M^2 Circuits Power Amplifier Load

Theory of Operation & Calibration Procedure

Theory of Operation

Input Loads

The inputs of the load panel are connected to two 50-Watt, 8-ohm power resistors mounted to a large internal heatsink. The maximum continuous dissipation is 50 Watts, however peak power handling for short bursts may go up to 100 Watts. The loads are both floating, with neither the tip or sleeve of the ¼" jack referenced to ground.

Load Sensing and Preamplifier

For each load, two sense wires feed a differential preamplifier. The input amplifier is composed of an input attenuator and differential amplifier. The differential attenuator is a fixed divide by 100, and is fed into a differential amplifier with a trimmable gain of 10. The sources of the input amplifiers are selected with the input relays. In their de-energized states, the loads are connected to their respective input attenuator. When the front panel switch is set to CAL, the relays switch the inverting inputs to ground, and the non-inverting inputs to the front panel BNC CAL connector.

Output Amplifier

The output amplifier consists of a single stage, with a selectable gain of 1 or 10. The gain is either selected by the front panel control, or by the detector circuit. When the front panel selector is in dBm mode, the amplifier has a gain of 10. When the switch is in the WATTS position, the amplifier has a gain of 1. When the switch is in the AUTO position, the detector circuit will change the gain based on the level of the signal across the load sense wires. When the switch is in the CAL position, the automatic gain is enabled by default.

Detector

The detector can be divided into two sections, the rectifier and the comparator. The outputs of both differential amplifiers are fed into an active rectifier and the output of each rectifier is fed into a common accumulator composed of a capacitor and discharge resistor. The comparator looks at the voltage present at the accumulator and compares it to the threshold voltage. If the accumulator voltage is greater than the threshold voltage, the output of the comparator changes states from low to high. The comparator's output is then sent to the relay driver transistor via a diode, which actuates the relay. In the relay's de-energized position, the output amplifier has a gain of 10. When the relay is energized the gain is reduced to 1. If the signal level drops, the accumulator no longer charges,

and the voltage is bled via the parallel resistor. Once the accumulator voltage drops below the threshold, the comparator changes states again and the relay circuit is de-energized. The threshold is preset to +2dBm, however the adjustment can be set for +4dBm if desired. The RC parallel combination sets the delay time for the comparator to return to its idle state. These are both socketed, so that the charge and discharge rate may be altered. The default delay is ~5 seconds. The SCALE RESET button dumps the accumulator's charge to ground, forcing the comparator back to its idle state. However, if the button is released, and the input level is great enough, the comparator will change states almost instantaneously. In either the AUTO or CAL mode the gain of the output amplifier is controlled by the detector. When in the manual mode of dBm or WATTS, the output of the detector is disconnected from the relay driver and the logic levels are provided by the front panel switch.

CAL Mode

The front panel selector switch has four positions, AUTO, WATTS, dBm, and CAL. The CAL position turns the auto gain on by default, and switches the input amplifiers to the CAL input instead of the loads. The inverting inputs are grounded, and the non-inverting inputs are connected to the CAL signal. This mode is used to calibrate the unit, or for a quick performance check.

Calibration Procedure

The items below must be followed in the presented order.

Equipment Required:

- Audio Signal Generator
- One or Two Channel AC Millivolt Meter
- Digital Voltmeter
- Two Channel Oscilloscope
- BNC Cable
- Small Adjustment Tool

Procedure

Turn on the unit, allow 5 minutes for it to stabilize.

Function Switch: CAL

Monitor Level: Fully CW in the CAL position

Power Supply Check

Using a digital voltmeter check that the power rails are +15V and -15V, +/-5%, referenced to the chassis. Scope the rails for any significant ripple. If the voltages are incorrect, or excessive ripple is observed, troubleshoot the power supply.

Input Attenuator Adjustment

The input attenuator adjustment is made with the input amplifier card removed, and placed in a test fixture. The fixture supplies the +15V and -15V, and provides a connection for the sense inputs and amplifier output. A common mode signal is fed into the + and – inputs, and the attenuator CM adjustment (R205) is trimmed for minimum output level. Unless one or more of the attenuator resistors is replaced, or the adjustment is disturbed, do not change the control's position.

Input Amplifier Adjustment

1. Set the frequency of the signal generator to 1kHz, and the output level to +10dBm. Connect the signal generator to the CAL input located on the front panel.
2. The METER SCALE indicator should switch to WATTS. Connect the AC millivolt meter to the MONITOR OUT, L BNC on the front panel.
3. Adjust the input amplifier gain of the left channel (R213) to obtain a reading of -10dBm on the millivolt meter.
4. Repeat the same process for the right channel.

Output Amplifier Adjustment

1. With the signal generator still connected to the CAL input, set the level to -10dBm.
2. Press the SCALE RESET button. The METER SCALE indicator should switch to dBm.
3. Adjust the left output amplifier gain (R307) for a reading of -10dBm on the millivolt meter.
4. Repeat for the right channel (R308).

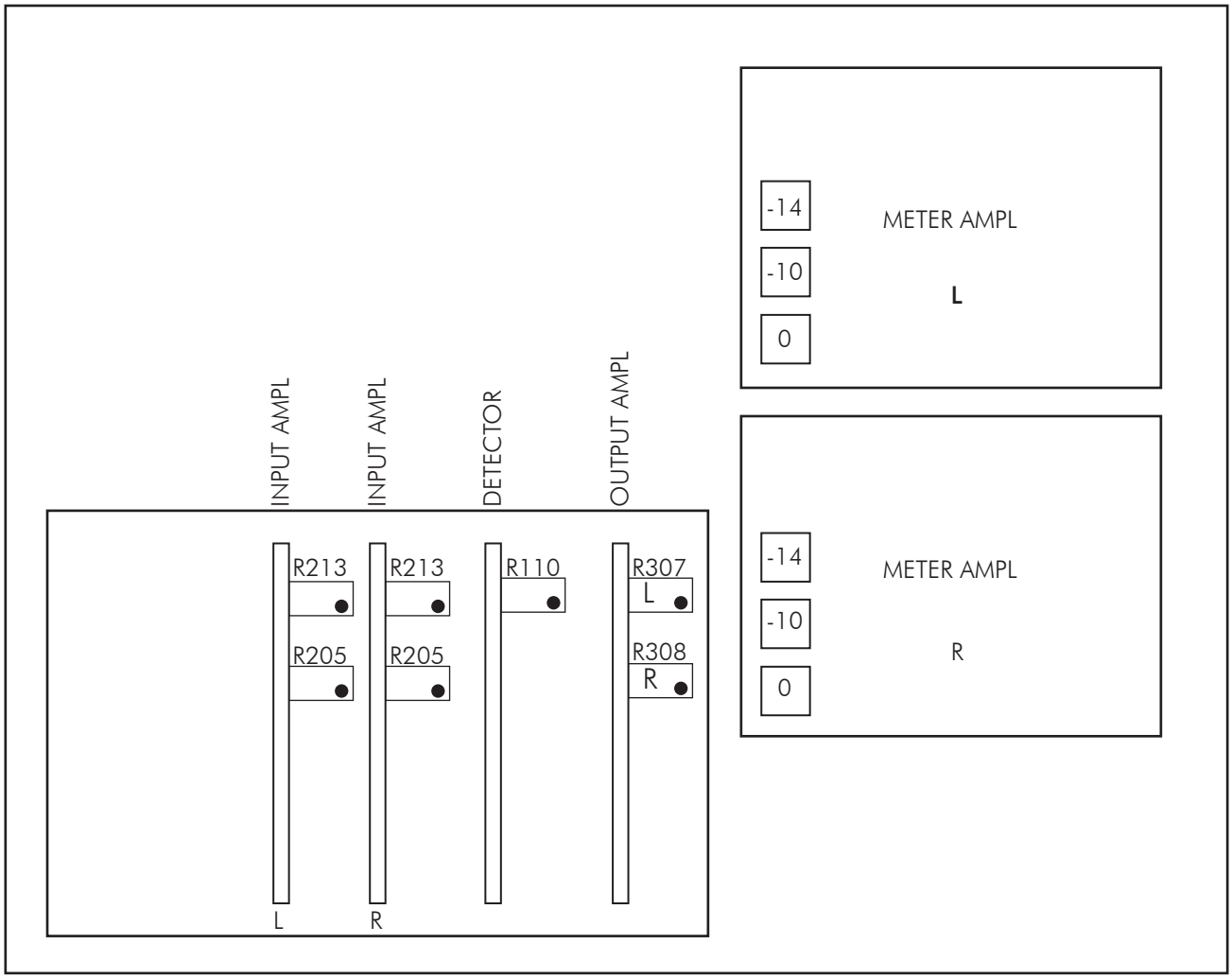
Detector Adjustment

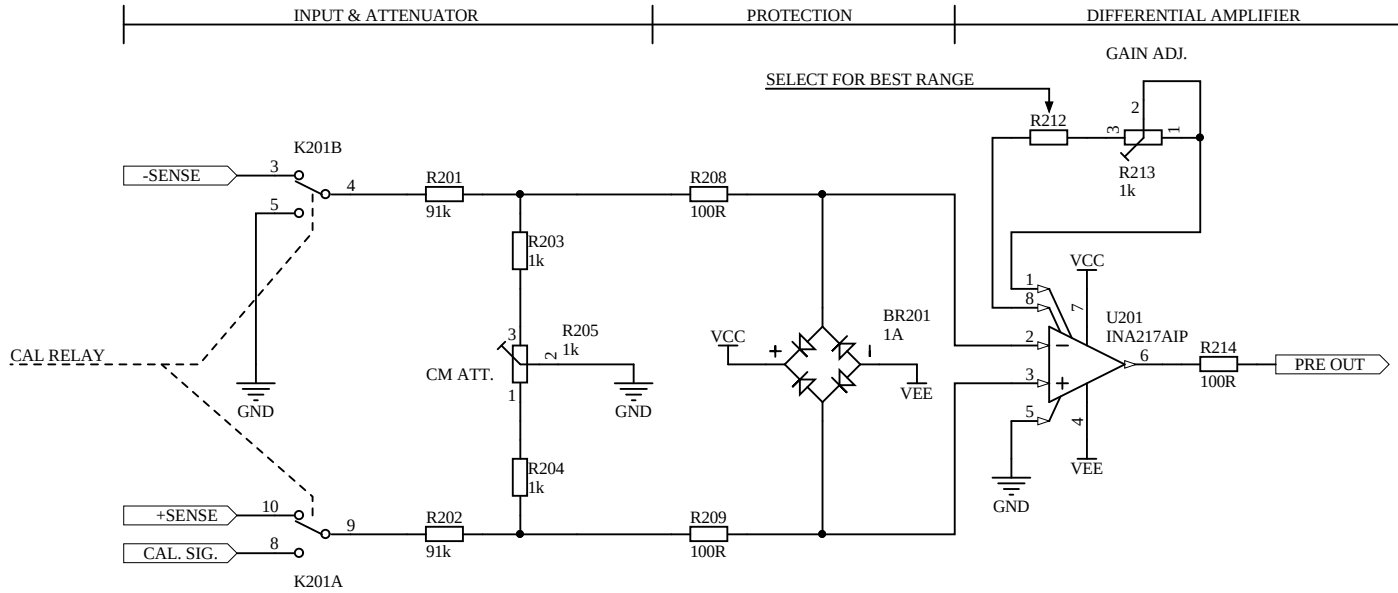
1. Set the signal generator output level to +2dBm or +4dBm, whichever is preferred.
2. If the METER SCALE indicator changes to WATTS, turn the threshold adjustment (R110) counter-clockwise until the indicator changes to dBm. Slowly advance the control clockwise until the indicator changes to WATTS.
3. Set the signal generator output to 0dBm, and slowly increase the level of the generator until the output of the load box reaches the selected trigger point. When it reaches the trigger point the output should automatically drop by 20dBm, and the METER SCALE indicator should read WATTS.

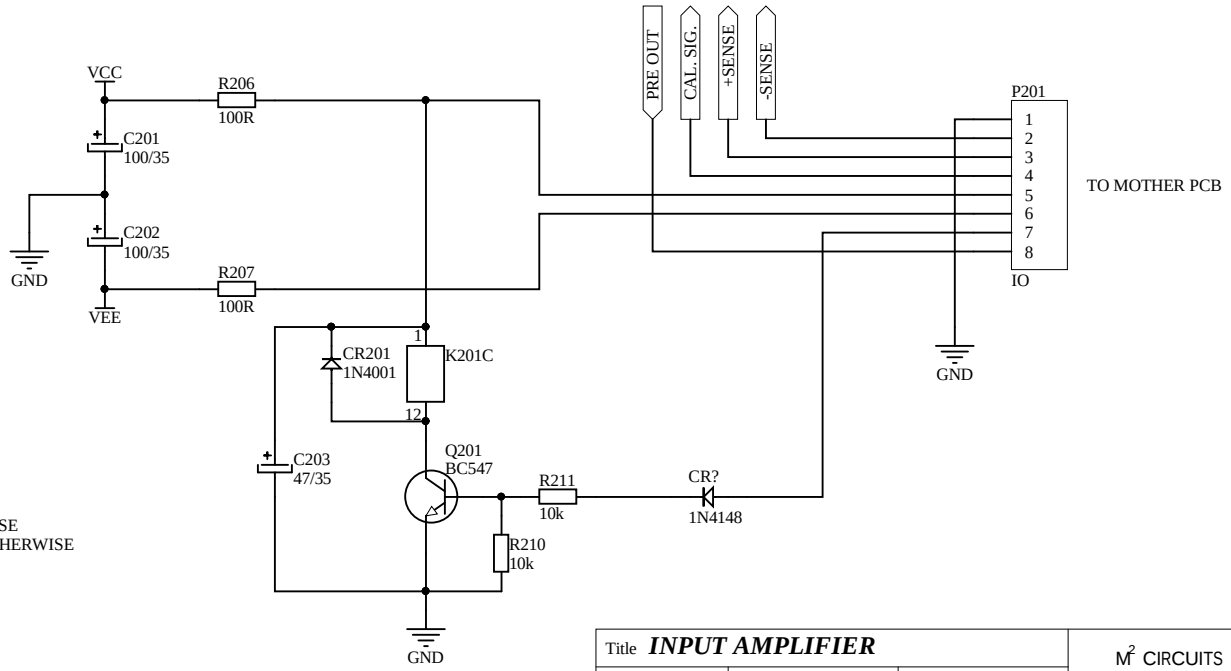
Meter Adjustment

1. Set the signal generator output to 0dBm.
2. Ensure that the METER SCALE indicator is showing dBm.
3. Adjust the left 0 adjustment so that the panel meter reads 0dBm.
4. Lower the level of the signal generator to -10dBm. Adjust the left -10 adjustment for an indication of -10dBm.
5. Set the signal generator to -14dBm, adjust the left -14 adjustment for an indication of -14dBm.
6. Repeat for the right channel meter.

LOCATION OF ADJUSTMENTS







NOTES:
- RESISTORS ARE 1/4 WATT, 5% UNLESS NOTED OTHERWISE
- CAPACITORS ARE IN MICROFARADS UNLESS NOTED OTHERWISE
- TRIM POTENTIOMETERS ARE 25 TURN

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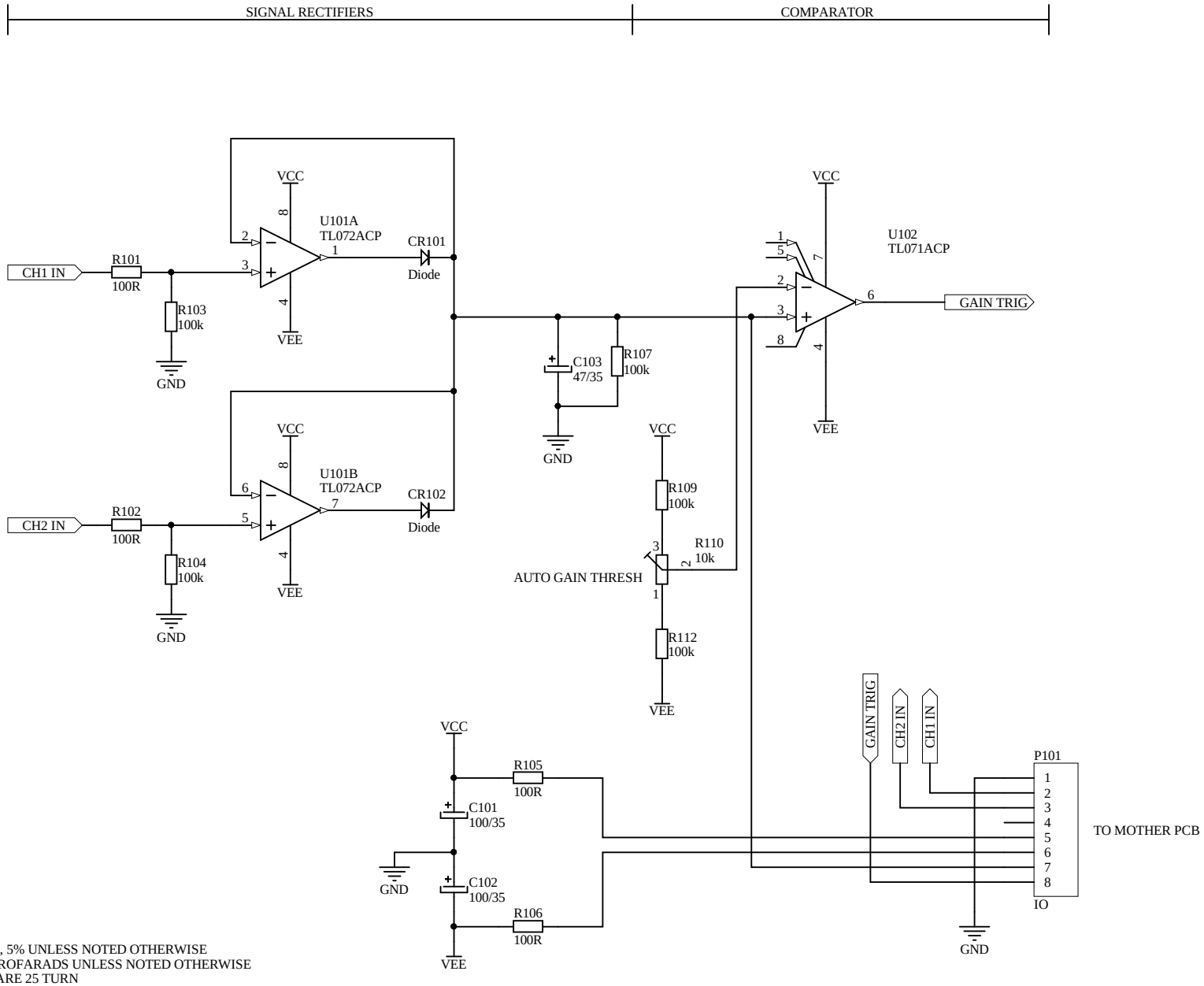

NOTES:
- RESISTORS ARE 1/4 WATT, 5% UNLESS NOTED OTHERWISE
- CAPACITORS ARE IN MICROFARADS UNLESS NOTED OTHERWISE
- TRIM POTENTIOMETERS ARE 25 TURN
- C103 AND R107 ARE SOCKETED FOR CHANGE OF TIMING

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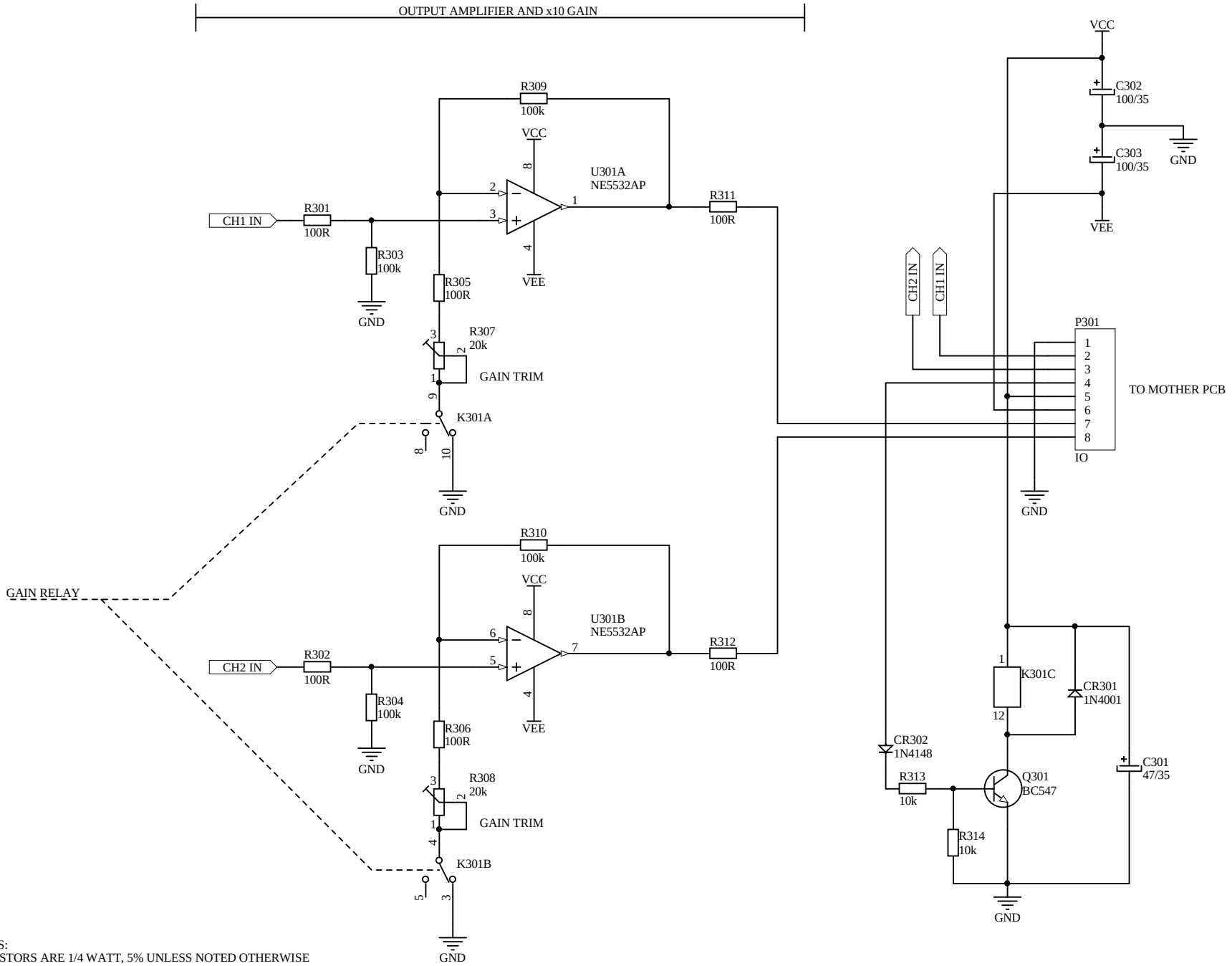

NOTES:
- RESISTORS ARE 1/4 WATT, 5% UNLESS NOTED OTHERWISE
- CAPACITORS ARE IN MICROFARADS UNLESS NOTED OTHERWISE
- TRIM POTENTIOMETERS ARE 25 TURN

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