



RHD2000-EVAL

Application Note: Adding an LED to Amplifier Boards



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Q:

How can an LED be added to an RHD2000 amplifier board (e.g., to aid in visual tracking)?

A:

All RHD2000 amplifier boards provide solder holes for +3.3V power (“VDD”) and ground (“GND”). A series combination of an LED and a current-limiting resistor should be soldered in series between these two holes, as shown in the photo above. (Note: The RHD2164 64-channel amplifier board does not have a VDD solder hole. See next page for more information on how to access +3.3V power in this board.)

One side of the LED will have a flat edge. The terminal on this side should be connected to ground. The other terminal should be connected through the resistor to power.

The value of the series resistor is chosen using the following equation:

$$R = (V_{DD} - V_{LED}) / I_{LED}$$

The power supply voltage V_{DD} will be approximately 3.3V. Most red, green, or yellow LEDs have voltage drops (V_{LED}) around 2.0V when they are active. Blue and white LEDs have voltage drops greater than 3.3V, so they cannot be used effectively with these boards.

The current I_{LED} required to produce a reasonable amount of light depends on the type of LED. Older LEDs require 10-20 mA of current, while newer “low power” LEDs produce the same amount of light with 1-2 mA of current.

This range of parameters yields resistances in the range of 65 Ω to 1300 Ω . It is recommended that different values be tried experimentally to determine a value of current that produces desired light levels before final soldering.

Some amplifier boards provide an additional solder hole for the RHD2000 auxiliary digital output pin **auxout**, labeled “DO” on the circuit board. (The RHD2164 amplifier board and the 16-channel RHD2132 amplifier board with 18-pin electrode connector omit this connection to save space.)

If the **auxout** signal is available and Version 1.4 (or later) of the interface software is used, then it is possible to control this pin in real time using a selected digital input signal on the RHD2000 USB interface board. Under the “Configure” tab in the RHD2000 interface software there is a button labeled “Configure Realtime Control” in the “Auxiliary Digital Output Pins” box. Clicking this button opens a dialog that allows users to enable real-time control and to select which digital input will be used to control the digital output pin on particular chips.

There is a latency of 4-5 amplifier sampling periods (e.g., 200-250 μ s with a sampling rate of 20 kS/s) from the digital input on the RHD2000 USB interface board to the **auxout** pin on the selected amplifier board. Control of the digital output will only be active during data acquisition; the pin will be pulled to ground when acquisition stops.

The **auxout** pin is capable of driving up to ± 2 mA of current from the nominal 3.3V chip supply. (Note that this supply voltage can vary from 2.9V – 3.5V depending on the length of SPI interface cable used, due to IR drops in the cable.) This is sufficient to drop a low power LED that does not require a high voltage drop.

If additional current drive and/or voltage range is required, an N-channel MOSFET transistor may be added, and the **auxout** pin used to control the gate of the MOSFET. The source of the MOSFET should be tied to ground, and the

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drain should be connected to an LED and current-limiting resistor in series, tied to the desired supply voltage. The MOSFET should be selected to have a threshold voltage less than 2.0V.

Accessing +3.3V Power on RHD2164 Amplifier Board

The RHD2164 64-channel amplifier board does not have a solder hole for +3.3V power ("VDD") due to space limitations. The VDD node is accessible by soldering a wire to the side of capacitor C1 opposite the GND solder hole, as shown below:

