



## RB-TDA2500-1

### CLASS-T DIGITAL AUDIO AMPLIFIER REFERENCE BOARD USING DIGITAL POWER PROCESSING (DPP™) TECHNOLOGY

Technical Information

Rev. 1.1 June 2005

#### GENERAL DESCRIPTION

The RB-TDA2500 reference board is based on the TDA2500 digital audio power amplifier driver from Tripath Technology. This board is designed to provide a simple and straightforward environment for the evaluation of the Tripath stereo TDA2500 amplifier driver.

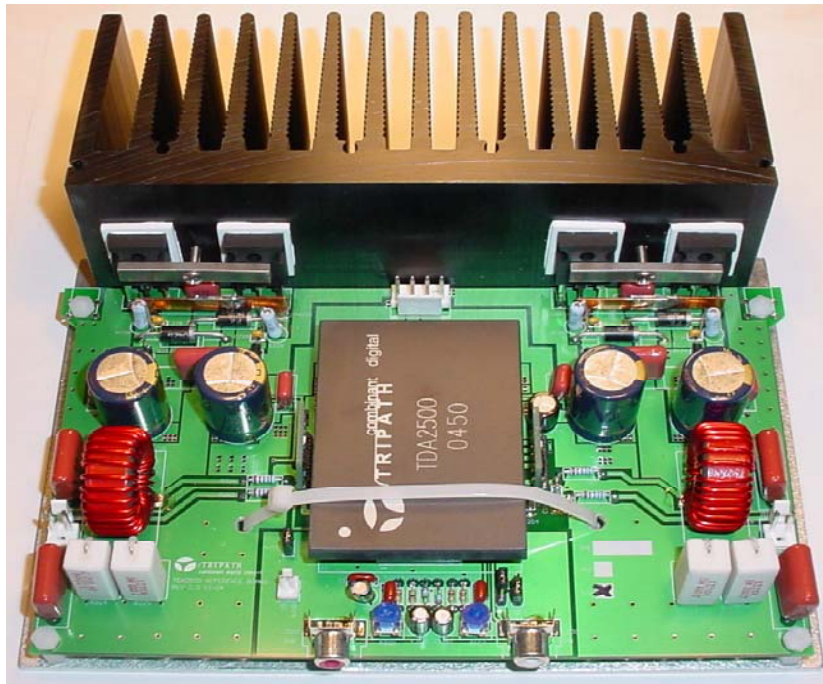
RB-TDA2500-1 – “LV” Version - Nominal supply voltage +/-60V to +/-93V

#### FEATURES

- RB-TDA2500-1: 2 x 500W continuous output power @ 0.1% THD+N, 4Ω, ±90V
- RB-TDA2500-1: 1000W continuous output power @ 0.1% THD+N, bridged 4Ω, ±75V
- Outputs short circuit protected

#### BENEFITS

- Quick and easy evaluation of the TDA2500 in multiple applications
- Uses only N-channel power MOSFETs
- Ready to use in many applications:
  - Pro-audio Amplifiers
  - High-end Audio Amplifiers
  - Distribution Amplifiers



## OPERATING INSTRUCTIONS

### Power Supply Description

There are four external power supplies required to operate this board: VPP, VNN, V12 and V5 (see Figures 1 and 2). VPP and VNN power the load and so must each be able to provide half of the desired output power, plus about 20% for overhead and margin. The TDA2500 amplifier also requires a supply, VN12, that is 12V more positive than VNN and tracks VNN. This VN12 power supply should be a regulated, positive 12V supply. Output and power supply connections are supplied using cable harnesses (not shown in picture). Typical current draw from the VN12 is 200mADC. The V5 draws about 50mA assuming the mute pin is connected to AGND (Mute jumper is shorted on RB-TDA2500-1 board).

Though not required from a device reliability standpoint, the following powering-up sequence is usually adhered to during bench evaluations: 1<sup>st</sup>) V5 and V10 2<sup>nd</sup>) VNN and 3<sup>rd</sup>) VPP. Please refer to the Turn-on/off Pop section for additional discussion on power supply sequencing

The positive and negative supply voltages do not have to match or track each other, but distortion or clipping levels will be determined by the lowest (absolute) supply voltage. Figure 1 shows the proper supply configuration for the RB-TDA2500.

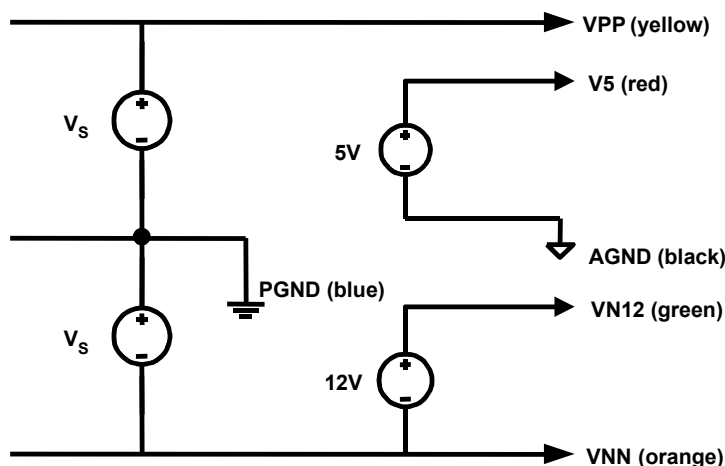


Figure 1

**Note:** To avoid signal degradation, AGND (Analog Ground) and PGND (Power Ground) should be kept separate at the power supply. They are connected internally on the TDA2500 module.

| Connector   | Power Supply |
|-------------|--------------|
| J5 (Yellow) | VPP          |
| J5 (Blue)   | PGND         |
| J5 (Orange) | VNN          |
| J5 (Green)  | VN12         |
| J2 (Red)    | V5           |
| J2 (Black)  | AGND         |

Table 1

## Input Connections

Audio input to the board is located at IN1 (J100) and CH2 IN2 (J200) (see Figures 2 and 3). The input can be a test signal or music source. The connectors are standard RCA types.

## Output Connections

There are two output connectors on the reference board for the speaker outputs. Channel 1 output and associated Power Ground 1 is located at J101. Channel 2 output and associated Power Ground 2 is located at J201. A two-wire harness for each output is provided. See Table 2 for the output connector wire colors. The TDA2500 can be operated as a two-channel single-ended amplifier, bridged mono output amplifier (see Figure 9) or with a passive crossover for a 2.1 channel application (refer to Application Note 13). Outputs can be any passive speaker(s) or test measurement equipment with resistive load (see Application Note 4 for more information on bench testing).

| Connector Name | Output | Ground |
|----------------|--------|--------|
| J101           | Red    | Blue   |
| J201           | White  | Blue   |

Table 2

## Turn-on/off Pop

To avoid turn-on pops, bring the mute from a high to a low state after all power supplies have settled. To avoid turn-off pops, bring the mute from a low to a high state before turning off the supplies. The only issue with bringing up the V5 last, or turning it off first, is clicks/pops. If the mute line is properly toggled (slow turn-on, quick turn-off), then any power up sequence is acceptable. In practice, the V5 will usually collapse before VPP and VNN. The same discussion holds true for the VN10 supply. It can collapse before VPP or VNN though this may cause a larger turn-off pop than if the mute had been activated before either the VN10 or V5 supply have collapsed. No damage will occur to the TDA2500 chipset if either the V5 or VN10 collapse before VPP or VNN, assuming the mute is asserted before the supplies start to discharge.

## RB-TDA2500 Board

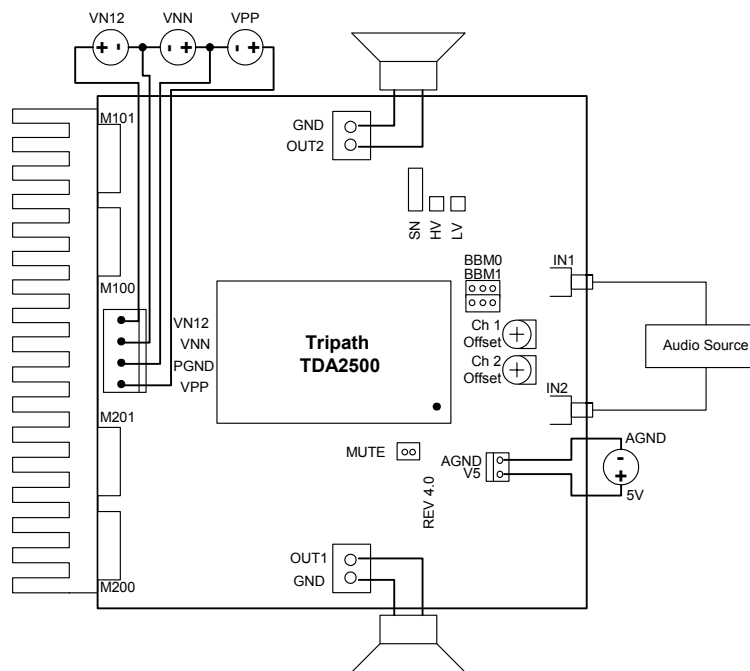


Figure 2

## ARCHITECTURE

A block diagram of one channel of the reference board is shown in Figure 3. The major functional blocks of the amplifier are described below.

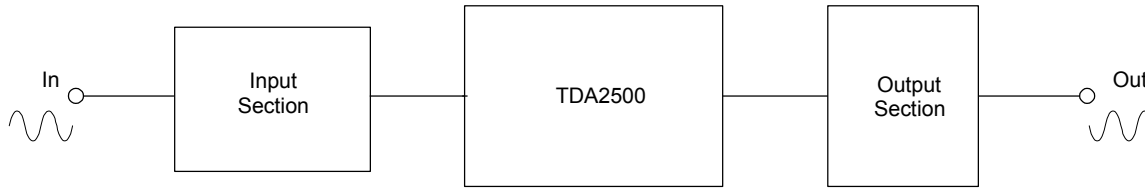


Figure 3

Note: The TDA2500 is an inverting amplifier.

### TDA2500 Amplifier Gain

The TDA2500 amplifier gain is the product of the input stage gain and the modulator gain. Additional information is available in the TDA2500 datasheet available at [www.tripath.com](http://www.tripath.com).

$$A_{VTDA2500} = A_{VINPSTAGE} * A_{VMODULATOR}$$

$$A_{VTA0105A} \approx -\frac{20k\Omega}{4.99k\Omega + R_I} \left( \frac{(1.0k\Omega + R_{FB}) * 2.02}{1020} + 1 \right)$$

For the RB-TDA2500-1 board;

$$R_I (R_{100}, R_{200}) = 49.9k\Omega$$

$$R_{FBC} (R_{106}, R_{206}) = 18.7k\Omega$$

$$A_{VTA0105A} \approx -\frac{20k\Omega}{54.89k\Omega} \left( \frac{19.7k\Omega * 2.02}{1020} + 1 \right) = -14.58 \frac{V}{V}$$

### Input Stage

Figure 5 shows one channel of the Input Stage. The TDA2500 amplifier is designed to accept unbalanced inputs. For the RB-TDA2500-1, the gain is -14.58V/V, or approximately 23.28 dB. Please note that the input stage of the TDA2500 is biased at approximately 2.5VDC. Therefore, for an input signal centered around ground (0VDC), the polarity of the coupling capacitor,  $C_{IN}$ , shown in Figure 4 is correct. In addition, the TDA2500 amplifier is an inverting amplifier.

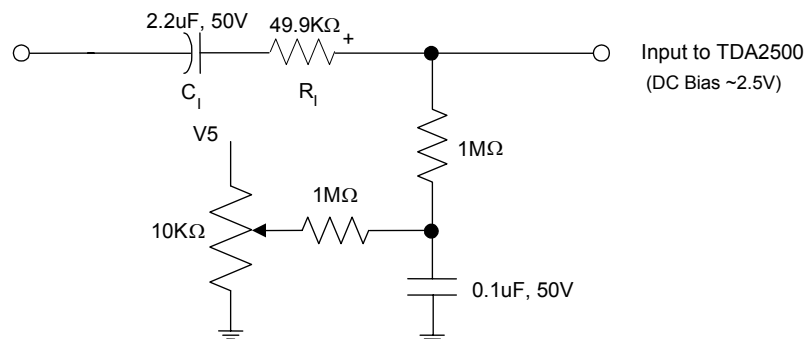


Figure 4

The value of the input capacitor,  $C_i$ , in Figure 5 (labeled C100 and C200 on the schematic), and the input resistor,  $R_{IN}$  (labeled R100 and R200), set the  $-3\text{dB}$  point of the input high-pass filter. The frequency of the input high pass pole,  $F_P$ ,  $-3\text{dB}$  point can be calculated as follows:

$$F_P = 1/(2\pi \times C_i \times R_i)$$

where:  $C_i$  = input capacitor value in Farads

$R_i$  = input resistor value in Ohms

Output offset voltages can be nulled by adjusting the  $10\text{K}\Omega$  potentiometer shown in Figure 4. Once set, and the TDA2500 reaches equilibrium, the offset does not typically drift. R103 is used to adjust the offset of CH1, and R203 is used to adjust the offset of CH2. If a different TDA2500 is placed in the RB-TDA2500 reference board, the offset of each channel will need to be re-trimmed.

### RB-TDA2500 Control Circuitry

The MUTE pin is brought out to an external 2-pin header, J1 (Figure 4). When a jumper is installed from Pin 1 to 2 of J4, the MUTE line is pulled to ground and the outputs are enabled. Note that if the MUTE jumper is removed, the MUTE pin floats high, and the amplifier is muted.

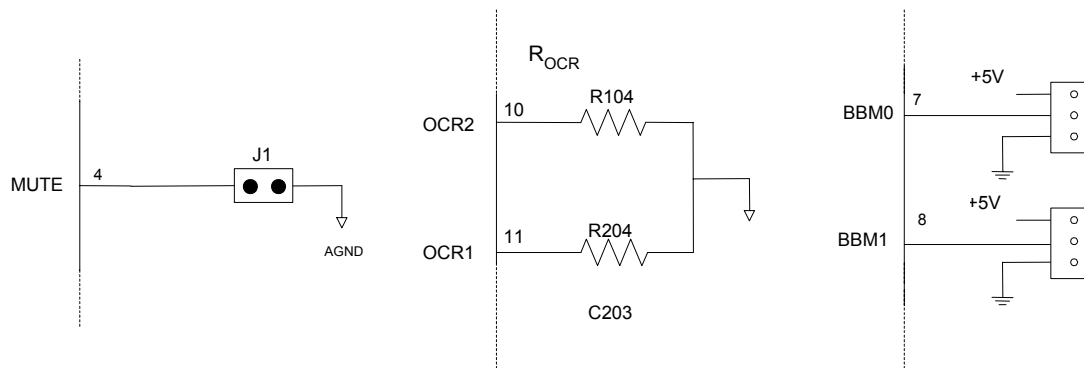


Figure 4

The resistors,  $R_{OCR}$  in Figure 4 (labeled R104 and R204 in the schematic), set the overcurrent threshold for the output devices. Note that these are NOT the sense resistors (the overcurrent sense resistors,  $R_S$ , are in the output stage). By adjusting the  $R_{OCR}$  resistor values, the threshold at which the amplifier “trips” can be changed. The range that the overcurrent trip point can be adjusted (by changing  $R_{OCR}$ ) is determined by the value of the sense resistors.

$R_{OCR}$  can be reduced, though if set too low of a value, this may result in an overcurrent threshold that is so high the amplifier will try to drive a short circuit, possibly damaging the output FETs. In addition, the power dissipation when driving lower impedances may become prohibitive resulting in reduced efficiency and possible FET damage.

Finally, the Break-Before-Make (or “BBM”) lines are used to control the “dead time” of the output FETs. The “dead time” is the period of time between the turn-off of one device and the turn-on of the opposite device on the same channel. If the two devices are both on at the same time, current “shoots through” from one supply to the other, bypassing the load altogether. Obviously, this will have a great impact on the overall efficiency of the amplifier. However, if the dead time is too long, linearity suffers. The optimum BBM setting will change with different output FETs, different operating voltages, different layouts and different performance requirements. For this reason, Tripath has provided a means to adjust the BBM0 (via J3) and BBM1 (via J4) settings. The stock setting for BBM is  $65\text{nS}$  for the RB-TDA2500-1 board. These settings should be verified over the full temperature and load range of the application to ensure that any thermal rise of the output FETs and TDA2500 does not impact the performance of the amplifier.

| BBM1 | BBM0 | DELAY |
|------|------|-------|
| 0    | 0    | 145nS |
| 0    | 1    | 105nS |
| 1    | 0    | 65nS  |
| 1    | 1    | 25nS  |

Note: The default delay jumper setting is 65nS for the RB-TDA2500-1

Figure 5

### RB-TDA2500 Over-current Circuitry

One advantage of the TDA2500 hybrid over previous Tripath modules is direct access to the internal over-current comparator inputs. The RB-TDA2500 takes advantage of this feature with the addition of an external circuit mounted on a small daughter card for each channel. This circuit is included at the end of this document.

The RB-TDA2500 comes with these daughter cards populated and enabled. The daughter cards are located at CD100 and CD200. In addition, the resistors labeled RFW100, RFW101, RFW200, and RFW201 are populated with zero ohm shorts.

With the RFWxxx resistors populated with zero ohm shorts, the internal half-wave circuit is actually converted into a full-wave detection circuit for the negative supply (VNN). The small discrete circuit on the daughter card is a full-wave detection circuit for the positive supply (VPP).

Full-wave detection ensures that the over-current trip point is consistent across all ranges of duty cycle and switching frequency. Thus, it is much easier to maximize the output current capability of the output stage without fear of exceeding the MOSFET current rating at intermediate load impedance.

Due to the external full-wave daughter card, the bias level is roughly twice that of the TDA2500 by itself. The bias level will cause more variation of the current trip point versus supply voltage magnitude as opposed to the TDA2500 using only the half-wave detection circuit. For the RB-TDA2500, the bias current is about 50 $\mu$ A for +/-60V and 60 $\mu$ A for +/-90V.

In many applications, the full-wave circuit will not be needed. By removing the daughter cards and shorting RHW100, RHW101, RHW200, and RHW201, the internal half-wave circuit can be used. For proper operation of half-wave detection, RFW100, RFW101, RFW200, and RFW201 must be removed.

The gate resistors (labeled R120 and R121 in Figure 6 and the attached schematic) are used to control MOSFET switching rise/fall times and thereby minimize voltage overshoots. They also dissipate a portion of the power resulting from moving the gate charge each time the MOSFET is switched. If  $R_G$  is too small, excessive heat can be generated in the driver. Large gate resistors lead to slower gate transitions resulting in longer rise/fall times and thus requiring a larger BBM setting.

The bypass capacitors C120/C121 are critical to the reduction of ringing on the output MOSFETs. These parts are placed as closely as possible to the leads of the MOSFETs, and the leads of the capacitors themselves are as short as practical. Their values will not change with different output MOSFETs.

The output filter, L100/C126, is a second order low-pass filters that recovers the analog audio signal. One of the benefits of the Class-T design is the ability to use output filters with relatively high cutoff frequencies. This greatly reduces the speaker interactions that can occur with the use of lower-frequency filters common in Class-D designs. Also, the higher-frequency operation means that the filter can be of a lower order (simpler and less costly).

RB-TDA2500 – KL/Rev. 1.1, 06.05

As important as the values themselves, the material used in the core is important to the performance of the filter. Core materials that saturates too easily will not provide acceptable distortion or efficiency figures. Tripath recommends a low- $\mu$  core, like type 2, iron powder cores. Micrometals, ([www.micrometals.com](http://www.micrometals.com)), is a main supplier of iron powder cores. The core part number used on the RB-TDA2500-1 is T106-2 and is wound with 29 turns of 16AWG wire.

The Zobel circuits R124-R127/C127 are there in case an amplifier is powered up with no load attached as well as terminating the amplifier with typical, “inductive” loudspeakers. The Q of the LC output filter, with no load attached, rises quickly out to 80kHz. Resonant currents in the filter and ringing on the output could reduce the reliability of the amplifier. The Zobel eliminates these problems by reducing the Q of the network significantly above 50kHz. Modifying the LC output filter should not require a recalculation of the Zobel components, though depending on application, the power capability of the Zobel resistor may need to be increased. The components used on the reference board should be quite adequate for almost all applications. The amplifier should never be operated without a zobel filter attached even if an output load is always present.

## Connection Diagram for Bridge Mode Operation

The amplifier is connected to the power supplies and load as shown in Figure 7. Note that an opamp inverter has been added in front of one of the channel inputs (i.e. Channel 2). The main reason for processing the channels out of phase is to avoid potential problems with switching power supplies, but it also simplifies the connections for bridged-mode operation. For bridged operation, simply connect the “-” terminal to the output of the inverted channel (Channel 1 output, J100 pin 1) and the “+” terminal to the output of the non-inverted channel with respect to the input signal (Channel 2 output, J200 pin 1). The opamp inverter shown in Figure 7 is not needed if the audio generator used for testing has 2 separate outputs with a phase switch.

There are tradeoffs to bridging an amplifier. For a given supply voltage, the output capability is theoretically increased by a factor of four. But this increased potential power comes at the expense of lower efficiency. Thus, the power supply voltage used for bridged operation is usually reduced such that the power dissipation in the output mosfets is not increased to a potentially damaging level. This usually results in twice the output power as compared to the single ended case.

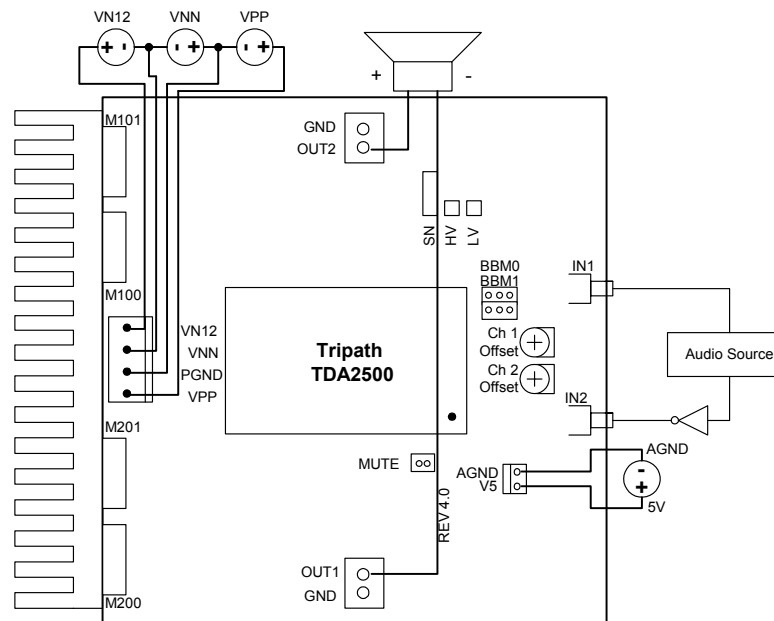


Figure 7



## Circuit Board Layout

The TDA2500 is a power (high current) amplifier that operates at relatively high switching frequencies. The output of the amplifier switches between  $V_{PP}$  and  $V_{NN}$  at high speeds while driving large currents. This high-frequency digital signal is passed through an LC low-pass filter to recover the amplified audio signal. Since the amplifier must drive the inductive LC output filter and speaker loads, the amplifier outputs can be pulled above the supply voltage and below ground by the energy in the output inductance. To avoid subjecting the TDA2500 and external mosfets to potentially damaging voltage stress, it is critical to have a good printed circuit board layout. It is recommended that Tripath's layout and application circuit be used for all applications and only be deviated from after careful analysis of the effects of any changes.

The following components are important to place near either their associated TDA2500 or output MOSFET pins. The recommendations are ranked in order of layout importance, either for proper device operation or performance considerations.

- The impedance of the output node (the connection between the top side MOSFET source to bottom side MOSFET drain) must be minimized. Reducing the parasitic trace inductance is the most effective way of limiting output node ringing. A flat, bar conductor, in parallel with the PCB output node trace, is quite effective at minimizing the inductance thereby reducing output transients due to the switching architecture.
- The capacitors,  $C_{HBR}$ , provide high frequency bypassing of the amplifier power supplies and will serve to reduce spikes and modulation of the power supply rails. Please note that both mosfet half-bridges must be decoupled separately. In addition, the voltage rating for  $C_{HBR}$  should be at least 400V as this capacitor is exposed to the full supply range,  $V_{PP}$ - $V_{NN}$ .
- The output diodes,  $D_O$ , are used to minimize overshoots/undershoots on the output node. Please note that the proper connection of these is "Drain to Drain" and "Source to Source" as shown in the Application/Test Circuit. Improper routing of these diodes will render them useless due to PCB trace inductance.
- The gate resistors,  $R_G$ , should be located as close to the output MOSFET gates leads as possible. In addition, the trace length from the pins LOx/HOx to the gate resistor should be minimized. To reduce the loop area, a parallel trace from LOxCOM/HOxCOM should be routed directly to the respective MOSFET source lead.
- $C_{FB}$  removes very high frequency components from the amplifier feedback signals and lowers the output switching frequency by delaying the feedback signals. The value of  $C_{FB}$ , in conjunction with internal processors delays, keeps the average switching frequency for channel 1 and channel 2 separated by 40kHz. This minimizes in-band audio noise. Locate these capacitors as close to their respective TDA2500 pin as possible.

Some components are not sensitive to location but are very sensitive to layout and trace routing.

- The routing of the sense resistors,  $R_S$ , must be Kelvin connected. This implies a direct trace from the respective TDA2500 pin to the sense resistor lead without interruption. If additional connections are made to the TDA2500 overcurrent sense pins or the traces, the overcurrent sense circuit may prematurely trigger. In no instance, should a sense pin on the TDA2500 be connected to other equal potential pins on the TDA2500. For instance, one should not connect LOxCOM to OCSxLP at the TDA2500.
- To maximize the damping factor and reduce distortion and noise, the modulator feedback connections should be routed directly from the pins of the output inductors.  $L_O$ .
- The output filter capacitor,  $C_O$ , and zobel capacitor,  $C_Z$ , should be star connected with the load return. The output ground feedback signal should be taken from this star point.
- To minimize the possibility of any noise pickup, the trace lengths of IN1 and IN2 should be kept as short as possible. This is most easily accomplished by locating the input resistors,  $R_I$  as close to the TDA2500 as possible. In addition, the offset trim resistor,  $R_{OFB}$ , which connects to either IN1, or IN2, should be located close to the TDA2500 input section.

## TDA2500 Grounding

Proper grounding techniques are required to maximize TDA2500 functionality and performance. Parametric parameters such as THD+N, Noise Floor and Crosstalk can be adversely affected if proper grounding techniques are not implemented on the PCB layout. The following discussion highlights some recommendations about grounding both with respect to the TDA2500 as well as general “audio system” design rules.

The TDA2500 is divided into two sections: the input section, which spans pins 1-12 and pins 35-38 and the output (high voltage) section, which spans pins 13 through pin 34. On the TDA2500 evaluation board, the ground is also divided into distinct sections, one for the input and one for the output. To minimize ground loops and keep the audio noise floor as low as possible, the input and output ground should not be externally connected. They are already connected internally via a ferrite bead between pin 1 and pin 28. Additionally, any external input circuitry such as preamps, or active filters, should be referenced to pin 1.

For the power section, Tripath has traditionally used a “star” grounding scheme. Thus, the load ground returns and the power supply decoupling traces are routed separately back to the power supply. In addition, any type of shield or chassis connection would be connected directly to the ground star located at the power supply. These precautions will both minimize audible noise and enhance the crosstalk performance of the TDA2500.

The TDA2500 incorporates a differential feedback system to minimize the effects of ground bounce and cancel out common mode ground noise. As such, the feedback from the output ground for each channel needs to be properly sensed. This can be accomplished by connecting the output ground “sensing” trace directly to the star formed by the output ground return, output capacitor,  $C_O$ , and the zobel capacitor,  $C_Z$ . Refer to the Application / Test Circuit for a schematic description.

## Performing Measurements on the RB-TDA2500

The TDA2500 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 TDA2500 amplifier switching pattern will degrade the measurement.

One feature of the TDA2500 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-TDA2500 Reference Board has a simple two-pole output filter with excellent performance in listening tests.

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

## Documentation

Soft copies of the schematics and layout can be provided upon request (available in Protel 2.8 format). Gerber files, with embedded apertures, are also available.

Tripath Technology, Inc. reserves the right to make any changes without further notice to improve reliability, function and design.

Tripath and Digital Power Processing are trademarks of Tripath Technology. Other trademarks referenced in this document are owned by their respective companies.

Tripath Technology, Inc. reserves the right to make changes without further notice to any products herein to improve reliability, function or design. Tripath does not assume any liability arising out of the application of use of any product or circuit described herein; neither does it convey any license under its patent rights nor the rights of others.

**TRIPATH'S PRODUCT ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PRESIDENT OF TRIPATH TECHNOLOGY, INC. As used herein:**

1. Life support devices or systems are devices or systems which, (a) are intended for surgical implant into the body, or (b) support or sustain life, and whose failure to perform, when properly used in accordance with instructions for use provided in this labeling, can be reasonably expected to result in significant injury of the user.
2. A critical component is any component of a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system, or to affect its safety or effectiveness.

## Contact Information

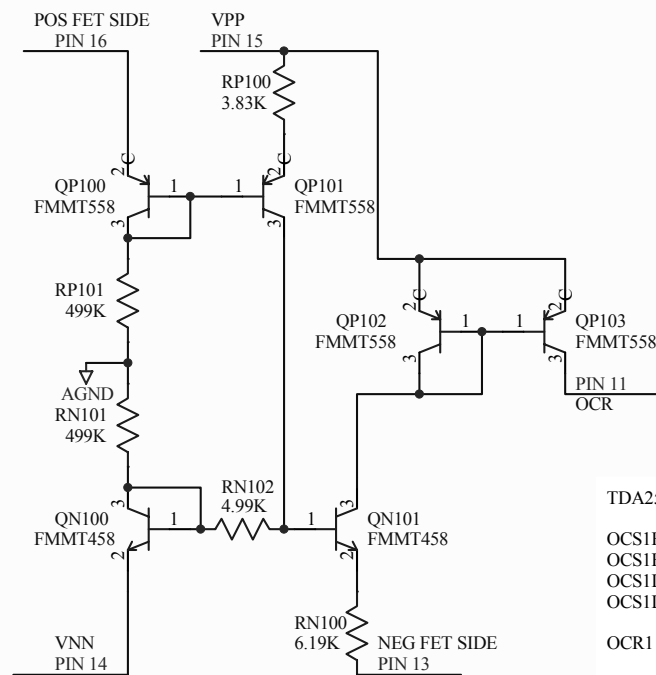
### **TRIPATH TECHNOLOGY, INC**

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

For more Sales Information, please visit us @ [www.tripath.com/cont\\_s.htm](http://www.tripath.com/cont_s.htm)

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





#### TDA2500 PINOUT

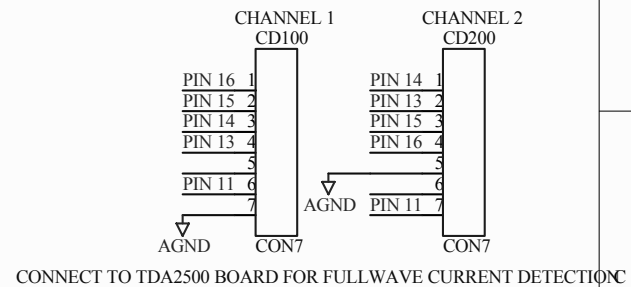
|             |             |
|-------------|-------------|
| OCS1HP - 16 | OCS2HP - 34 |
| OCS1HN - 15 | OCS2HN - 33 |
| OCS1LP - 13 | OCS2LP - 32 |
| OCS1LN - 14 | OCS2LN - 31 |

OCR1 - 11      OCR2 - 10

#### NOTE:

- 1) MAKE SURE RFW100, RFW101, RFW200, AND RFW201 ARE POPULATED WITH ZERO OHM RESISTORS ON THE RB-TDA2500 BOARD
- 2) MAKE SURE RHW100, RHW101, RHW200, AND RHW201 ARE OPEN ON THE RB-TDA2500 BOARD

|   |                          |                 |
|---|--------------------------|-----------------|
| Title<br>POSITIVE SIDE FULLWAVE CURRENT DETECTION CIRCUIT |                          |                 |
| Size<br>A   | Number                   | Revision<br>0.2 |
| Date:   | 29-Apr-2005              | Sheet of        |
| File:   | C:\DLAYOUTS\PSFW1 R1.SCH | Drawn By:       |

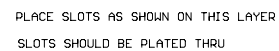


## Bill of Material for C:\DLAYOUTS\TDA2500\RB2500R1\TDA25001.Sch

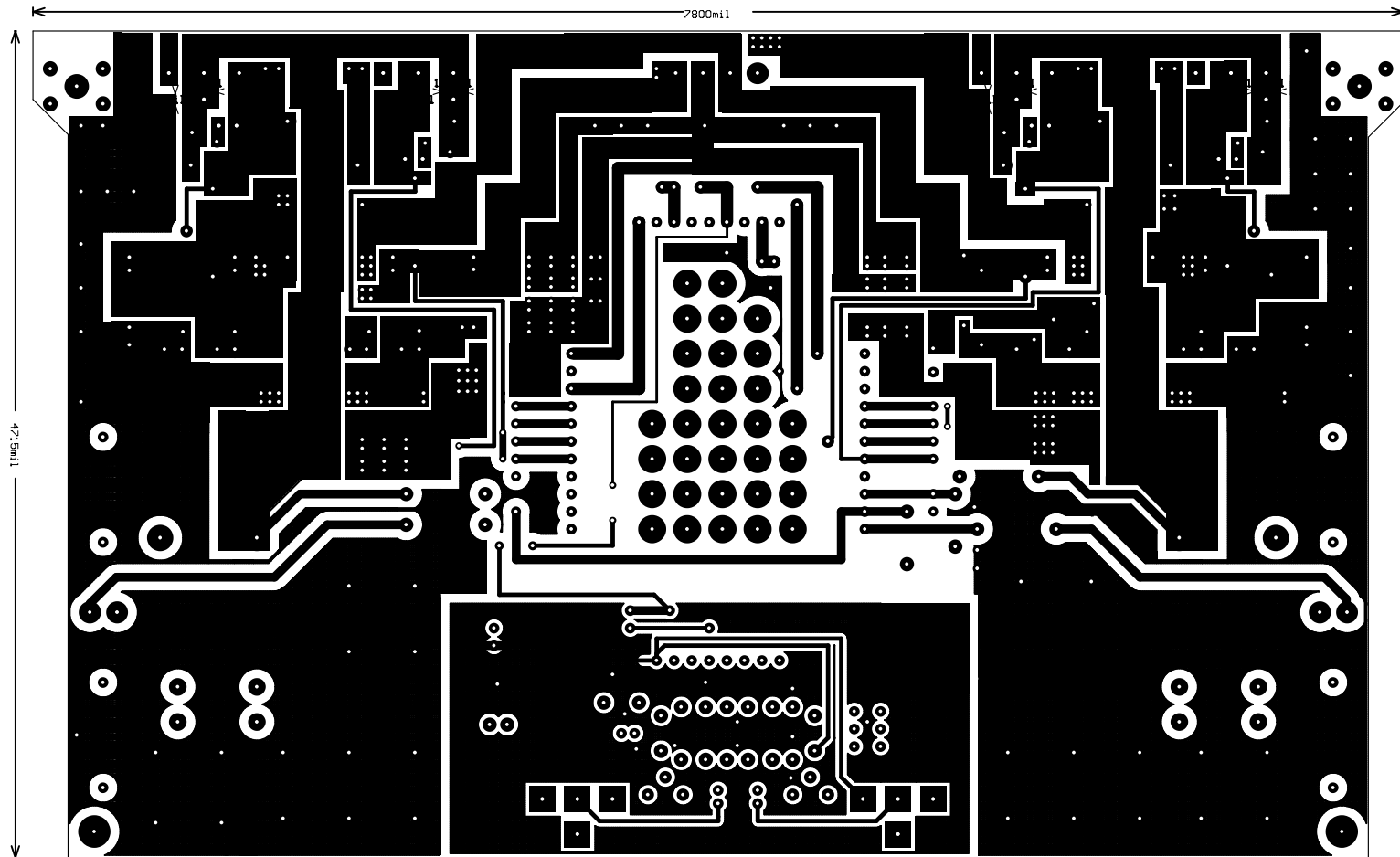
| Used | Part Type     | Designator                                      | Footprint   | Part Field 1             | Part Field 2   | Part Field 3         |
|------|---------------|---|-------------|--------------------------|----------------|----------------------|
| ==== | =====         | =====   | =====       | =====                    | =====          | =====                |
| 4    | 0 OHM         | RFW100 RFW101 RFW200 RFW201                     | 0805        | 1/8W, 1%                 | *              | *                    |
| 4    | 0.01OHM/2W    | R122 R123 R222 R223                             | RESLVR1     | OHMITE                   | 12FR010        | DK 12FR010-ND        |
| 6    | 0.1UF/250V    | C120 C122 C123 C220 C222 C223                   | C0U1MF40    | PANASONIC                | ECQ-E2104KF    | DK EF2104-ND         |
| 3    | 0.1UF/50V     | C1 C101 C201                                    | C0U1MF05    | PANASONIC                | ECQ-V1H104JL   | DK P4525-ND          |
| 4    | 0.22uF/100V   | C126 C127 C226 C227                             | C0U033MF40  | PANASONIC                | ECH-S1224JZ    | DK PS1224J-ND        |
| 2    | 1.0UF/250V    | C121 C221                                       | C1U0MF40    | PANASONIC                | ECQ-E2105KF    | DK EF2105-ND         |
| 1    | 1.21M         | R1  | 0805        | 1/8W, 1%                 | *              | *                    |
| 2    | 1.33M         | R2 R4   | 0805        | 1/8W, 1%                 | *              | *                    |
| 2    | 1000pF/50V    | C3 C4   | 0805        | 10% NPO                  | *              | *                    |
| 4    | 100pF/200V    | C128 C129 C228 C229                             | CGLDMAX     | KEMET                    | C315C101J2G5CA | DK 399-1895-ND       |
| 2    | 10K OHM       | R104 R204                                       | RES50       | 1/8W, 1%                 | *              | *                    |
| 2    | 10K POT       | R103 R203                                       | POTSTURN    | PANASONIC                | 3306P-1-103    | DK 3306P-103-ND      |
| 4    | 100HM/2W      | R128 R129 R228 R229                             | R3WVERT     | PANASONIC                | ERG-2SJ100     | DK P10W-2BK-ND       |
| 1    | 10pF          | C106  | 0805        | 5% NPO, 50V              | *              | *                    |
| 1    | 10UF/50V      | C2  | C10UEL05    | PANASONIC                | ECA-1HHG100    | DK P5567-ND          |
| 2    | 11.3uH        | L100 L200                                       | IND33UH     | MICROMETALS              | T106-2 CORE    | 29 turns, 16awg wire |
| 1    | 150W DRVR     | I1  | DRV150 2    | TRIPATH TECHNOLOGY, INC. | *              | *                    |
| 4    | 18.7KOHM/0.6W | R105 R106 R205 R206                             | RES1W045    | BC Components            | B0207C18K70F5T | DK BC18.7KZCT-ND     |
| 4    | 1M            | R101 R102 R201 R202                             | RES50       | 1/8W, 5%                 | *              | *                    |
| 2    | 2.2UF/50V     | C100 C200                                       | C10UEL05    | PANASONIC                | ECA-1HHG2R2    | DK P5564-ND          |
| 1    | 220UF/25V     | C5  | C10UEL05    | PANASONIC                | EEU-FM1E221    | DK P12383-ND         |
| 1    | 22pF          | C206  | 0805        | 5% NPO, 50V              | *              | *                    |
| 1    | 3.57M         | R3  | 0805        | 1/8W, 1%                 | *              | *                    |
| 4    | 330UF/100V    | C124 C125 C224 C225                             | C330UEL16   | PANASONIC                | EEU-FC2A331S   | DK P10783-ND         |
| 4    | 330HM/5W      | R124 R125 R224 R225                             | PWR5WRT     | XICON                    | PRM5-33        | MSR 280-PRM5-33      |
| 2    | 49.9K         | R100 R200                                       | RES50       | 1/8W, 1%                 | *              | *                    |
| 4    | 5.6OHM/1W     | R120 R121 R220 R221                             | 2512        | PANASONIC                | ERJ-1TYJ5R6U   | DK PT5.6XCT-ND       |
| 1    | CON2          | J2  | CON2B       | WALDOM                   | 22-23-2021     | DK WM4200-ND         |
| 1    | CON4          | J5  | PWR4        | WALDOM                   | 26-60-4040     | DK WM4622-ND         |
| 2    | CON7          | CD100 CD200                                     | CON7_100MIL | *                        | *              | *                    |
| 2    | CPR2PIN       | CPR100 CPR200                                   |             | *                        | *              | *                    |
| 1    | JUMPER        | J1  | GJMPR001    | *                        | *              | *                    |
| 2    | JUMPER3       | J3 J4   | GJMP3001    | *                        | *              | *                    |
| 4    | MUR420        | D125 D126 D225 D226                             | 267 03      | ON SEMICONDUCTOR         | MUR420         | NWK - 08F2106        |
| 8    | NS            | D120 D121 D220 D221 RHW100 RHW101 RHW200 RHW201 | 0805        | 1/8W, 5%                 | *              | *                    |
| 2    | PWR2          | J101 J201                                       | PWR2        | WALDOM                   | 26-60-4020     | DK WM4620-ND         |
| 2    | RCAJACK       | J100 J200                                       | RCAJACK     | DGS PRO AUDIO            | *              | MSR 161-0390         |
| 4    | STW34NB20     | M100 M101 M200 M201                             | TO3PMSFT    | ST MICROELECTRONICS      | STW34NB20      | *                    |

Bill of Material for C:\DLAYOUTS\TDA2500\POSFWCH1\PSFW1\_R1.Sch

| Used | Part    | Type  | Designator  | Footprint   | Part      | Field 1 | Part      | Field 2 | Part         | Field 3 |
|------|---------|-------|-------------|-------------|-----------|---------|-----------|---------|--------------|---------|
| ==== | =====   | ===== | =====       | =====       | =====     | =====   | =====     | =====   | =====        | =====   |
| 1    | 3.83K   |       | RP100       | 0603        | 1/10W, 1% | *       |           |         | *            |         |
| 1    | 4.99K   |       | RN102       | 0603        | 1/10W, 1% | *       |           |         | *            |         |
| 2    | 499K    |       | RN101 RP101 | 1206        | 1/8W, 1%  | *       |           |         | *            |         |
| 1    | 6.19K   |       | RN100       | 0603        | 1/10W, 1% | *       |           |         | *            |         |
| 2    | CON7    |       | CD100 CD200 | CON7 100MIL | *         |         |           |         | *            |         |
| 2    | FMMT458 | QN100 | QN101       | SOT23       | ZETEX     |         | FMMT458TA |         | FMMT458CT-ND |         |
| 4    | FMMT558 | QP100 | QP101 QP102 | SOT23       | ZETEX     |         | FMMT558TA |         | FMMT558CT-ND |         |
|      |         |       | QP103       |             |           |         |           |         |              |         |



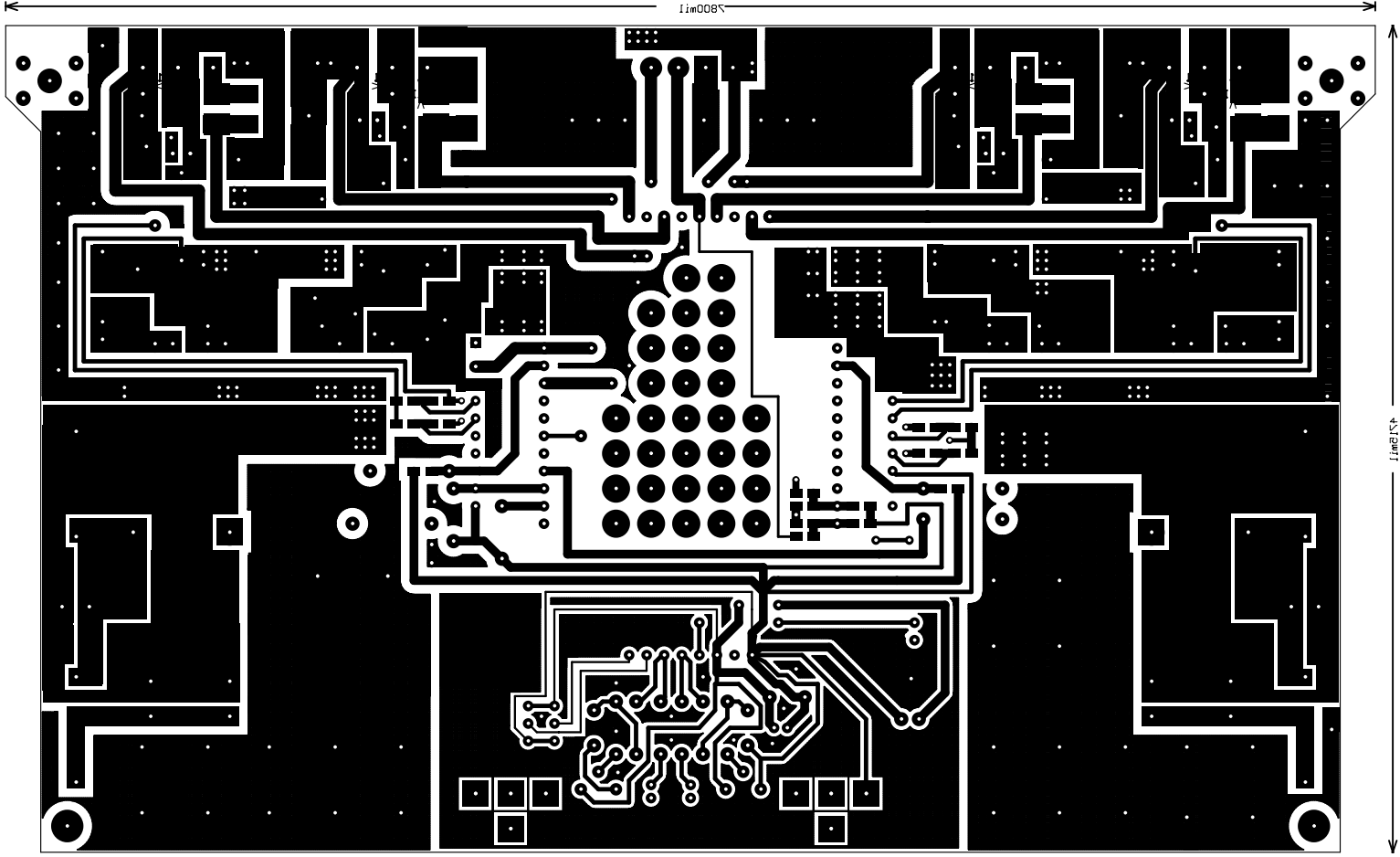




FABRICATION NOTES  
 MATERIAL: FR-4 OR EQUIVALENT  
 0.062 +/- 0.002 THICKNESS  
 2 OZ COPPER, ALL LAYERS  
 SOLDERMASK OVER BARE COPPER, USE BLUE  
 SILKSCREEN TO BE WHITE  
 ALL HOLES PLATE THRU  
 FABRICATE PER IPC STANDARDS

NOTE: THERE ARE SLOTS ON THIS BOARD  
 125mil x 50mil

PLACE SLOTS AS SHOWN ON THIS LAYER  
 SLOTS SHOULD BE PLATED THRU



SLITS SHOULD BE PLATED THRU  
PLACE SLITS AS SHOWN ON THIS LAYER  
110.00mm x 110.00mm  
NOTE: THERE ARE SLITS ON THIS BOARD

FABRICATE PER IPC STANDARDS  
ALL HOLES PLATE THRU  
SILKSCREEN TO BE WHITE  
SOLDERMASK OVER BARE COPPER, USE BLUE  
3 OZ COPPER, ALL LAYERS  
0.002 +/- 0.002 THICKNESS  
MATERIAL: FR-4 OR EQUIVALENT  
FABRICATION NOTES

SLOTS SHOULD BE PLATED THRU

