



DVHF+2800T 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 15 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

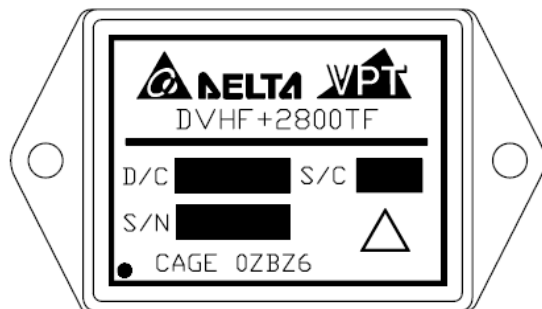


Figure 1 – DVHF+2800T / DVHF+2800TF DC-DC Converter
(Exact marking may differ from that shown)

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	+15°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power	15 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T _{CASE} = +125°C)	6.5 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(26 / 29) Grams
ESD Rating per MIL-PRF-38534	3A		

Parameter		Conditions	DVHF+28512T			DVHF+28515T			Units
			Min	Typ	Max	Min	Typ	Max	
STATIC									
INPUT Voltage		Continuous	15	28	50	15	28	50	V
		Transient, 1 sec ⁴	-	-	80	-	-	80	V
Current		Inhibited	-	2	5.0	-	2	5.0	mA
		No Load	-	25	60	-	25	60	mA
Ripple Current		Full Load ⁵ , 20Hz to 10MHz	-	25	50	-	25	50	mA _{p-p}
Inhibit Pin Input ⁴			0	-	1.5	0	-	1.5	V
Inhibit Pin Open Circuit Voltage ⁴			12	15	17	12	15	17	V
UVLO Turn On			10.5	-	14.5	10.5	-	14.5	V
UVLO Turn Off ⁴			8.5	-	13.5	8.5	-	13.5	V
OUTPUT Voltage	V _{MAIN}	T _{CASE} = 25°C	4.95	5.0	5.05	4.95	5.0	5.05	V
	+V _{AUX}		11.88	12.0	12.12	14.85	15.0	15.15	V
	-V _{AUX}		-12.24	-12.0	-11.76	-15.30	-15.0	-14.70	V
	V _{MAIN}	T _{CASE} = -55°C to +125°C	4.85	5.0	5.15	4.85	5.0	5.15	V
	+V _{AUX}		11.64	12.0	12.36	14.55	15.0	15.45	V
	-V _{AUX}		-12.48	-12.0	-11.52	-15.60	-15.0	-14.40	V
Power ⁴	Total		0	-	15	0	-	15	W
	V _{MAIN}		0	-	7.5	0	-	7.5	W
	±V _{AUX} ⁶		0	-	7.5	0	-	7.5	W
Current ³	V _{MAIN}		0	-	1.5	0	-	1.5	A
	±V _{AUX}	Either Output ⁶	0	-	0.44	0	-	0.35	A
Ripple Voltage	V _{MAIN}	Full Load ⁵ , 20Hz to 10MHz	-	10	50	-	10	50	mV _{p-p}
	±V _{AUX}		-	20	80	-	20	80	mV _{p-p}
Line Regulation	V _{MAIN}	V _{IN} = 15V to 50V	-	2	20	-	2	20	mV
	±V _{AUX}		-	5	50	-	5	50	mV
Load Regulation	V _{MAIN}	No Load to Full Load ^{5,8}	-	15	50	-	15	50	mV
	+V _{AUX}		-	10	50	-	10	50	mV
	-V _{AUX}		-	15	200	-	15	200	mV
Cross Regulation	±V _{AUX}	+V _{OUT} = 30%, -V _{OUT} = 70% +V _{OUT} = 70%, -V _{OUT} = 30%	-	150	450	-	150	450	mV
EFFICIENCY		Full Load ⁵	74	79	-	74	79	-	%
LOAD FAULT POWER DISSIPATION		Overload ⁴	-	-	7.5	-	-	7.5	W
		Short Circuit	-	-	7.5	-	-	7.5	W
CAPACITIVE LOAD ⁴			-	-	500	-	-	500	μF
SWITCHING FREQUENCY			550	650	700	550	650	700	kHz
SYNCHRONIZATION FREQUENCY ⁷			700	750	800	700	750	800	kHz
ISOLATION		500 V _{DC} , T _{CASE} = 25°C	100	-	-	100	-	-	MΩ

MTBF (MIL-HDBK-217F) ⁹	AIF @ T _C = 55°C	-	464	-	-	464	-	kHrs
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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	+15°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power	15 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T _{CASE} = +125°C)	6.5 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(26 / 29) Grams
ESD Rating per MIL-PRF-38534	3A		

Parameter		Conditions	DVHF+28512T			DVHF+28515T			Units
			Min	Typ	Max	Min	Typ	Max	
DYNAMIC									
Load Step Output Transient	V _{MAIN} ±V _{AUX}	Half Load to Full Load	-	130	400	-	130	400	mV _{PK}
			-	220	500	-	210	500	mV _{PK}
Load Step Recovery ²	V _{MAIN} ±V _{AUX}		-	400	650	-	400	650	μSec
			-	200	350	-	150	350	μSec
Line Step Output Transient ⁴	V _{MAIN} ±V _{AUX}	V _{IN} = 15V to 50V	-	50	150	-	50	150	mV _{PK}
			-	300	500	-	300	500	mV _{PK}
Line Step Recovery ^{2, 4}	V _{MAIN} ±V _{AUX}		-	100	200	-	100	200	μSec
			-	250	500	-	250	500	μSec
Turn On Delay		V _{IN} = 0V to 28V	-	10	17	-	10	17	mSec
Turn On Overshoot	V _{MAIN} ±V _{AUX}		-	0	25	-	0	25	mV _{PK}
			-	0	50	-	0	50	mV _{PK}

Notes:

1. This note intentionally not used.
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. 7.5W on V_{MAIN} and 7.5W on ±V_{AUX}.
6. Up to 70% of the total auxiliary power or current can be drawn from either of the auxiliary outputs.
7. Synchronization is TTL signal with V_{SYNC MAX} = 6V.
8. -V_{AUX} is 5% Load to Full Load at -55°C.
9. 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	+15°C
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C
Output Power	15 Watts	Lead Solder Temperature (10 seconds)	270°C
Power Dissipation (Full Load, T _{CASE} = +125°C)	6.5 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(26 / 29) Grams
ESD Rating per MIL-PRF-38534	3A		

Parameter		Conditions	DVHF+285R715T			Units	
			Min	Typ	Max		
STATIC							
INPUT Voltage		Continuous	15	28	50	V	
		Transient, 1 sec ⁴	-	-	80	V	
Current		Inhibited	-	2	5.0	mA	
		No Load	-	25	60	mA	
Ripple Current		Full Load ⁵ , 20Hz to 10MHz	-	25	50	mA _{p-p}	
Inhibit Pin Input ⁴			0	-	1.5	V	
Inhibit Pin Open Circuit Voltage ⁴			12	15	17	V	
UVLO Turn On			10.5	-	14.5	V	
UVLO Turn Off ⁴			8.5	-	13.5	V	
OUTPUT Voltage		T _{CASE} = 25°C	V _{MAIN}	5.643	5.7	5.757	V
			+V _{AUX}	14.85	15.0	15.15	V
			-V _{AUX}	-15.30	-15.0	-14.70	V
		T _{CASE} = -55°C to +125°C	V _{MAIN}	5.529	5.7	5.871	V
			+V _{AUX}	14.55	15.0	15.45	V
			-V _{AUX}	-15.60	-15.0	-14.40	V
Power ⁴		Total	0	-	15	W	
		V _{MAIN}	0	-	7.5	W	
		±V _{AUX} ⁶	0	-	7.5	W	
Current ³		V _{MAIN}	0	-	1.32	A	
		±V _{AUX}	Either Output ⁶	0	-	0.35	A
Ripple Voltage		Full Load ⁵ , 20Hz to 10MHz	V _{MAIN}	-	10	50	mV _{p-p}
			±V _{AUX}	-	20	80	mV _{p-p}
Line Regulation		V _{IN} = 15V to 50V	V _{MAIN}	-	2	20	mV
			±V _{AUX}	-	5	50	mV
Load Regulation		No Load to Full Load ^{5,8}	V _{MAIN}	-	15	50	mV
			+V _{AUX}	-	10	50	mV
			-V _{AUX}	-	15	200	mV
Cross Regulation		+V _{OUT} = 30%, -V _{OUT} = 70% +V _{OUT} = 70%, -V _{OUT} = 30%	-	150	450	mV	
EFFICIENCY		Full Load ⁵	74	79	-	%	
LOAD FAULT POWER DISSIPATION		Overload ⁴	-	-	7.5	W	
		Short Circuit	-	-	7.5	W	
CAPACITIVE LOAD ⁴			-	-	500	μF	
SWITCHING FREQUENCY			550	650	700	kHz	
SYNCHRONIZATION FREQUENCY ⁷			700	750	800	kHz	
ISOLATION		500 V _{DC} , T _{CASE} = 25°C	100	-	-	MΩ	

MTBF (MIL-HDBK-217F) ⁹	AIF @ T _C = 55°C	-	464	-	kHrs
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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	+15°C		
Input Voltage (Transient, 1 second)	80 Volts	Storage Temperature	-65°C to +150°C		
Output Power	15 Watts	Lead Solder Temperature (10 seconds)	270°C		
Power Dissipation (Full Load, T _{CASE} = +125°C)	6.5 Watts	Weight (Maximum) (Un-Flanged / Flanged)	(26 / 29) Grams		
ESD Rating per MIL-PRF-38534	3A				

Parameter		Conditions	DVHF+285R715T			Units
			Min	Typ	Max	
DYNAMIC						
Load Step Output Transient	V _{MAIN} ±V _{AUX}	Half Load to Full Load	-	130	400	mV _{PK}
			-	210	500	mV _{PK}
Load Step Recovery ²	V _{MAIN} ±V _{AUX}		-	400	650	μSec
			-	150	350	μSec
Line Step Output Transient ⁴	V _{MAIN} ±V _{AUX}	V _{IN} = 15V to 50V	-	50	150	mV _{PK}
			-	300	500	mV _{PK}
Line Step Recovery ^{2, 4}	V _{MAIN} ±V _{AUX}		-	100	200	μSec
			-	250	500	μSec
Turn On Delay		V _{IN} = 0V to 28V	-	10	17	mSec
Turn On Overshoot	V _{MAIN}		-	0	25	mV _{PK}
	±V _{AUX}		-	0	50	mV _{PK}

Notes:

1. This note intentionally not used.
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. 7.5W on V_{MAIN} and 7.5W on ±V_{AUX}.
6. Up to 70% of the total auxiliary power or current can be drawn from either of the auxiliary outputs.
7. Synchronization is TTL signal with V_{SYNC MAX} = 6V.
8. -V_{AUX} is 5% Load to Full Load at -55°C.
9. Correction factor of 0.12 added to ceramic capacitors.

BLOCK DIAGRAM

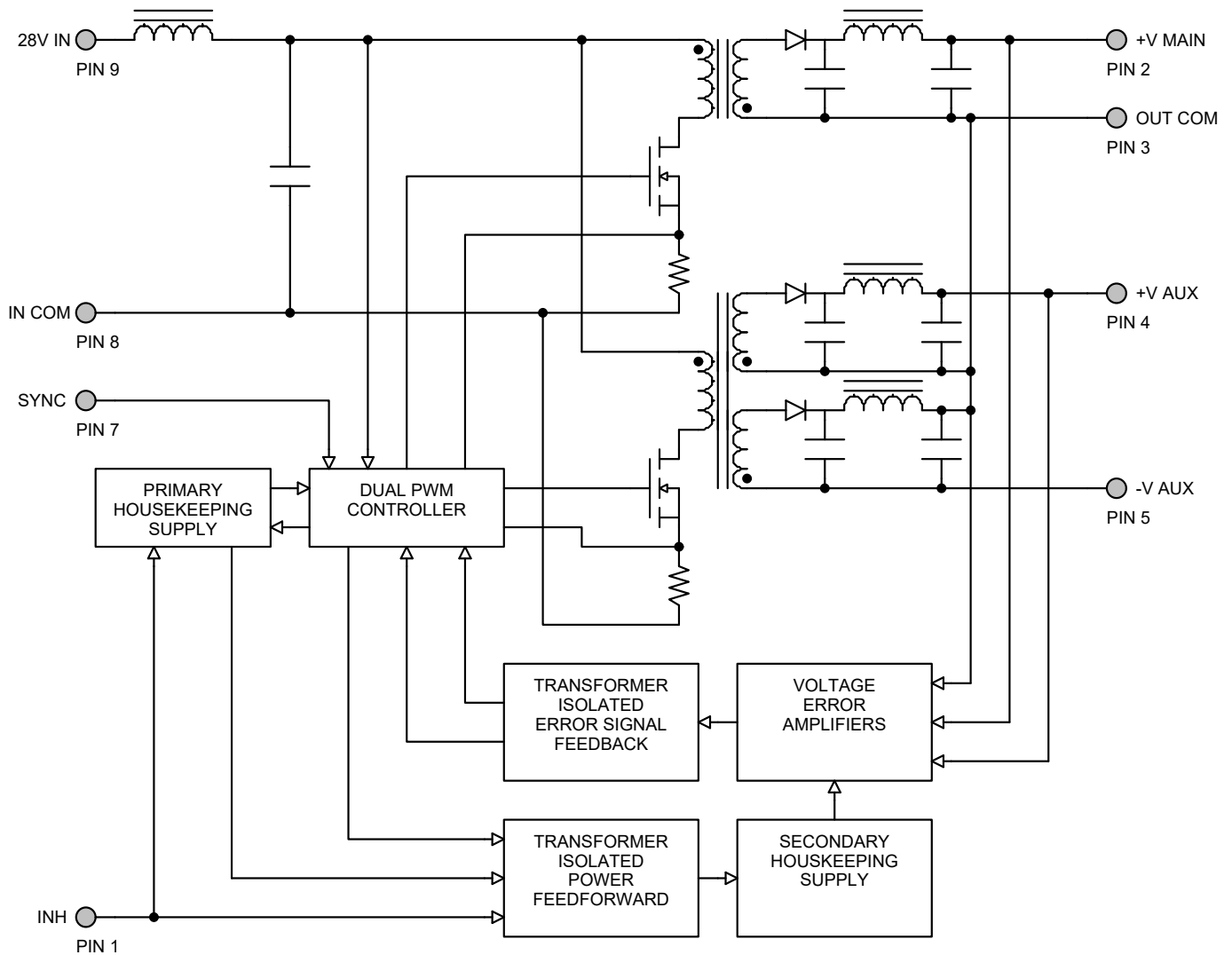


Figure 2

CONNECTION DIAGRAM

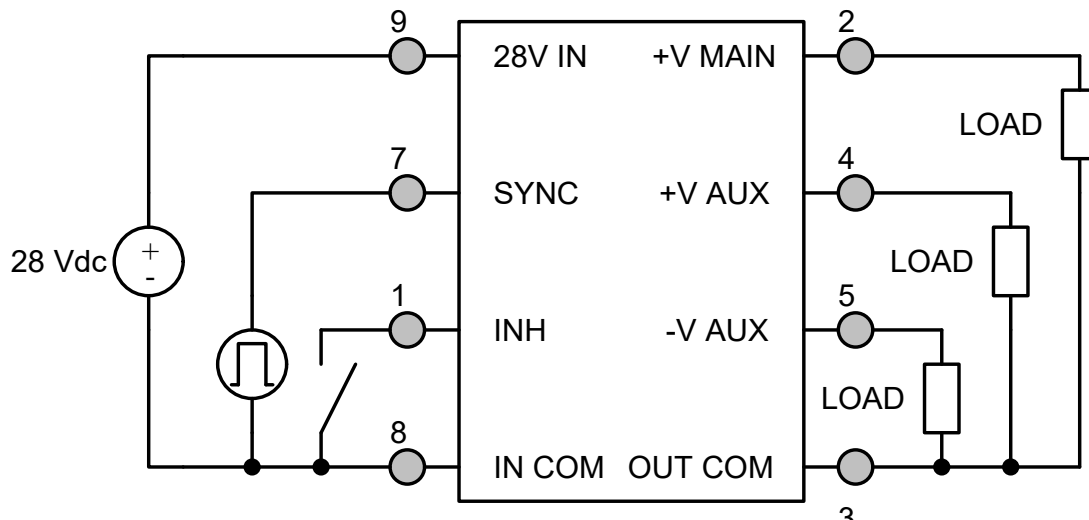


Figure 3

INHIBIT DRIVE CONNECTION DIAGRAMS

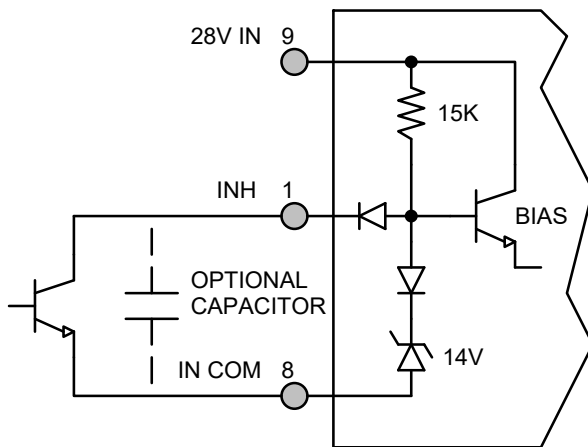


Figure 4 – Internal Inhibit Circuit and Recommended Drive
(Shown with optional capacitor for turn-on delay)

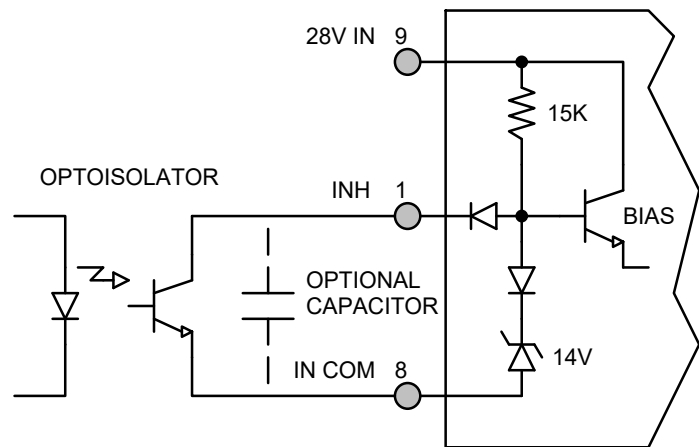


Figure 5 – Isolated Inhibit Drive
(Shown with optional capacitor for turn-on delay)

EMI FILTER HOOKUP DIAGRAM

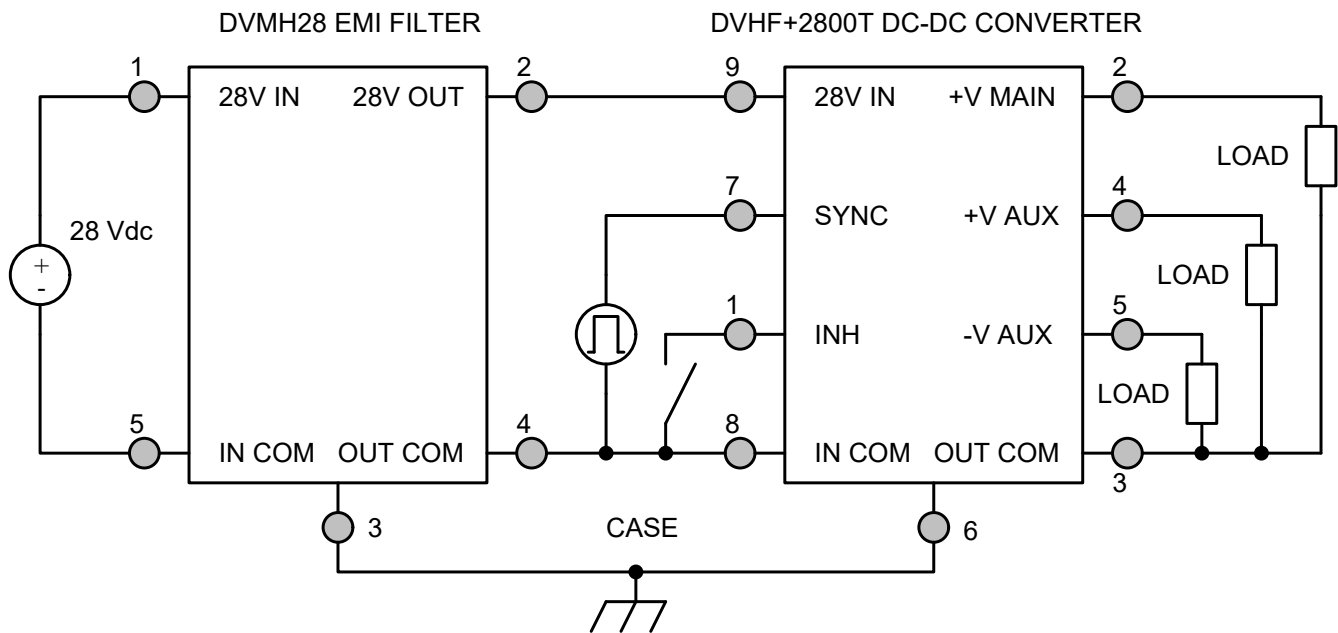


Figure 6 – Converter with EMI Filter

EFFICIENCY PERFORMANCE CURVES ($T_{CASE} = 25^{\circ}C$)

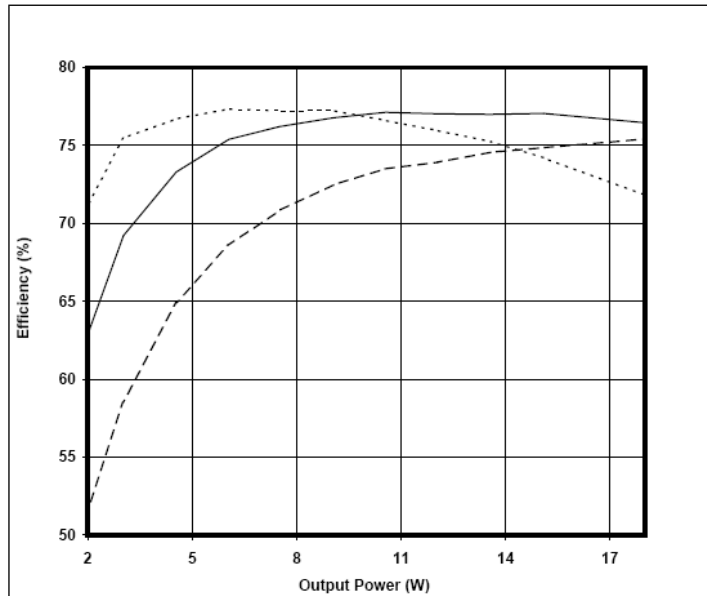
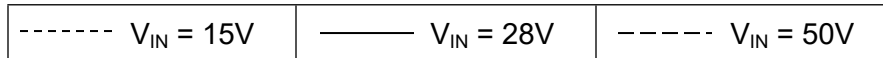


Figure 7 – DVHF+28512T
Efficiency (%) vs. Output Power (W)

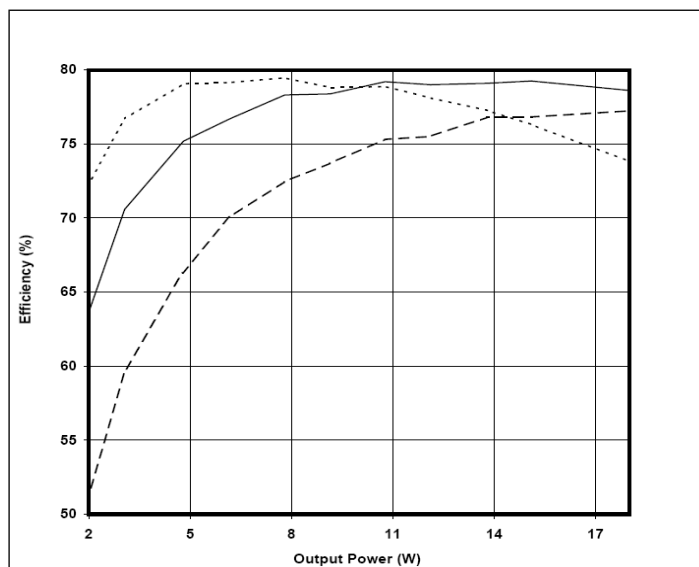


Figure 8 – DVHF+28515T
Efficiency (%) vs. Output Power (W)

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

—◆— +laux = 10%	- - - +laux = 30%	- - - +laux = 50%	— +laux = 70%
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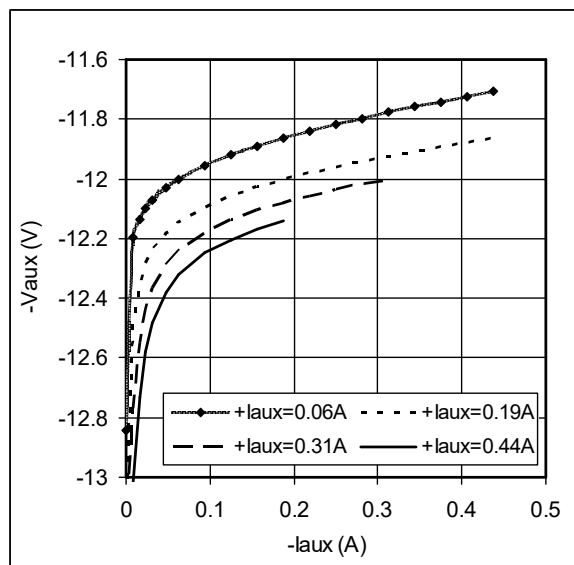


Figure 9 – DVHF+28x12T

-Vaux (V) vs. -laux (A)

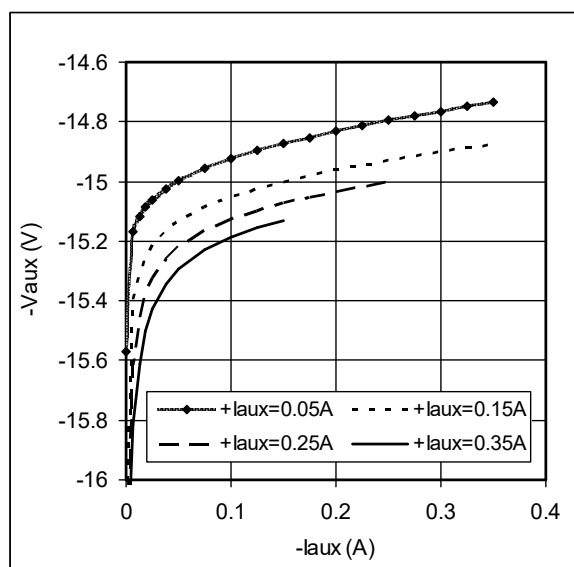


Figure 10 – DVHF+28x15T

-Vaux (V) vs. -laux (A)

EMI PERFORMANCE CURVES

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

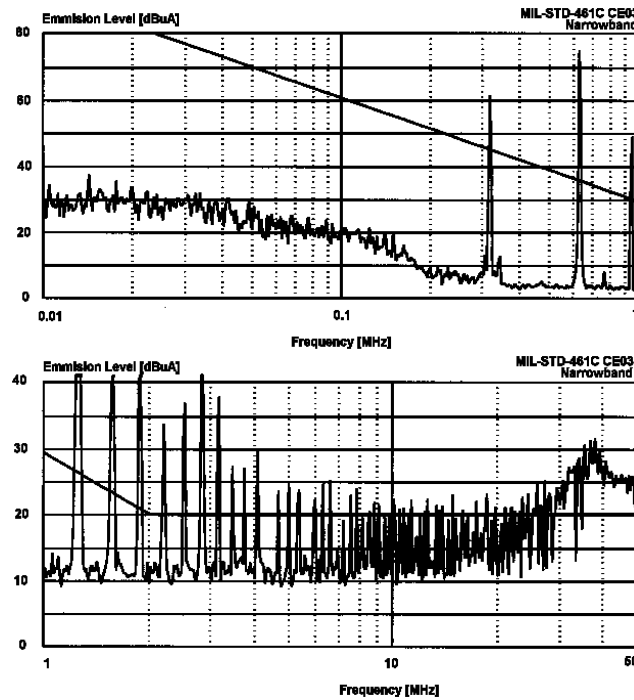


Figure 11 – DVHF+2800T without EMI Filter

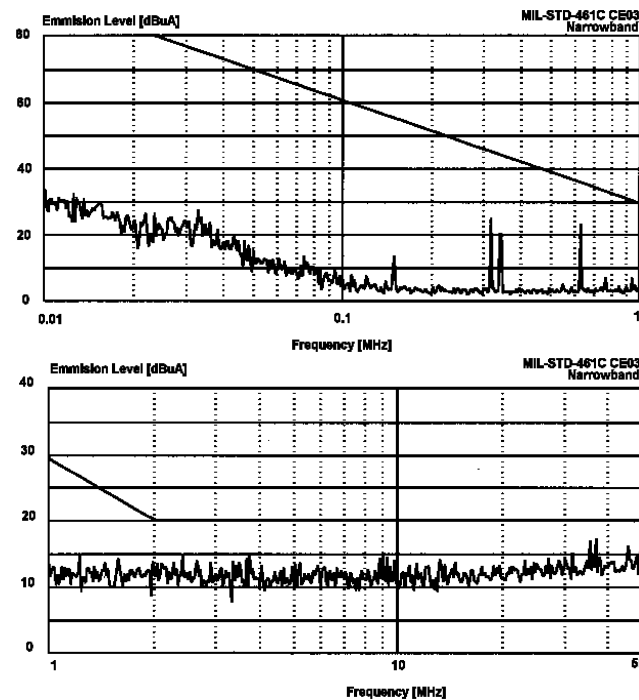
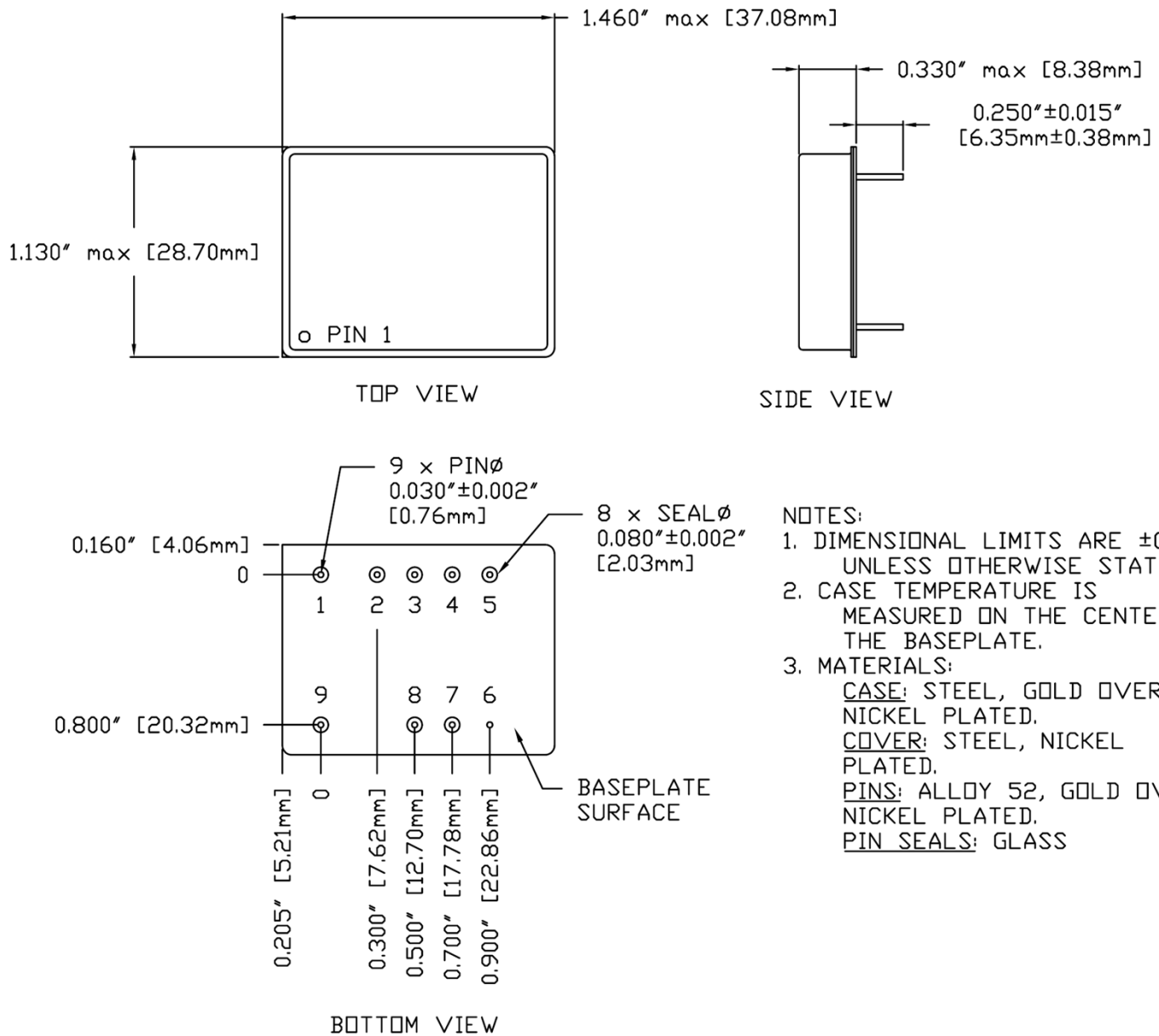


Figure 12 – DVHF+2800T with EMI Filter

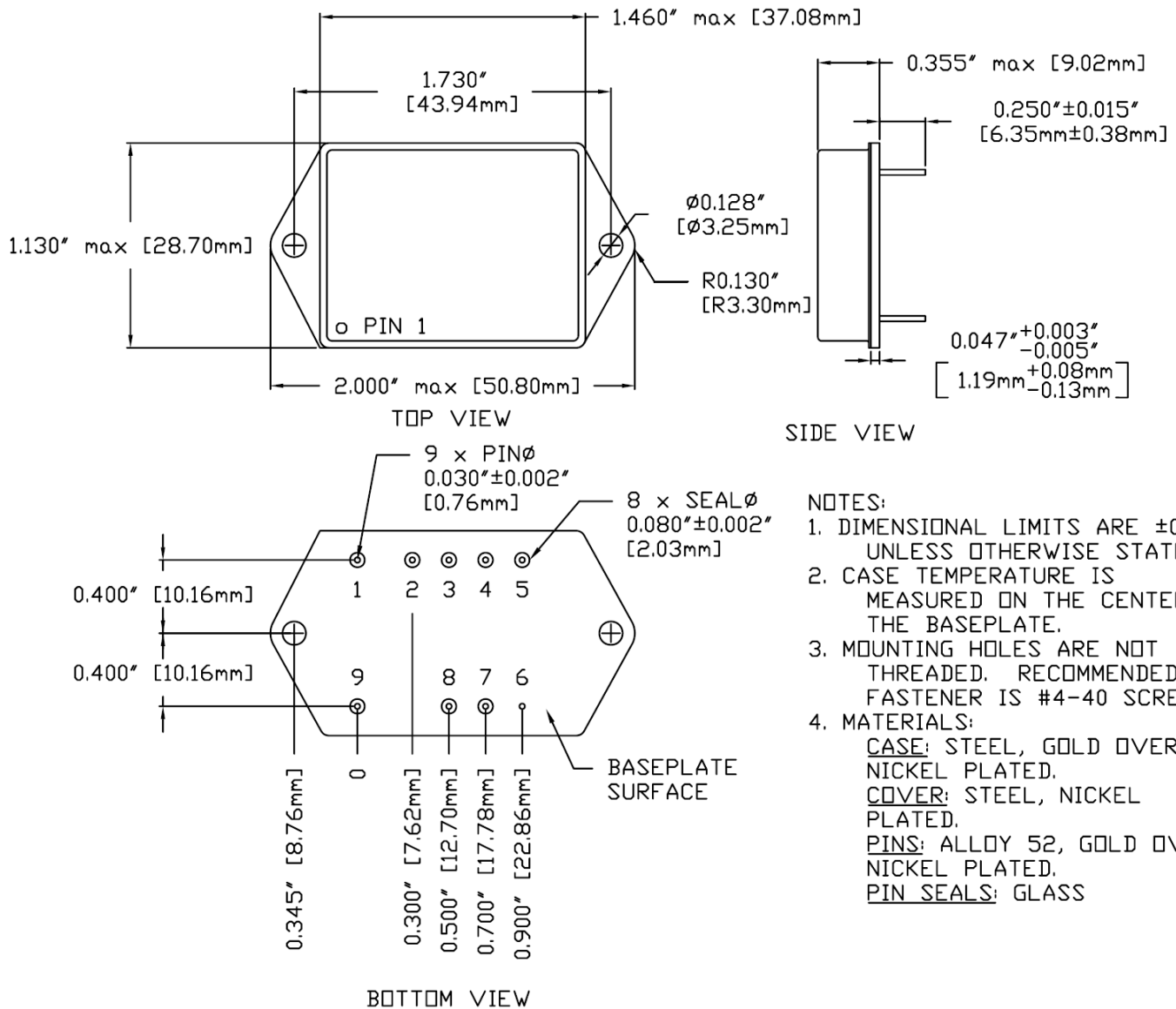
PACKAGE SPECIFICATIONS (NON-FLANGED)



Pin	Function	Pin	Function	Pin	Function
1	INHIBIT	4	+V AUX	7	SYNC
2	+V MAIN	5	-V AUX	8	IN COM
3	OUT COM	6	CASE	9	28V IN

Figure 13 – Non-Flanged Package and Pinout

PACKAGE SPECIFICATIONS (FLANGED)



Pin	Function	Pin	Function	Pin	Function
1	INHIBIT	4	+V AUX	7	SYNC
2	+V MAIN	5	-V AUX	8	IN COM
3	OUT COM	6	CASE	9	28V IN

Figure 14 – Flanged Package and Pinout

PACKAGE PIN DESCRIPTION

Pin	Function	Description
1	INHIBIT	Logic Low = Disabled Output. Connecting the inhibit pin to input common causes converter shutdown. Logic High = Enabled Output. Unconnected or open collector TTL.
2	+V MAIN	Positive Main Output Voltage Connection
3	OUT COM	Output Common Connection
4	+V AUX	Positive Auxiliary Output Voltage Connection
5	-V AUX	Negative Auxiliary Output Voltage Connection
6	CASE	Case Connection
7	SYNC	Synchronization Signal
8	IN COM	Input Common Connection
9	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	512	T	F	/KL1	-	XXX
1	2	3	4	5	6		7

(1)

(2)

(3)

Product Series	Nominal Input Voltage		Main Output Voltage, Auxiliary Output Voltages	
DVHF+	28	28 Volts	512 515 5R715	+ 5 Volts, $\pm$ 12 Volts + 5 Volts, $\pm$ 15 Volts +5.7 Volts, $\pm$ 15 Volts

(4)

(5)

(6)

(7)

Number of Outputs		Package Option		Screening Code ^{1,2,3}		Additional Screening Code
T	Triple	None F	Non-Flanged Flanged	None /ES /H /KL1	Standard Extended Class H KL1	Contact Sales

- Notes:
1. Contact the VPT Inc. 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)	DVHF+2800T Series Similar Part Number
5962-0820601HXC	DVHF+28512T/H
5962-0820601HXA	DVHF+28512T/H-E
5962-0820601HYC	DVHF+28512TF/H
5962-0820601HYA	DVHF+28512TF/H-E
5962-0820602HXC	DVHF+28515T/H
5962-0820602HXA	DVHF+28515T/H-E
5962-0820602HYC	DVHF+28515TF/H
5962-0820602HYA	DVHF+28515TF/H-E
*TBD	DVHF+285R715T/H DVHF+285R715T/H-E DVHF+285R715TF/H DVHF+285R715TF/H-E

Do not use the DVHF+2800T 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 DLA Land and Maritime (Previously known as DSCC) website at <https://landandmaritimeapps.dla.mil/programs/defaultapps.asp>. 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. 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
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