



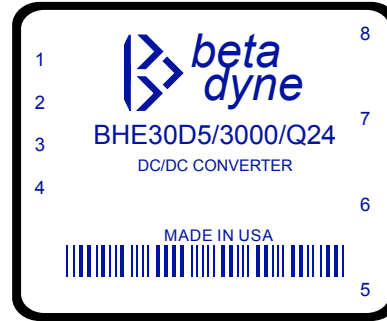
# BHE30 DC/DC DUAL CONVERTER

High Efficiency 30W,4:1 Input Range

US Patent 5,777,519

## Key Features

- Wide input voltage range 4:1
- Less than 60mV output noise
- Efficiency up to 88%
- Six-sided shielding
- Soft start
- Hiccup short circuit protection
- Adjustable output
- 1mA off state current
- 50µS transient response
- Industry standard pinouts



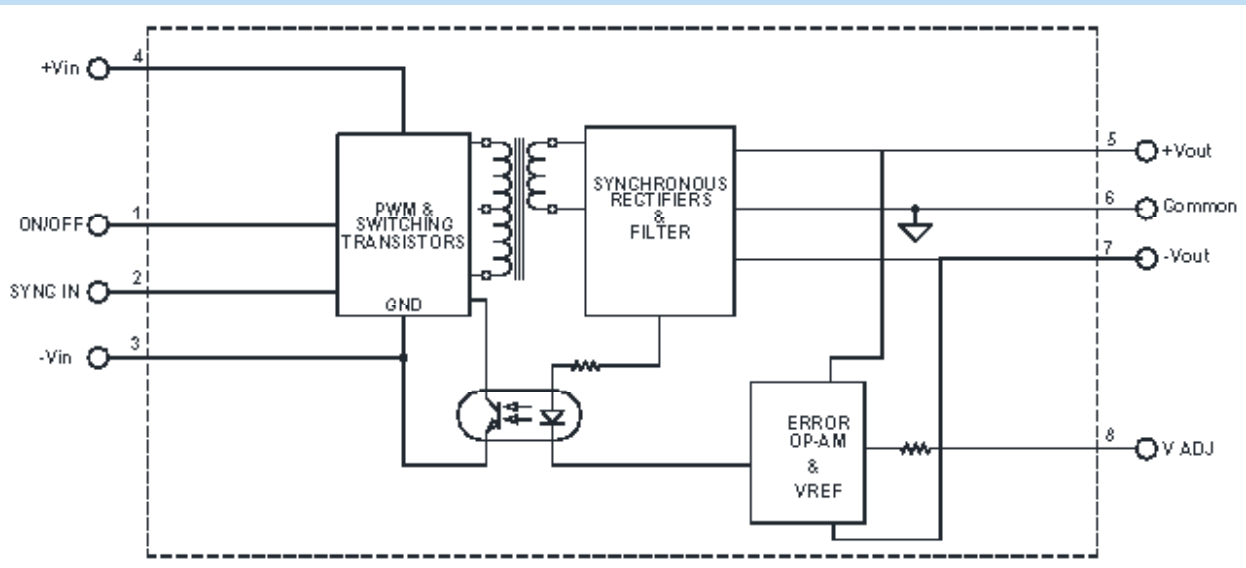
Beta Dyne is protected under various patents, including but not limited to U.S. Patent numbers: 5,777,519; 6,188,276; 6,262,901; 6,452,818; 6,473,3171.

## Applications

- High-Resolution Data Converters
- Instrumentation
- Test & Measurement
- Telecom

## Functional Description

The BHE30 Dual series is a family of high-performance, low-noise, isolated DC/DC converters consisting of dual output models. The converter incorporates low switching noise techniques at its input and rectification on the output to provide 30W of output power up to 88% efficiency in a 1.98x1.58x.40 case. It's high efficiency and SMT Technology allow the converter to operate from -40°C to +75°C without derating. All models are designed to meet the BASIC requirements of UL/EN60950-1 and CE mark.



Typical Block Diagram of BHE30 Dual Output Converter

## Electrical Specifications

### INPUT SPECIFICATIONS

Unless otherwise specified, all parameters are given under typical +25°C with nominal input voltage and under full output load conditions.

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Input Voltage Range	See Model Selection Guide				
Input Filter	LC				
Reverse Polarity Input Current	External series-blocking diode			12	A
Input Surge Current (20µS Spike)				10	A
Short Circuit Current Limit			150		% I <sub>IN</sub>
Undervoltage Shutdown, 24V <sub>in</sub>		7.5			Vdc
Undervoltage Shutdown, 48V <sub>in</sub>		14.5			Vdc
Off State Current,			2		mA
Remote ON/OFF Control, Positive Logic	Standard on All Model				
Converter ON	Open (Open Collector)				
Converter OFF		-0.6	0	0.2	Vdc
Logic Input Reference	-Input				
Logic Compatibility	TTL Open Collector or CMOS Open Drain				
Remote ON/OFF Control, Negative Logic	"N" Suffix				
Converter ON	ON (Pulled low to 0-0.6V)				
Converter OFF	Open(Open Collector)				
Logic Input Reference	-Input				
Logic Compability	Standard TTL Logic				

### OUTPUT SPECIFICATIONS

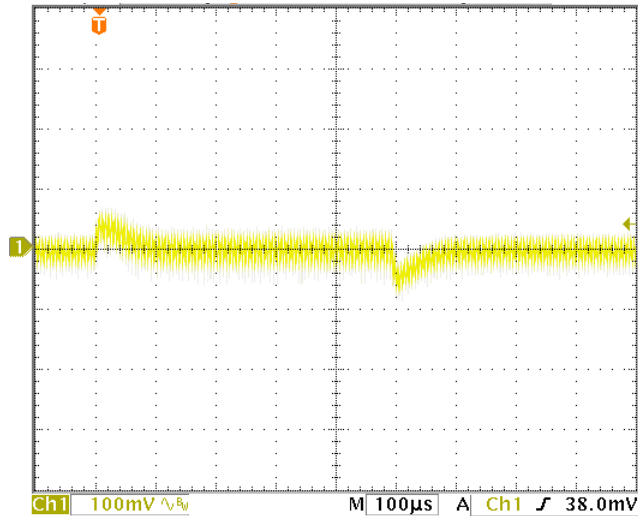
PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Voltage and Current Ratings	See Model Selection Guide				
Output Voltage Accuracy			±1	±1.5	%
Output Voltage Adjustment	See Figure 9		5	±10	%
Minimum Load	With balanced output loads	None			% of FL
Minimum Load	With unbalanced output loads, see Table 1.	10			% of FL
Ripple & Noise (20 MHz Bandwidth)			1	1.5	% of V <sub>PP</sub>
Line Regulation	Minimum V <sub>IN</sub> to maximum V <sub>IN</sub>		±.5	±1.0	%
Load Regulation	NL to FL		±.2	±.5	%
Temperature Coefficient @ FL			0.02		%/°C of V <sub>OUT</sub>
Transient Response Time (to within 0.5% of V <sub>OUT</sub> )	50% FL to FL to 50% FL, See Figure 1		50		µS
Short Circuit Protection	All outputs, by Hiccup technique				

### ENVIROMENTAL & GENERAL SPECIFICATIONS

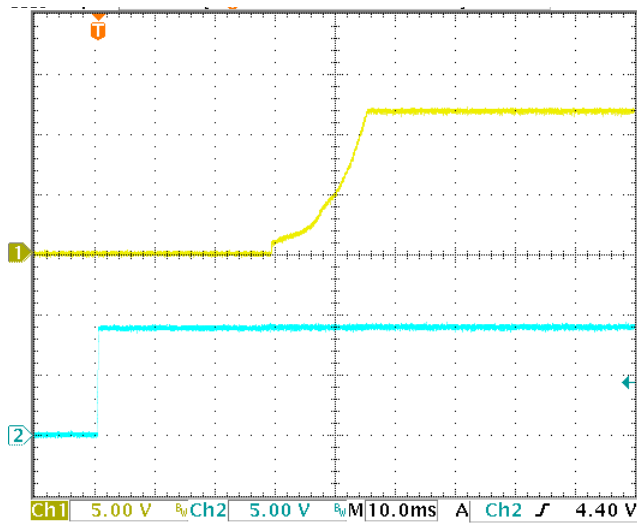
PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Efficiency	See Model Selection Guide				
Isolation Voltage (1 min.)			1500		Vdc
Isolation Resistance			100		MΩ
Isolation Capacitance			1090		pF
Switching Frequency			200		kHz
MTBF	per MIL-HNBK-217F(Ground Benign, +25C)		1 x 10 <sup>6</sup>		Hours
Thermal Resistance			1.0		°C/W
Operating Temperature, Industrial		-40		+75	°C/W
Maximum Operating Case Temperature				110	°C
EMI/RFI	Six-sided continuous shielded metal case				
Humidity	Up to 95% non-condensing				

**PHYSICAL CHARACTERISTICS**

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Dimensions (L×W×H)	1.98×1.58×0.400 in. (50.29×40.13×10.16mm)				
Weight	1.80 oz. (51.02g)				
Case Material	Coated metal				
Shielding Connection, 12, 24V <sub>IN</sub>	-Input (Pin 3)				
Shielding Connection, 48V <sub>IN</sub>	+Input (Pin 4)				



**FIGURE 1. Transient response of BHE30D5/3000/Q24 from Full load (3A) to Half Load (1.5A).**



**FIGURE 2. Start up & delay time of a BHE30D12/1250/Q24 at V<sub>IN</sub>=24V and I<sub>OUT</sub>=1.25A.**

## Model Selection Guide

MODEL NUMBER	INPUT				OUTPUT		
	Voltage (Vdc)		Current (mA)		Voltage (Vdc)	Current (mA)	Efficiency Full Load (%)
	Nominal	Range	No Load	Full Load			
BHE30D5/3000/Q24	24	9-36	17	1434	+/-5	+/-3000	87
BHE30D12/1250/Q24	24	9-36	86	1448	+/-12	+/-1250	86
BHE30D15/1000/Q24	24	9-36	84	1436	+/-15	+/-1000	87
BHE30D5/3000/Q48	48	18-72	13	720	+/-5	+/-3000	87
BHE30D12/1250/Q48	48	18-72	87	707	+/-12	+/-1250	88
BHE30D15/1000/Q48	48	18-72	122	707	+/-15	+/-1000	88

Contact factory for custom input and output voltage combinations

All BHE units come with the ON/OFF(pin 4) control function which is a positive polarity. If a negative polarity is required please add the suffix "N" to the part number. Standard on BHE dual units is the SYNC(pin 3), if not needed please add the suffix "NS" to the part number. See page 5 for ordering guide.

8

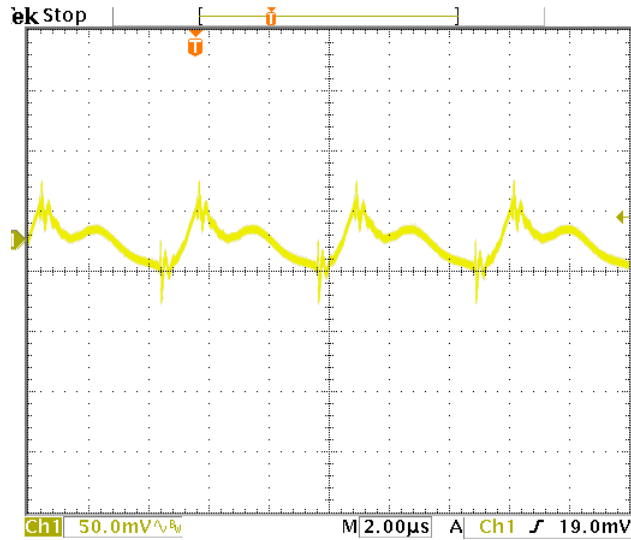


FIGURE 3. Typical  $+V_{OUT}$  output ripple of BHE30D5/3000/Q24 at  $V_{IN}=24V$ ,  $I_{OUT}=+3A$  with no external capacitors.

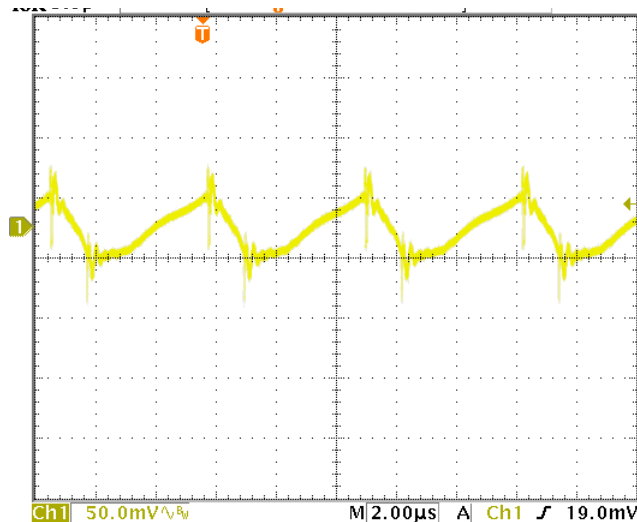


FIGURE 4. Typical  $-V_{OUT}$  output ripple of BHE30D5/3000/Q24 at  $V_{IN}=24V$ ,  $I_{OUT}=-3A$  with no external capacitors.

**ORDERING GUIDE**

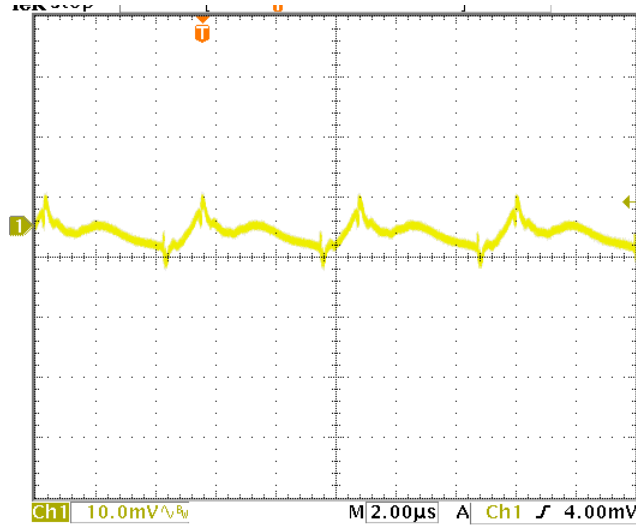
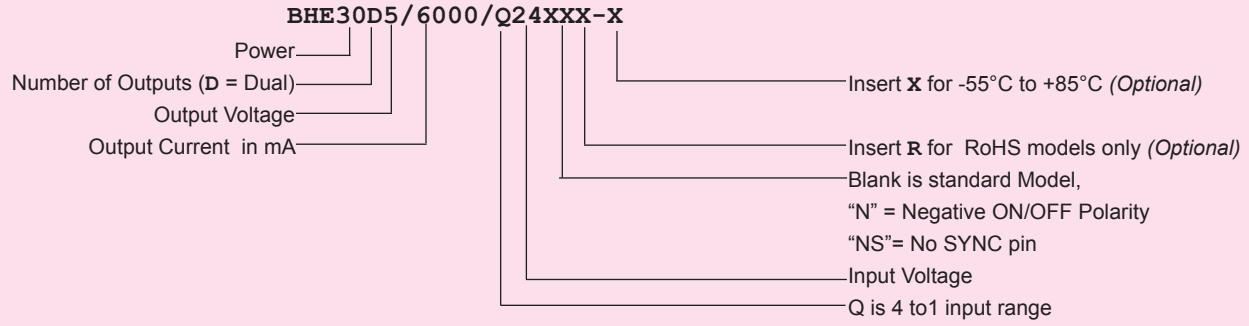


FIGURE 5. Typical +V<sub>OUT</sub> output ripple of BHE30D5/3000/Q24 at V<sub>IN</sub>=24V, I<sub>OUT</sub>=+3A with 180µF external capacitors.

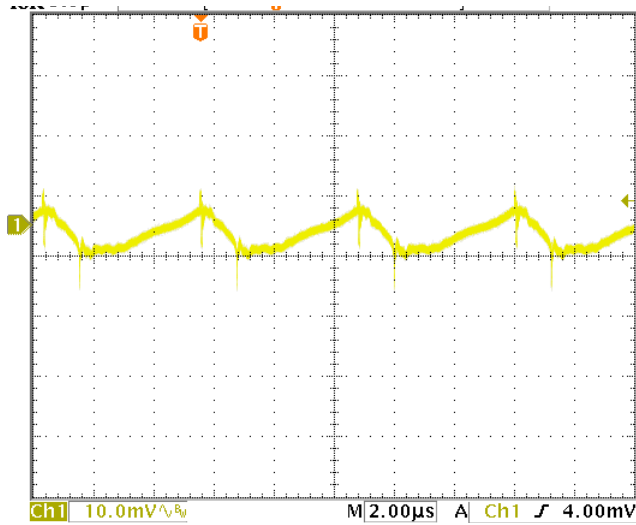
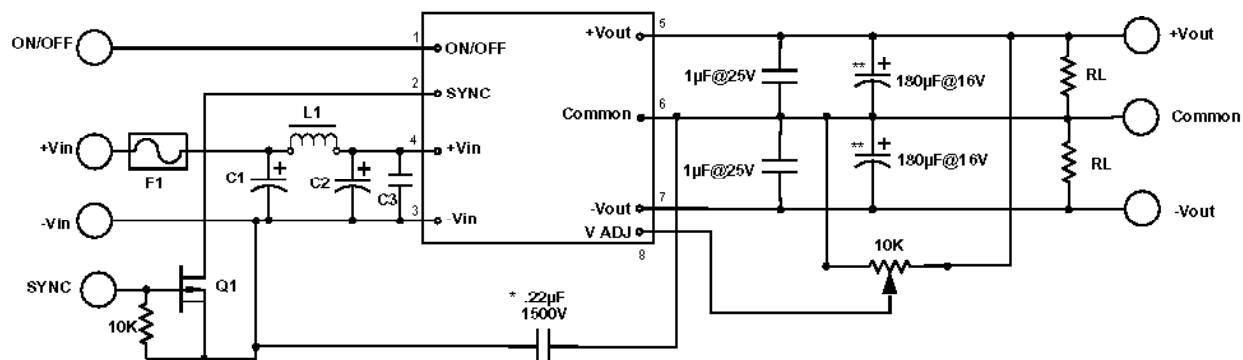


FIGURE 6. Typical -V<sub>OUT</sub> output ripple of BHE30D5/3000/Q24 at V<sub>IN</sub>=24V, I<sub>OUT</sub>=-3A with 180µF external capacitors.

Vin(V)	+Vout(V)	+Iout(A)	-Vout(V)	-Iout(A)	
48	5.0304	3	5.0072	3	full load(FL)
48	5.0066	3	5.0318	2.25	3/4 of FL
48	4.9812	3	5.0582	1.5	1/2 of FL
48	4.9443	3	5.096	0.75	1/4 of FL
48	4.8712	3	5.170	0.3	10% of FL

TABLE 1. BHE30D5/3000/Q48 cross regulation data with varying output loads.



$V_{IN}$	F1 (A)	C1 (Low ESR) ( $\mu F$ )	L1 (Low ESR) ( $\mu H$ )	C3 (ceramic) ( $\mu F$ )
24	6	47@25V	1	2.2@100V
48	3	22@50V	.6	2.2@100V

\*\*OPTIONAL PART TO FURTHER REDUCE OUTPUT RIPPLE  
 \*OPTIONAL PARTS  
 Q1=2N7002 OR EQUIVALENT

FIGURE 7. Typical connection diagram of BHE30 Dual DC/DC Converter

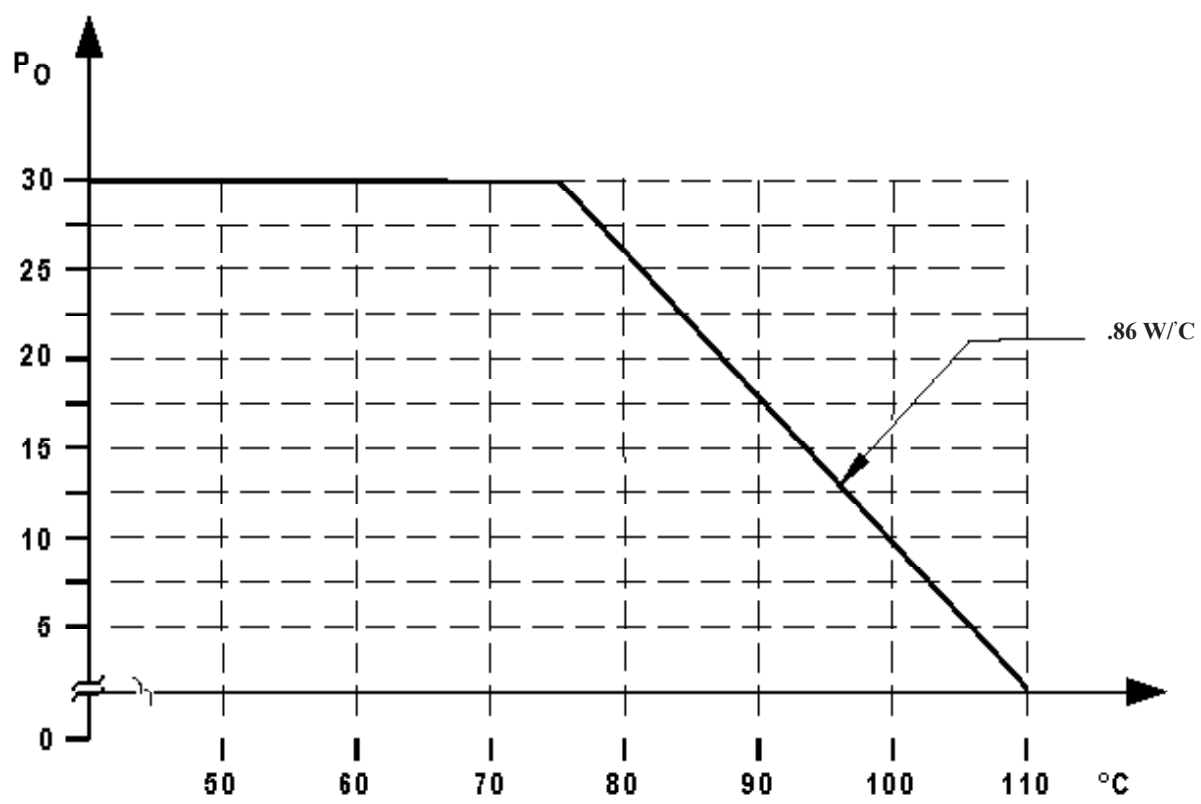
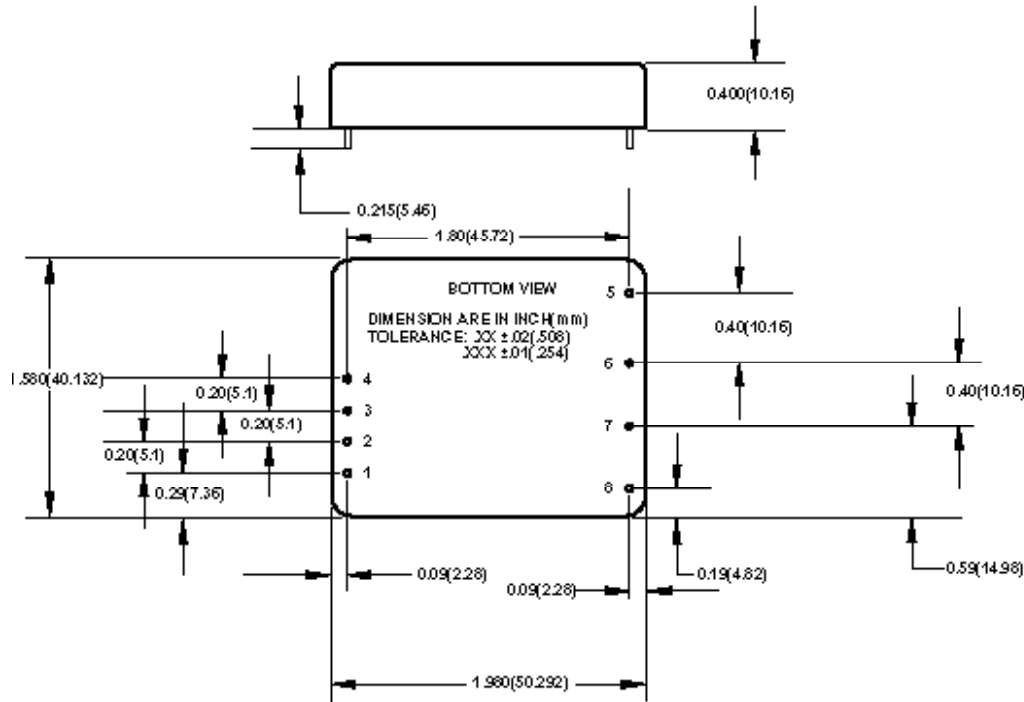


FIGURE 8. Derating diagram of the BHE30D5/3000/Q24

**MECHANICAL SPECIFICATIONS**



Pin	Function
	<b>DUAL</b>
1	ON/OFF
2	SYNC
3	-V <sub>IN</sub>
4	+V <sub>IN</sub>
5	+V <sub>OUT</sub>
6	COMMON
7	-V <sub>OUT</sub>
8	V <sub>OUT</sub> ADJ

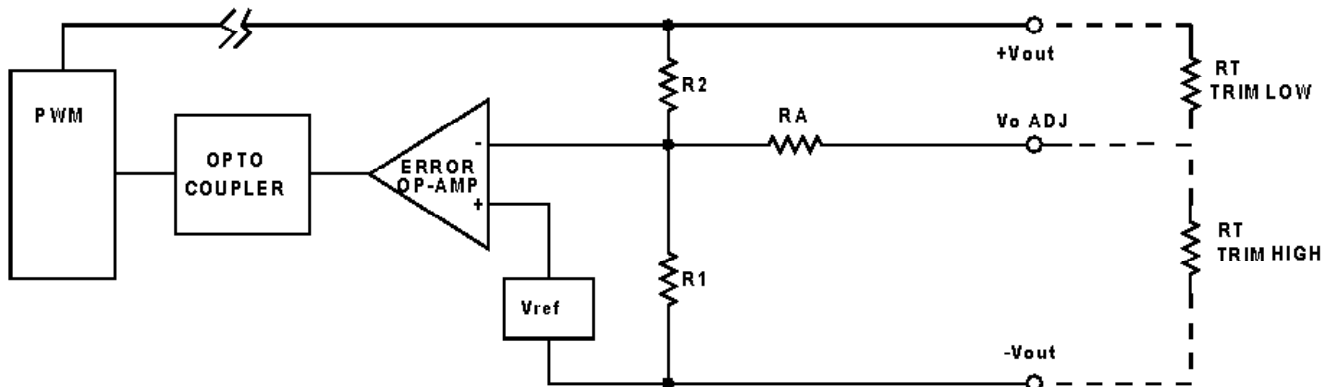


FIGURE 9. Typical connection diagram of BHE30D output adjustment circuit

Where Vo is the required higher value:

$$R_{\text{TRIM HIGH}} = [(R_1 R_2 V_{\text{REF}}) / \{V_O R_1 - V_{\text{REF}}(R_1 + R_2)\}] - R_A \text{ in KOhm}$$

Where Vo is the required lower value:

$$R_{\text{TRIM LOW}} = [(V_O - V_{\text{REF}}) R_1 R_2] / ((R_1 + R_2) V_{\text{REF}} - V_O R_1) - R_A \text{ in KOhm}$$

**Output Adjustment Component Values**

V <sub>OUT</sub> (V)	R <sub>2</sub> (KOhm)	R <sub>1</sub> (KOhm)	R <sub>A</sub> (KOhm)	V <sub>REF</sub> (V)
+/-5	7.50	2.49	18.2	2.5
+/-12	21.5	2.49	22.1	2.5
+/-15	27.4	2.49	23.7	2.5