



## EB-TK2050

# CLASS-T DIGITAL AUDIO AMPLIFIER 2 CHANNEL TK2050 EVALUATION BOARD

Technical Information – Board Rev. 2.1

Revision 1.0 – September 2002

### GENERAL DESCRIPTION

The EB-TK2050 Revision 2.1 is a stereo 50W per channel audio amplifier designed to provide a simple and straightforward environment for the evaluation of the TK2050 amplifier. For additional documentation on the TK2050, see the TK2050 Data Sheet.

### APPLICATIONS

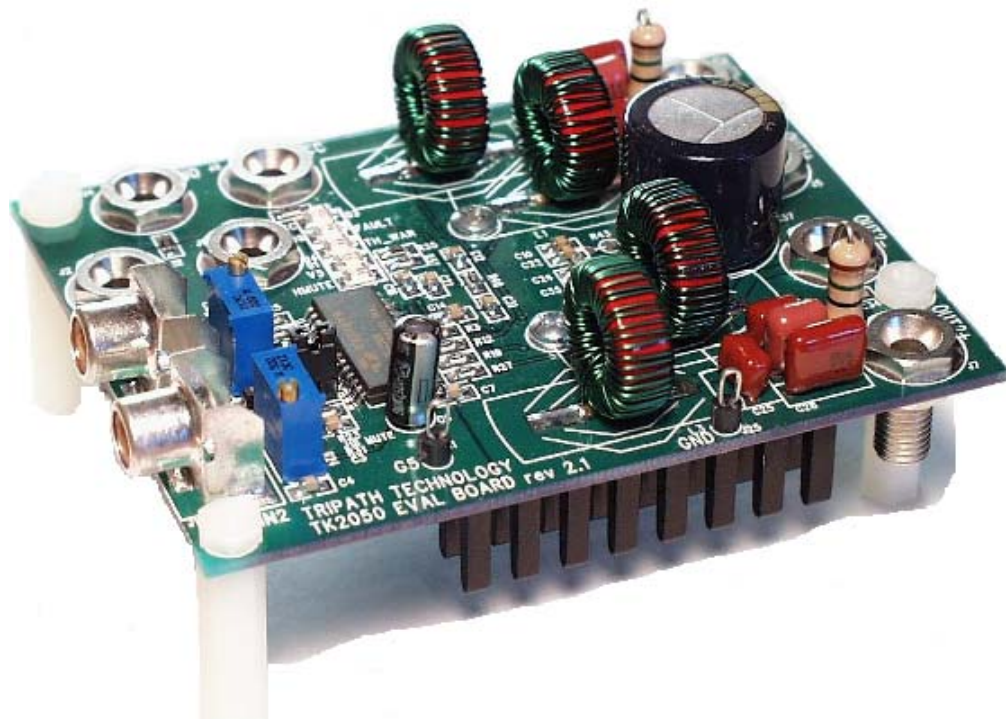
- 6Ω and 8 Ω stereo
- 4 Ω mono (parallel operation)
- Home Theater Receivers
- Multi-channel Distribution
- Powered DVD Systems
- Mini/Micro Systems

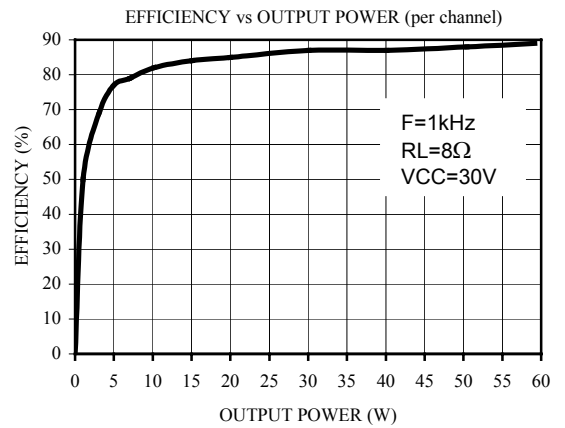
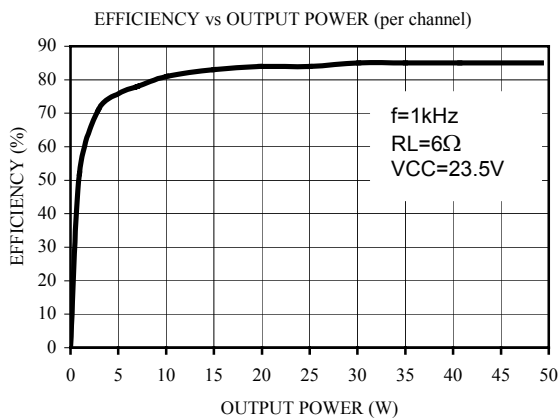
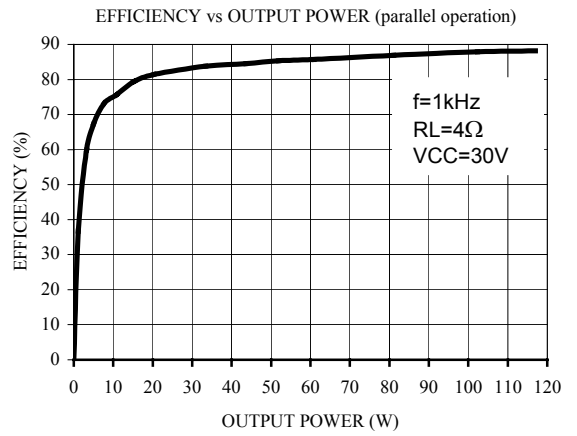
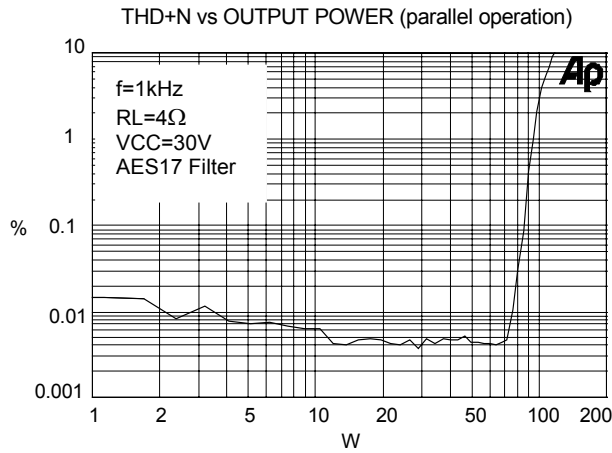
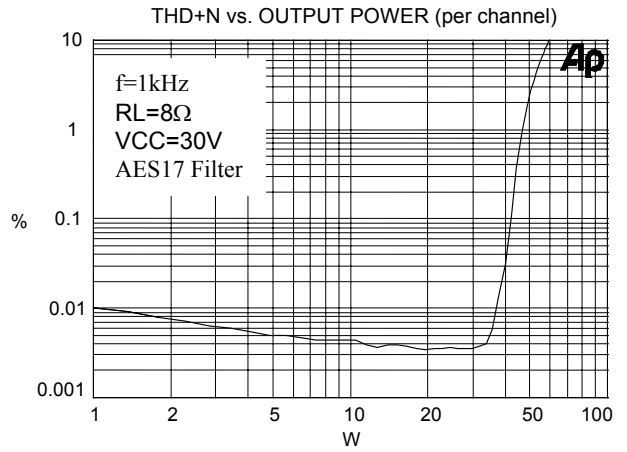
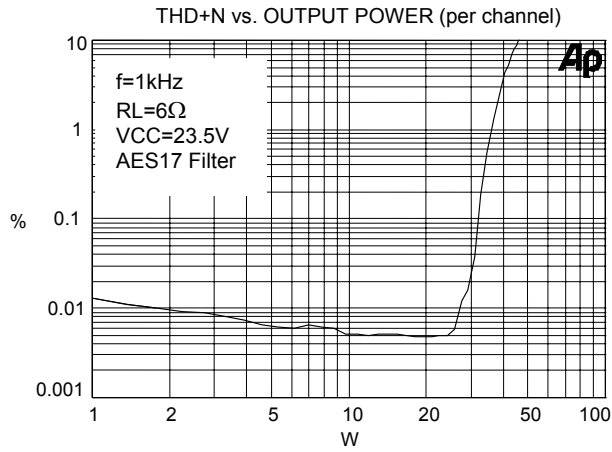
### BENEFITS

- More power per cubic inch for 50W/Channel design
- Simplifies thermal management
- Signal Quality comparable to high quality, linear amplifiers
- Simple building block for multi-channel design

### FEATURES

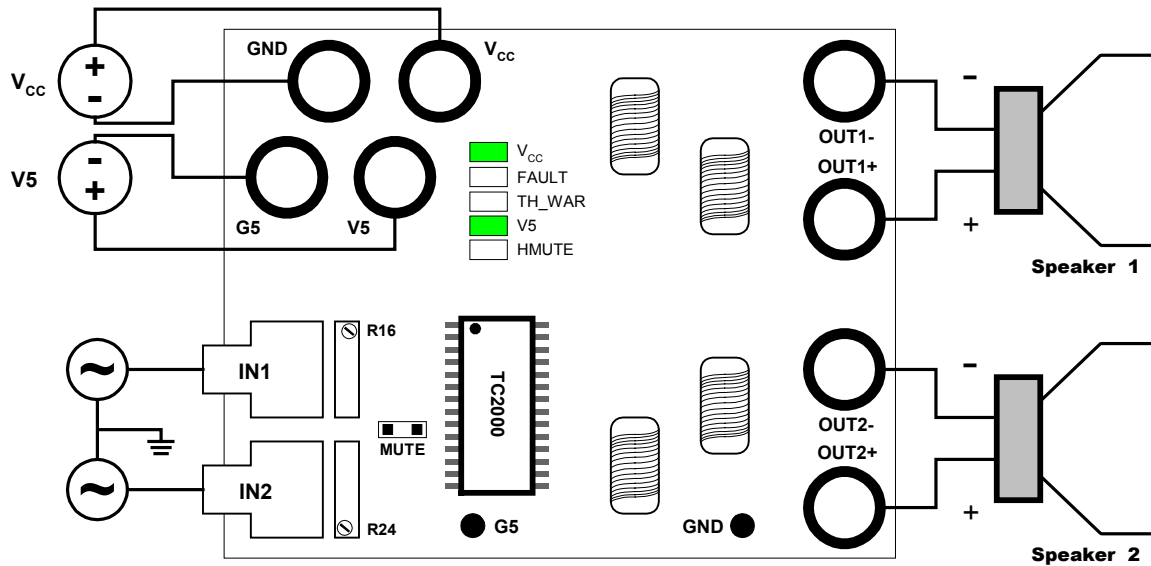
- Low Noise Floor: <135uV A-weighted
- Low Distortion:
  - .005% THD+N, 20W, 6Ω
  - .005% THD+N, 30W, 8Ω
- High Efficiency:
  - 85% @ 46W, 6Ω
  - 89% @ 59W, 8Ω
- Over-Current Protection
- Over and Under Voltage Protection
- Over Temperature Protection





## OPERATING INSTRUCTIONS

### BOARD CONNECTION DIAGRAM



### POWER SUPPLIES

Two external power supplies are required to operate the EB-TK2050: V<sub>CC</sub> (referenced to GND), and V<sub>5</sub> (referenced to G5). The V<sub>5</sub> ground (G5) must be kept separate from the V<sub>CC</sub> ground (GND). GND and G5 are joined at a common point on the EB-TK2050 with a 0Ω resistor (R1).

The Minimum and Maximum V<sub>CC</sub> supply voltages are +10V and +30V, respectively.

The V<sub>5</sub> supply voltage is 5V. Please see the TK2050 Data Sheet for Minimum and Maximum values.

The V<sub>CC</sub> and V<sub>5</sub> power supply connections are standard female banana plug connectors. Please refer to the Board Connection Diagram for the connector locations on the EB-TK2050.

### OUTPUTS

The output connections for each channel of the EB-TK2050 are made with standard female banana plug connectors. The output of the TK2050 is differential; therefore each output has a positive output (OUT1+ and OUT2+) and a NEGATIVE OUTPUT (OUT1- AND OUT2-). Please refer to the Board Connection Diagram for the connector locations on the EB-TK2050.

### INPUTS

The input connection for each channel of the EB-TK2050 is made using two RCA connectors (female). The RCA connectors are labeled IN1 and IN2. These inputs share a common ground referenced to G5. Please refer to the Board Connection Diagram for the connector locations on the EB-TK2050.

### MUTE CONTROL JUMPER

There is a 2-pin header located near the inputs that provides external control of the MUTE function. With a jumper loaded in this location, MUTE is pulled to G5 and the amplifier is in normal operation. When the jumper is removed, the MUTE line is pulled to V<sub>5</sub> and the amplifier is muted. Please refer to the Board Connection Diagram for the connector locations on the EB-TK2050.

## INDICATOR LED'S

The EB-TK2050 has five condition indicator LED's:

- VCC glows green when VCC is within operational limits.
- FAULT glows red when the amplifier has detected a short circuit on the outputs or when the overtemperature circuitry has disabled the amplifier.
- TH-WAR is an early warning temperature indicator which glows red when the TP2050 die reaches an internal temperature of 130°C.
- V5 glows green when V5 is within operational limits.
- HMUTE glows red when a fault occurs or the MUTE header is installed. Please refer to the TK2050 Data Sheet for a complete description of HMUTE.

Please refer to the Board Connection Diagram for the LED locations on the EB-TK2050.

## OUTPUT OFFSET NULL

There are two multi-turn potentiometers, R16 (Channel 1) and R24 (Channel 2), that are used to manually trim the output offset to 0Vdc. Please refer to the Board Connection Diagram for the potentiometer locations on the EB-TK2050. The Evaluation board is shipped with the offset nulled to within +/-10mV at 30V VCC.

## GAIN SETTING

The gain of the EB-TK2050 Rev 1.3 is set to 15V/V. The gain of the TK2050 is the product of the TC2000 (control stage) gain and the TP2050 (power stage) gain. The control stage gain is set to unity. Before changing the gain of the EB-TK2050, please refer to the Amplifier Gain section of the EB-TK2050 Data Sheet.

## Performing Measurements on the EB-TK2050 Rev 2.1:

The TK2050 operates by generating a high frequency switching signal based on the audio input. This signal is sent through a low-pass filter that recovers an amplified version of the audio input. The frequency of the switching pattern is spread spectrum in nature and typically varies between 100kHz and 1MHz, which is well above the 20Hz – 20kHz audio band. The pattern itself does not alter or distort the audio input signal, but it does introduce some inaudible components.

The measurements of certain performance parameters, particularly noise related specifications such as THD+N, are significantly affected by the design of the low-pass filter used on the output as well as the bandwidth setting of the measurement instrument used. Unless the filter has a very sharp roll-off just beyond the audio band or the bandwidth of the measurement instrument is limited, some of the inaudible noise components introduced by the TK2050 amplifier switching pattern will degrade the measurement by including out of band (audio) energy.

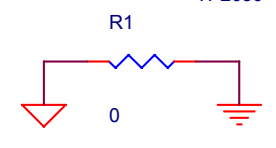
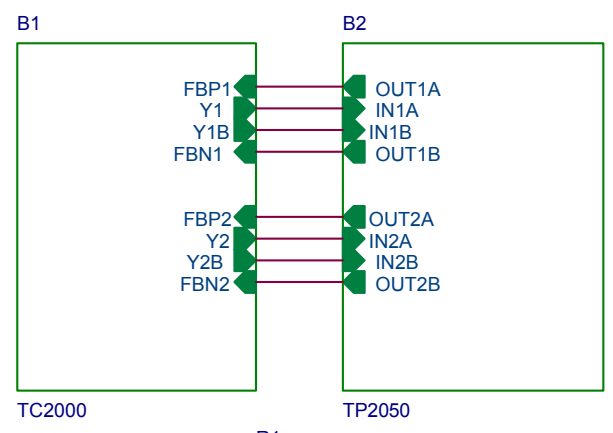
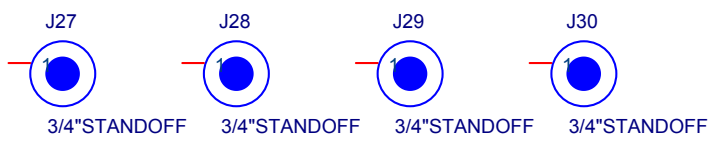
One feature of the TK2050 is that it does not require large multi-pole filters to achieve excellent performance in listening tests, usually a more critical factor than performance measurements. Though using a multi-pole filter may remove high-frequency noise and improve THD+N type measurements (when they are made with wide-bandwidth measuring equipment), these same filters degrade frequency response. The EB-TK2050 has a simple two-pole output filter with excellent performance in listening tests. (See Application Note 4 for additional information on bench testing)

## Contact Information

### **TRIPATH TECHNOLOGY, INC**

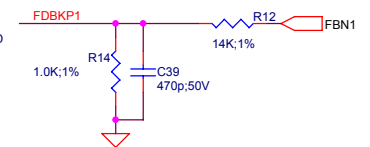
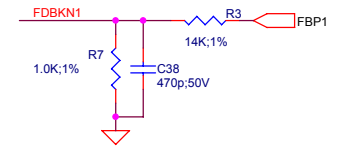
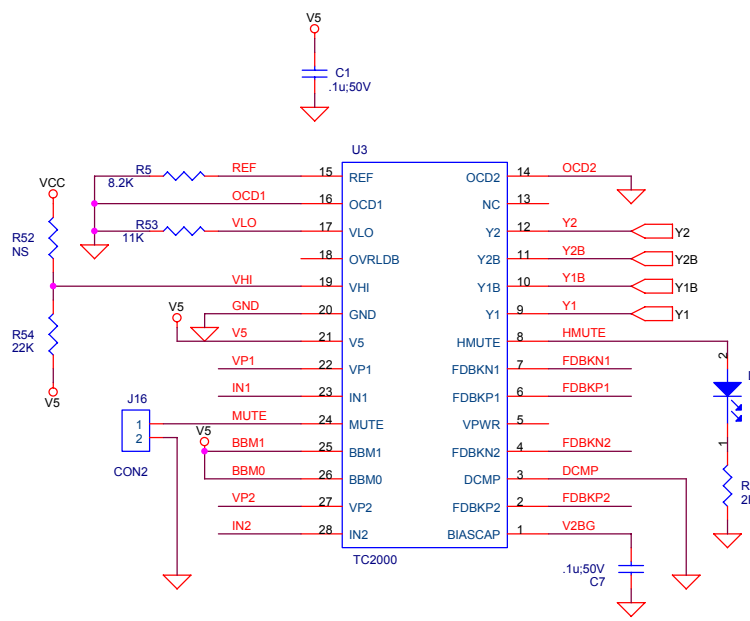
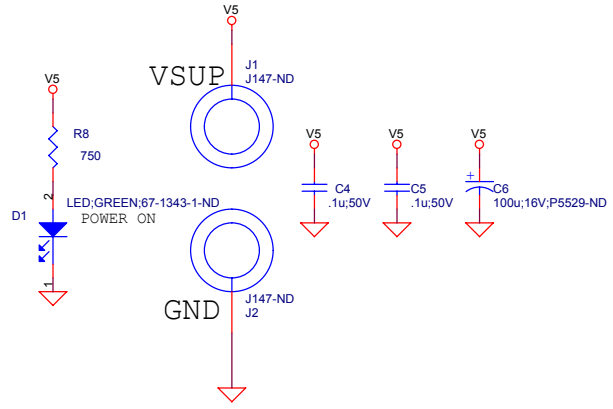
2560 Orchard Parkway, San Jose, CA 95131  
408.750.3000 - P  
408.750.3001 - F

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For more Technical Information, please visit us @ [www.tripath.com/data.htm](http://www.tripath.com/data.htm)

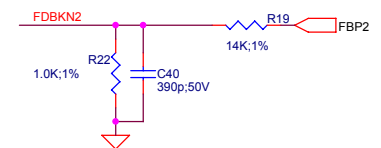


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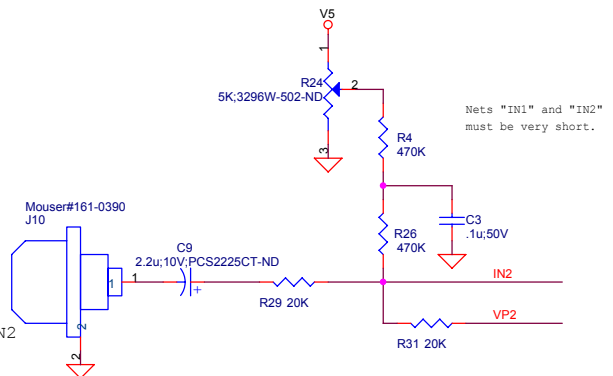
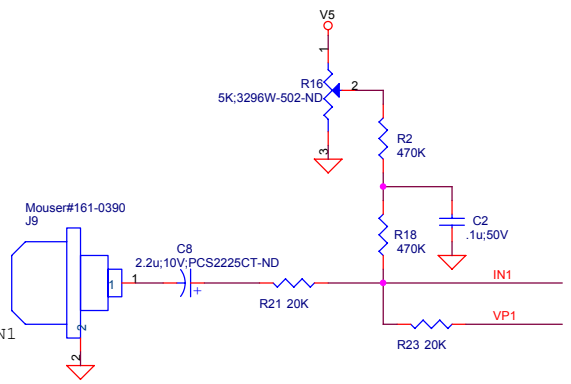
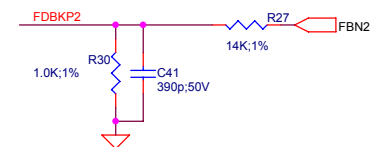
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Size	Document Number	Rev
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Date:	Monday, May 20, 2002	Sheet 1 of 4



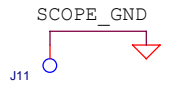
C38, C39, C40, and C41 must be very close to U3.



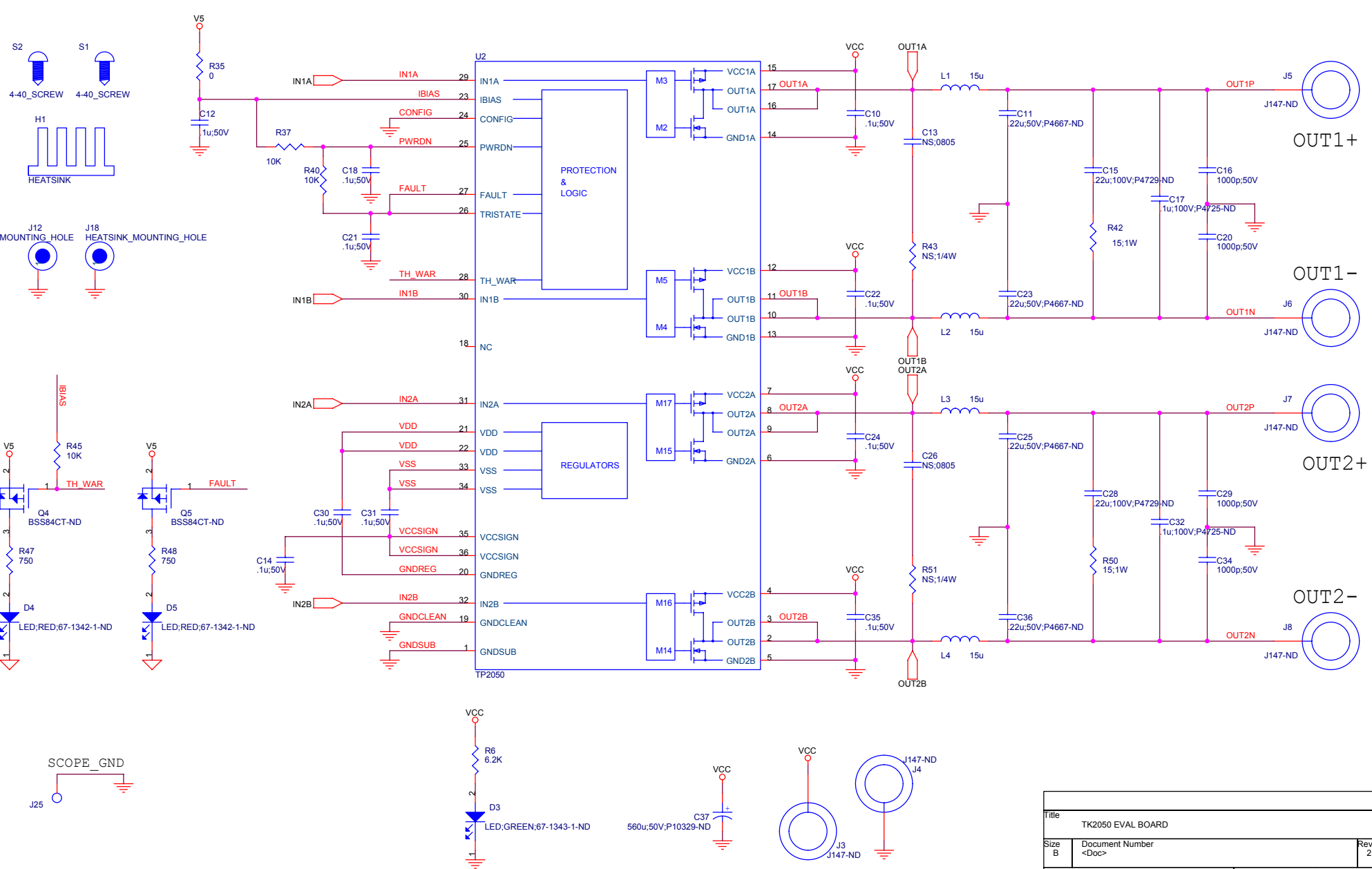
R3, R7, R12, R14, R19, R22, R27, and R30 must be close to U3.



Nets "IN1" and "IN2" must be very short.



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Date: Monday, May 20, 2002	Sheet 2	of 4



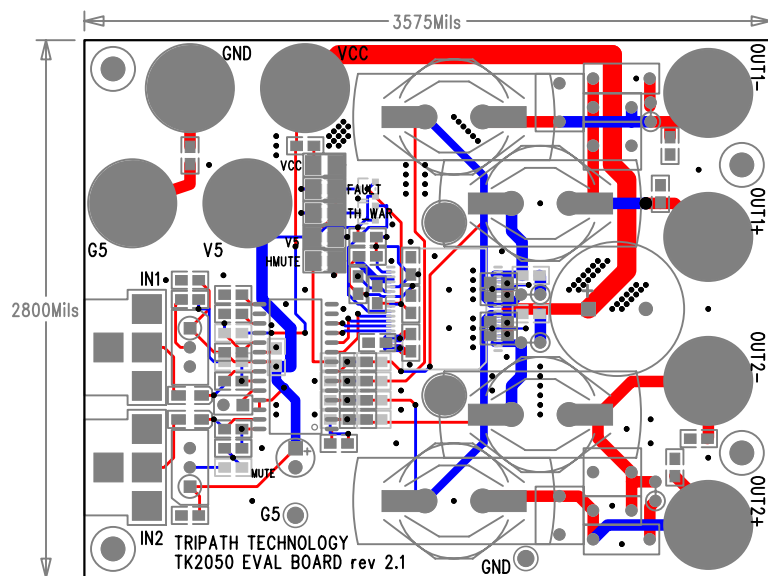
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Date:	Tuesday, May 21, 2002	Sheet 3 of 4



Part numbers ending with "-ND" are Digikey.com part numbers.

Bill Of Materials July 1,2002 10:08:44  
Page1

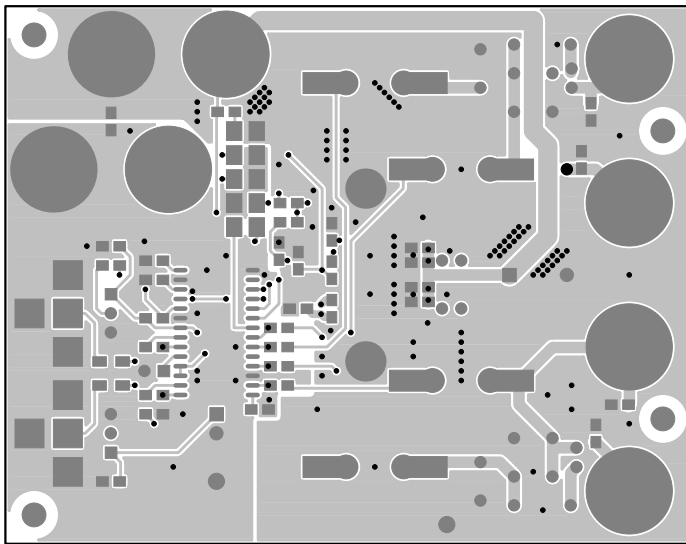
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1	16	C1,C2,C3,C4,C5,C7,C10, C12,C14,C18,C21,C22,C24, C30,C31,C35	.1u;50V	CAP0805	
2	1	C6	100u;16V;P5529-ND	cape\100\200	
3	2	C8,C9	2.2u;10V;PCS2225CT-ND	CAP3216	
4	4	C11,C23,C25,C36	.22u;50V;P4667-ND	CAP200F	use metallized film capacitor
6	2	C15,C28	.22u;100V;P4729-ND	CAP7.5\10X4	use metallized film capacitor
7	4	C16,C20,C29,C34	1000p;50V	CAP0805	
8	2	C32,C17	.1u;100V;P4725-ND	CAP200W	use metallized film capacitor
9	1	C37	560u;50V;P10329-ND	CAPE\300\700	low ESR switching grade capacitor
10	2	C39,C38	470p;50V	CAP0805	
11	2	C41,C40	390p;50V	CAP0805	
14	1	H1	HEATSINK		IERC P002B Ewing Foley, inc - Jennifer Giovanetti - (408) 942-2403
21	4	L1,L2,L3,L4	15u	INDMULT	AW600-06-48T-24-V - American Cores - Julie Yuan - (714)850-4660
24	4	R2,R4,R18,R26	470K	RES0805	
25	4	R3,R12,R19,R27	14K;1%	RES0805	must be 1%
26	1	R5	8.2K	RES0805	
28	4	R7,R14,R22,R30	1.0K;1%	RES0805	must be 1%
30	2	R24,R16	5K;3296W-502-ND	vres_190x390	
31	4	R21,R23,R29,R31	20K	RES0805	
33	3	R37,R40,R45	10K	RES0805	
34	2	R50,R42	15;1W	R1\4WA	must be at least 1W
37	1	R53	11K	RES0805	
38	1	R54	22K	RES0805	
39	2	S1,S2	4-40_SCREW		mounting screws for heatsink
40	1	U2	TP2050	SO36PWR	
41	1	U3	TC2000	SO28	
These parts are optional:					
5	2	C26,C13	NS;0805	CAP0805	do not stuff
12	2	D3,D1	LED;GREEN;67-1343-1-ND	LEDSMT	indicator LEDs
13	3	D2,D4,D5	LED;RED;67-1342-1-ND	LEDSMT	indicator LEDs
15	8	J1,J2,J3,J4,J5,J6,J7,J8	J147-ND	BANANA_PLT_A	banana jacks for speaker outputs and power
16	2	J9,J10	Mouser#161-0390	RCA	Mouser#161-0390; RCA jacks for line level input
17	2	J25,J11	5011K-ND	sip-1p_loop	test points
18	2	J12,J18	HEATSINK_MOUNTING_HOLE	STANDOFF_440G	mounting holes for heatsinks
19	1	J16	CON2	SIP-2P	MUTE jumper
20	4	J27,J28,J29,J30	3/4"STANDOFF	STANDOFF_440	mounting holes
22	2	Q4,Q5	BSS84CT-ND	SOT23_FC	transistors for driving LEDs
23	2	R35,R1	0	RES0805	can be shorted
27	1	R6	6.2K	RES0805	resistors for LEDs
29	3	R8,R47,R48	750	RES0805	resistors for LEDs
32	1	R33	2K	RES0805	resistors for LEDs
35	2	R43,R51	NS;1/4W	R1\4WA	do not stuff
36	1	R52	NS	RES0805	do not stuff



**VIEWED FROM TOP SIDE  
COMPOSITE DRAWING**

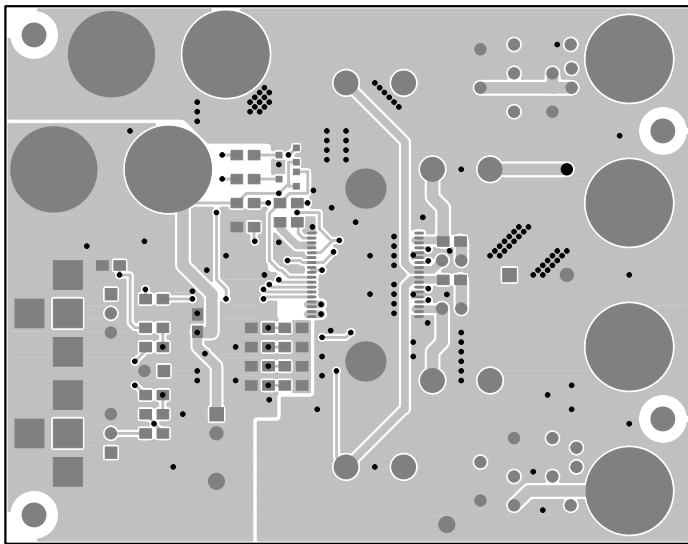
- Top Trace RED
- Bottom Trace BLUE
- Top Component DARK GRAY
- Bottom Component LIGHT GRAY

**FABRICATION NOTES—  
DOUBLE SIDED BOARD  
MATERIAL: .062 FR-4  
2 OZ COPPER, ALL LAYERS**



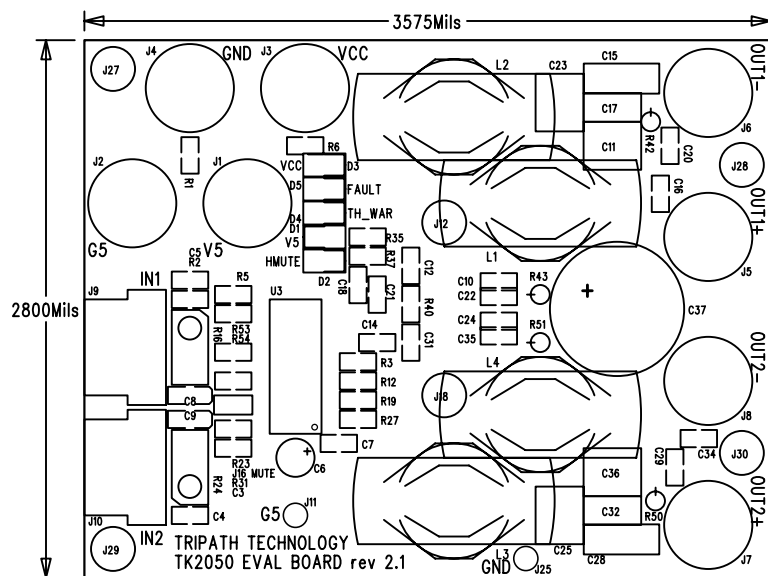
VIEWED FROM TOP SIDE  
TOP SIDE ETCH

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DOUBLE SIDED BOARD  
MATERIAL: .062 FR-4  
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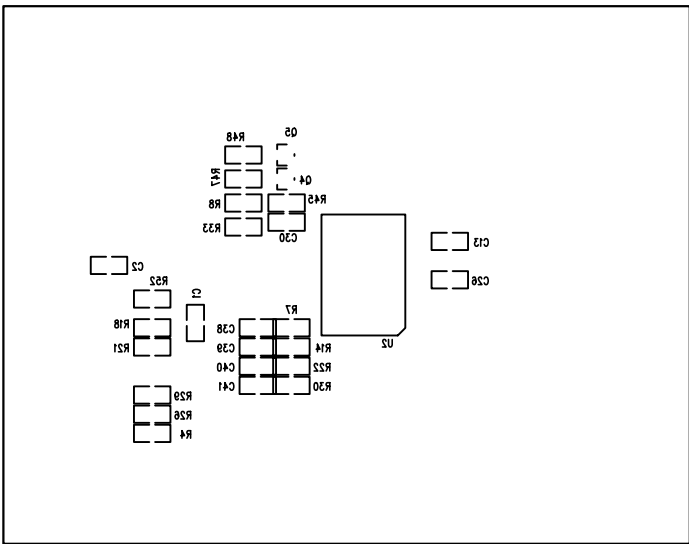
VIEWED FROM TOP SIDE  
BOTTOM SIDE ETCH

FABRICATION NOTES—  
DOUBLE SIDED BOARD  
MATERIAL: .062 FR-4  
2 OZ COPPER, ALL LAYERS



VIEWED FROM TOP SIDE  
SILKSCREEN TOP

FABRICATION NOTES—  
DOUBLE SIDED BOARD  
MATERIAL: .062 FR-4  
2 OZ COPPER, ALL LAYERS



VIEWED FROM TOP SIDE  
SILKSCREEN BOTTOM

FABRICATION NOTES—  
DOUBLE SIDED BOARD  
MATERIAL: .062 FR-4  
2 OZ COPPER, ALL LAYERS