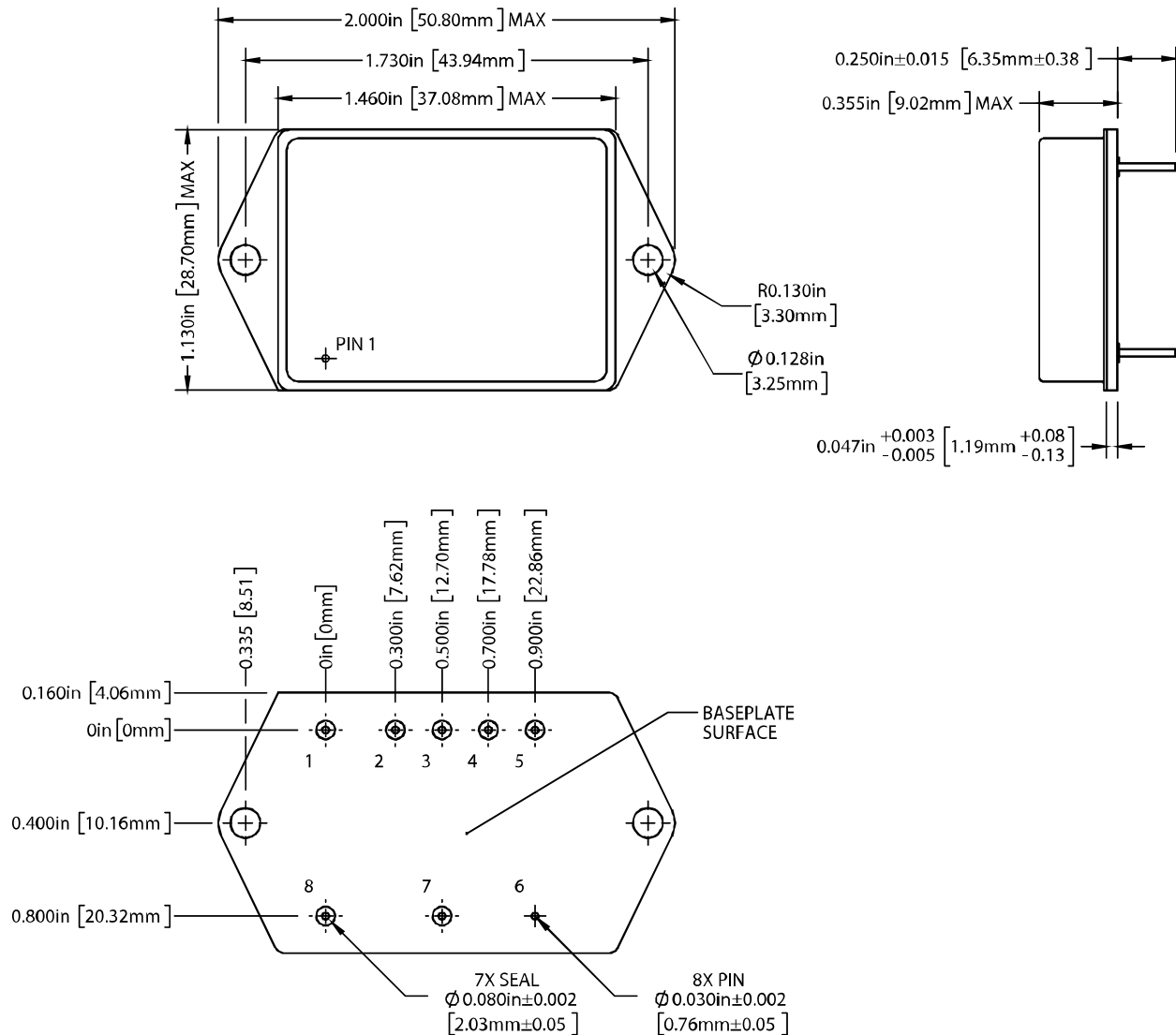
Notes:

1. Dimensional limits are $\pm 0.005"$ unless otherwise specified.
2. Case temperature is measured on the center of the baseplate.
3. Material:
Case (Steel, Gold over Nickel Plated), Cover (Steel, Nickel Plated), Pins (Alloy 52, Gold over Nickel Plated), Pin Seal (Glass).

Pin	Function	Pin	Function
1	INHIBIT	5	N/C
2	+V OUT	6	CASE
3	OUT COM	7	IN COM
4	-V OUT	8	28V IN

Figure 17 – Non-Flanged Package and Pinout

PACKAGE SPECIFICATIONS (FLANGED)



Notes:

1. Dimensional limits are ± 0.005 " unless otherwise specified.
2. Case temperature is measured on the center of the baseplate.
3. Mounting holes are not threaded. Recommended fastener is #4-40 screw.
4. Material:
Case (Steel, Gold over Nickel Plated), Cover (Steel, Nickel Plated), Pins (Alloy 52, Gold over Nickel Plated), Pin Seal (Glass).

Pin	Function	Pin	Function
1	INHIBIT	5	N/C
2	+V OUT	6	CASE
3	OUT COM	7	IN COM
4	-V OUT	8	28V IN

Figure 18 – Flanged Package and Pinout

PACKAGE PIN DESCRIPTION

Pin	Function	Description
1	INHIBIT	Logic Low = Disabled Output. Connecting the inhibit pin to input common (PIN 7) causes converter shutdown. Logic High = Enabled Output. Unconnected or open collector TTL.
2	+V OUT	Positive Output Voltage Connection
3	OUT COM	Output Common Connection
4	-V OUT	Negative Output Voltage Connection
5	N/C	No Connection
6	CASE	Case Connection
7	IN COM	Input Common Connection
8	28V IN	Positive Input Voltage Connection

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

Test	MIL-STD-883 Test Method, Condition	No Suffix (Standard) Non-QML 5	/ES (Extended) Non-QML 5	/H (Class H)	/KL1 Non-QML 5,9
Non-Destructive Bond Pull	TM2023	• ⁴	• ⁴	• ⁴	•
Internal Visual	TM2010, TM2017, TM2032 (MIL-STD-750, TM2072, TM2073)	•	•	•	•
Temperature Cycling	TM1010, Condition C -65°C to 150°C, Ambient			•	•
	TM1010, Condition B -55°C to 125°C, Ambient		•		
Constant Acceleration	TM2001, 3000g, Y1 Direction			•	•
	TM2001, 500g, Y1 Direction		•		
PIND ⁷	TM2020, Condition A				•
Pre Burn-In Electrical	25°C				•
Burn-In	TM1015, 320 hrs, 125°C, Case Typ				•
	TM1015, 160 hrs, 125°C, Case Typ			•	
	96 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 or B1		•	•	•
	TM1014, Gross Leak, Condition C1 or B2		•	•	•
	Gross Leak, Dip (No Bomb), Visual Verification	•			
Radiography ⁸	TM2012				•
External Visual	TM2009	•	•	•	•

Notes:

- Contact Sales for more information concerning additional environmental screening and testing options desired.
- 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.
- 100% R&R testing with all test data included in product shipment.
- Not required per MIL-PRF-38534. Test is performed for additional product quality assurance.
- Non-QML products may not meet all requirements of MIL-PRF-38534.
- Note intentionally not used.
- PIND test Certificate of Compliance included in product shipment.
- Radiographic test Certificate of Compliance and film(s) or data CD included in product shipment.
- KL1 products are identical in every way with Class K products in compliance with MIL-PRF-38534 revision L and later revisions except they contain elements evaluated to the requirements of MIL-PRF-38534 revision K and previous revisions. These devices are not marked with an SMD number or MIL-PRF-38534 certification mark and are marked with -KL1 screening code in place of -K.

ORDERING INFORMATION

DVHF	28	05	D	F	/KL1	-	XXX
1	2	3	4	5	6		7

(1) Product Series	(2) Nominal Input Voltage	(3) Output Voltage	(4) Number of Outputs
DVHF	28	28 Volts	Dual
		05 07 12 15	± 5 Volts ± 7 Volts ± 12 Volts ± 15 Volts

(5) Package Option	(6) Screening Code ^{1,2,3}	(7) Additional Screening Code
None F	Non-Flanged Flanged	Contact Sales
	None /ES /H /KL1	Standard Extended Class H Class KL1

- Notes:
1. Contact the VPT Sales Department for availability of Class H (/H) and KL1 (/KL1) 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.
 3. -KL1 products are identical in every way with Class K products in compliance with MIL-PRF-38534 revision L and later revisions except they contain elements evaluated to the requirements of MIL-PRF-38534 revision K and previous revisions. These devices are not marked with an SMD number or MIL-PRF-38534 certification mark and are marked with -KL1 screening code in place of -K.

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)	DVHF2800D Series Similar Part Number
5962-0324401HXC 5962-0324401HXA 5962-0324401HYC 5962-0324401HYA	DVHF2805D/H DVHF2805D/H-E DVHF2805DF/H DVHF2805DF/H-E
5962-0324401KXC 5962-0324401KXA 5962-0324401KYC 5962-0324401KYA	DVHF2805D/K DVHF2805D/K-E DVHF2805DF/K DVHF2805DF/K-E
5962-0324402HXC 5962-0324402HXA 5962-0324402HYC 5962-0324402HYA	DVHF2812D/H DVHF2812D/H-E DVHF2812DF/H DVHF2812DF/H-E
5962-0324402KXC 5962-0324402KXA 5962-0324402KYC 5962-0324402KYA	DVHF2812D/K DVHF2812D/K-E DVHF2812DF/K DVHF2812DF/K-E
5962-0324403HXC 5962-0324403HXA 5962-0324403HYC 5962-0324403HYA	DVHF2815D/H DVHF2815D/H-E DVHF2815DF/H DVHF2815DF/H-E
5962-0324403KXC 5962-0324403KXA 5962-0324403KYC 5962-0324403KYA	DVHF2815D/K DVHF2815D/K-E DVHF2815DF/K DVHF2815DF/K-E
5962-0324404HXC 5962-0324404HXA 5962-0324404HYC 5962-0324404HYA	DVHF2807D/H DVHF2807D/H-E DVHF2807DF/H DVHF2807DF/H-E
5962-0324404KXC 5962-0324404KXA 5962-0324404KYC 5962-0324404KYA	DVHF2807D/K DVHF2807D/K-E DVHF2807DF/K DVHF2807DF/K-E

Do not use the DVHF2800D 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. SMDs can be downloaded from the DLA Land and Maritime (Previously known as DSCC) website at <https://landandmaritimeapps.dla.mil/programs/defaultapps.asp>. 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:

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