Data Sheet

HBT Series – Half-Brick DC/DC Converter
48V Input
60 Watt Triple Output

Applications

- Distributed power architectures
- Data and Telecommunications Equipment
- Computer Equipment
- Distributed power architectures
- LAN/WAN applications
- Data processing applications

Features

- 60 Watts maximum total output power
- Three fully isolated outputs 5V/12V/12V
- 5V output provides up to 12 Amps
- (2) 12V outputs each provide up to 2.5 Amps
- Excellent cross regulation
- Low profile – 12.7 mm
- High efficiency topology, 88% Typical
- Output overcurrent & overvoltage protection
- Overtemperature protection
- Set point accuracy ± 2.0%
- 1500V Input/output isolation meets basic insulation requirements
- UL 1950 Recognized, CSA 22.2 No. 950-95 certified; TUV IEC950

Description

The HBT17ZGHH DC-DC Converter operates over an input voltage range of 33Vdc to 75Vdc and provides three isolated output voltages. The 5V output can provide a full 60W (12 Amperes) of output power and each 12V output can provide up to 30W (2.5 Amperes) of output power. The input is fully isolated from each output and each output is isolated from one another. The isolation of each output provides flexible output configurations and separate output returns, which are important in preventing cross-interference between different loads in system applications. The module has a typical full load efficiency of 88%.

The two-board construction optimizes thermal performance. Power devices are connected to an Integrated Metal Substrate base plate to minimize thermal impedance and a separate control board is physically isolated from the hotter IMS board. This approach allows for lower average component temperatures on the control board and increases the overall reliability. The comprehensive standard feature set includes remote on/off, and output trim.

Selection Chart

Model	Input voltage range, VDC	Input current, max, ADC	Output voltage, VDC	Output rated current, ADC	Output Ripple and Noise, mV p-p	Efficiency %
HBT060ZGHH-A	33-75	3.0	5.0/12.2/12.2	12/2.5/2.5	125/150/150	88

Table 1. Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Units
Input Voltage Continuous Transient	 Vi Vi	 - -	 80 100	 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	Pomax	-	60	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	33	48	75	Vdc
Maximum Input Current	Ii	-	-	3	A
Input Ripple Rejection (120Hz)		-	60	-	dB
Inrush Transient		-	-	1	A^2s
Input Reflected Ripple (See Fig.1)				100	MA_{p-p}

Fusing considerations

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

Table 3. Output Specifications

Parameter	Symbol	Min	Typ	Max	Units
Output Power	Po1 Po2 Po3	- - -	- - -	60 30 30	W W W
Output Voltage Set Point (Vi=48Vdc, Io1=6A, Io2=Io3=1.25A)	Vo1 Vo2, Vo3	4.9 11.834	5.0 12.2	5.1 12.566	Vdc Vdc
Output Line Regulation: (Vi=Vi,min to Vi,max) (Io1=6A, Io2=Io3=1.25A)	Vo1	-	0.02	0.1	%
Output Load Regulation: (0.5A to Iomax)	Vo1	-	0.2	0.4	%
Output Load Regulation: (Vi = Vi.min to Vi,max) (All Loading Conditions)	Vo2, Vo3	10.5	-	13.5	Vdc
Output Temperature Regulation: (Tbase =-40°C to +100°C)	All Outputs	-	0.02	0.05	%/°C
Output Current (Maximum output power limited to 60W)	Io1 Io2 Io3	0.5 0 0	6 1.25 1.25	12 2.5 2.5	A A A

Parameter	Symbol	Min	Typ	Max	Units
Output Ripple (See Figure 2) (DC to 20MHz) (Io1 = 6A, Io2,Io3 = 1.25A)	Vo1 Vo2 Vo3	- - -	125 150 150	200 250 250	mVp-p mVp-p mVp-p
Output Current Limit inception (Other outputs at no load)	Io1 Io2 Io3	- - -	16 6.5 6.5	18 7 7	A A A
Transient Response (50% to 100% Load Step, ΔIo/Δt=0.1A/uSec)					
Peak Deviation	Vo1	-	75	200	mV
Settling Time (Vo, 1% of Vo1)		-	50	150	µSec
Overvoltage Limit	Vo1	5.9	-	6.5	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% Vonom)		-	3.5	5	mSec
Switching Frequency		-	440	-	KHz
Output Voltage Adjust (Vo1 only)	Vo,adj	8	-	9	%Vo,nom
Thermal Shutdown		+105		+115	°C
Undervoltage Lockout					
Turn-on		-	32	32.9	V
Turn-off		28	30	-	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	500	-	-	Vdc
Resistance, Input - Output	10	-	-	MΩ
Capacitance, Input - Output	-	1000	-	pF

Table 7. EMI & Regulatory Agency Compliance

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

Table 8. General Specifications

Parameter	Min	Typ	Max	Units
Efficiency η (V_i=48Vdc, I_{o1}=6A, I_{o2}=I_{o3}=1.25A)	86	87.5	-	%
Calculated MTBF (Po=60W, Tbp=40°C)	-	900	-	kHrs

Table 9. Physical

Parameter	Min	Typ	Max	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			

Feature Descriptions

Output Over-voltage Clamp

The output overvoltage clamp consists of a separate control loop, independent of the primary control loop. This control loop has a higher voltage set point than the primary loop. In a fault condition which creates an excessive output voltage, the converter goes into “Hiccup Mode” (turns off and restarts periodically in a pre-programmed fashion), 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 mechanism that prevents catastrophic voltages from occurring on the output under any single-fault condition.

Output Current Protection

To provide protection in an output overload or short circuit condition, the converter is equipped with a current limiting circuit, which can protect the converter from damage under a fault condition indefinitely. At the current-limit inception point due to an output overload, the converter goes into “Hiccup Mode” and limits both the peak output current and the duration of the operation. The converter recovers automatically to its normal operation once the output overload or short circuit is removed.

Enable

Two enable options are available-Positive Logic and Negative Logic. Positive Logic turns the converter on when a logic-high is present at the enable pin, and turns the converter off when a logic-low is present at the enable pin. Negative Logic turns the converter off when a logic-high is present at the enable pin, and turns the converter on when a logic-low is present at the enable pin.

Output Voltage Adjustment

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

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

Note: Output Vo1 is the only trimable output. Output Vo2 and Vo3 only follow how Vo1 is trimmed.

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

Where $R_{adj\text{-}down}$ is the trim-down resistance value and A, B, and D are constants defined in Table 10.

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

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

Where $R_{adj\text{-}up}$ is the trim-up resistance value and A, B, C, and D are constants defined in Table 10:

A	B	C	D
4990	25500	2.5	2.5

Table 10 Output Adjustment Variables.

Thermal Considerations

The power converter operates in various thermal environments. Sufficient cooling should be provided to help ensure reliable operation of the converter. Major heat-dissipating components are thermally coupled to the metal substrate. Heat is removed from the metal substrate by conduction, convection, and radiation to the surrounding environment. Proper cooling can be verified by measuring the temperature of the substrate. It is recommended the substrate temperature be maintained below 100 ºC for reliable operation. When necessary, an additional heat sink can be attached to the substrate to achieve desired thermal performance.

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 substrate temperature versus local ambient temperature (T_A).

Use of Figures 4 and 5 to properly determine proper airflow for cooling the converter at a given output power and a maximum ambient temperature is illustrated in the following example.

Example

What is the minimum airflow required for the device operating with an input voltage range of 33V to 75V, an output power of 60 W, at a maximum ambient temperature of 70 ºC?

Solution:

Given: Vi = 33V-75V, Po = 60 W, T_A = 70 ºC.
Step 1 (Determining P_D): From Figure 5, the maximum power dissipation is 12W (occurs at Vin = 33V)
Step 2 (Determine airflow): From Figure 4, to maintain the substrate temperature below 100C, the airflow has to be greater than 160LFM (interpolated between curves for 100LFM and 200LFM).

Test Setup

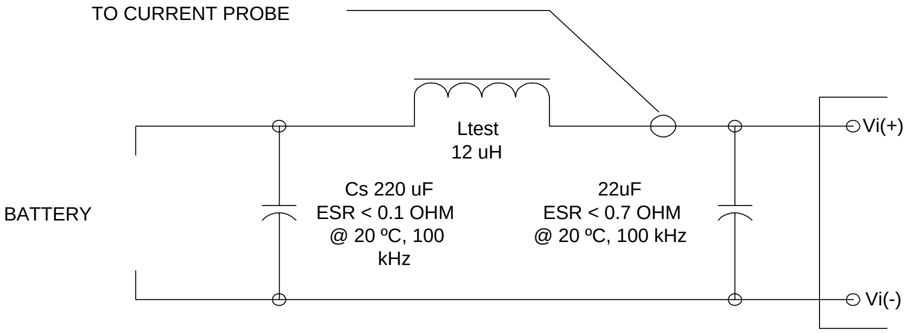


Figure 1 Input Reflected Ripple Current Test Set-up:
Note: Measure input reflected-ripple current with a simulated inductance (Ltest) of 12 uH. Capacitor Cs offsets possible battery impedance. Measure current as shown above.

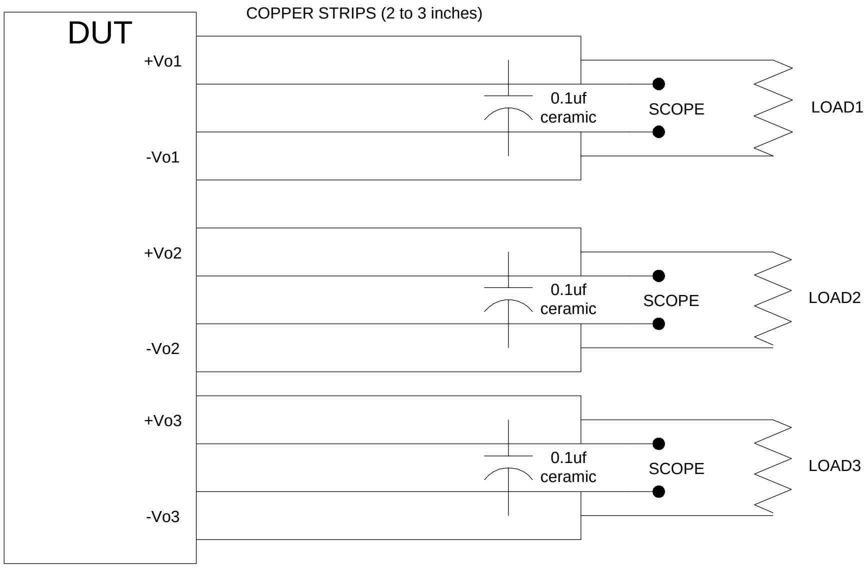


Figure 2: Output Ripple Measurement Test Set-up:
Note: Use a 0.1uf ceramic capacitor. Scope measurement should be made using a BNC socket. Position loads between 51 mm and 76 mm (2 in. and 3 in.) from module.

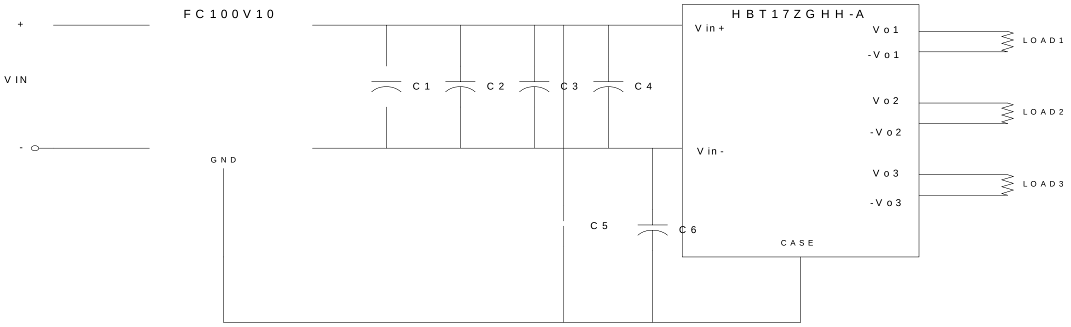


Figure 3: Input filter configuration required to meet CISPR 22 Class A for Conducted Emissions.

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

Thermal Considerations

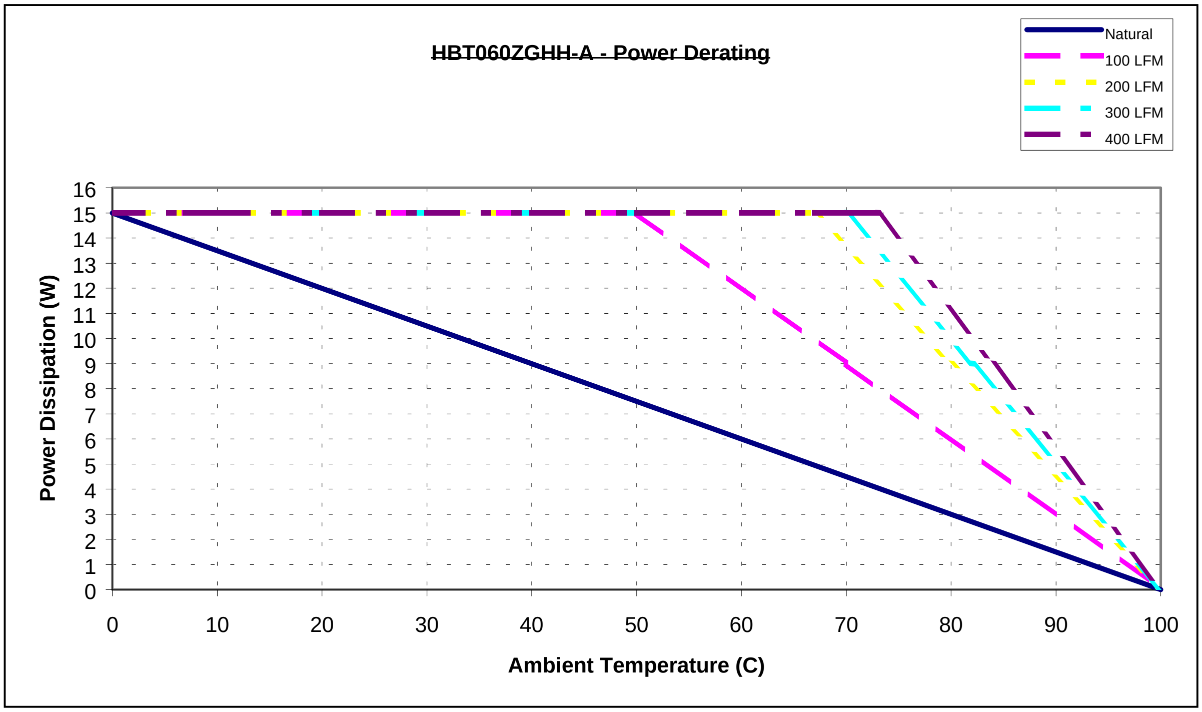


Figure 4. Maximum Allowable Power Dissipation to maintain substrate at 100 ^{o}C

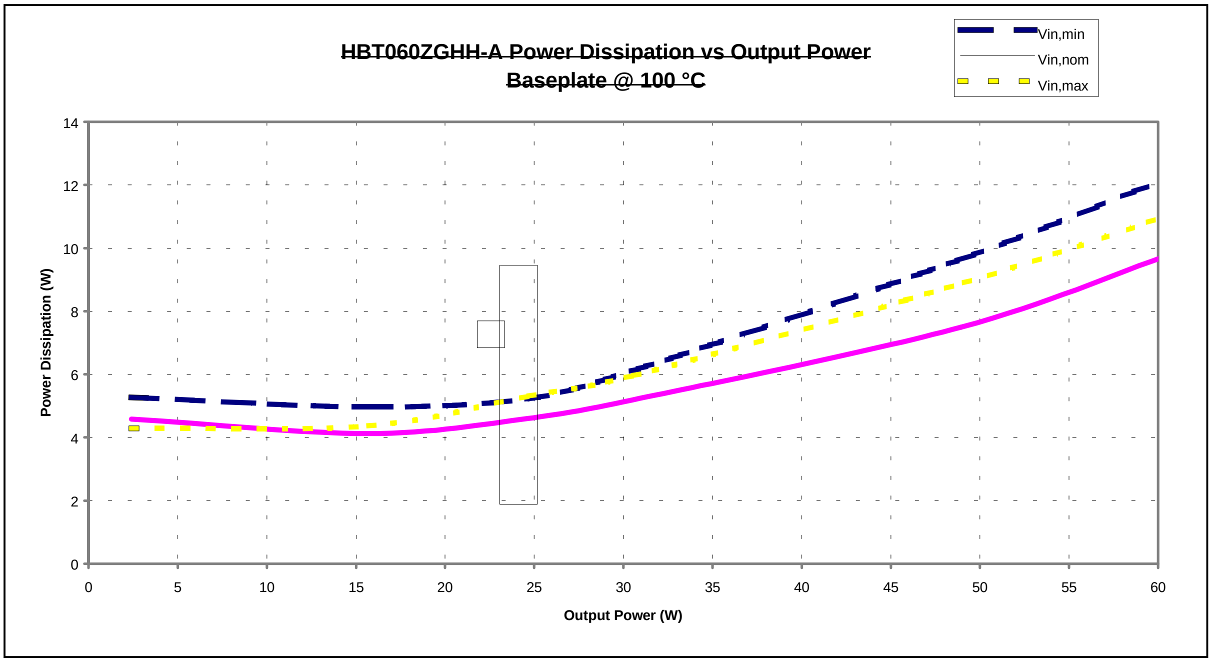


Figure 5. Power Dissipation vs. Output Power (substrate temperature maintained at 100 ^{o}C)

Thermal Considerations (continued)

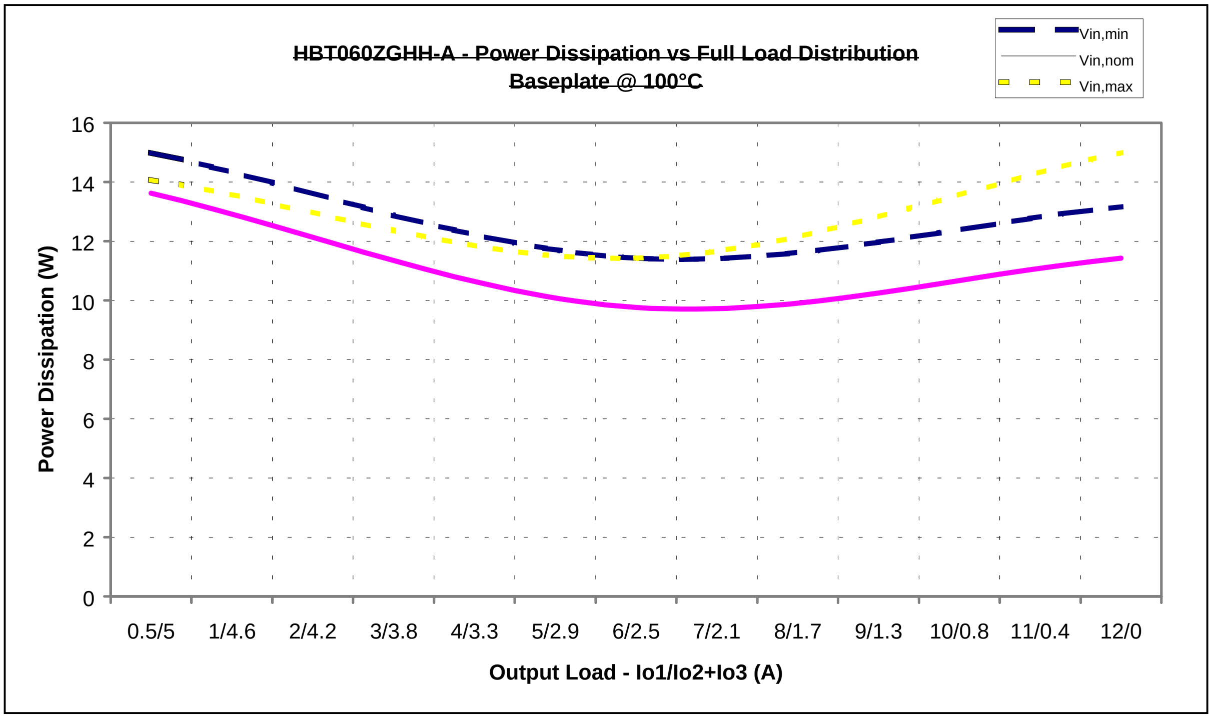


Figure 6. Power Dissipation vs. Full Load Distribution

Characteristic Curves *T_A = 25 ºC, nominal input voltage, and rated load unless otherwise specified.*

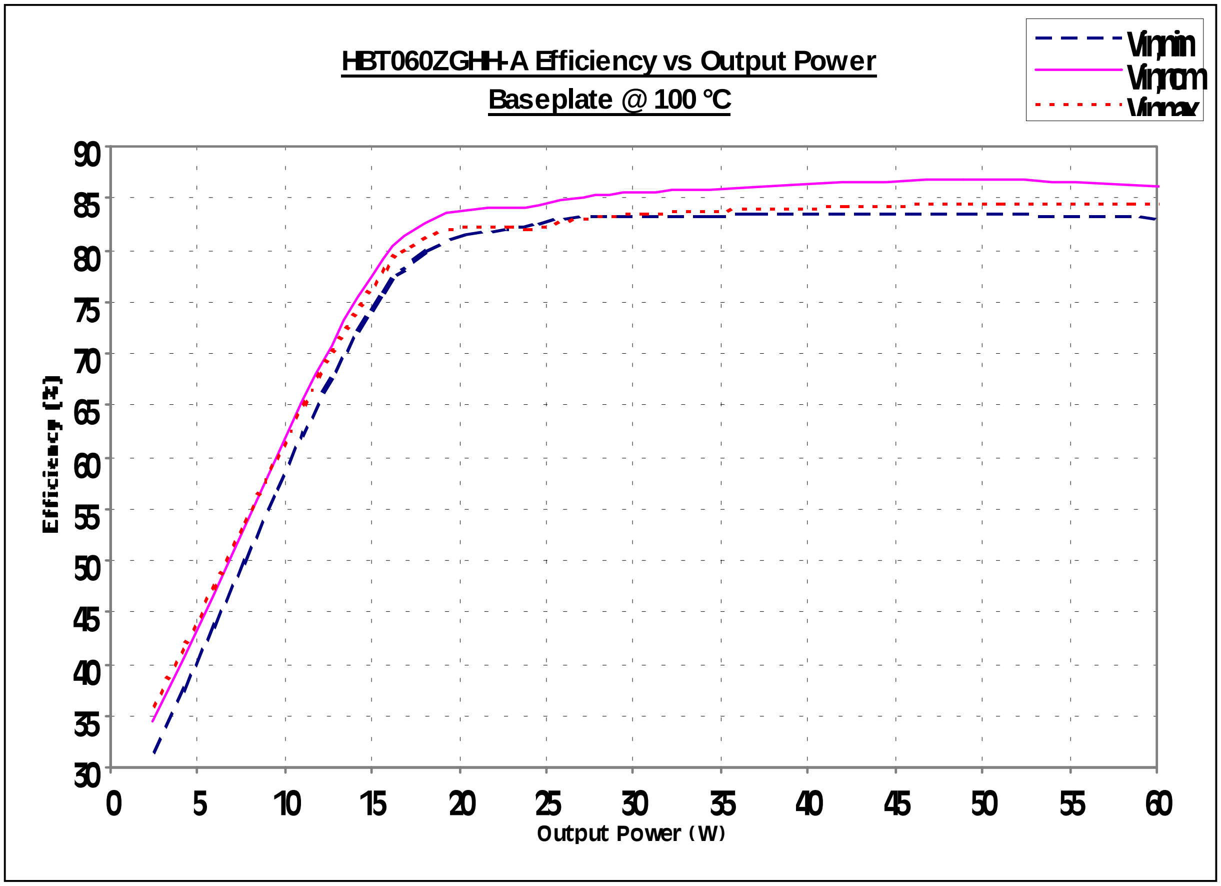


Figure 7. Efficiency vs. Output Power

Characteristic Curves *T_A = 25 ºC, nominal input voltage, and rated load unless otherwise specified.*

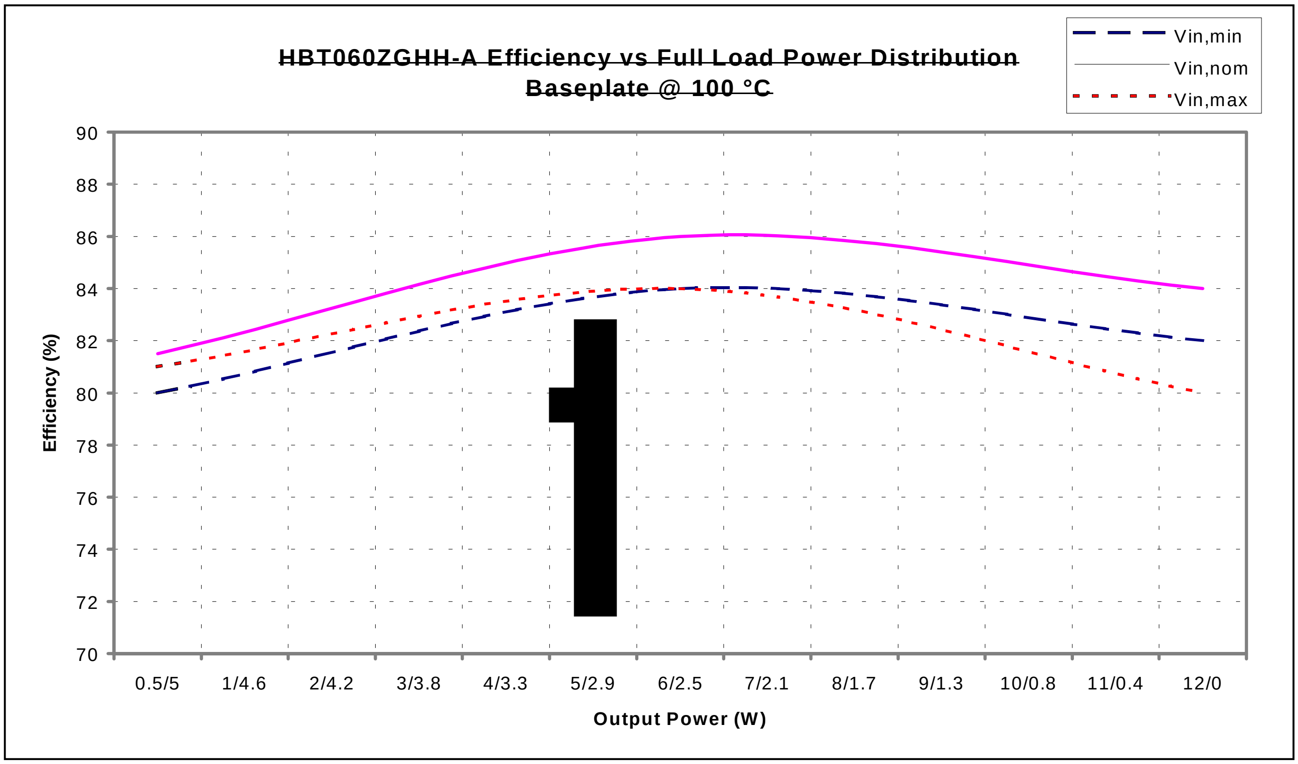


Figure 8 – Efficiency vs. FL Power Distribution

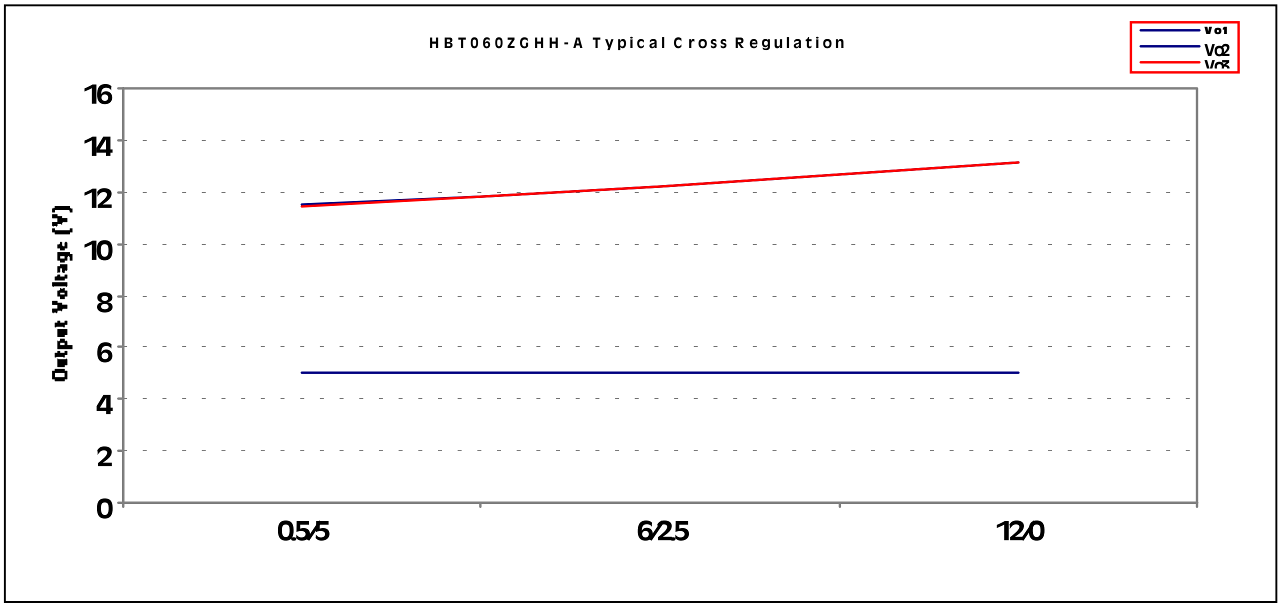
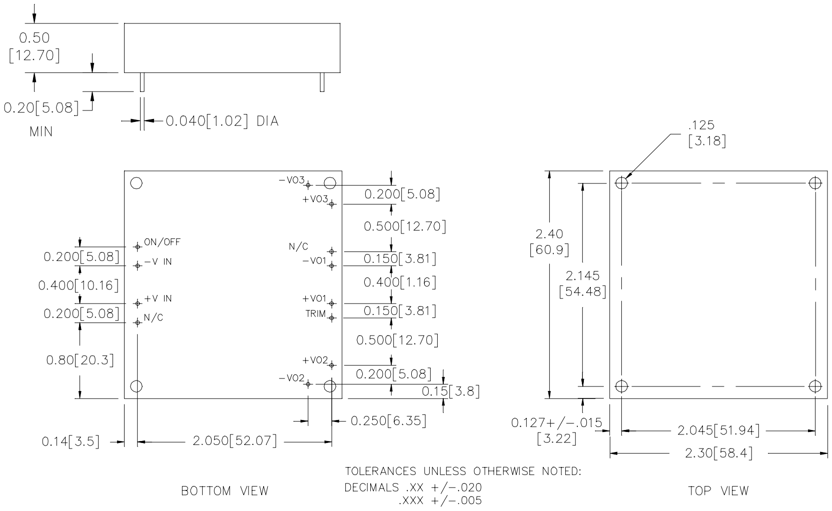


Figure 9. Typical Cross Regulation

Mechanical Drawing



Pin	Function
1	On/off
2	-Vin
3	+Vin
4	NC
5	-Vo2
6	+Vo2
7	Trim
8	+Vo1
9	-Vo1
10	NC
11	+Vo3
12	-Vo3

PIN VIEW

Tolerances:	.xx ± .020 (.5)
	.xxx ± .010 (.25)
Pin diameter:	± .0.002 (.05)

Ordering Information

Options	**Suffixes to add to part number**
Remote On/Off	Positive- Standard, no suffix required
	Negative- Add “N” suffix
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.
2. Power-One products are not authorized for use as critical components in life support systems, equipment used in hazardous environments, or nuclear control systems without the express written consent of the President of Power-One, Inc.
3. Specifications are subject to change without notice.