

# PRELIMINARY



Q50000, Q50001

50W HIGH-VOLTAGE ADJUSTABLE  
DC/DC CONVERTER

beta  
dyne

1	11
2	10
3	9
4	8
	7
	6
	5

MADE IN USA

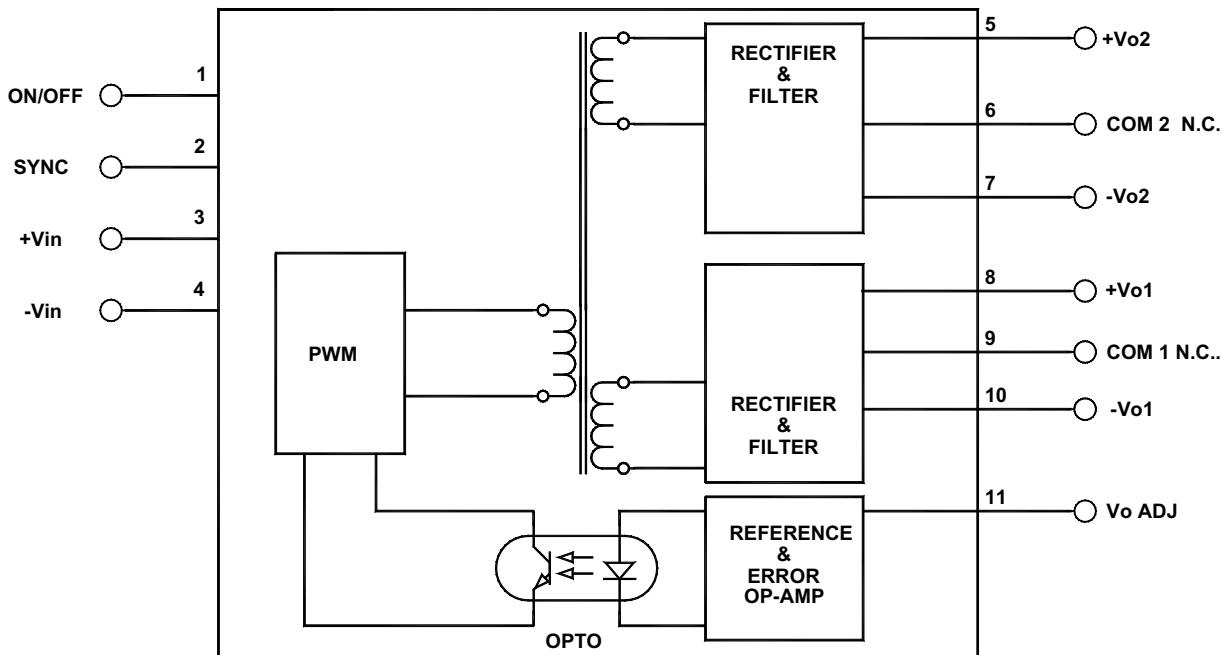
## Key Features

- Efficiency up to 87%
- Wide input voltage range (2:1)
- Six-sided shielding
- Soft start
- Dual Outputs
- Short circuit and thermal protection
- Adjustable output
- External Synchronization
- Input over/under voltage

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.

## Functional Description

The Q50000 series is a 50W dual high output voltage DC/DC converter. The converter accepts 2:1 input voltage and generates a bipolar output of  $\pm 60V_{OUT}$  for the Q50001 and  $\pm 210V_{OUT}$  for the Q50000. Additional features include input over/under voltage, short circuit and over temperature protection. With additional output filter the output noise can be reduced to 20mV and the sync function will synchronize the switching frequency to an external clock thus eliminating beat frequencies to occur if more than one converter is used in the system. The output adjust function can set the output to any desired voltage from Vout nominal to  $\pm 10\%$  of Vout. These converters can be used to power high voltage power amplifiers, piezoelectrics ceramic transducers, or other circuits which require high output voltages and voltage with very low output noise supply.



Typical Q50000 Block Diagram

## Electrical Specifications

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

### INPUT SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Input Voltage Range	Q50000, Q50001	36	48	72	Vdc
Startup Voltage for Bias Converter		8.6			Vdc
Input Startup Voltage, 48V <sub>IN</sub>		35	36		Vdc
Input Overvoltage Protection, 48V <sub>IN</sub>		74	76		Vdc
Input Filter	Pi				
Reverse Polarity	Internal parasitic shunt diodes				
Input Surge Current (20μS Spike)				10	A
Short Circuit Current Limit	See Short Circuit Protection		150		% I <sub>IN</sub>
Off State Current			750		μA
Remote ON/OFF Control					
Supply ON	Pin 1 Open (Open circuit voltage: 13V max.)				
Supply OFF		-0.6	0	0.8	Vdc
Logic Input Reference	To -V <sub>IN</sub> for ON/OFF and SYNC				
Logic Compatibility for Reference	TTL Open Collector or CMOS Open Drain				

### OUTPUT SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Output Voltage	Q50000		±210		Vdc
Output Voltage	Q50001		±60		Vdc
Output Voltage Accuracy			±0.5	±1	%
Output Voltage Adjustable	See Note 6		±10		% of Vout
Ripple & Noise	To further reduce output ripple, See Figure 1	.5	1		%
Output Current	Q50000		±119		mA
Output Current	Q50001		±420		mA
Line Regulation			±.01	±.1	%
Load Regulation			±.05		%
Temperature Coefficient @ FL		0.02			%/°C
Transient Response Time	30% FL to FL to 30% FL, See Figure 2,3		20		ms
Short Circuit Protection	By input current limiting				

### GENERAL SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Efficiency	Q50000, V=48V, R <sub>LOAD</sub> =5KΩ		86		%
Efficiency	Q50001, V=48V, R <sub>LOAD</sub> =300Ω		87		%
Isolation Voltage (1 min.), Input to Output			1500		Vdc
Isolation Voltage (1 min.), Output to Output			500		Vdc
Isolation Resistance			10 <sup>9</sup>		Ω
Isolation Capacitance			220		pF
Switching Frequency, Power Stage			200		kHz
Switching Frequency, BIAS Stage			200		kHz
External Sync Frequency	See Figure 1,5,6,7,100ns pulse		210		kHz
Turn On Delay	See Figure 4		350		ms
Soft Start Time	See Figure 4		12	20	ms

## ENVIRONMENTAL SPECIFICATIONS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Operating Temperature, Industrial (Ambient)*	See notes in 1,2,4 & 5	0		+50	°C
Storage Temperature Range		-55		+125	°C
Thermal Resistance			1.6		°C/W <sub>DISS</sub>
Heatsink Thermal Res	See Figure 10		2.5		°C/W <sub>DISS</sub>
Maximum Operating Case Temperature				95	°C
Thermal Turn Off, Case Temperature		75	85	95	°C
Thermal Hysteresis			20		°C
Humidity	Up to 95% non-condensing				
Cooling	Free-air convection				
EMI/RFI	Six-sided continuous shielded metal case				
MTBF	per MIL-HNBK-217F (Ground benign, +25°C)		485,000		hours

## PHYSICAL CHARACTERISTICS

PARAMETER	CONDITION / NOTE	MIN	TYP	MAX	UNIT
Dimensions (L×W×H)	3.00×2.50×0.75 in. (76.20×63.50×19.5mm)				
Weight	7.9 oz. (225g)				
Case Material	Coated metal				
Shielding Connection, 48V <sub>IN</sub>	Case Shield (Pin 3,+V <sub>IN</sub> )				

\* See notes 1,2, 4 and 5

### Notes

<sup>1</sup> ! WARNING - Usage of input fuse with adequate ratings is essential to avoid possible hazard and damage of the unit. A suppressor diode with adequate ratings is intended to be connected in series to the supply for reverse polarity protection.

<sup>2</sup> Contact factory for other operating temperature range.

<sup>3</sup> The maximum input current at any given input range measured at minimum input voltage is given as  $1.6 \cdot I_{NOMINAL}$ . Nominal input current is the typical value measured at the input of the converter under full-load room temperature and nominal input voltage (48V<sub>IN</sub>).

<sup>4</sup> Adequate insulation is to be provided to the converters at the end usage as per applicable requirements.

<sup>5</sup> Temperature rise on the case of the converters is to be considered during the end usage as per applicable requirements.

<sup>6</sup> Vout adjustment is referenced to -Vout(Vo1)

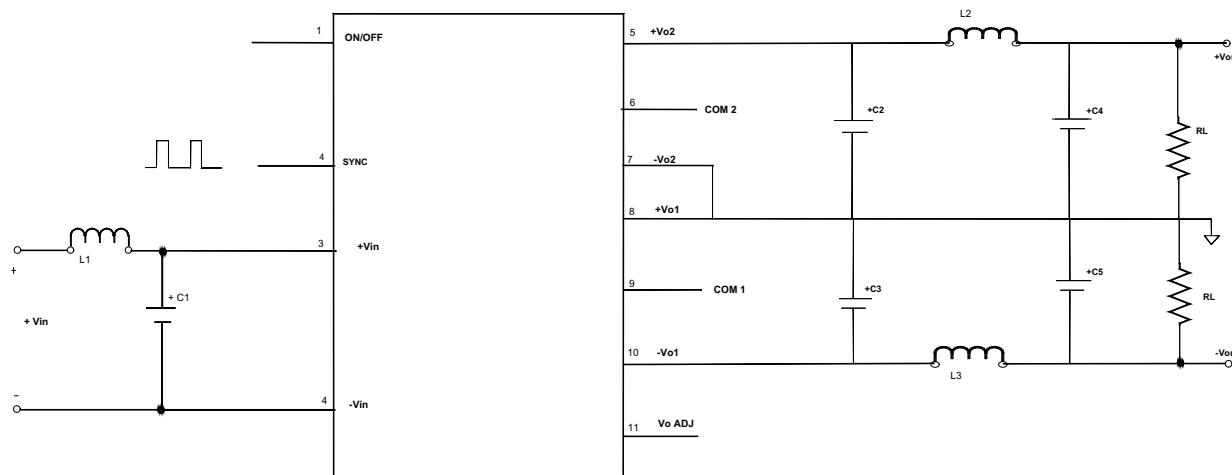


FIGURE 1. Typical connection diagram of the Q50000

C1 = 100μF@100V, electrolytic capacitor

C2-C5 = 100μF@250V ceramic capacitor

L1 = (12-22)μH

L2,L3 = 68μH

SYNC pulse is a 210kHz frequency, 100ns pulse, 5V TTL signal

Contact factory for custom input and output voltage combinations

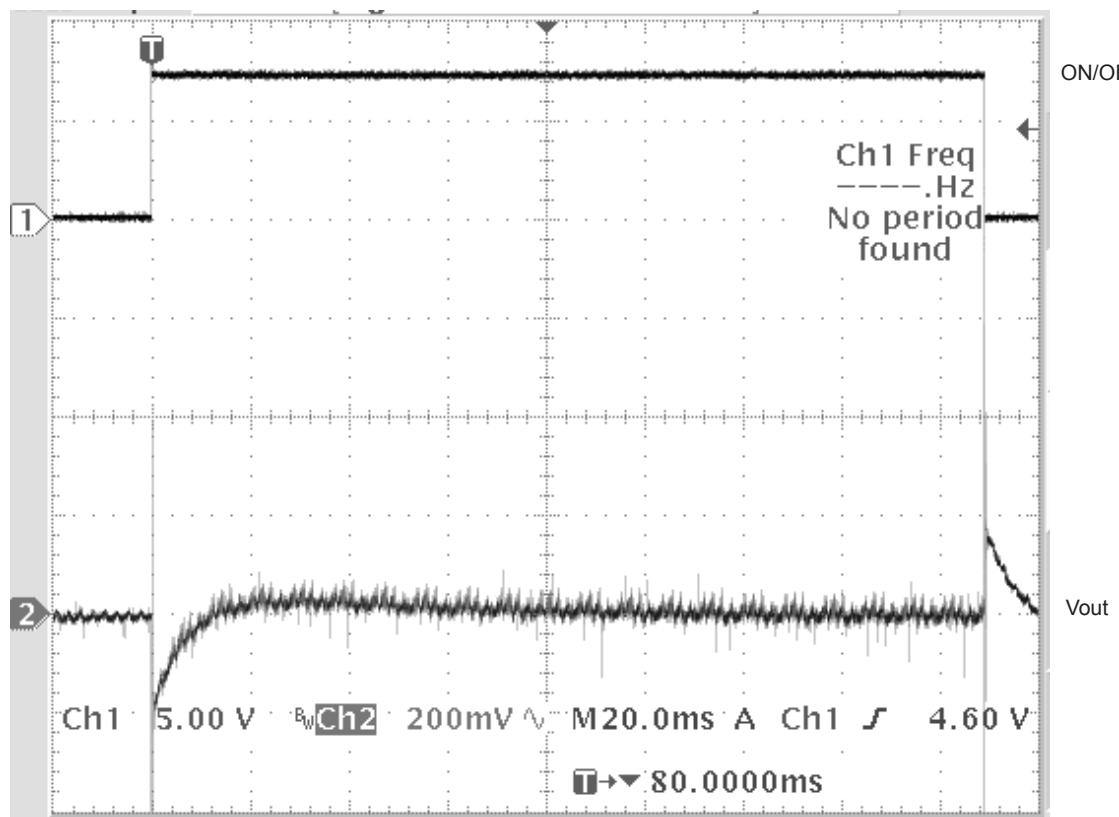


FIGURE 2. Transient response of Q50000, 30% of FL to FL to 30% of FL

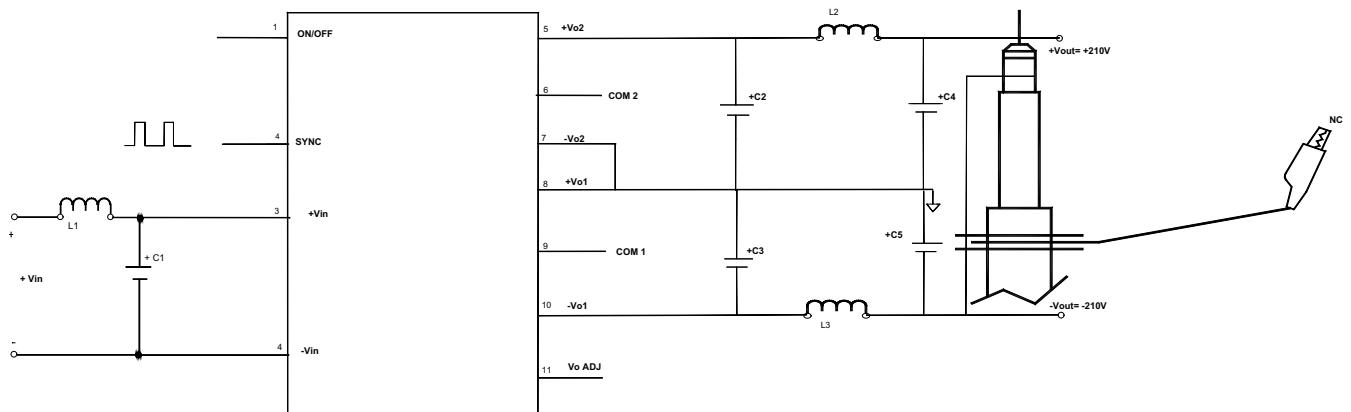


FIGURE 3. Setup for output ripple measurement of Q50000 with external synchronization

C1 = 100 $\mu$ F@100V, electrolytic capacitor

C2,C3 = 100 $\mu$ F@250V ceramic capacitor

C4,C5 = 22 $\mu$ F@250V ceramic capacitor

L1 = (12-22) $\mu$ H

L2,L3 = 68 $\mu$ H

SYNC pulse is a 210kHz frequency, 100ns pulse, 5V TTL signal

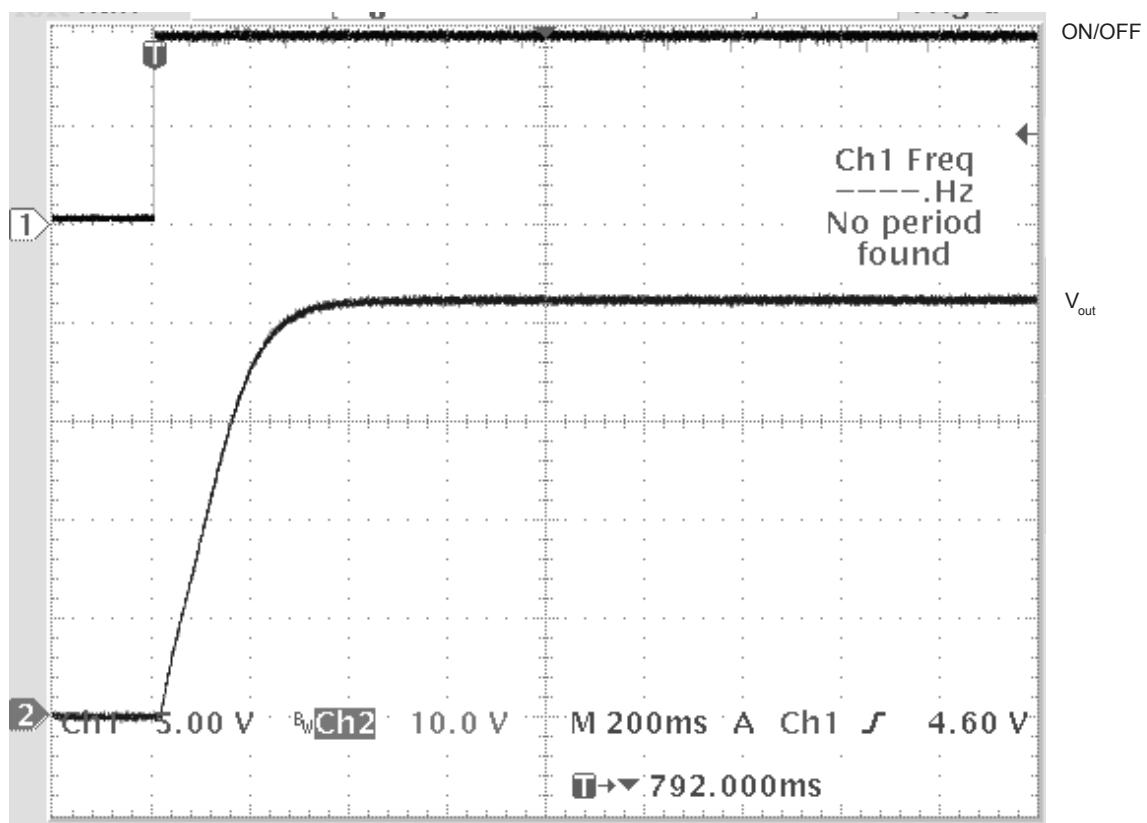


FIGURE 4. Typical turn on delay and soft start of Q50000

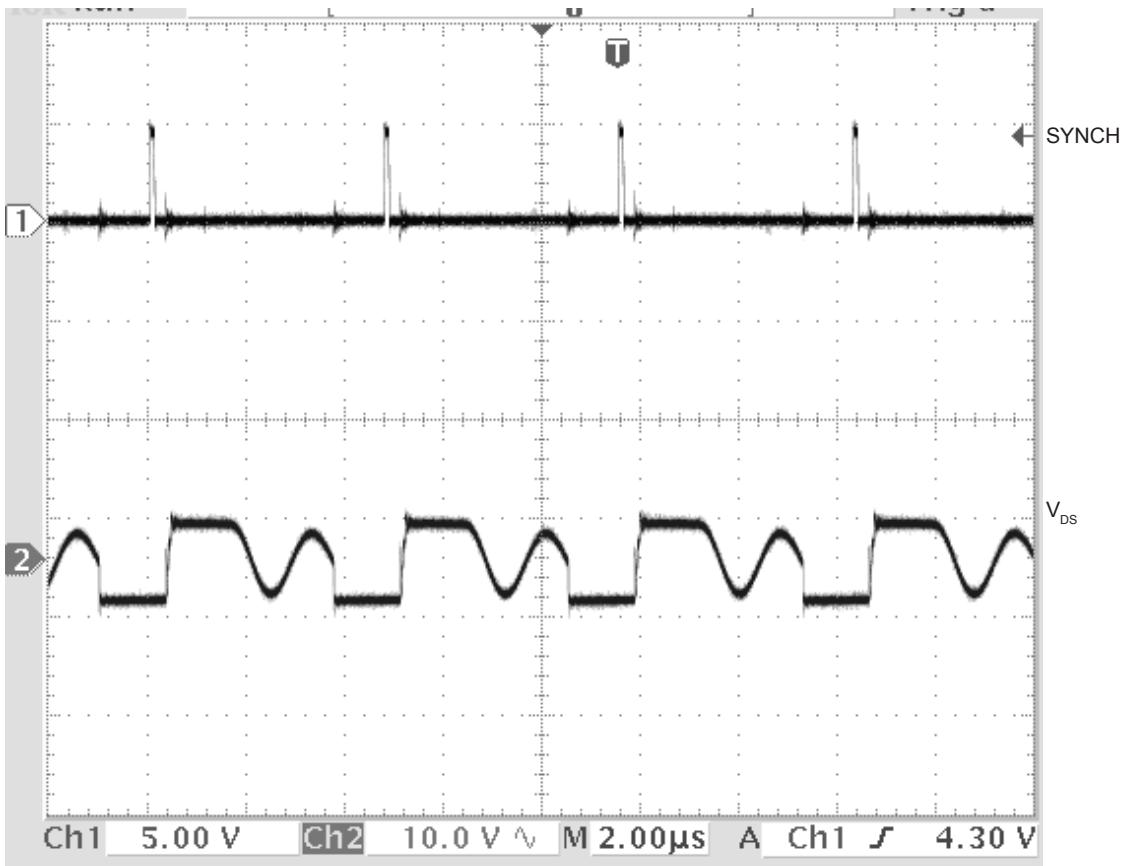
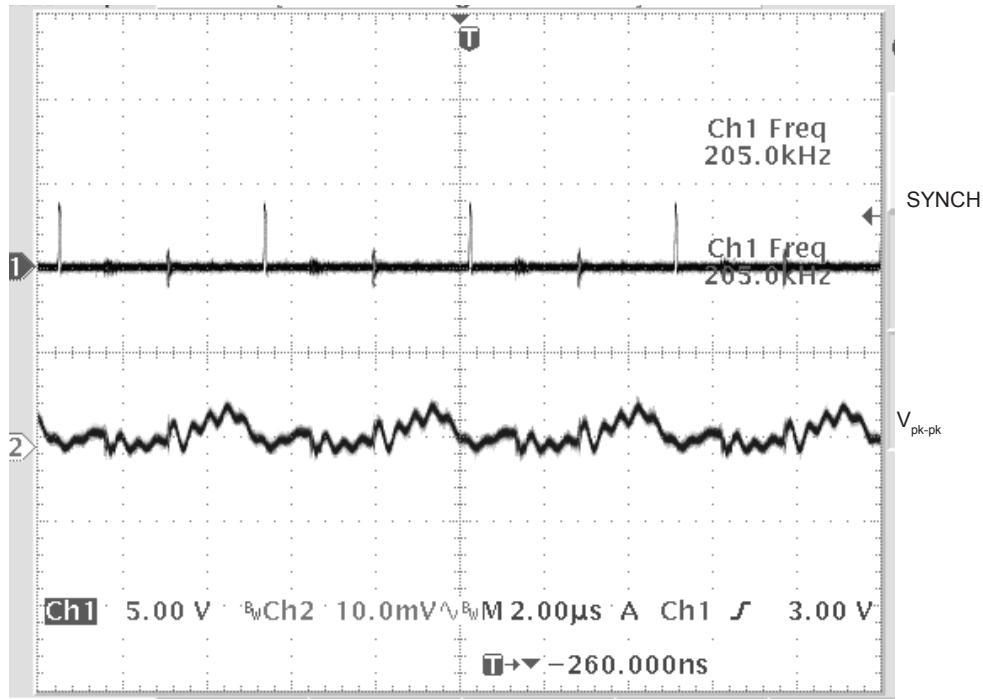
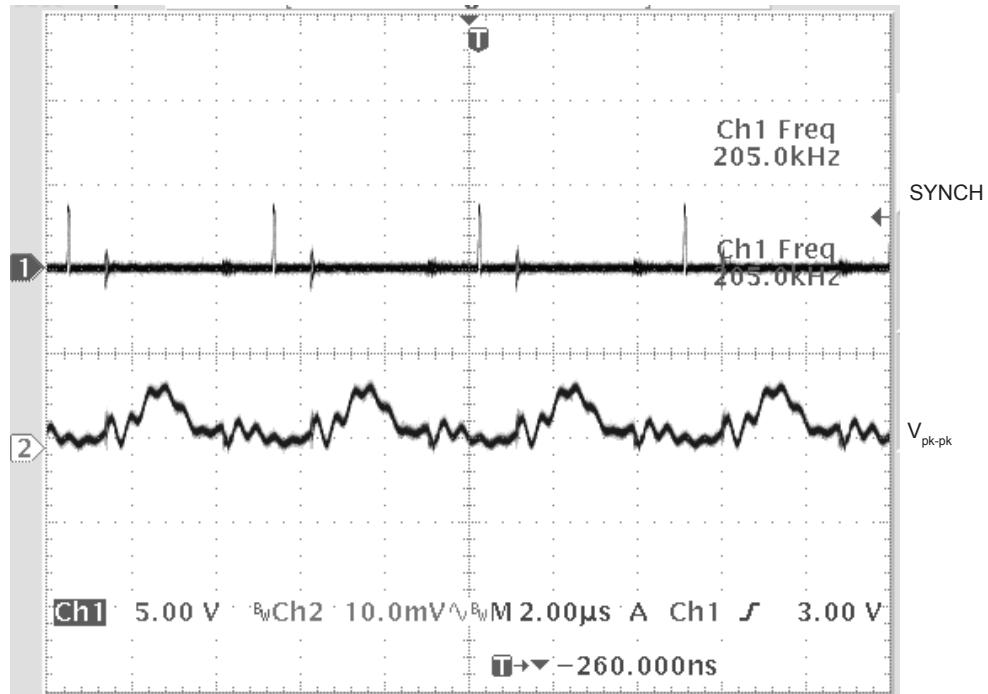


FIGURE 5. Synchronization pulse and drain of V<sub>DS</sub> internal switching MOSFET of Q50000 wth 30% of full load.

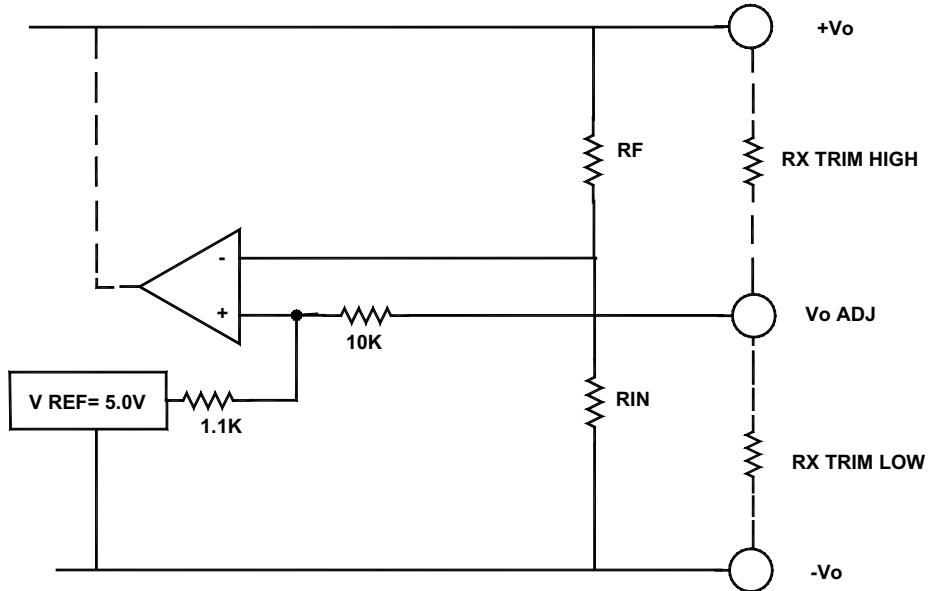


**FIGURE 6. Synchronization pulse and output ripple of Q50000 at half of full load.**



**FIGURE 7. Synchronization pulse and output ripple of Q50000 at full load.**

FIGURE 8. Trim output equations for the Q50000.



$$R_x = \frac{1.1}{\frac{V_o \text{ nominal}}{V_o \text{ low}} - 1} - 10K$$

$V_o$  is measured with reference  $-V_o$

EXAMPLE: To trim the converter low for  $V_o = 380V(+/-190V)$ , the calculation for the trim resistor:

$$R_x = \frac{1.1}{\frac{V_o \text{ nominal}}{V_o \text{ low}} - 1}$$

$$R_x = \frac{1.1}{\frac{420}{380} - 1} - 10K = 450 \text{ Ohms}$$

EXAMPLE: To trim the converter high for  $V_o = 440V(+/-220V)$ , the calculation for the trim resistor:

$$R_x = \frac{1.086}{.0119 - \frac{5}{V_o \text{ high}}} - 10K$$

$$R_x = \frac{1.086}{.0119 - \frac{5}{440}} - 10K = 2.024M - 10k = 2.012M \text{ Ohms}$$

model	$R_F$	$R_{IN}$
Q50000	1.4M	16.87K
Q50001	392K	17K

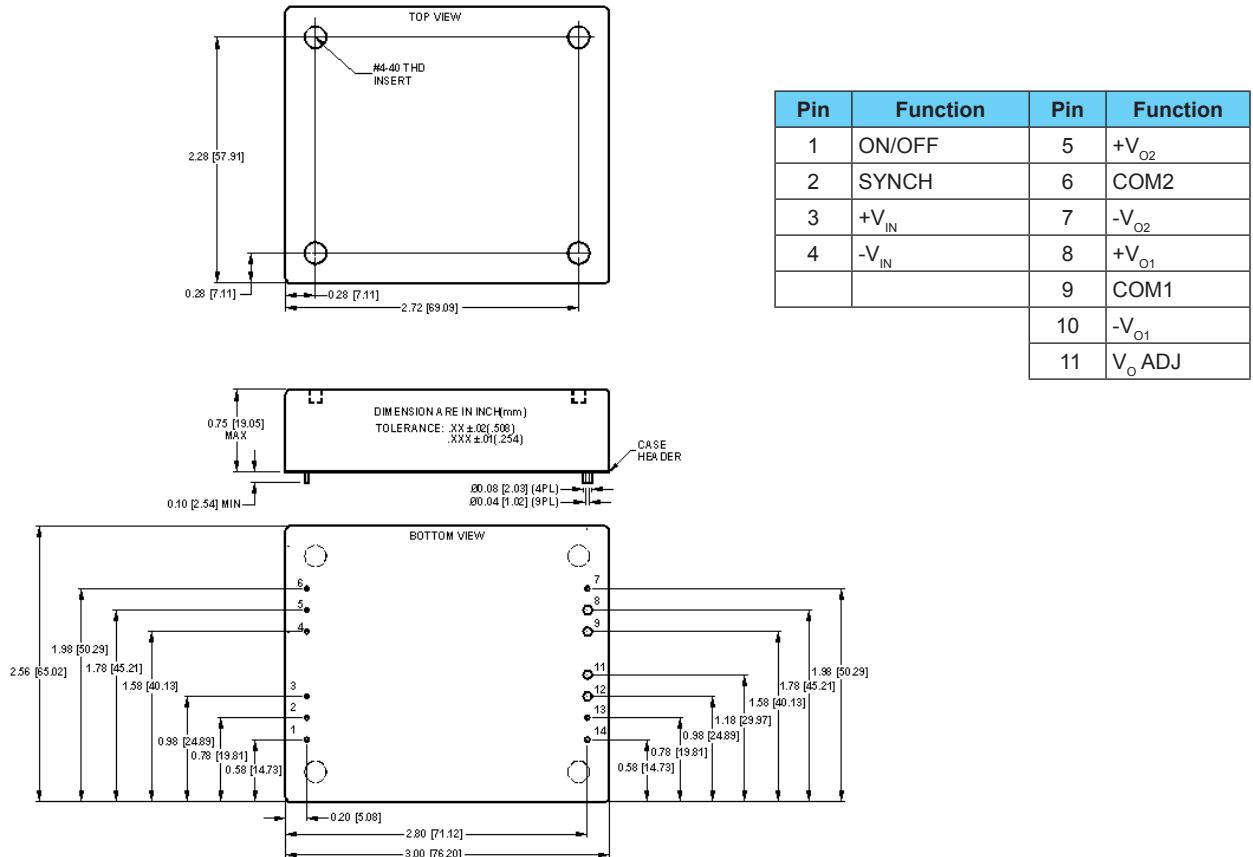


FIGURE 9. Case Mechanical Specifications

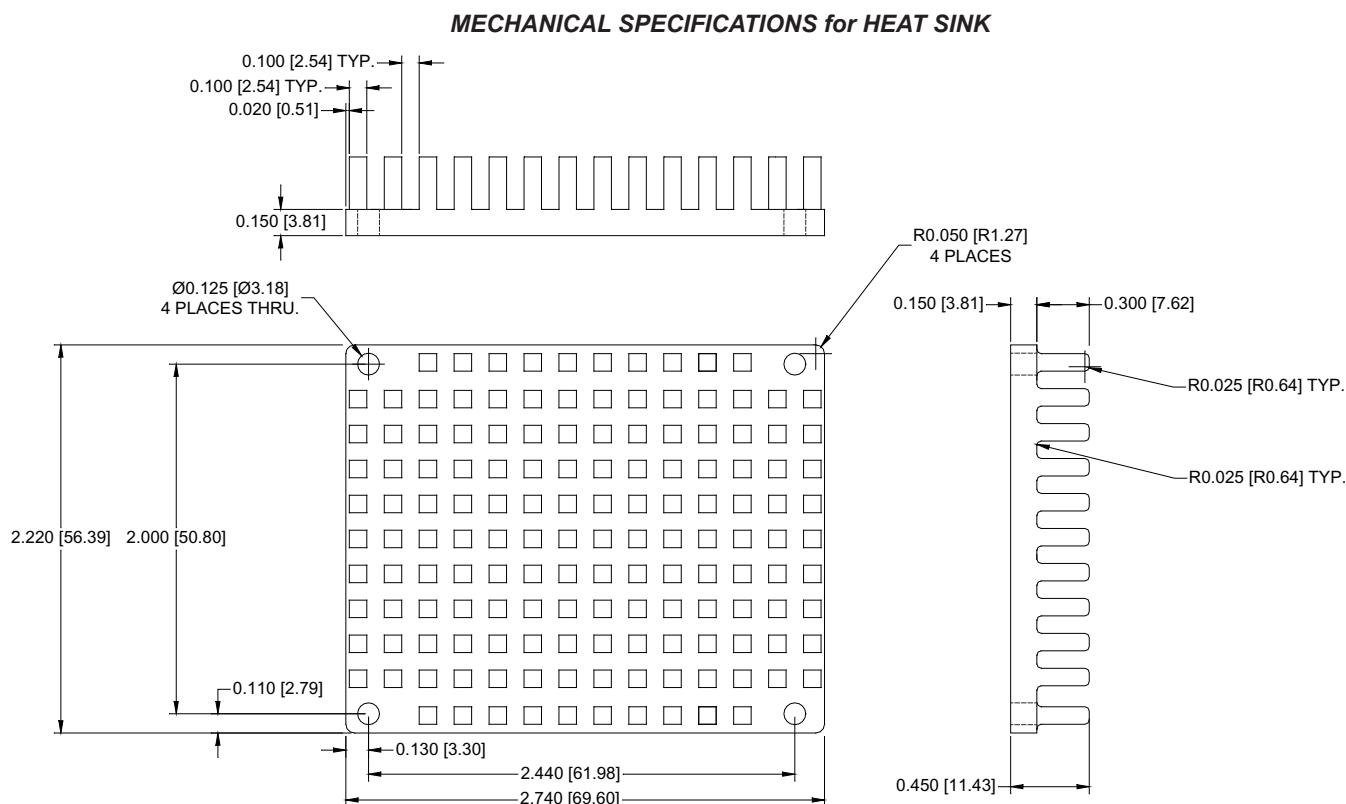


FIGURE 10. Mechanical Specifications of Optional Heat Sink for the Q50000, Q50001