



## RB-TK2150

# CLASS-T DIGITAL AUDIO AMPLIFIER 2 CHANNEL TK2150 EVALUATION BOARD

Technical Information – Board Rev. 1.0 and 2.0

Revision 1.0 – July 2002

### GENERAL DESCRIPTION

The RB-TK2150 Revision 2.0 is a stereo, 175W (6Ω) per channel audio amplifier designed to provide a simple and straightforward environment for the evaluation of the TK2150 amplifier driver. For additional documentation on the TK2150, see the TK2150 Data Sheet.

### APPLICATIONS

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

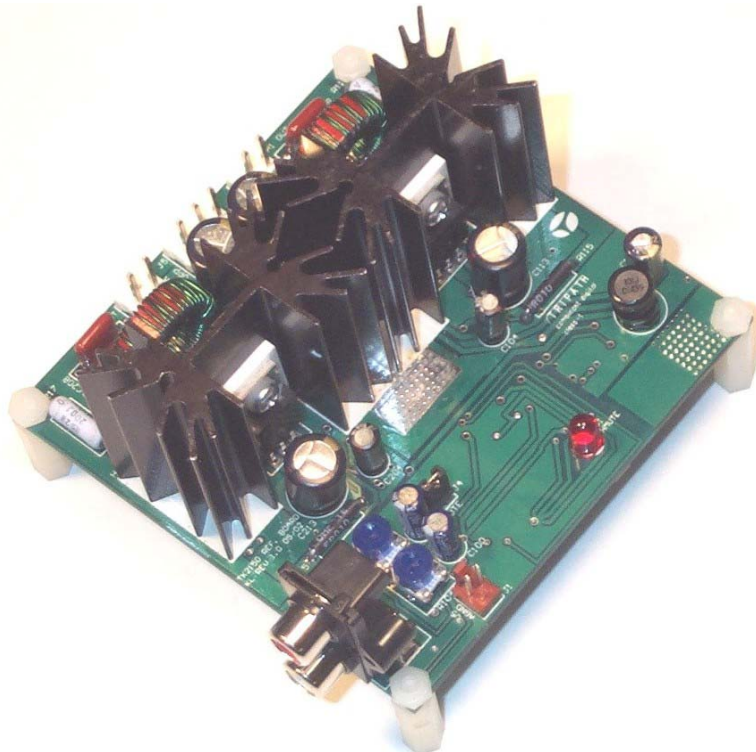
### BENEFITS

- Single Ended Outputs
- Simplifies thermal management
- Signal Quality comparable to high quality, linear amplifiers
- Simple building block for multi-channel design

### FEATURES

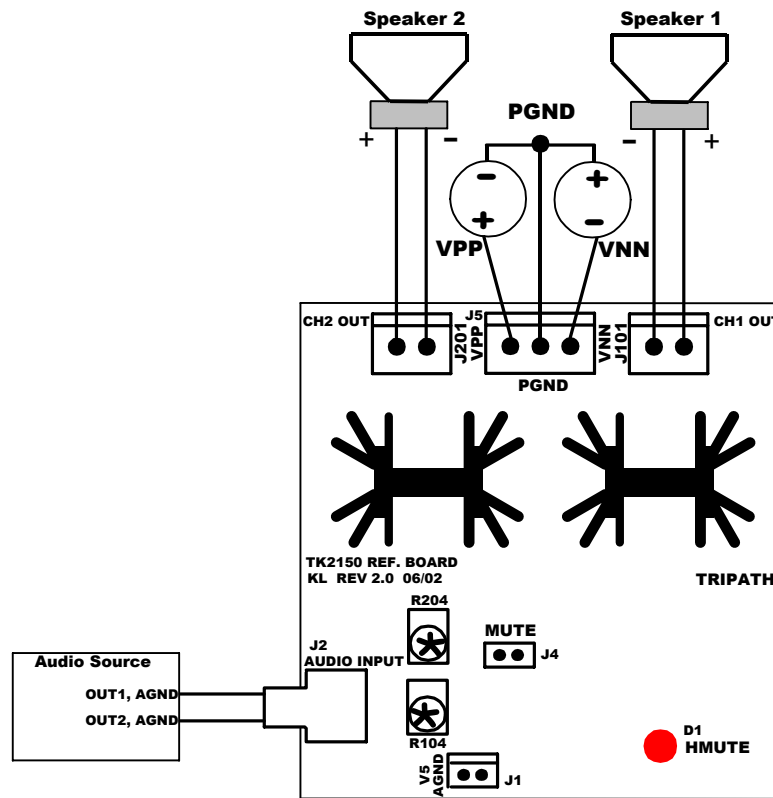
- Low Noise Floor: <195uV A-weighted \*
- Low Distortion:
  - .03% THD+N, 70W, 8Ω \*
  - .03% THD+N, 110W, 6Ω \*
- High Efficiency:
  - 90% @ 145W, 8Ω \*
  - 85% @ 190W, 6Ω \*
- Over-Current Protection
- Over and Under Voltage Protection
- Over Temperature Protection

\*(+/-45V Supply Voltage)



## OPERATING INSTRUCTIONS

### BOARD CONNECTION DIAGRAM



### POWER SUPPLIES

Three external power supplies are required to operate the RB-TK2150: VPP (referenced to PGND), VNN (referenced to PGND) and V5 (referenced to AGND). The V5 ground (AGND) must be kept separate from the VPP and VNN ground (PGND). PGND and AGND are joined at a common point on the RB-TK2150 with a ferrite bead (L1).

The minimum and maximum VPP and VNN supply rail voltages are +/-30V to +/-48V, respectively. Operation outside these set minimum and maximum supply voltages will cause the TC2001 to shut off the output stages of the amplifiers. The removal of the under-voltage or over-voltage condition returns the TK2150 to normal operation. Please see the Over- and Under- Voltage Protection section of the TK2150 Data Sheet for a more detailed discussion of the rail supply range.

The V5 supply voltage is 5V and should be well regulated. Please see the TK2150 Data Sheet for minimum and maximum values.

The VPP and VNN power supply connection is made with a standard .156" Molex header (J5). The V5 connection is made with a standard .100" Molex header (J1). Please refer to the Board Connection Diagram for the header locations on the RB-TK2150 and the attached Bill-Of-Materials for the header part numbers.

The TP2150 has an internal hysteretic buck converter, which, in conjunction with a few components supply the VN10 voltage required by the TP2150 MOSFET Driver. These external components include a P-Channel FET, 100uF inductor, ultra-fast recovery rectifier diode, and a few passive resistors and capacitors. The diode may be replaced with a Schottky diode rated at least 200mA, 50nS and appropriately voltage rated.

## OUTPUT

The output connections for each channel of the RB-TK2150 are made with standard .156" Molex headers (J101, J201). The output of the TK2150 is single-ended; therefore each output has a signal output (labeled CH1 OUT and CH2 OUT) and a ground output (not labeled, connected to PGND). Please refer to the Board Connection Diagram for the header locations on the RB-TK2150.

## BRIDGED OUTPUT

The RB-TK2150 is not optimized for bridge mode testing. Though the TK2150 is capable of supporting 400W, bridged into  $8\Omega$ , the RB-TK2150 is not thermally optimized for full power, bridged mode testing. Also, the externally controlled current limit is optimized for single-ended operation and will trip before full power is achieved. If high power, bridge mode operation is needed, additional heat sinking may be required. In addition, higher current FETs will be required at +45V with  $8\Omega$  bridged loads.

## INPUT

The input connection for each channel of the RB-TK2150 is made using a dual RCA connector (female). The dual RCA connector is labeled AUDIO INPUT (J2). The red RCA is the input to CH1 and the white RCA is the input to CH2. These inputs share a common ground referenced to AGND. Please refer to the Board Connection Diagram for the connector locations on the RB-TK2150.

## JUMPER SETTINGS

There is a 2-pin header for the MUTE (J4) control of the TK2150. With the jumper in place the part is unmuted. When the jumper is removed the mute pin is pulled high (5V) and the amplifier is muted. Please refer to the Board Connection Diagram for the connector locations on the RB-TK2150. To minimize turn on/off pops, place the amplifier in mute while bringing up/turning off the power supplies.

## INDICATOR LED'S

The RB-TK2150 has a red LED (D1) labeled HMUTE. The HMUTE LED will glow red and both outputs are muted when a fault occurs or the MUTE jumper is removed. The most likely causes for a fault are over-current, over-voltage or under-voltage. Please refer to the TK2150 Data Sheet for a complete description of HMUTE. Please refer to the Board Connection Diagram for the LED location on the RB-TK2150.

## OUTPUT OFFSET NULL

There are two potentiometers, R104 (Channel 1) and R204 (Channel 2) that are used to manually trim the output offsets to 0Vdc. Please refer to the Board Connection Diagram for the potentiometer locations on the EB-TK2150. The Evaluation board is shipped with any offsets nulled within +/-10mV.

## GAIN SETTING

The gain of the RB-TK2150 is set to 13.3V/V. The gain of the TK2150 is the product of the TC2001 (control stage) gain and the TP2150 (power stage) gain. The control stage gain is set to .664V/V. The gain of the TP2150 (power stage) is set to 20.09. The TP2150 (power stage) gain is determined from the maximum allowable feedback level for the modulator. Once the designer chooses the maximum supply voltages the feedback level can be optimized and the power stage gain is set. From this point any minor gain adjustments can be made at the control stage. Before changing the gain of the RB-TK2150, please refer to the Amplifier Gain section of the EB-TK2150 Data Sheet.

**PERFORMING MEASUREMENTS ON THE RB-TK2150:**

The TK2150 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 TK2150 amplifier switching pattern will degrade the measurement by including out of band (audio) energy.

One feature of the TK2150 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 RB-TK2150 has a simple two-pole output filter with excellent performance in listening tests.

(See Application Note 4 for additional information on bench testing)

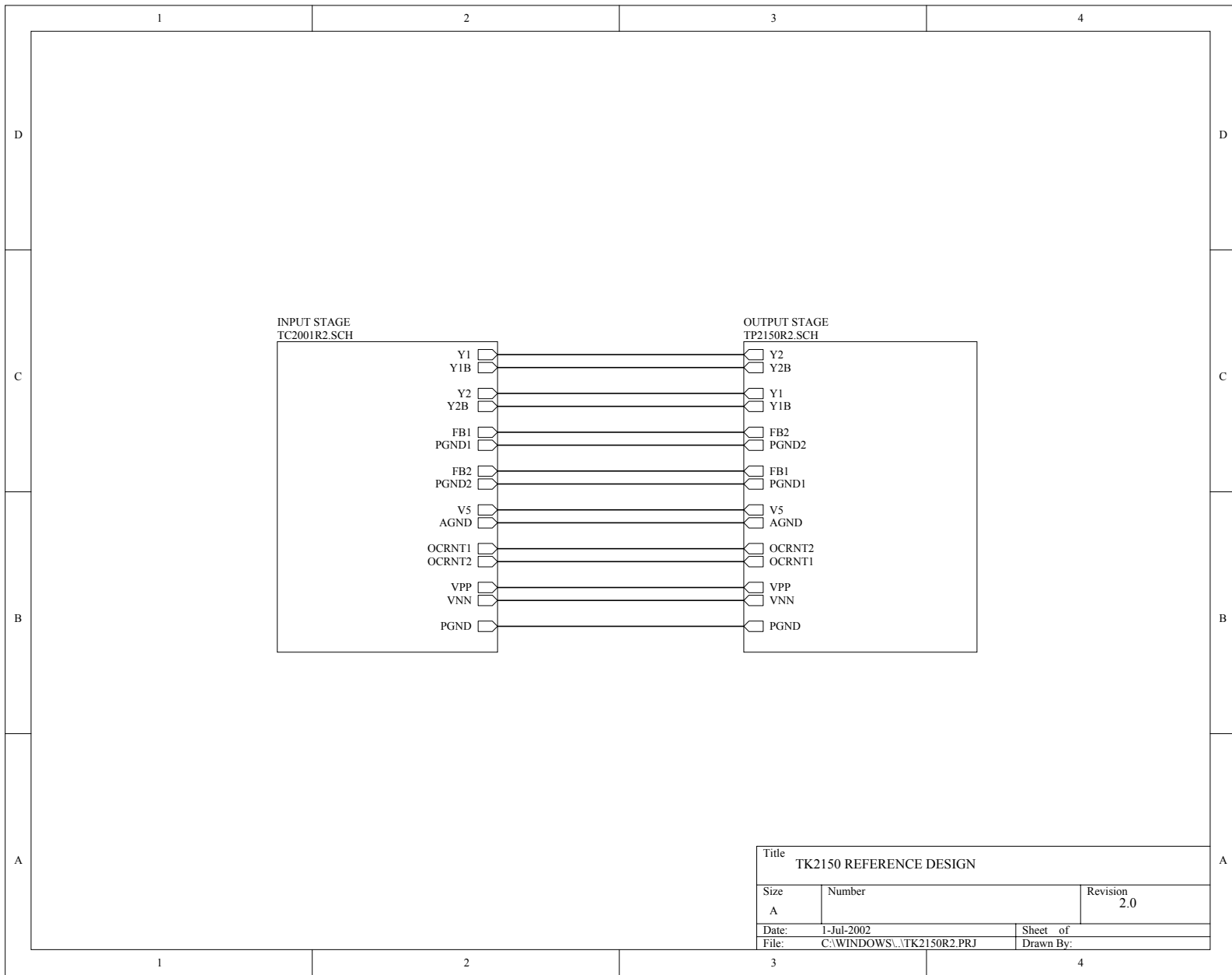
## Contact Information

### World Wide Sales Offices

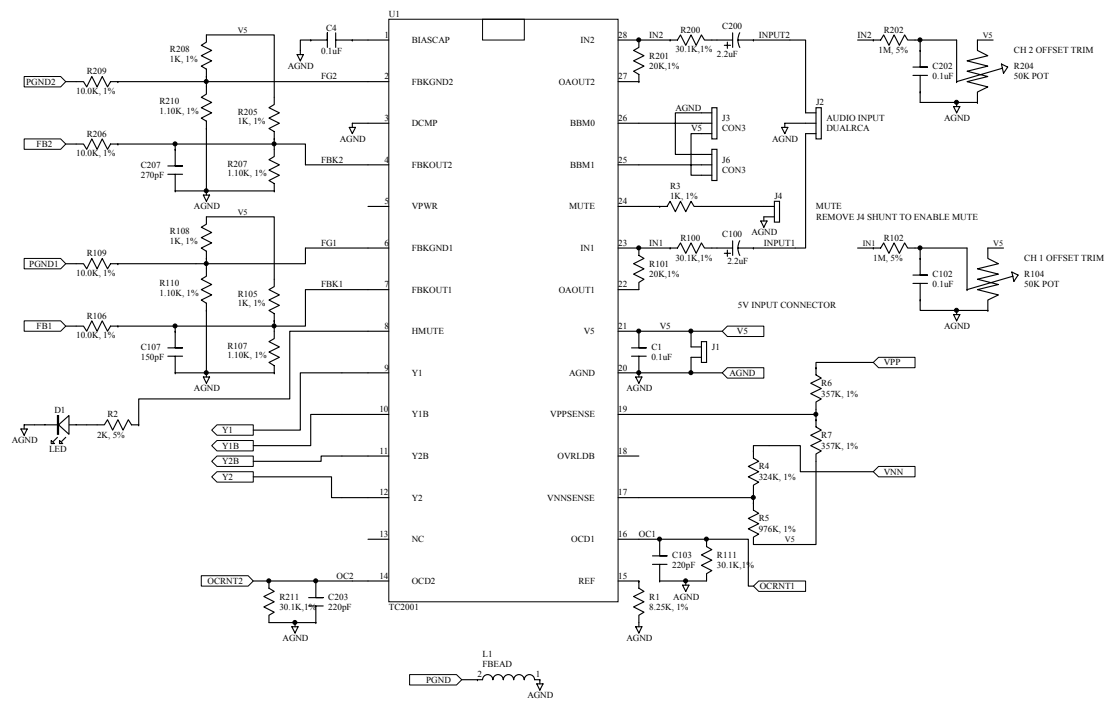
United States & Europe	Jim Hauer	<a href="mailto:jhauer@tripath.com">jhauer@tripath.com</a>	408.567.3089
SE Asia & China	Eugene Hsu	<a href="mailto:ehsu@tripath.com">ehsu@tripath.com</a>	886.2.2653.7428
Japan & Korea	Osamu Ito	<a href="mailto:ito@tripath.com">ito@tripath.com</a>	81.42.334.2433

**TRIPATH TECHNOLOGY, INC**

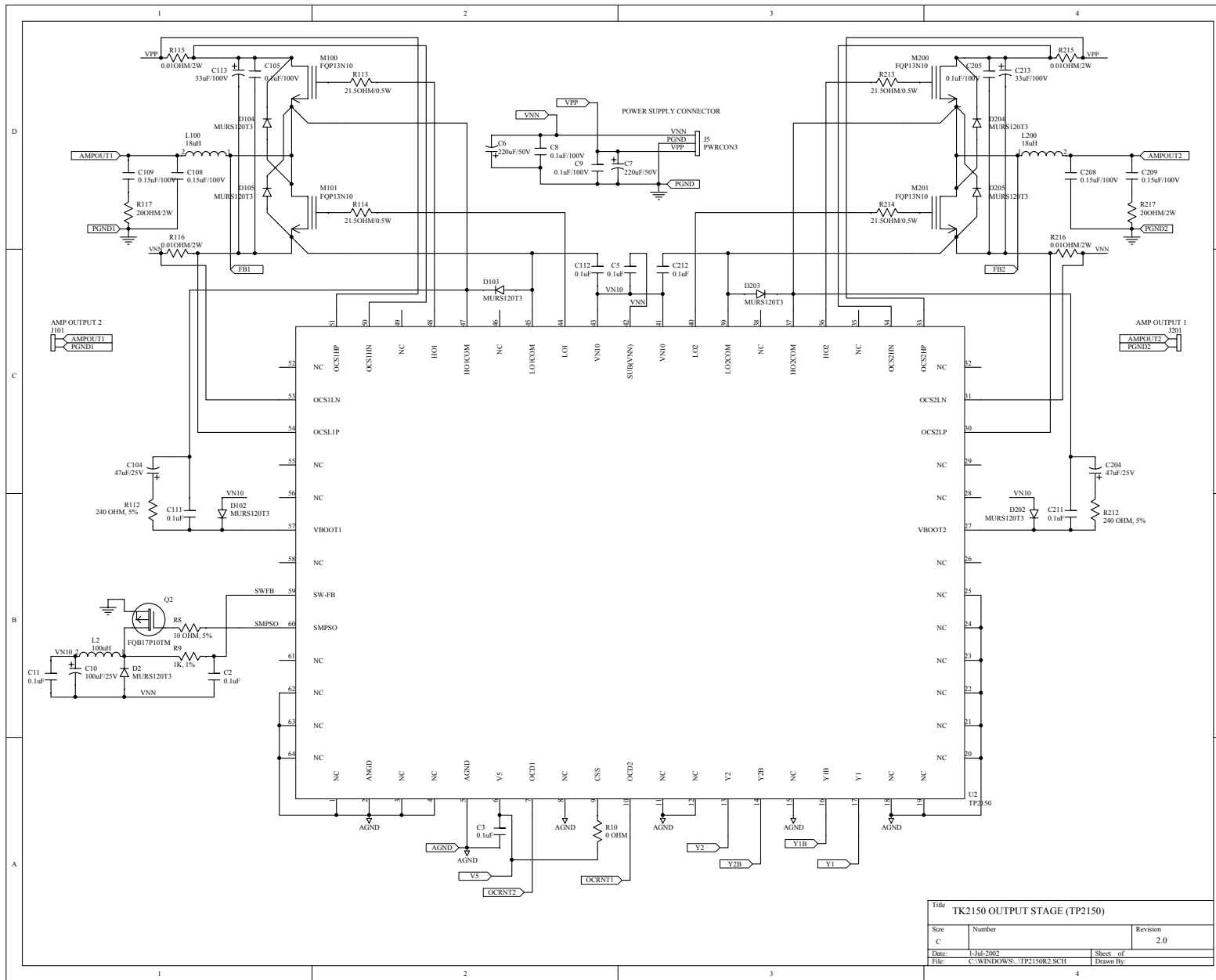
3900 Freedom Circle  
 Santa Clara  
 CA 95054  
 408.567.3000  
[www.tripath.com](http://www.tripath.com)



Title			TK2150 REFERENCE DESIGN		
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A			2.0		
Date:	1-Jul-2002		Sheet of		
File:	C:\WINDOWS\TK2150R2.PRJ		Drawn By:		



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TC2001 - TK2150 INPUT STAGE		
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File:	C:\WINDOWS\...TC2001R2.SCH	Drawn By:

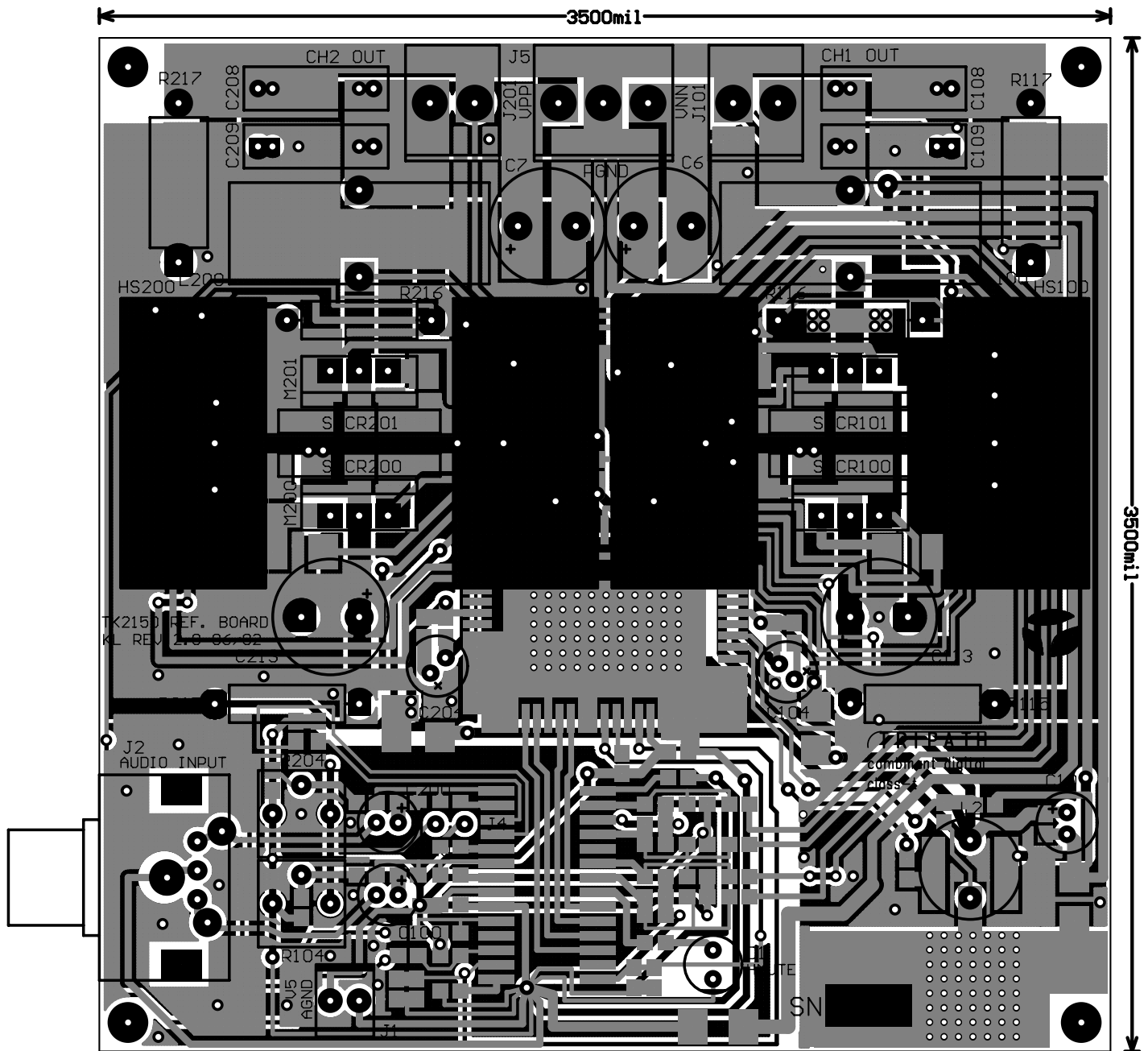


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## Bill of Material for C:\WINDOWS\DESKTOP\LAYOUT~1\TK2150PC\2150R2\_0\TK2150R2.Prj

Used	Part Type	Designator	Footprint	Part Field 1	Part Field 2	Part Field 3
1	0 OHM	R10	0805	*	*	*
4	0.01OHM/2W	R115 R116 R215 R216	RLVR1RG2	OHMITE	12FR010	DK 12FR010-ND
4	0.15uF/100V	C108 C109 C208 C209	C0U22PL10	PANASONIC	ECQ-B1154JF	DK P4658-ND
12	0.1uF	C1 C102 C11 C111 C112 C2 C202 C211 C212 C3 C4 C5	0805	20% TOL.	*	*
4	0.1uF/100V	C105 C205 C8 C9	1210			
4	1.10K, 1%	R107 R110 R207 R210	0805	*	*	*
1	10 OHM, 5%	R8	0805	*	*	*
4	10.0K, 1%	R106 R109 R206 R209	0805	*	*	*
1	100uF/25V	C10	C10UEL05	PANASONIC	ECA-1EHG101	DK P5540-ND
1	100uH	L2	IND1UH	ISI	*	*
1	150pF	C107	0805	NPO 5%	*	*
2	18uH	L100 L200	T80	COIL WINDING SPEC	T84-2 CORE	57TURNS / 24AWG
6	1K, 1%	R105 R108 R205 R208 R3 R9	0805	*	*	*
2	1M, 5%	R102 R202	0805	*	*	*
2	2.2uF	C100 C200	C10UEL05	PANASONIC	ECA-1HHG2R2	DK P5564-ND
2	20K, 1%	R101 R201	0805	*	*	*
2	20OHM/2W	R117 R217	PWR2W	PANASONIC	ERG-2SJ200	DK P20W-2BK-ND
4	21.5OHM/0.5W	R113 R114 R213 R214	2010	PANASONIC	ERJ-12SF21R5U	DK PO21.5ACCT-ND
2	220pF	C103 C203	0805	NPO 5%	*	*
2	220uF/50V	C6 C7	C100UEL06	PANASONIC	EEU-FC1H221	DK-P10325-ND
2	240 OHM, 5%	R112 R212	0805	*	*	*
1	270pF	C207	0805	NPO 5%	*	*
1	2K, 5%	R2	0805			
4	30.1K, 1%	R100 R111 R200 R211	0805	*	*	*
1	324K, 1%	R4	0805	*	*	*
2	33uF/100V	C113 C213	C100UEL06	PANASONIC	EEU-FC2A330	DK P10771-ND
2	357K, 1%	R6 R7	0805	*	*	*
2	47uF/25V	C104 C204	C10UEL05	PANASONIC	ECA-1EHG470	DK P5539-ND
2	50K POT	R104 R204	POTSTURN	BOURNS	3306P-1-103	DK 3306P-103-ND
1	8.25K, 1%	R1	0805	*	*	*
1	976K, 1%	R5	0805	*	*	*
2	CON2	J101 J201	PWR2	WALDOM	26-60-4020	DK WM4620-ND
1	CON2LPWR	J1	CON2B	WALDOM	22-23-2021	DK WM4200-ND
2	CON3	J3 J6	0805JMPR	*	*	*
1	DUALRCA	J2	DUALRCAVERT	CUI INC.	RCJ-2223	DK CP-1435-ND
1	FBEAD	L1	2010	*	*	*
1	FQB17P10TM	Q2	D2PAK2	FAIRCHILD SEMI.	FQB17P10TM	*
4	FQP13N10	M100 M101 M200 M201	TO220	FAIRCHILD SEMI	FQP13N10	*
1	HDR2	J4	GJMPR001	*	*	*
1	LED	D1	LED1	RED LED	*	*
9	MURS120T3	D102 D103 D104 D105 D2 D202 D203 D204 D205	SMB	MOTOROLA	MURS120T3	*
1	PWRCON3	J5	CON3	WALDOM	26-60-4030	DK WM4621-ND
1	TC2001	U1	SOP28	TRIPATH TECHNOLOGY	*	*
1	TP2150	U2	LQFP64	TRIPATH TECHNOLOGY	*	*





FABRICATION NOTES

THIS IS A DOUBLE SIDED BOARD

MATERIAL: FR-4 OR EQUIVALENT

0.062 +/- 0.007 THICKNESS

2 OZ COPPER, ALL LAYERS

SOLDERMASK OVER BARE COPPER, USE GREEN

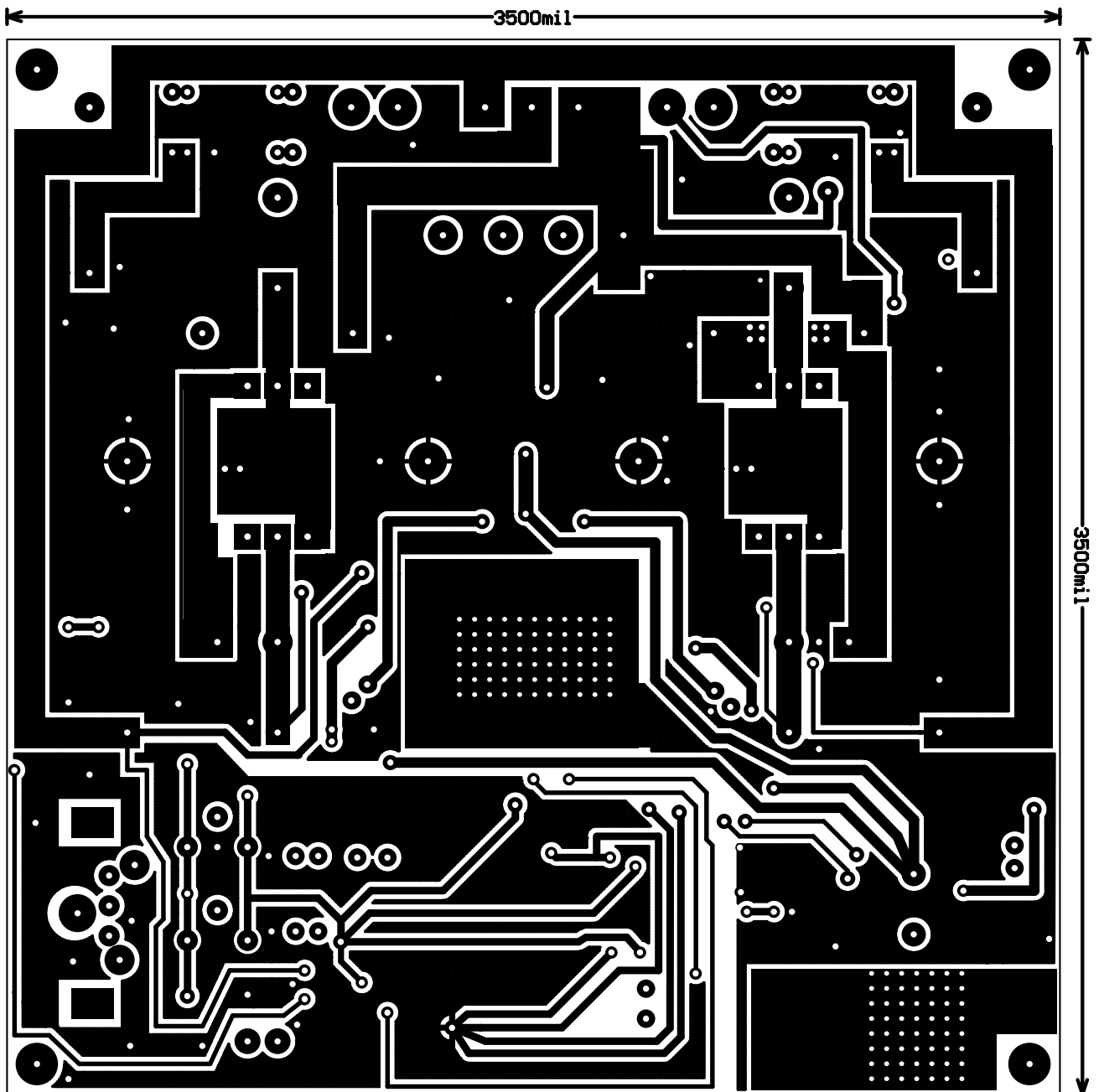
SILKSCREEN TO BE WHITE

TOP SIDE SILKSCREEN MUST COVER TOP SOLDERMASK

THUS, THE COPPER ON VIAS AND PADS SHOULD NOT APPEAR  
IF THERE IS SILKSCREEN AT SAME POSITION

NOTE: THERE ARE TWO SLOTS ON THIS BOARD  
120mil x 80mil

SLOTS SHOULD BE PLATED THRU  
FABRICATE PER IPC STANDARDS  
Board size is 3.50 x3.50



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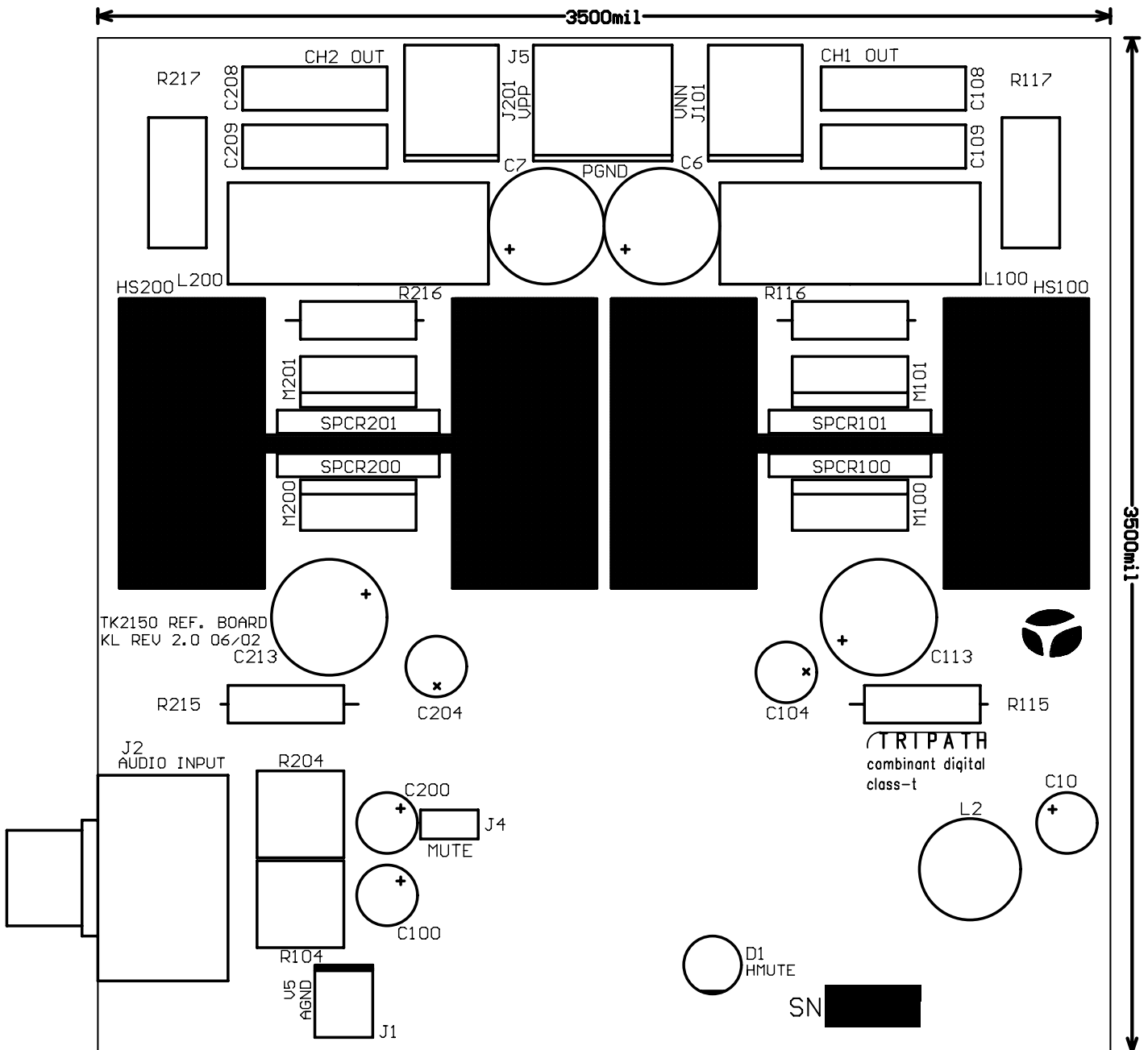
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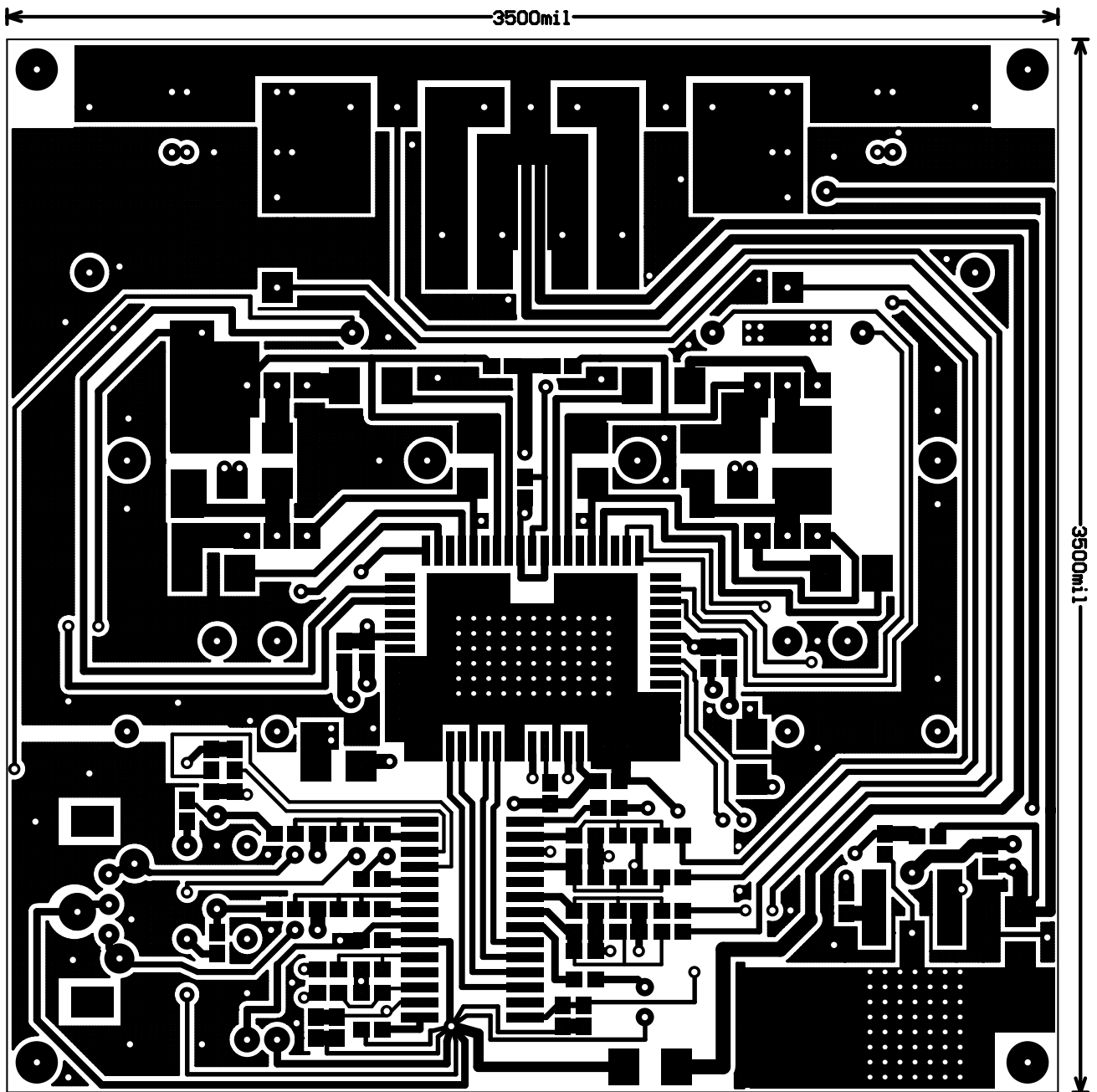
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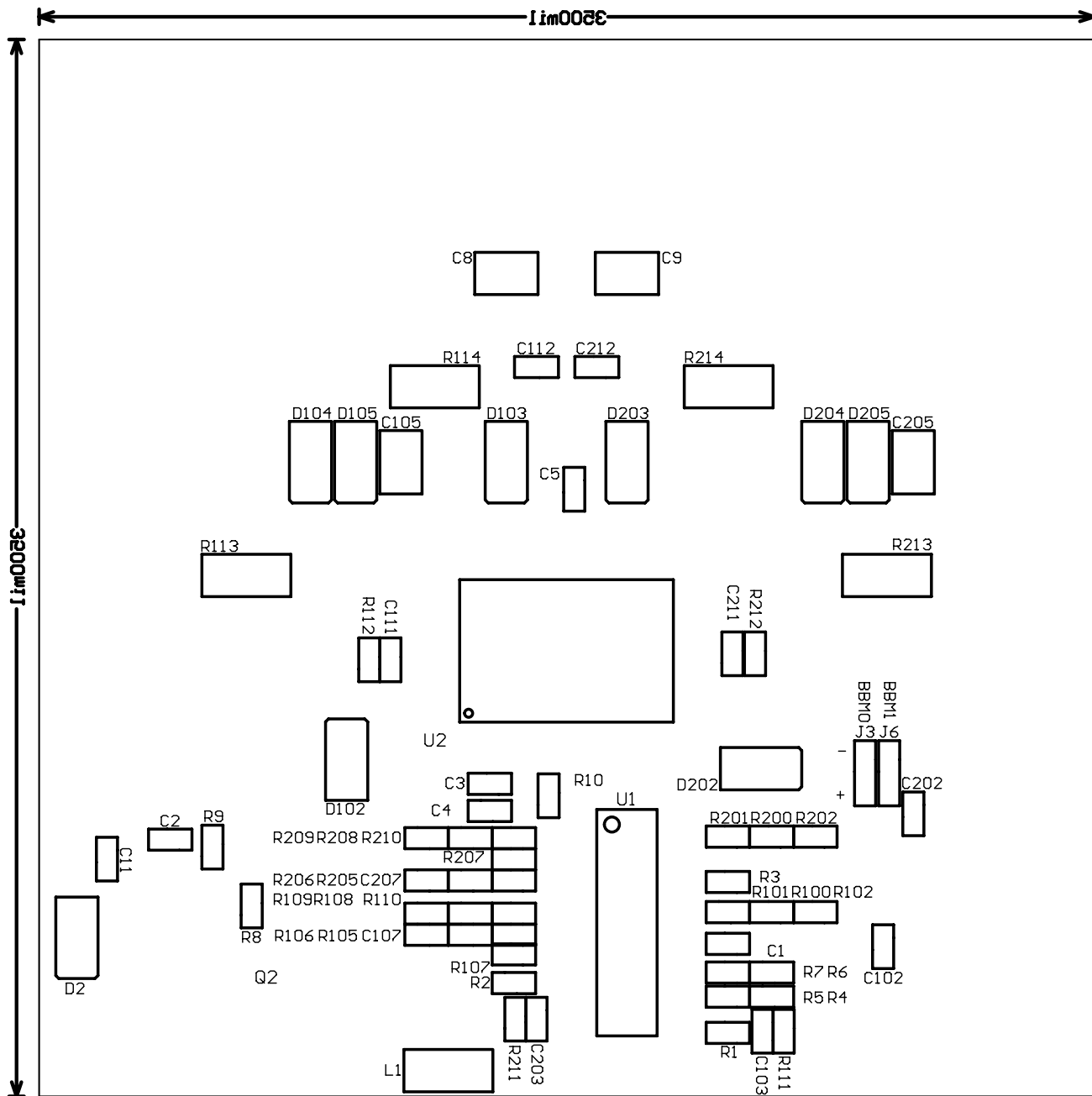
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3200um1

1im002E

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