DATA SHEET

Power Your Critical Mission Today

HTD1R5N-2800D SERIES

HIGH TEMPERATURE HYBRID DC-DC CONVERTERS

HTD1R5N – Exact marking may differ from that shown

Models Available
Input: 14 V to 40 V continuous, 50 V transient
1.5 W, dual outputs of ±5 V, ±12 V, Non-Isolated
Temperature: 185 °C operating

1.0 DESCRIPTION

The HTD Series of high temperature DC-DC converters is specifically designed for extreme temperature environments.

Hybrid microcircuit technology provides superior reliability in high temperature applications. Bare semiconductor die are integrated with passive components using thick film conductors on a ceramic substrate. A hermetic metal package protects internal components for long term reliability.

The HTD1R5N Series utilizes a boundary mode, peak current controlled flyback topology. The flyback topology achieves high efficiency at low power levels, over a wide input voltage range. The main output is tightly regulated with a wide bandwidth, precision voltage control loop.

High temperature performance is guaranteed through screening, product qualification, component lot testing and analysis. The HTD Series has been characterized over the full operating temperature range from -55 °C to +185 °C, including electrical performance, operating life, temperature cycling, mechanical shock and vibration.

The HTD Series is intended for harsh environments including down-hole oil and gas, MWD/LWD and wireline logging tools, aircraft engine electronics, and other industrial applications.

1.1 FEATURES

- Non-Isolated
- 1.5 W rated output power
- Wide input voltage range
- Low noise
- Undervoltage lockout
- Short circuit protection
- Soft start

1.2 HIGH TEMPERATURE CHARACTERIZATION

- Guaranteed performance to 185 °C operating

1.3 MANUFACTURING AND COMPLIANCE

- Manufactured in a MIL-PRF-38534 Class H and Class K facility
- MIL-STD-883
- ISO-9001

1.4 PACKAGING

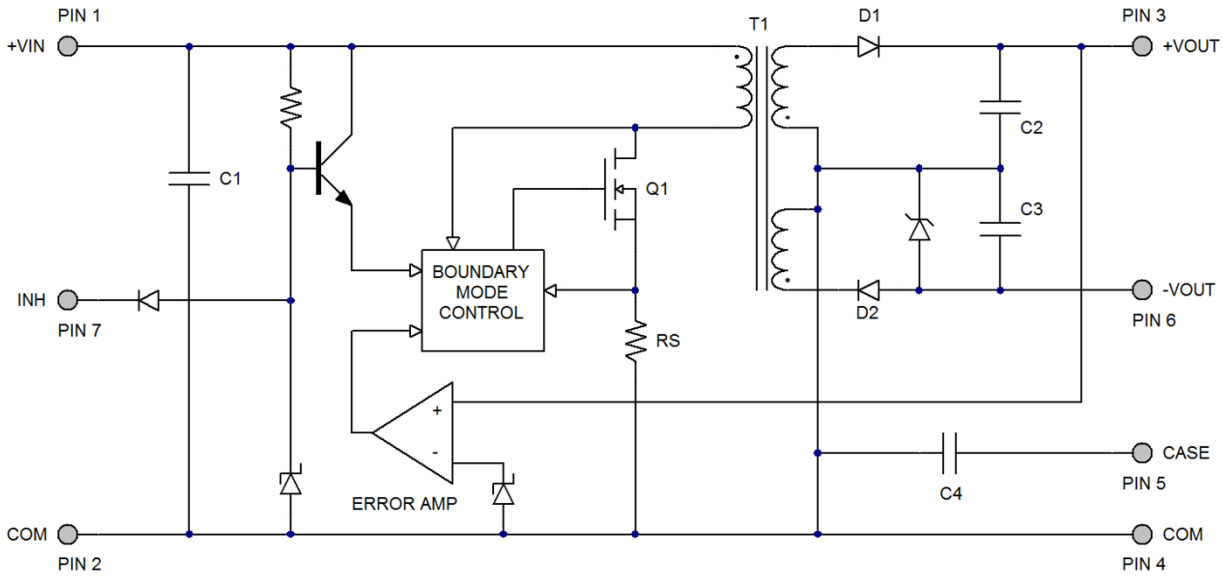
- Low-profile: 0.975” x 0.800” x 0.270”
- Max weight: 11 g
- Industry standard pinout
- Precision projection-welded hermetic metal case

1.5 SIMILAR PRODUCTS AND ACCESSORIES

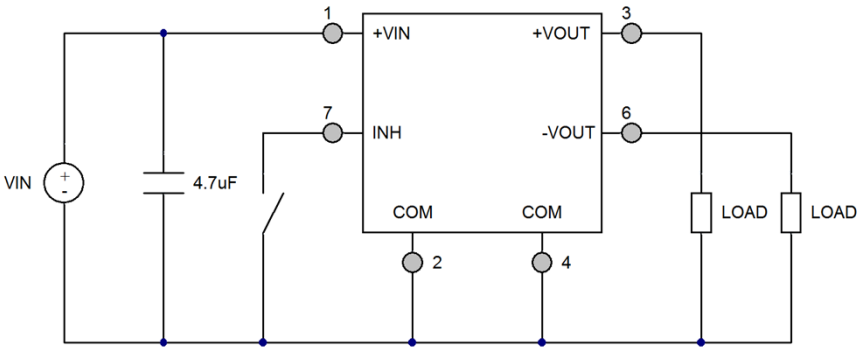
- HTD1R5N-1200D 1.5 W non-output isolated DC-DC converter
- HTD1R5B-1200D 1.5 W output isolated DC-DC converter
- Custom versions available

2.0 DIAGRAMS

2.1 BLOCK DIAGRAM



2.2 CONNECTION DIAGRAM



3.0 SPECIFICATIONS

3.1 ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings			
Input Voltage (Continuous):	-0.5 V to 40 V	Operating Temperature (Full Load):	-55 °C to +185 °C
Input Voltage (Transient, 1 second):	-0.5 V to 50 V	Storage Temperature:	-65 °C to +185 °C
		Lead Solder Temperature (10 seconds):	400 °C

3.2 PERFORMANCE SPECIFICATIONS

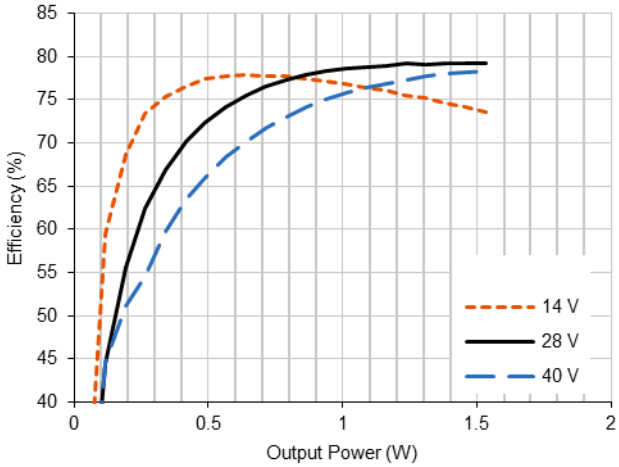
Tcase = -55 °C to +185 °C, Vin = +28 V ± 5%, Pout = 1.5W[1], Unless Otherwise Specified

		HTD1R5N-2805D			HTD1R5N-2812D			
Parameter	**Conditions[5]**	**Min**	**Typ**	**Max**	**Min**	**Typ**	**Max**	**Units**
INPUT								
Voltage	Continuous	14	28	40	14	28	40	V
	Transient, 1 sec[4]	-	-	50	-	-	50	V
Current	INH < 1.5 V	-	0.3	0.5	-	0.3	0.5	mA
	No Load	-	7	12	-	7	12	mA
Ripple Current[5]	20 Hz to 10 MHz	-	35	60	-	35	60	mApp
Undervoltage Lockout	Turn-On	7	-	13	7	-	13	V
	Turn-Off[4]	6	-	12	6	-	12	V
OUTPUT STATIC								
Voltage	+Vout, Tcase = 25 °C	4.95	5	5.05	11.88	12	12.12	V
	+Vout, Tcase = -55 °C to +185 °C	4.90	5	5.10	11.76	12	12.24	V
	-Vout, Tcase = 25 °C	4.90	5	5.10	11.76	12	12.24	V
	-Vout, Tcase = -55 °C to +185 °C	4.85	5	5.15	11.64	12	12.36	V
Power[2]	Total	0	-	1.5	0	-	1.5	W
	Either Output	0	-	0.9	0	-	0.9	W
Current[2]	Total	0	-	300	0	-	125	mA
	Either Output	0	-	180	0	-	75	mA
Ripple Voltage	20 Hz to 10 MHz	-	35	70	-	25	50	mVpp
Line Regulation	+Vout, V_{IN} = 14 V to 40 V	-	1	40	-	1	40	mV
	-Vout, V_{IN} = 14 V to 40 V	-	20	50	-	30	100	mV
Load Regulation	+Vout, No Load to Full Load	-	5	25	-	5	25	mV
	-Vout, No Load to Full Load	-	100	200	-	50	200	mV
Cross Regulation, -Vout	+Vout: 60% load, -Vout: 40% load	-	100	200	-	100	200	mV
	+Vout: 40% load, -Vout: 60% load							
OUTPUT DYNAMIC								
Load Step, Half to Full Load, Either Output	Output Transient	-	50	100	-	100	200	mVpk
	Recovery[3]	-	-	400	-	-	400	µs
Turn-On, Vin = 0 to 28 V	Delay	-	5	10	-	5	10	ms
	Overshoot	-	0	25	-	0	50	mVpk
FUNCTION								
INH Pin Input[4]	Output Inhibited	0	-	1.5	0	-	1.5	V
INH Pin Open Circuit Voltage[4]	Output Enabled	5	-	8	5	-	8	V
GENERAL								
Efficiency		72	78	-	75	82	-	%
Capacitive Load[4]		-	-	100	-	-	100	µF
Switching Frequency	V_{IN} = 28 V, 1.5 W	200	290	350	200	290	350	kHz
	V_{IN} = 14 V to 40 V, No Load to 1.5 W[4]	100	-	800	100	-	800	kHz
Case Isolation	500 V DC, Tcase = 25 °C	100	-	-	100	-	-	MΩ
Weight	Standard package option	-	-	11	-	-	11	g

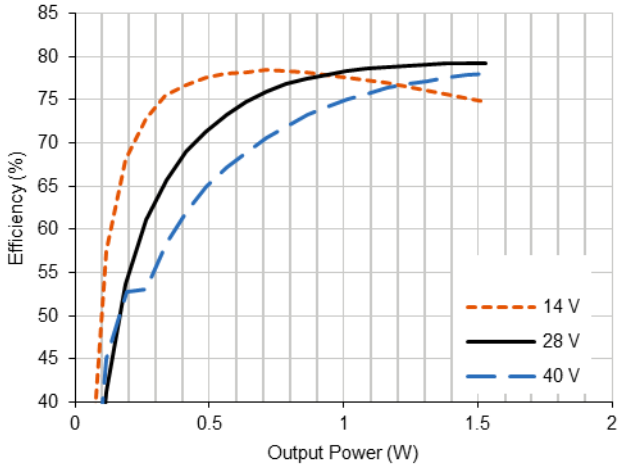
1. Half load at +Vout and half load at –Vout.
2. Up to 60% of the total power or current can be drawn from either of the two outputs.
3. Time for output voltage to settle within 1% of steady-state value.
4. Verified by initial electrical design verification. Post design verification, parameter shall be guaranteed to the limits specified.
5. With 4.7uF capacitor from +VIN to COM.

4.0 HTD1R5N-2805D PERFORMANCE CURVES

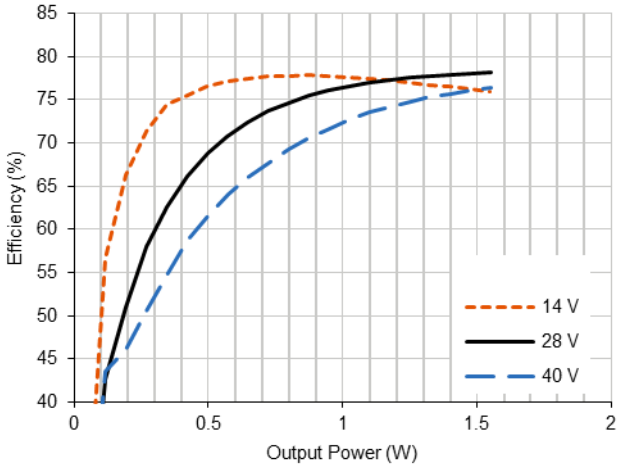
4.0.1 HTD1R5N-2805D Efficiency (Typical, 185 °C)



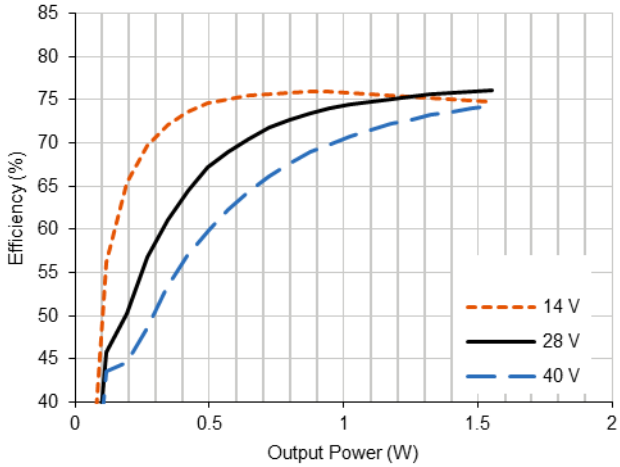
4.0.2 HTD1R5N-2805D Efficiency (Typical, 155 °C)



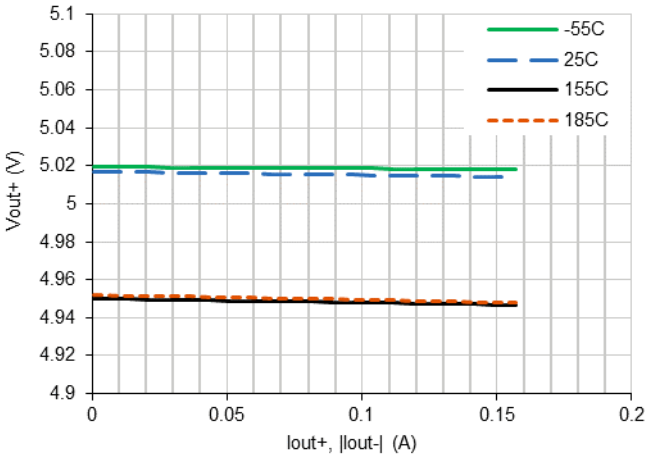
4.0.3 HTD1R5N-2805D Efficiency (Typical, 25 °C)



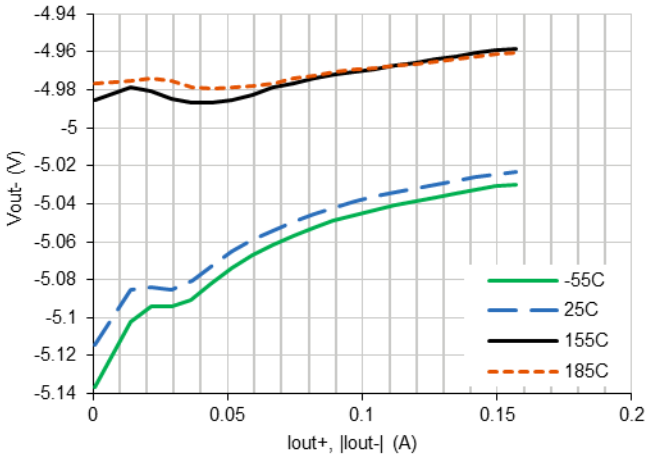
4.0.4 HTD1R5N-2805D Efficiency (Typical, -55 °C)



4.0.5 HTD1R5N-2805D Output Voltage vs. Current

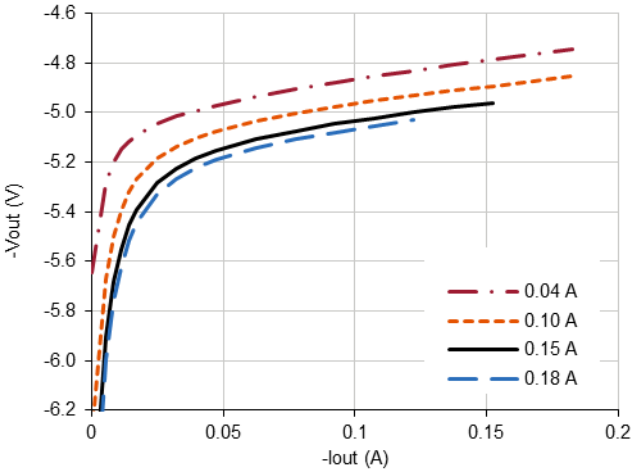


4.0.6 HTD1R5N-2805D Output Voltage vs. Current



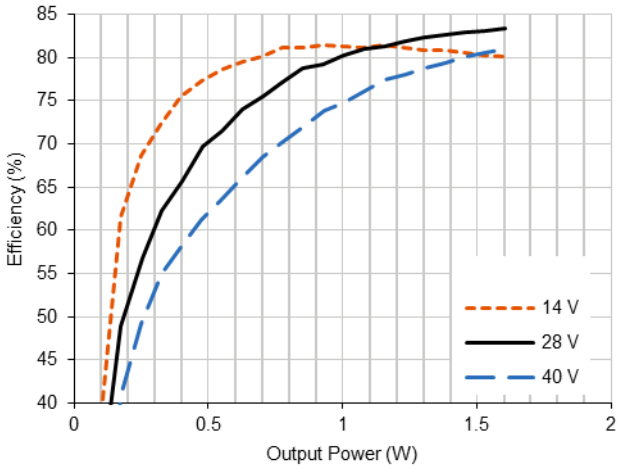
4.0 HTD1R5N-2805D PERFORMANCE CURVES (CONTINUED)

4.0.7 HTD1R5N-2805D Cross Regulation (Typical, 25 °C)

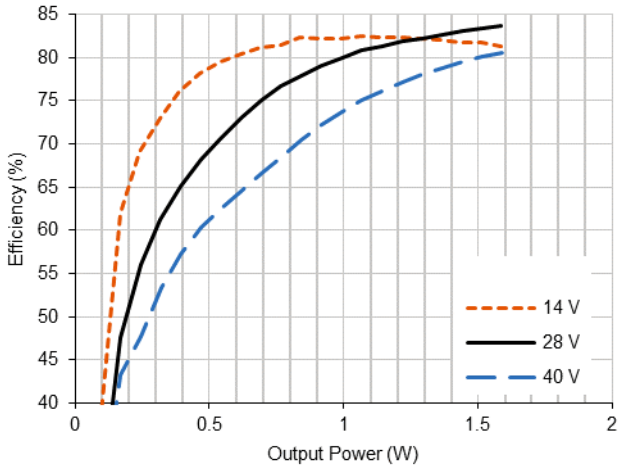


4.1 HTD1R5N-2812D PERFORMANCE CURVES

4.1.1 HTD1R5N-2812D Efficiency (Typical, 185 °C)

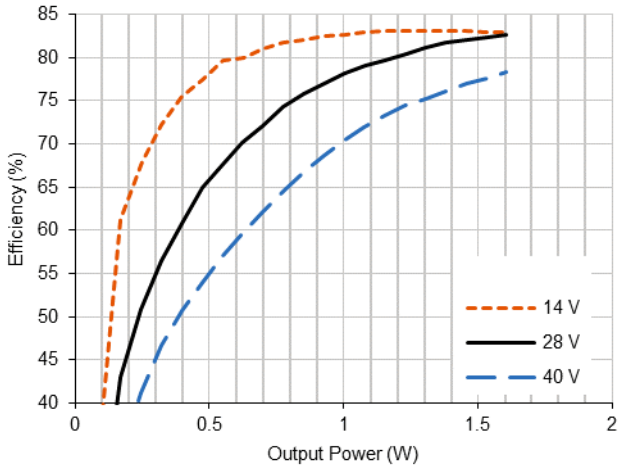


4.1.2 HTD1R5N-2812D Efficiency (Typical, 155 °C)

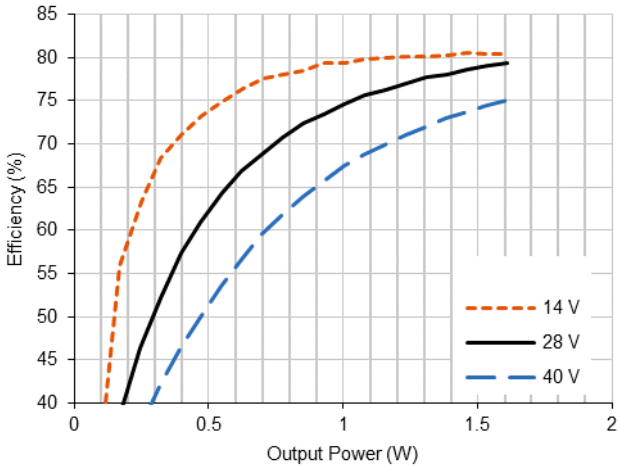


4.1 HTD1R5N-2812D PERFORMANCE CURVES (CONTINUED)

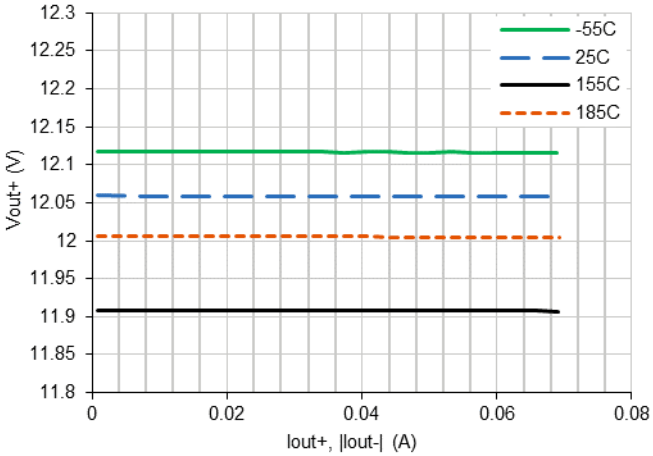
4.1.3 HTD1R5N-2812D Efficiency (Typical, 25 °C)



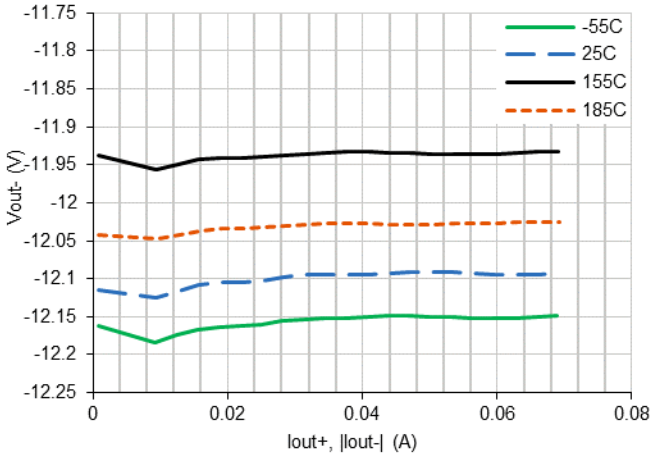
4.1.4 HTD1R5N-2812D Efficiency (Typical, -55 °C)



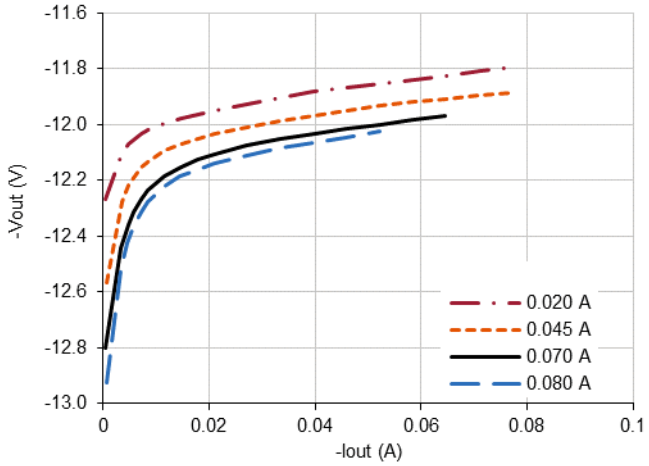
4.1.5 HTD1R5N-2812D Output Voltage vs. Current



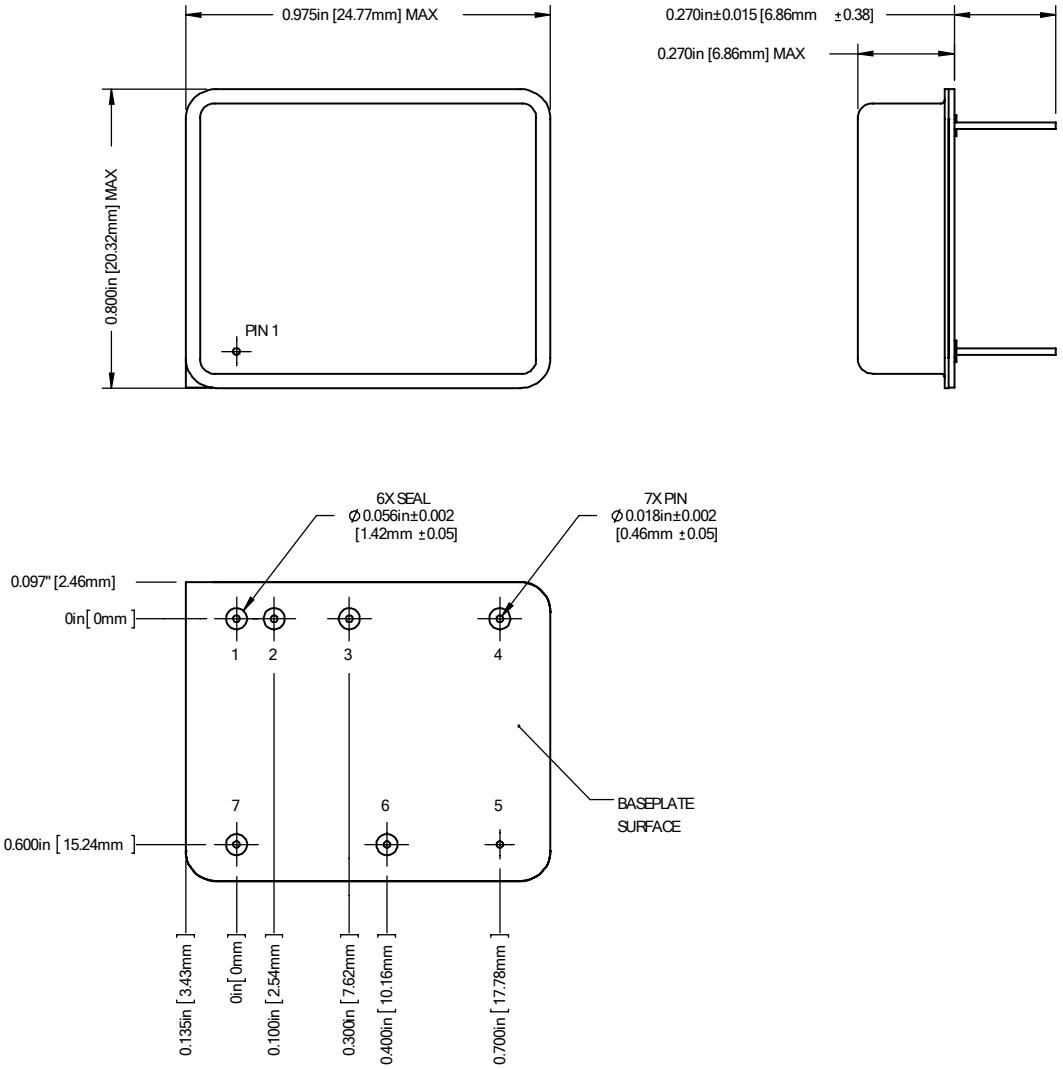
4.1.6 HTD1R5N-2812D Output Voltage vs. Current



4.1.7 HTD1R5N-2812D Cross Regulation (Typical, 25 °C)



5.0 MECHANICAL OUTLINES AND PINOUT



1. Tolerances are ±0.005" unless otherwise stated
2. Case temperature is measured on the center of the baseplate surface
3. Materials: Case (Steel, gold over nickel plated); Cover (Steel, nickel plated); Pin (Copper-cored alloy 52, gold over nickel plated); Pin Seals (Glass)

Pin	Function	Pin	Function	Pin	Function	Pin	Function
1	+VIN	3	+VOUT	5	CASE	7	INHIBIT
2	COM	4	COM	6	-VOUT		

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 HTD1R5N-2800D Series is a non-isolated dual-output peak current controlled boundary mode flyback converter. It provides a positive and negative output voltage with respect to the COM pin. Up to 60% of the total output power is available from either output. The internal voltage regulation loop actively regulates the positive output voltage. The negative output is regulated by cross-regulation of the transformer winding.

6.1.2 External Components

The HTD1R5N-2800D Series has internal input and output capacitors. For reliable operation, a 4.7 µF input decoupling capacitor is recommended. Additional input capacitance and inductance are optional. The HTD Series is stable and has low output ripple with no load capacitance. For low noise applications, a small ceramic capacitor, 1 µF to 10 µF, at the output will improve performance. Output capacitance can be added up to the maximum listed in Section 3.2.

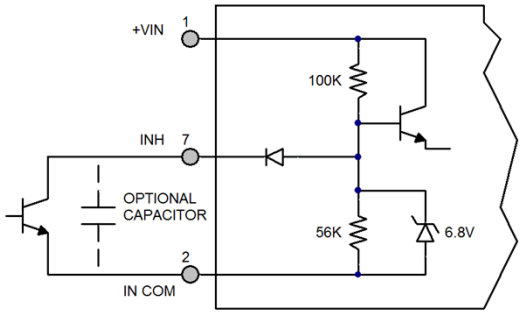
6.1.3 Source Impedance

The impedance of the input source can interact with the DC-DC converter and can 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 simply the cable resistance multiplied 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. In some cases, additional input capacitance will be needed to stabilize the system.

6.2 FUNCTION DESCRIPTIONS

6.2.1 On/Off Control (INH)

The INH (Inhibit) pin is a control pin referenced to COM. 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 COM 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 HTD1R5N-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 tolerate slow ramping input voltage waveforms.

6.3.2 Output Soft Start

The HTD1R5N-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 4 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 HTD1R5N-2800D Series provides output short circuit protection. During a load fault condition, a peak current limiting function reduces the converter duty cycle and switching frequency to limit the total output current into the fault. The short circuit protection feature senses the transformer primary current. It does not distinguish if the fault is on the positive or negative output. The converter will continue to operate into any overload or short circuit condition. This feature allows the converter 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 converter in this condition.

6.4 THERMAL CONSIDERATIONS

The HTD1R5N-2800D Series is rated for full power operation at 185 °C. The operating temperature of the converter is specified on the baseplate of the converter. The converter is designed to be conduction-cooled, with the baseplate mounted to a heat sink, chassis, PCB or other thermal surface. The internal power dissipating components are mounted to the baseplate of the converter and all heat flow is through the baseplate and mounting flanges. The lid of the converter does not provide a good thermal path.

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

7.0 ENVIRONMENTAL SCREENING

100% tested per MIL-STD-883 as referenced to MIL-PRF-38534.

Contact sales for more information concerning additional environmental screening and testing options. VPT, Inc. reserves the right to ship higher screened or SMD products to meet orders for lower screening levels at our sole discretion unless specifically forbidden by customer contract.

Test	MIL-STD-883 Test Method, Condition	High Temp Non-QML[1]
Non-Destructive Bond Pull	TM2023	•[2]
Internal Visual	TM2010, TM2017, TM2032 (MIL-STD-750, TM2072, TM2073)	•
Temperature Cycling	TM1010, Condition H -55 °C to 185 °C, Ambient	•
Constant Acceleration	TM2001, 3000g, Y1 Direction	•
Pre Burn-In Electrical	25 °C	•
Burn-In	TM1015, 48 hrs., 155 °C, Case Typ	•
Final Electrical	MIL-PRF-38534, Group A Subgroups 1-6 -55 °C, 25 °C, 185 °C[3]	•
Hermeticity (Seal)	TM1014, Fine Leak, Condition A2 or B1	•
	TM1014, Gross Leak, Condition C or B2	•
External Visual	TM2009	•

1. Non-QML products may not meet all requirements of MIL-PRF-38534
2. Not required per MIL-PRF-38534. Test performed for additional product quality assurance
3. 100% R&R testing with all test data included in product shipment

9.0 ORDERING INFORMATION

HTD1R5N -	28	05	D
1	2	3	4

(1) Product Series	(2) Nominal Input Voltage	(3) Output Voltage	(4) Number of Outputs
HTD1R5N	**28** 28 Volts	**05** 05 Volts **12** 12 Volts	**D** Dual

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, source inspection, and/or special element evaluation.

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

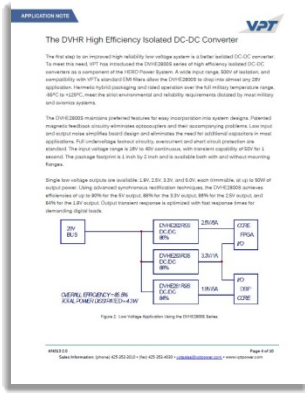
All information contained in this datasheet is believed to be accurate, however, no responsibility is assumed for possible errors or omissions. The products or specifications contained herein are subject to change without notice.

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