power-one®
Changing the Shape of Power

Features

- RoHS lead solder exemption compliant
- 75 Watts total output power
- Wide input range 18 V – 60 V
- Independent dual outputs
- Flexible load sharing
- Open-frame design with IMS board
- Low profile – 12.7 mm height
- Start-up into high capacitive load
- Output overcurrent protection (self restart)
- Output overvoltage protection (self restart)
- Overtemperature protection (self restart)
- Setpoint accuracy $\pm$ 2.0%
- Output voltage trim adjust, independent for each output
- Input/output isolation: 1500 V
- UL 1950 Recognition, CSA 22.2 No. 950-95 certification

Applications

- Distributed power architectures
- Telecommunications equipment
- LAN/WAN applications
- Data processing applications

Description

The HWD Series provides onboard conversion of standard telecom and datacom input voltages into two isolated low-voltage outputs. These products offer a unique combination of wide input range, low profile, and high current capability. High efficiency and advanced thermal management enable these half-brick products to deliver full rated power at 55 °C ambient temperature with 200 LFM airflow (without the addition of heat sinks).

Model Selection						
Model	**Input Voltage Range, VDC**	**Input Current, Max, ADC**	**Output Voltage, VDC**	**Output Rated Current, ADC**	**Output Ripple and Noise, mV p-p**	**Efficiency %**
HWD075DGE-A	18-60	5.5	5.0/3.3	15/15	100	81% @ 24 Vin 79% @ 48 Vin

Table 1. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Units
Input Voltage Continuous Transient (100 msec)	Vi Vi	- -	60 100	VDC VDC
Operating Baseplate Temperature Note 1	Tb	-40	+100	°C
Storage Temperature	Tstg	-55	+125	°C
Input to Output Isolation	-	-	1500	VDC
Output Short Circuit Duration	-	-	Continuous	-
Total Output Power	$P_o$max	-	75	W
No Load Power Dissipation		-	6	W

Electrical Specifications

Unless otherwise indicated, specifications apply over all input voltages, resistive load, and Tbp=+40°C.

Table 2. Input Specifications

Parameter	Symbol	Min	Typ	Max	Units
Voltage Range	Vi	18*	24/48	60	VDC
Maximum Input Current	Ii	-	-	5.5	A
Input Ripple Rejection (120 Hz)		-	60	-	dB
Inrush Transient		-	-	1	A^2s
Input Reflected Ripple (see figure 1)		-	-	250	mA p-p

• Module will operate within specification with an input voltage of 18 VDC, but must be turned on with an input voltage > 19.5 VDC. See Undervoltage Lockout Specification.

Fusing Considerations

<u>CAUTION</u>

This DC-DC converter is not internally fused. An external input fuse must always be used.

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Table 3. Output Specifications

Parameter	Symbol	Min	Typ	Max	Units
Output Power	Po1	-	-	75	W
	Po2	-	-	50	W
	Po1+Po2	-	-	75	W
Output Voltage Set Point	Vo1	4.9	5.0	5.1	VDC
(Vi=24 VDC or Vi=48 VDC,	Vo2	3.23	3.3	3.37	VDC
Io1,Io2=7.5A)					
Output Line Regulation:	Vo1,Vo2	-	0.05	0.2	%
(Vi=Vi,min to Vi,max)					
(Io1, Io2=7.5A)					
Output Load Regulation:	Vo1,Vo2	-	0.5	1	%
(Io,min to Io,max)					
Output Temperature Regulation:	All Outputs	-	0.02	0.05	%/°C
(Tbase =-40 °C to +100 °C)					
Output Current	Io1	0.5	7.5	15	A
(Maximum output power limited to 75 W)	Io2	0.5	7.5	15	A
Output Ripple (See Figure 2)	Vo1	-	75	100	mVp-p
(DC to 20 MHz)	Vo2	-	75	100	mVp-p
(Io1,Io2 = 7.5 A)					
Output Current Limit inception	Io1	-	17	19	A
(Other outputs at no load)	Io2	-	21	23	A
Transient Response					
(50% to 100% Load Step,					
ΔIo/Δt=0.1A/uSec)					
Peak Deviation	Vo1	-	100	200	mV
	Vo2	-	200	300	mV
Settling Time (Vo, 1% of Vo1)		-	150	250	μsec
Overvoltage Limit	Vo1,clamp	5.9	-	6.5	VDC
	Vo2,clamp	3.6	-	4.7	VDC

Table 4. Feature Specifications

Parameter	Symbol	Min	Typ	Max	Units
Remote On/Off, Primary side					
Vlow		-	-	1	V
Vhigh		-	-	7	V
Sink Current-Logic Low		-	-	2	mA
Turn-on time (Within 1% $V_o$nom)		-	3.5	5	msec
Switching Frequency		-	350	-	kHz
Output Voltage Adjust					
Adjust Up Vo1		5.39	5.5	5.61	VDC
Vo2		3.55	3.63	3.71	VDC
Adjust Down Vo1		4.41	4.5	4.59	VDC
Vo2		2.91	2.97	3.03	VDC
Thermal Shutdown		+105		+115	°C
Undervoltage Lockout					
Turn-on		-	19.2	19.5	V
Turn-off		16.5	16.8	-	V

Table 5. Environmental

Parameter	Min	Typ	Max	Units
Operating Baseplate Temperature	-40	-	+100	°C
Operating Humidity (non-condensing)	-	-	95	%
Storage Humidity (non-condensing)	-	-	95	%

Table 6. Isolation Specifications

Parameter	Min	Typ	Max	Units
Input to Each Output	1500	-	-	VDC
Input to Baseplate	1500	-	-	VDC
Output to Output	-	-	-	VDC
Resistance, Input - Output	10	-	-	MΩ
Capacitance, Input - Output	-	2200	-	pF

Table 7. EMI and Regulatory Agency Compliance

Conducted Emissions (With input filter configuration in Figure 3.)	CISPR 22 class A
Safety	UL60950 Recognized, CAN/CSA C22.2 No. 60950-00 Recognized

Table 8. General Specifications

Parameter	Min	Typ	Max	Units
Efficiency η (Vi=24 VDC, Io1,Io2 = 7.5 A) (Vi=48 VDC, Io1,Io2 = 7.5 A)	79 77	81 79	- -	%
Calculated MTBF (Po=60 W, Tbp=40 °C)	-	900	-	kHrs

Table 9. Physical

Parameter				Units
Dimensions	2.30 (58.4)	2.40 (60.9)	0.50 (12.70)	in (mm)
Weight			2.4(68)	oz(g)
Markings & labeling	Includes Part Number, Power-One Logo, Date Code and Country of Manufacture			

Mechanical Diagram

Pin	Function
1	-Vin
2	Case
3	On/Off
4	+Vin
5	+Vo2
6	+Vo2 Rtn
7	Trim 2
8	+Vo1
9	+Vo1 Rtn
10	Trim 1
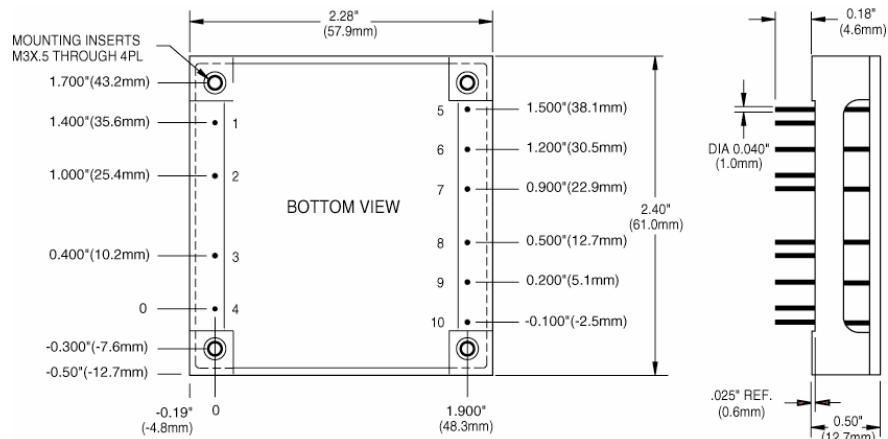
Table 10. Ordering Information

Options	Suffixes to add to part number
Remote On/Off	Positive- Standard, no suffix required
	Negative- Add "N" suffix
Trim	Negative- Standard, no suffix required
Pin Length	0.18"- Standard, no suffix required
	0.11"- Add "8" suffix
	0.15"- Add "9" suffix

Notes
1. Consult factory for the complete list of available options.

Test Setup
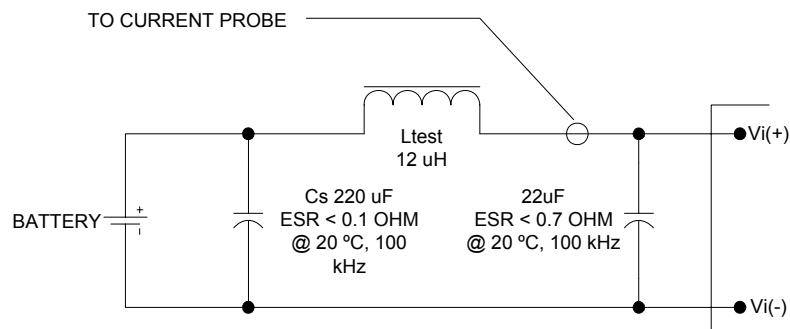
Figure 1. Input Reflected Ripple Current Test Set-up

Note: Measure input reflected-ripple current with a simulated inductance (Ltest) of 12 µH. Capacitor Cs offsets possible battery impedance. Measure current as shown above.
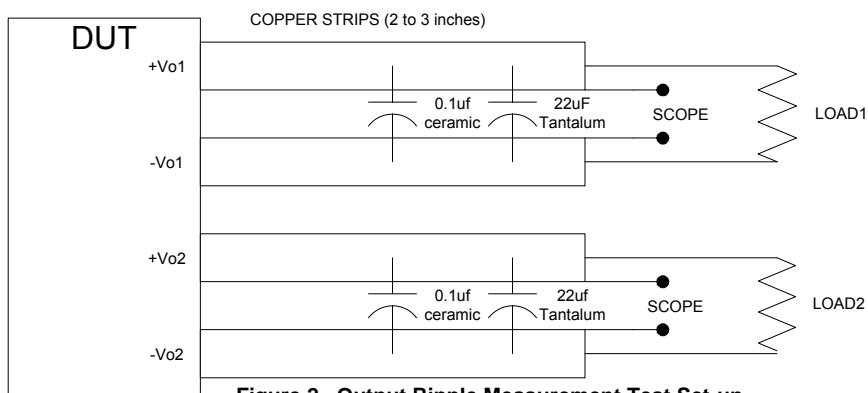
Figure 2. Output Ripple Measurement Test Set-up

Note: Use a 0.1µF ceramic and 22µF tantalum capacitor. Scope measurement should be made using a BNC socket. Position loads between 51 mm and 76 mm (2 in. and 3 in.) from module.
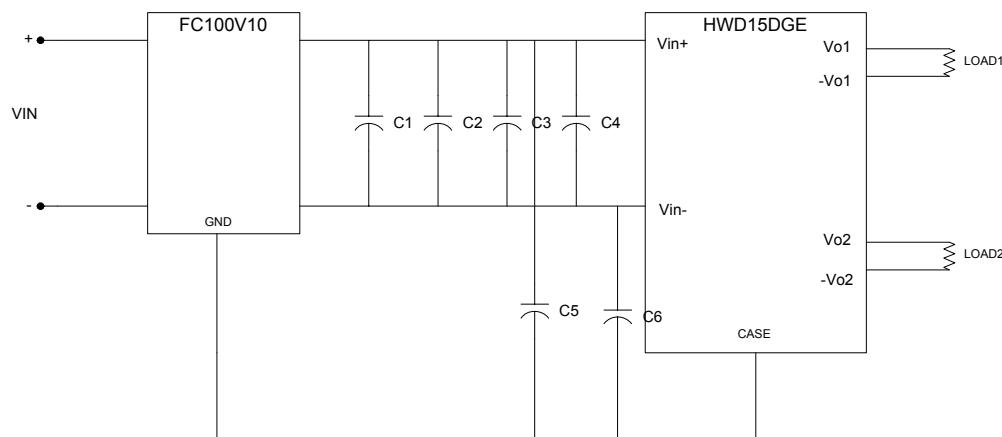
Figure 3. Input Filter Configuration Required to Meet CISPR 22 Class A for Conducted Emissions

Table 11. Part List for Input Filter

Ref. Des	Description	Manufacture
C1, 2	0.47uF @100V MLC Capacitor (1812)	AVX or Equivalent (Equiv.)
C3	100uF @ 100V Alum. Electrolytic Capacitor	Nichicon NRSZ Series or Equiv.
C4	22uF@ 100V Alum. Electrolytic Capacitor	United Chemicon KMG Series or Equiv.
C5, 6	0.01uF MLC Capacitor	AVX or Equiv.
F1	FC100V10 Input Filter Module	Power-One

FEATURE DESCRIPTIONS

Output Overvoltage Clamp

The output overvoltage clamp consists of a separate control loop, independent of the primary control loop. This control loop has a higher voltage setpoint than the primary loop. In a fault condition the converter goes into "Hiccup Mode", and the output overvoltage clamp ensures that the output voltage does not exceed Vo,clamp,max. This secondary control loop provides a redundant voltage control that reduces the risk of output overvoltage.

Output Current Protection

To provide protection in an output overload or short circuit condition, the converter is equipped with current limiting circuitry and can endure the fault condition for an unlimited duration. At the point of current-limit inception, the converter goes into "Hiccup Mode", causing the output current to be limited both in peak and duration. The converter operates normally once the output current is brought back into its specified range.

Enable

Two enable options are available. Positive Logic Enable and Negative Logic Enable. Positive Logic Enable turns the converter ON during a logic-high voltage on the enable pin, and OFF during a logic-low. Negative Logic Enable turns the converter OFF during a logic-high and ON during a logic-low.

Output Voltage Adjustment

Output voltage adjustment is accomplished by connecting an external resistor between the Trim Pin and either the +Vo1 or –Vo1 Pins.

With an external resistor between the Trim Pin and +Vo1 Pin (Radj-down) the output voltage set point (Vo,adj) decreases. The following equation determines the required external resistor value to obtain an adjusted output voltage:

$$\text{Radj, dn} = \left[\frac{(Vo, adj - D)A}{Vo, nom - Vo, adj} - B \right] \text{ohm}$$

Where Radj-down is the resistance value and A, B, and D are defined in Table 7.

With an external resistor between the Trim Pin and –Vo1 Pin (Radj-up) the output voltage set point (Vo,adj) increases. The following equation determines the required external resistor value to obtain an adjusted output voltage:

$$\text{Radj, up} = \left[\frac{A \cdot D}{(Vo, adj - D) - C} - B \right] \text{ohm}$$

Where Radj-up is the resistance value and A, B, C, and D are defined in Table 12.

Table 12.Output Adjustment Variables

Output	A	B	C	D
Vo1	4990	2000	2.5	2.5
Vo2	4990	2000	0.8	2.5

THERMAL CONSIDERATIONS

The power converter operates in a variety of thermal environments: however, sufficient cooling should be provided to help ensure reliable operation of the converter. Heat-dissipating components are thermally coupled to the case. Heat is removed by conduction, convection, and radiation to the surrounding environment. Proper cooling can be verified by measuring the case temperature.

Heat Transfer Characteristics

Increasing airflow over the converter enhances the heat transfer via convection. Figure 4 shows the maximum power that can be dissipated by the converter without exceeding the maximum case temperature versus local ambient temperature (T_A) for natural convection through 400 ft/min.

Systems in which these converters are used generate airflow rates of 50 ft/min due to other heat dissipating components in the system. Therefore, the natural convection condition represents airflow rates of approximately 50 ft/min. Use of Figure 4 is shown in the following example.

Example

What is the minimum airflow required for the device operating at 24 V, an output power of 60 W, and maximum ambient temperature of 60 ºC.

Solution:
        Given: Vi = 24 V, Po = 60 W, T_A = 60 ºC.
        Determine P_D (Figure 4): P_D = 13 W.
   Determine airflow (Figure 4): v = 200 ft/min

HWD15DGE - Power Derating
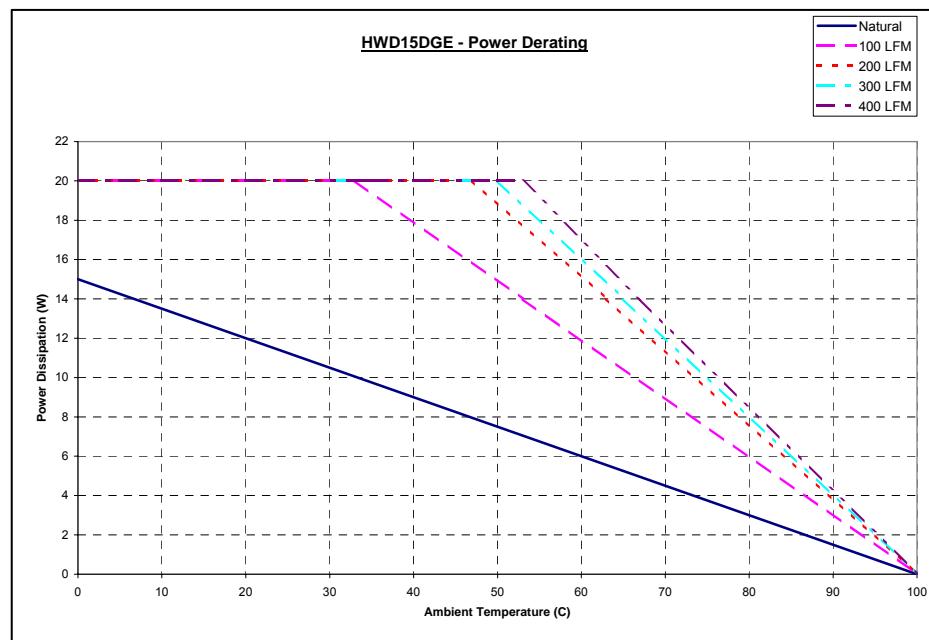
Figure 4. Power Derating Curve

**HWD15DGE Power Dissipation vs Output Power**
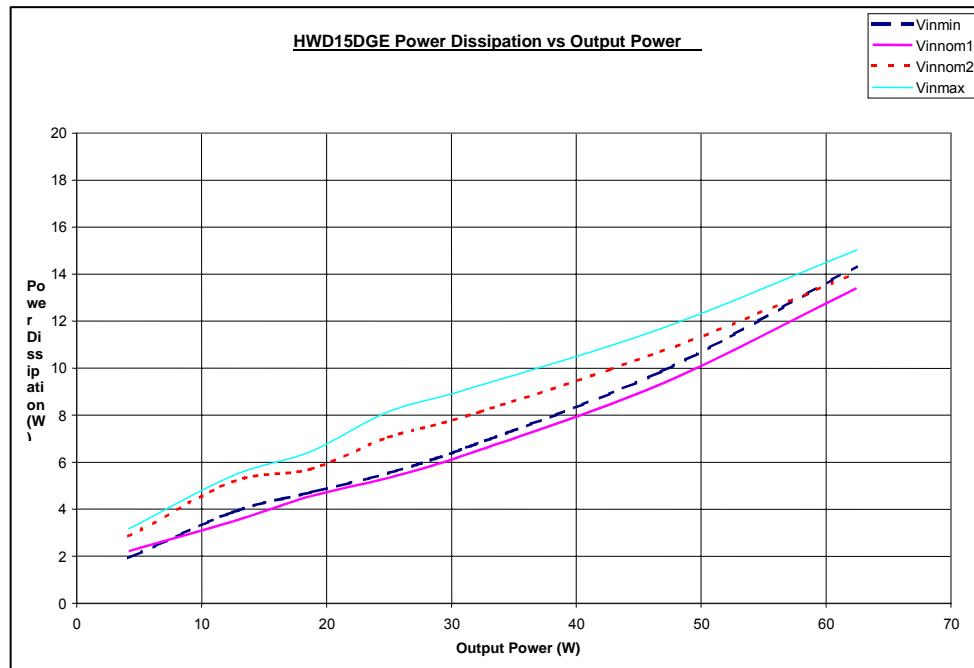
Figure 5. Power Dissipation Vs. Output Power
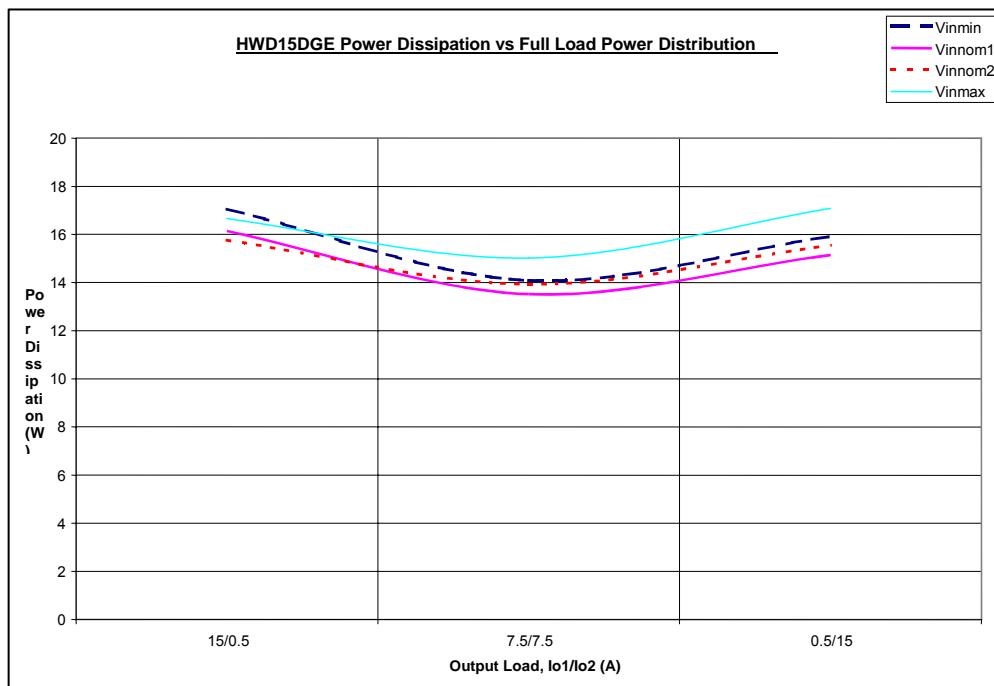
Figure 6. Power Dissipation Vs. Full-Load Distribution

Characteristic Curves

Tb = 40 ºC, nominal input voltage, and rated load unless otherwise specified.
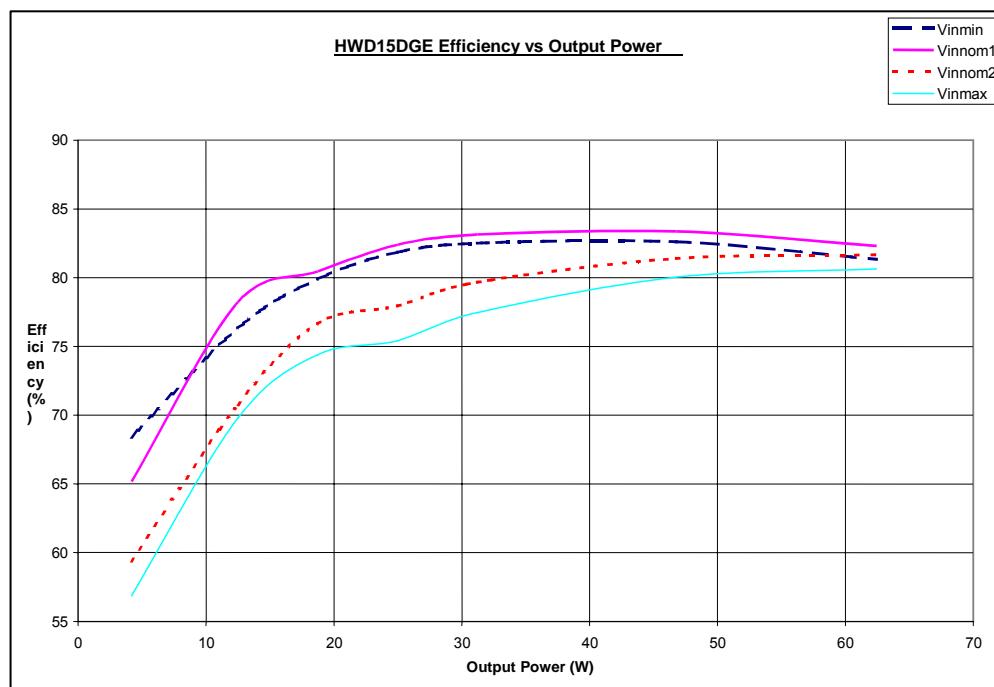
Figure 7. Efficiency Vs. Output Power

**HWD15DGE Efficiency vs Full Load Power Distribution**
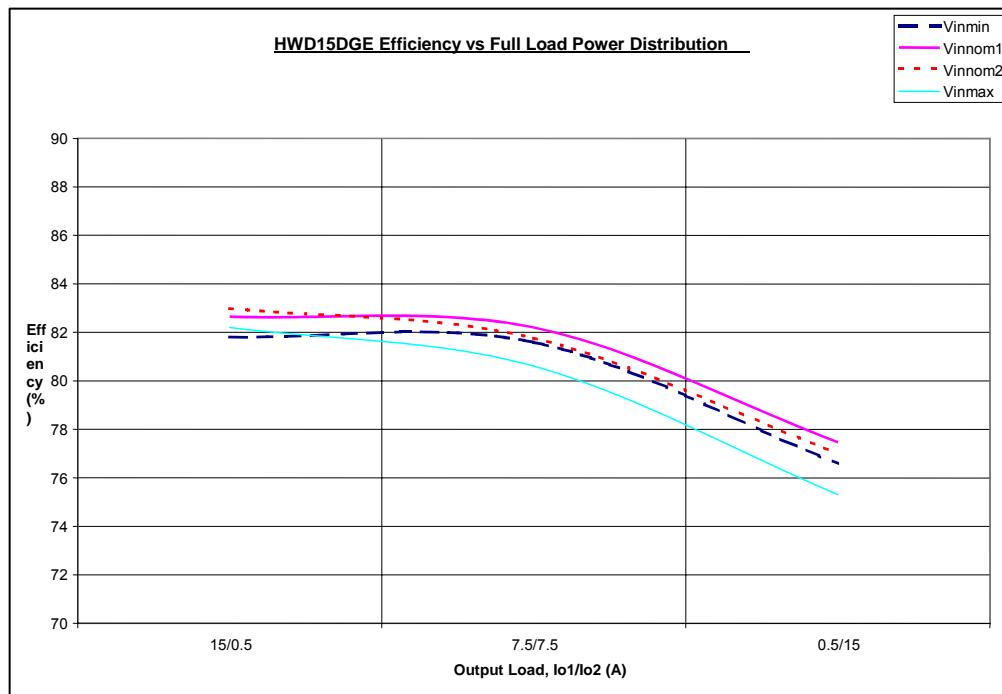
Figure 8.Efficiency Vs. Full-Load Power Distribution
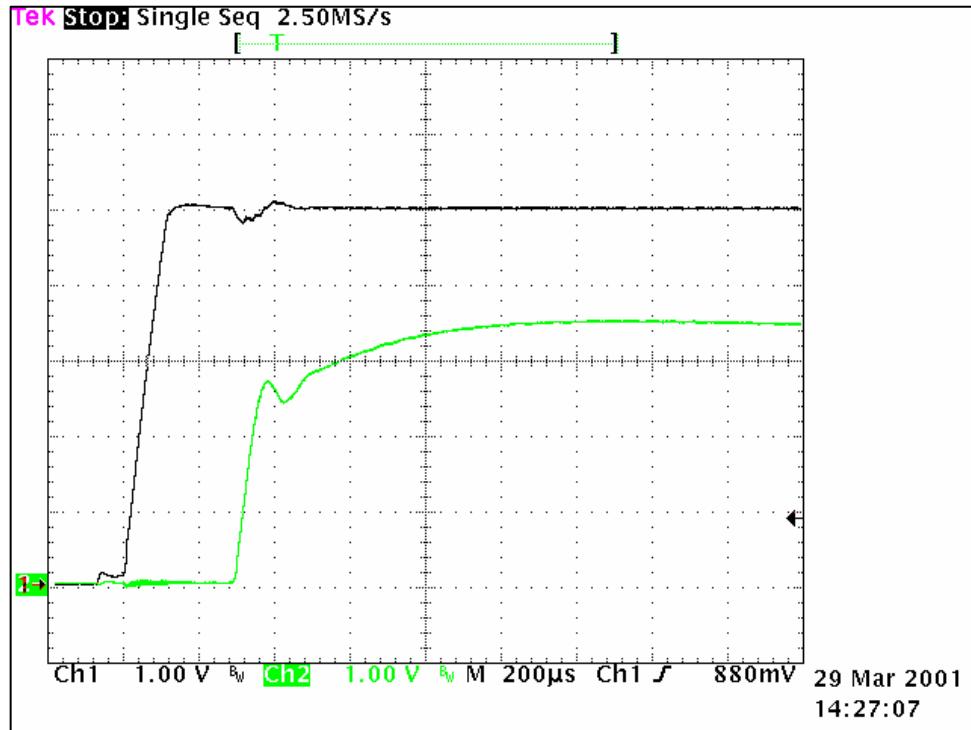
**Figure 9. Typical Turn-ON Characteristics**
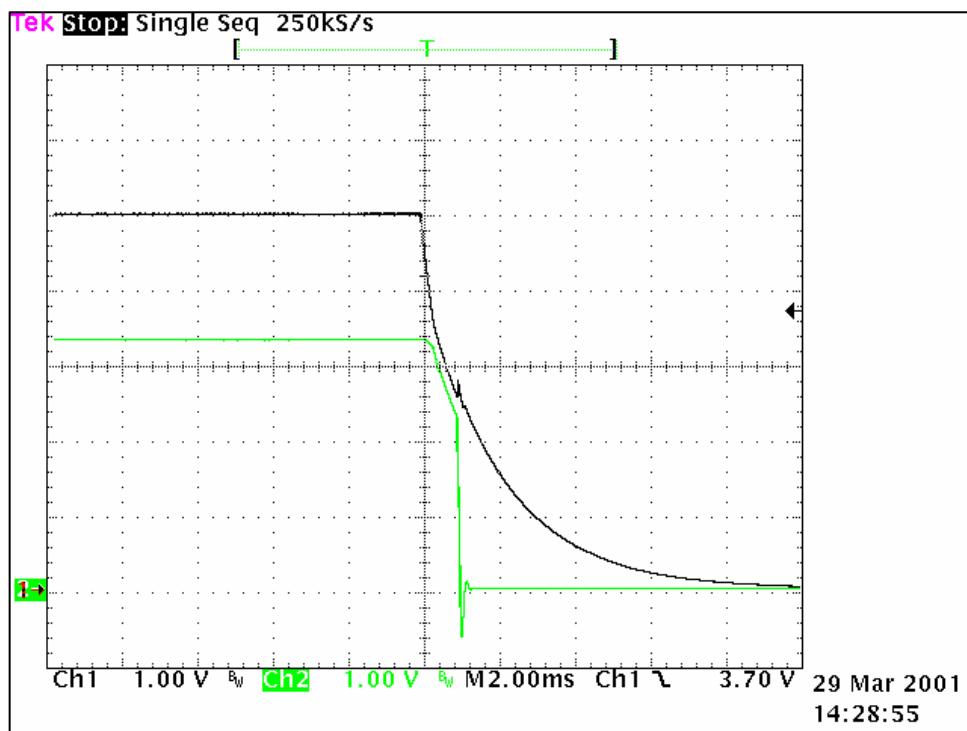
Figure 10. Typical Turn-OFF Characteristics

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