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REVISION HISTORY

10/07—Revision 0: Initial Version

OVERVIEW OF THE ADAU1513, ADAU1590, AND ADAU1592

The EVAL-ADAU1513/ADAU1590/ADAU1592 can be used for quick evaluation of [ADAU1513](#), [ADAU1590](#), and [ADAU1592](#) Class-D amplifiers. The ADAU1590 and ADAU1592 consist of stereo Class-D amplifiers based on sigma-delta ($\Sigma\Delta$) architecture. The ADAU1513 is a stereo integrated power stage part.

The ADAU1590 and ADAU1592 offer excellent audio performance. The closed-loop architecture reduces THD + N to about 85 dB. The LFCSP with a bottom exposed pad allows heat dissipation through PCB copper. A highly efficient output stage requires no extra heat sink for 2x15W applications in 6 mm². The ADAU1590 and ADAU1592 use $512 \times f_s$ clock generated using an external crystal or ceramic resonator. Internally, the clock is divided by 2 to derive $256 \times f_s$ master clock. The modulator works at $256 \times f_s$ clock. The closed-loop $\Sigma\Delta$ architecture improves the THD + N and PSRR. The selectable PGA gain

setting allows part to be configured at 4 different gain settings from 0 dB, 6 dB, 12 dB, or 18 dB. The parts also allow two modes of operation either stereo or mono (for high output current driving in low impedances). The parts have pop-and-click suppression during turn-on and turn-off.

The ADAU1513 is a power stage only part, which accepts 3.3 V logic level digital differential pulse-width modulated (PWM), inputs from external modulator. The inputs to the power stage can be fed from an external PWM controller such as the [ADAV4201](#).

The ADAU1513, ADAU1590, and ADAU1592 have built-in output short-circuit protection, overcurrent protection, and thermal protection.

EVALUATION BOARD HARDWARE

The board allows single-supply operation ranging from 9 V to 18 V and consists of one footprint for ADAU1513, ADAU1590, ADAU1592, which provides up to 2x15W output. The footprint on the PCB is optimized for both LFCSP (CP-48-1) and TQFP (SV-48-5) packages. The typical load impedance is 6 Ω, but 4 Ω or 8 Ω operation is possible with minor component changes to an output LC filter. The board is designed as 4-layer PCB. The top and bottom layers are for signals, whereas Layer 2 and Layer 3 are used as GND and a power plane. The board is designed for typical stereo or 2-channel audio amplifier application. The PCB layout is important to achieve good audio performance and EMI performance. The following sections offer useful guidelines for designing the board.

SUPPLY DECOUPLING

Power supply decoupling is the most critical element in the design of switching amplifier boards. For the evaluation board to work properly, it is very important to pay attention to the selection and placement of the supply decoupling capacitors. The typical 0.1 μF multilayer ceramic chip (MLCC) in either a 0805 or 1206 package is most suitable for a high frequency decoupling capacitor and must be placed as close as possible to the ADAU1513, ADAU1590, or ADAU1592. The X7R or X5R dielectric should be given preference over Y5V or Z5U. The placement of these components is also important. The 0.1 μF high frequency decoupling capacitors must be placed as close to the part as possible. In addition, take care that the supply and GND connection to the PVDD and PGND pins of ADAU1513, ADAU1590, and ADAU1592 is direct. Avoid placing vias in the traces connecting decoupling capacitors to PVDD and PGND pins. Higher value MLCC or 1 μF tantalum capacitors may also be used.

SCHOTTKY DIODE

The Schottky diodes limit the voltages at the bridge output from exceeding damaging levels, due to the presence of inductors. Hence, the diodes must be placed very close to the ADAU1513, ADAU1590, or ADAU1592 to provide a low inductive current return path.

LC FILTER

The EVAL-ADAU1513/ADAU1590/ADAU1592 uses a 2-pole Butterworth filter for reconstruction of the output signal. The inductor forms an important element as it can limit the THD + N performance as well as EMI performance. The EVAL-ADAU1513/ADAU1590/ADAU1592 uses a shielded drum core inductor. The current saturation limit must be greater than 5 A for preventing the saturation of the inductor at high output powers. Though the unshielded drum cores saturation current rating is higher than the shielded current rating, the shielded ones are preferred and aid in reducing the EMI radiation. The typical polyester or film capacitors are used for the output filter. See Table 1 for typical LC filter component values for commonly used loads.

Table 1. Output LC Filter Component Value

Load Impedance (Ω)	Inductors L4, L5, L6, L7 (μH)	Capacitors C31, C32, C33, C34 (F)
4	10	1.5
6	15	1
8	22	0.68

INPUT/OUTPUT CONNECTORS

The EVAL-ADAU1513/ADAU1590/ADAU1592 has two RCA jack connectors for analog input and three pairs of binding posts for amplifier outputs and power supply connections. The RCA jacks, J2 and J1, are left- and right-channel analog inputs.

Binding Post TP5 (red) and Binding Post TP8 (black) are positive and negative left-channel speaker outputs, whereas Binding Post TP6 (red) and Binding Post TP9 (black) are positive and negative right-channel speaker outputs. Binding Post TP7 (red) and Binding Post TP10 (black) are positive PVDD and PGND power supply inputs to the board.

The 5-pin male header, P1, is the test input port for internal use only and should not be connected to the evaluation board.

The dual row, 8-pin male header, P2, is a control I/O port useful for accessing the error flag outputs, mute inputs, and reset inputs.

The dual row, 16-pin male header, P3, is a PWM input port used for logic level PWM inputs to the ADAU1513 only.

The 2-pin male headers, P6 and P8, are used to provide the AVDD and DVDD supply. These must be installed to provide 3.3 V, AVDD, and DVDD to all the circuits on board.

An SMA type connector, J3, is used for external clock input

JUMPERS AND SWITCHES

The 3-way toggle switch, S1, is used for reset, as well as to mute or turn on the amplifier. S1 has three positions that are used as reset/mute/on. The reset position is momentary (see Figure 2).

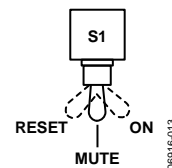


Figure 2. Reset/Mute/On Switch

The 4-way rotary switch, S2, is used for setting PGA gain and the 2-pin jumpers, P4 and P5, must be installed for S2 to be effective. See Figure 3 for switch settings. The switch has four positions, which can be used to set either 0 dB, 6 dB, 12 dB, or 18 dB of PGA gain. Switch S2 is effective only for [ADAU1590](#) or [ADAU1592](#).

The PGA switch settings are as follows:

- Position 0 = 0 dB PGA gain (approximately 1 V rms input for a clipped output)
- Position 1 = 6 dB PGA gain (approximately 0.5 V rms input for a clipped output)
- Position 2 = 12 dB PGA gain (approximately 0.25 V rms input for a clipped output)
- Position 3 = 18 dB PGA gain (approximately 0.125 V rms input for a clipped output)

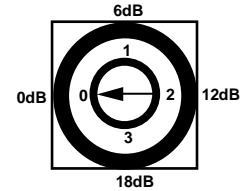


Figure 3. PGA Setting Switch S2

The 3-pin jumper, P9, is for using either the external or the internal clock for the board. When P9 is set for external, the external clock is fed at J3. When P9 is set for internal, the internal clock is generated using the quartz crystal or ceramic resonator on the board. This is used to provide the master clock for ADAU1590, or ADAU1592.

The volume can be controlled using a potentiometer, VR1, and is effective for ADAU1590 or ADAU1592 only.

BOARD CONNECTIONS SETUP

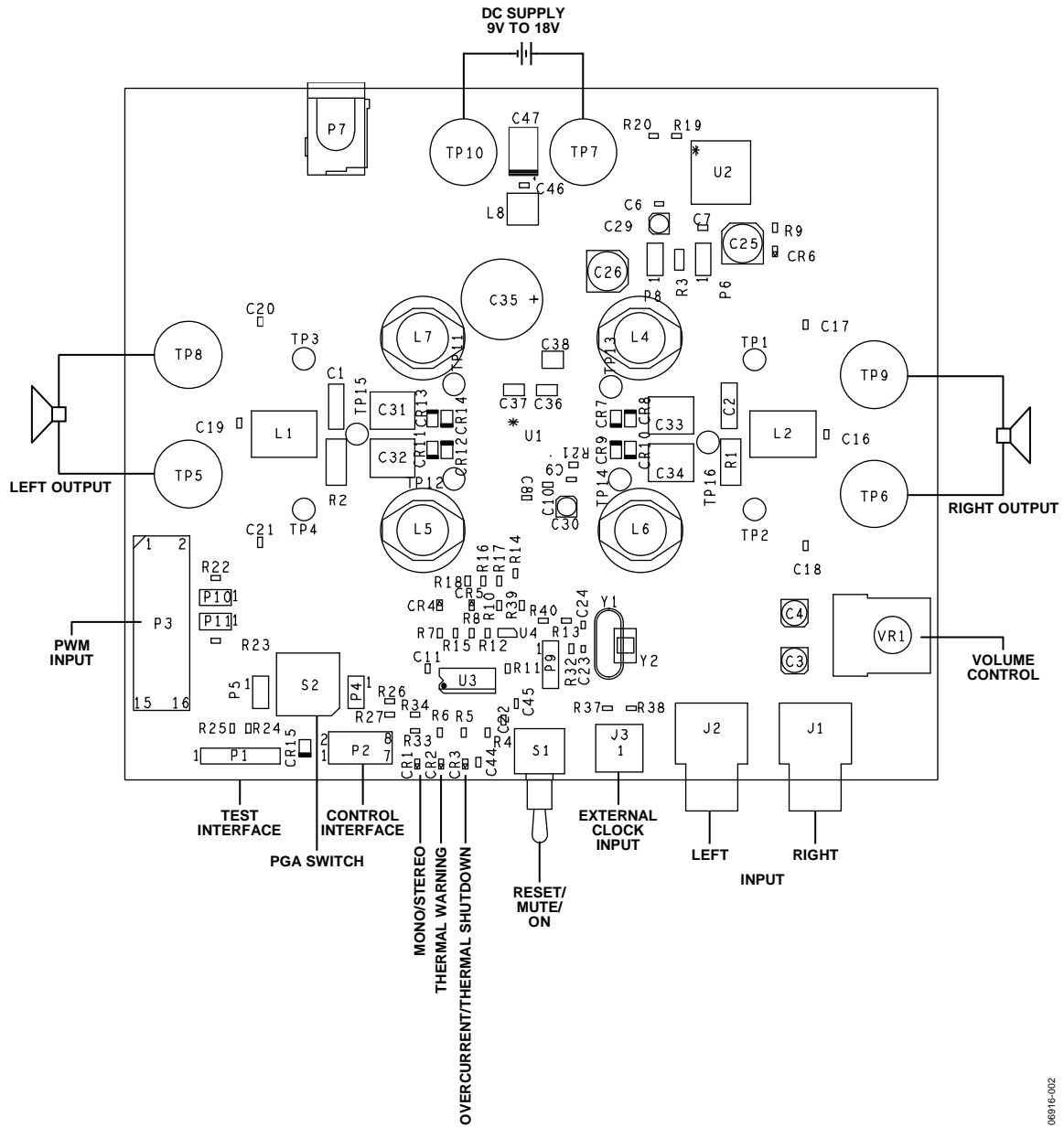


Figure 4.

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BOARD SETTING UP INSTRUCTION

Setting up the EVAL-ADAU1513/ADAU1590/ADAU1592 is simple; the user needs a power supply, input source, and load for quick evaluation of the board. Use a single 9 V to 18 V, either variable or fixed, 3 A to 5 A current rating for power supply.

Use a sine wave signal generator 0 V to 2 V rms variable output or suitable audio source (stereo) for the [ADAU1590](#), [ADAU1592](#). Use a suitable PWM input source 3.3 V logic, differential type for the [ADAU1513](#).

Use two 6 Ω or 8 Ω/20 W resistive loads or suitable speakers for load.

ADAU1590, ADAU1592

See Figure 4 for the connection board setup of the ADAU1590, or ADAU1592.

1. Connect the power supply positive lead to TP7 and 0 V lead to TP10 of the board. Do not turn on the power supply at this time.
2. Connect the suitable load across TP5 and TP8 for the left channel; connect the suitable load across TP6 and TP9 for the right channel.
3. Connect the input signal source to J2 for the left channel and J1 for the right channel. Ensure that Switch S1 is at the

center position (mute). Place the PGA switch (S2) in the 0 dB position (arrow at 0 position).

4. Turn VR1 fully counterclockwise (minimum volume) and turn on the power supply to the desired voltage, in the range of 9 V to 18 V. Make sure the red LED CR4 (mute) and green LED CR6 (power) are on.
5. Move S1 to the on position. The mute LED should turn off. Slowly turn the VR1 clockwise and adjust the volume control to the desired output level. If the speakers are connected, the audio output should be heard on the speakers or be available at the load resistors.

Note that the red LED, CR2, is a thermal warning. It lights up when the junction temperature reaches ~135°C.

The red LED, CR3, is an error indicator. It turns on when the junction temperature reaches 150°C thermal shutdown or in overcurrent condition (when the amplifier detects the overcurrent condition or short circuit on the outputs). The amplifier shuts itself down and mute needs to be asserted and then deasserted to restore the amplifier to normal operation.

The red LED CR1 is a mono mode indicator and turns on when the part is configured for mono mode operation.

Use S1 to reset/mute the amplifier.

ADAU1513

See Figure 4 for the connection board setup of the [ADAU1513](#).

1. Connect the power supply positive lead to TP7 and the 0 V lead to TP10 of the board. Do not turn on the power supply at this time.
2. Connect the suitable load across TP5 and TP8 for the left channel, across TP6 and TP9 for the right channel.
3. Connect the pulse-width modulated signal source to P3, Pin 13, and Pin 15 for the left channel and Pin 9 and Pin 11 for the right channel. See Table 2 for pinout details.

Table 2. PWM Input Header Pin

P3 Pin Number	Signal Name
9	PWM input right negative polarity
11	PWM input right positive polarity
13	PWM input left negative polarity
15	PWM input left positive polarity
2, 4, 6, 8, 10, 12, 14	GND

4. Ensure that Switch S1 is at the center position (mute). Place the PGA switch, S2, to the 0 dB position (arrow at the 0 position), and the PWM source is in mute condition.

5. Turn on the power supply to the desired supply voltage in the range of 9 V to 18 V. Make sure only the red LED CR4 (mute) and green LED CR6 (power) are on.
6. Move Switch S1 to the on position. The mute LED should turn off. Unmute the PWM source. If speakers are connected, the audio output can be heard.

Note that the on board volume control is ineffective when using the ADAU1513. The digital modulator is expected to have volume control in this application.

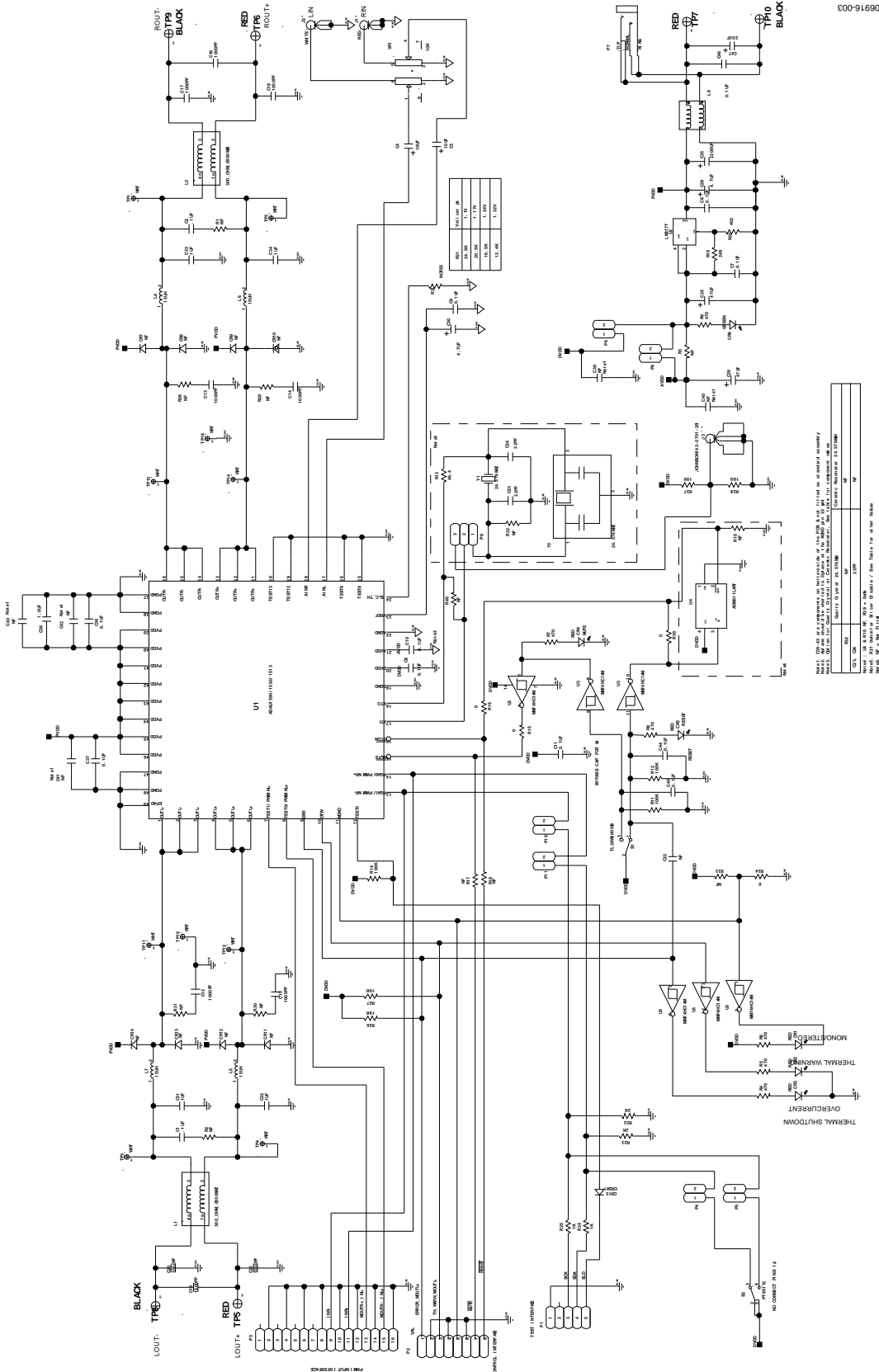
The PGA switch, S2, is inactive when using the ADAU1513.

The red LED, CR2, is the thermal warning and lights up when the junction temperature reaches ~135°C.

The red LED, CR3, is an error indicator. It turns on when the junction temperature reaches 150°C thermal shutdown or in overcurrent (when the amplifier detects the overcurrent condition or short circuit on outputs). The amplifier shuts down and mute needs to be asserted and deasserted to restore the amplifier in normal operation.

Use Switch S1 to reset the amplifier.

SCHEMATICS AND ARTWORK



000-91690

REF	VAL	QTY	UNIT
U1	ADAU1513	1	IC
U2	MAX4423	1	IC
U3	MAX9813	1	IC
U4	MAX9813	1	IC
U5	LED	1	LED
U6	LED	1	LED
U7	MAX9813	1	IC
U8	LED	1	LED
U9	LED	1	LED

Figure 5. Schematic

EVAL-ADAU1513/ADAU1590/ADAU1592

BOARD LAYOUT

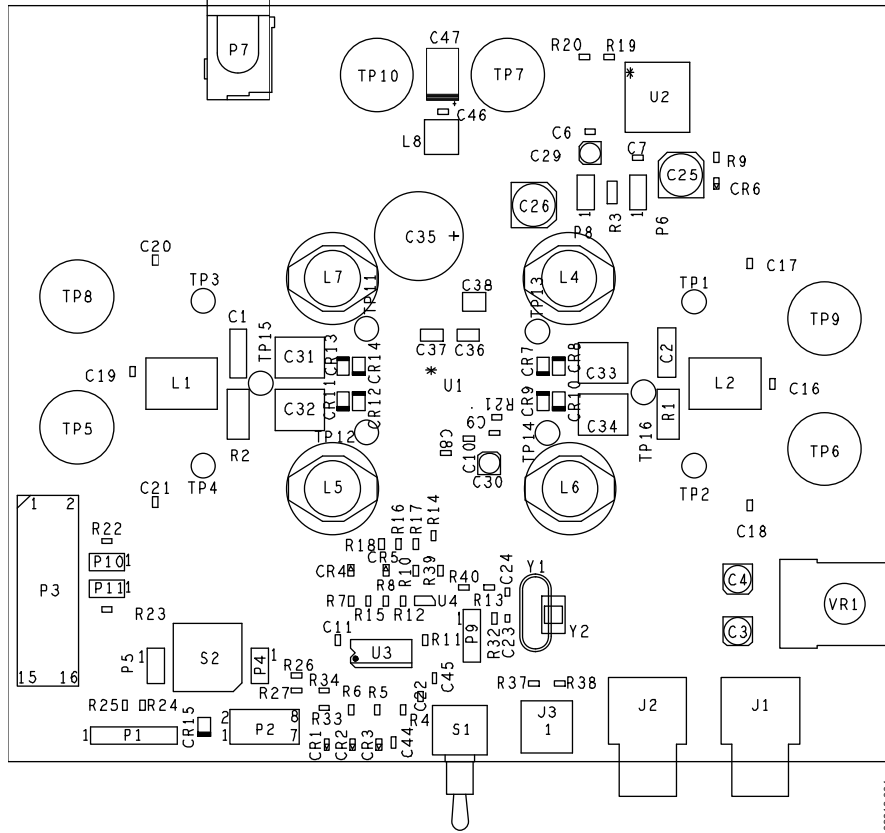


Figure 6. Top Assembly

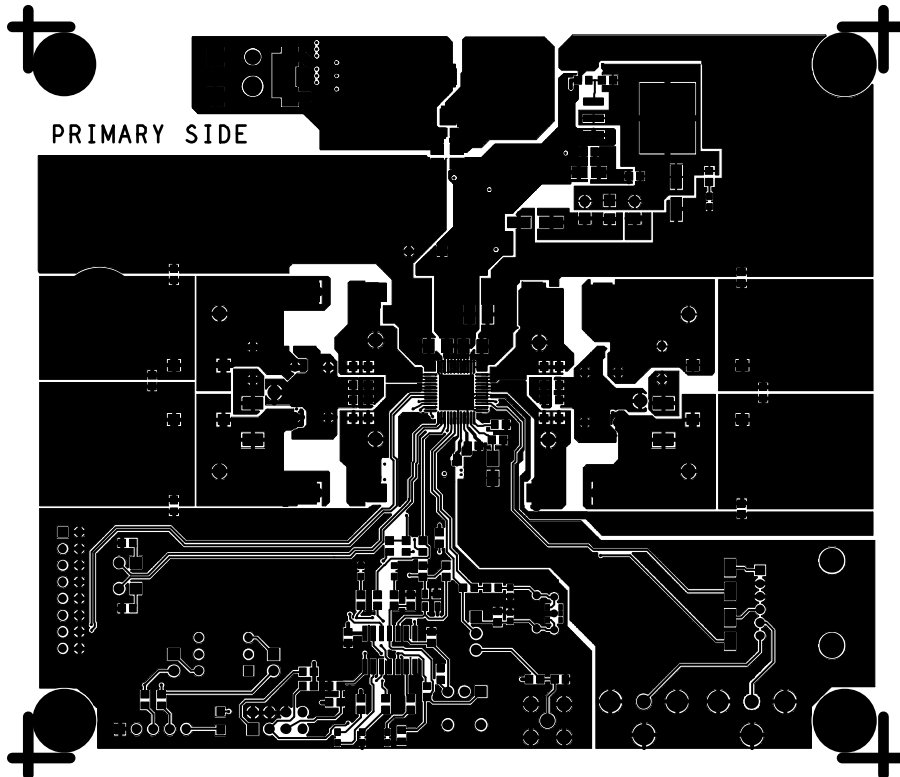


Figure 7. Top Layer
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