Tree Inspection Kit handheld measuring system

A brief explanation of the project and its objective.

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Designer's signature

Supervisor's signature

Sheet title: **Project introduction and block diagram**

Project title: **TIK_HandheldSystem.PrjPcb**

Desginer: **Juan Del Pino Mena**

Date: **2022-03-20** Revision: **0.1** Sheet 1 of 8

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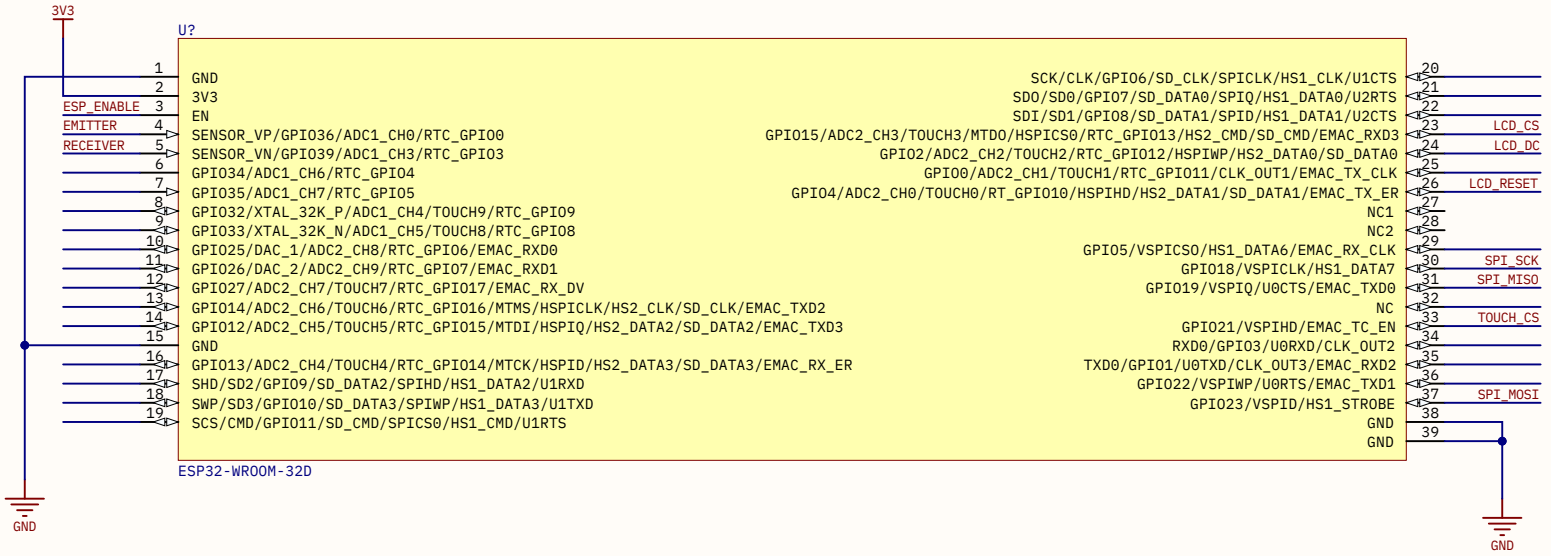

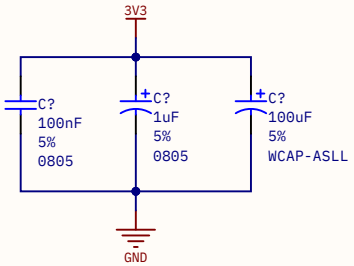

Recommended smoothing/bypass capacitors are 0.1 µF and 10 µF, ceramic, low ESR. Should be placed close to the chip and with short return paths. [ESP32-WROOM-32D datasheet, page 21] Added one extra 100 µF electrolytic cap to filter current spikes.

ESP32-WROOM-32D µController

MicroController hardware configuration and I/O pins

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Designer's signature	Sheet title: **ESP32 Microcontroller**		
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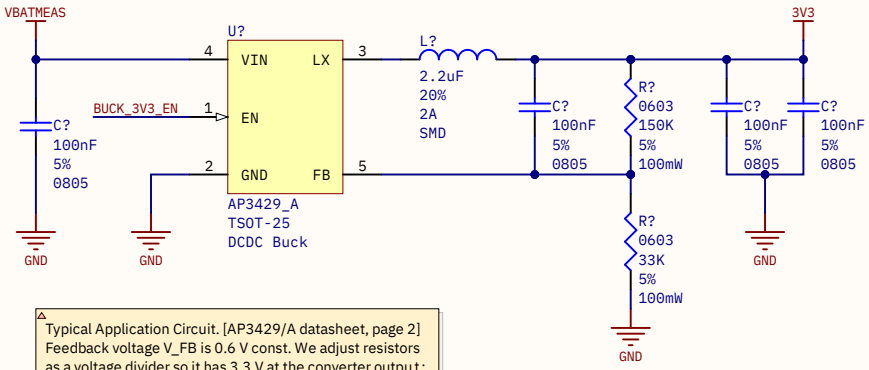
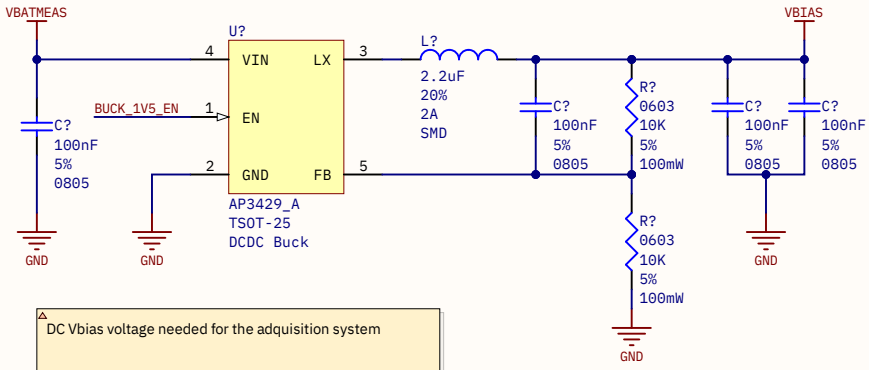
3V3 Rail. Main system power.



Typical Application Circuit. [AP3429/A datasheet, page 2]
Feedback voltage V_FB is 0.6 V const. We adjust resistors as a voltage divider so it has 3.3 V at the converter output:
V_FB = V_out · (R2)/(R1+R2) -> R2 = 2/9 · R1.
Capacitors should be placed close to the chip.

1V5 Rail. VBIAS for adquisition circuit



DC Vbias voltage needed for the adquisition system

Power management

Battery DC/DC step-down converter, charging and battery level and current measurement circuitry.

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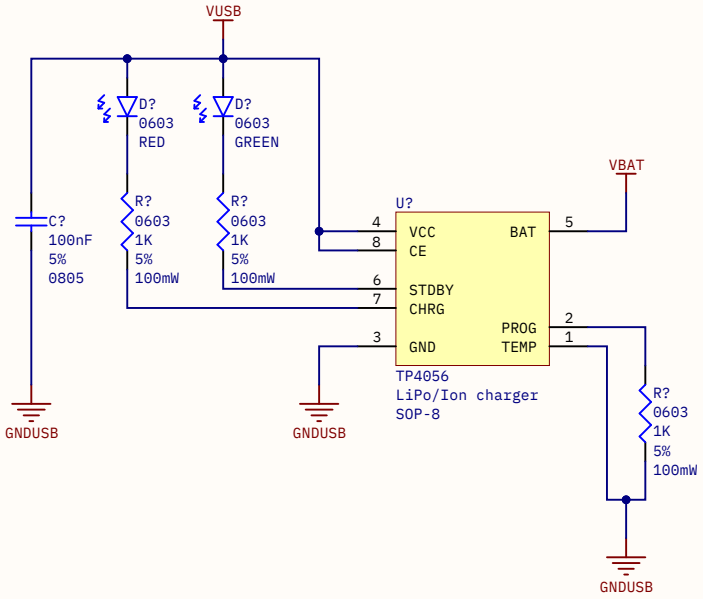
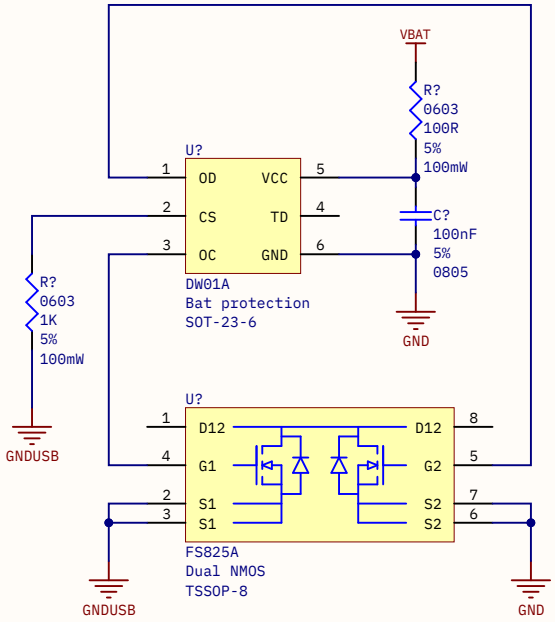
Battery Charging IC



Based on TP4056 charger module schematics

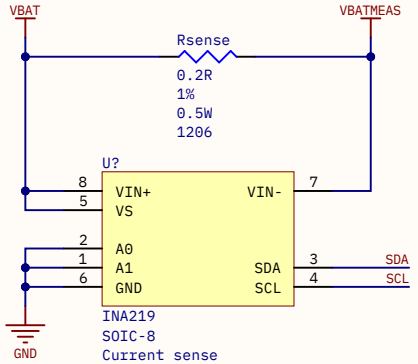
Battery protection



Dos masas, referencias distintas, que quedan semi-conectadas por los NMOS cuando se conecta el USB.

GND: Circuit GND
GNDUSB: USB Circuit GND

Battery output current sense



Current sense resistor should be a power resistor. All system power will pass thru it.

Battery charging circuitry

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Designer's signature	Sheet title: **Battery charger**		
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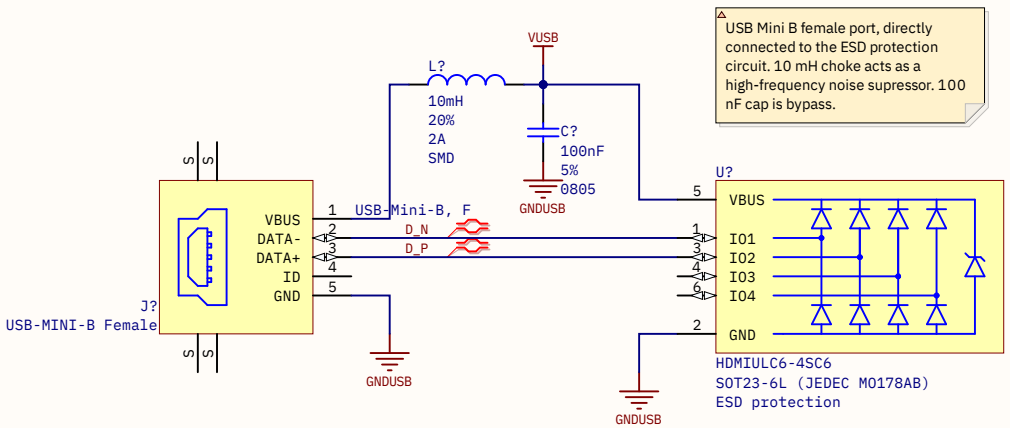
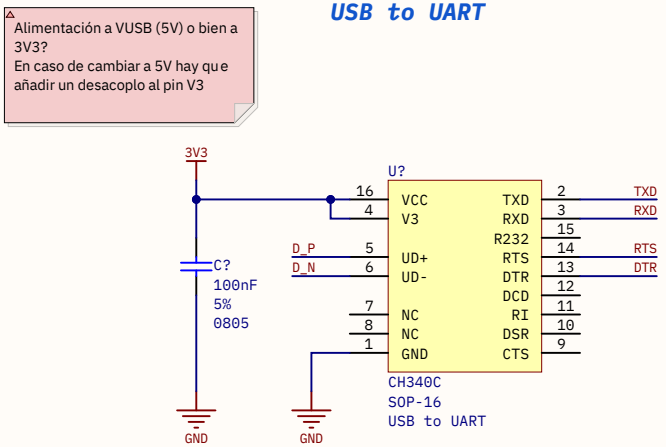
USB connector and ESD protection circuit



USB to UART



USB interface

USB is used as a programming interface, as well as a power source for the charging circuit

As it's an external connector, it needs to have a protection circuit against electro-static discharge

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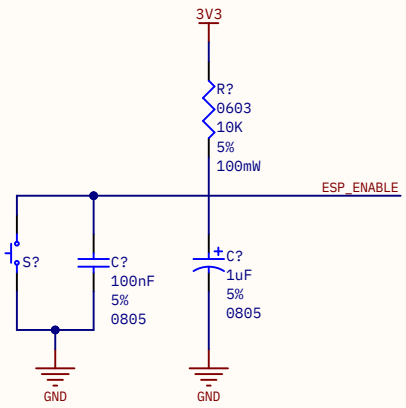
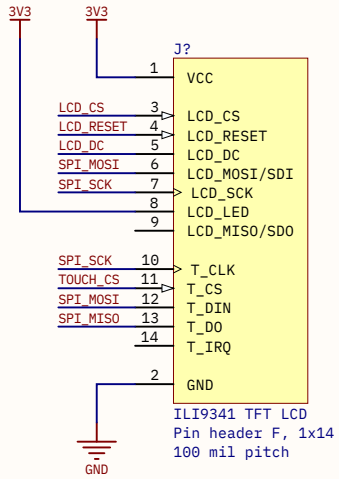
Reset



To ensure power stability to the microcontroller during powerup, this RC filter introduces a delay on the ENABLE pin. Usual values are 10 kΩ, 1 µF (τ = 10 ms). [ESP32-WROOM-32D datasheet, page 22]

Reset switch design same as ESP32 DevKit V1 reference design

LCD TFT Touch Display



User Interface

TFT LCD touchscreen, rotary encoder, on/off and reset switches

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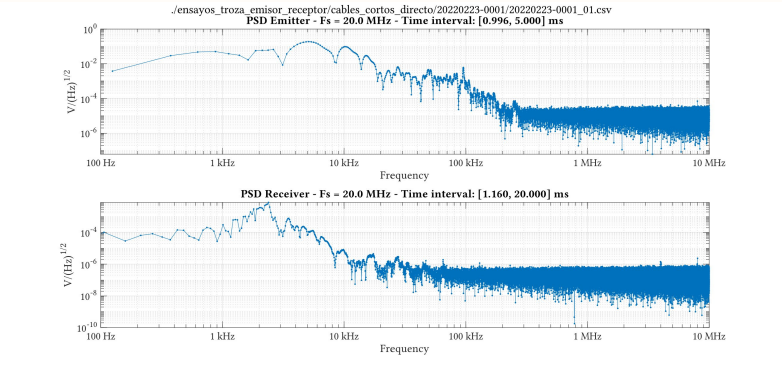
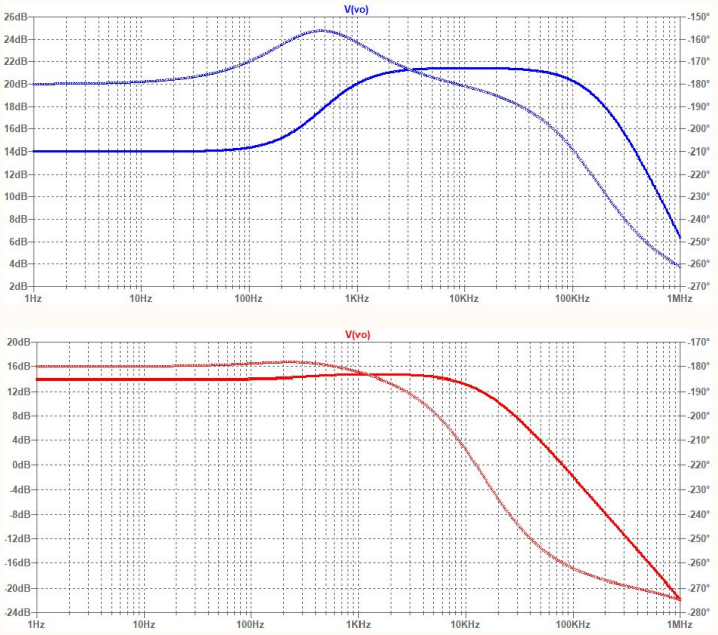
Example of a Voltage Spectral Density of trunk signals



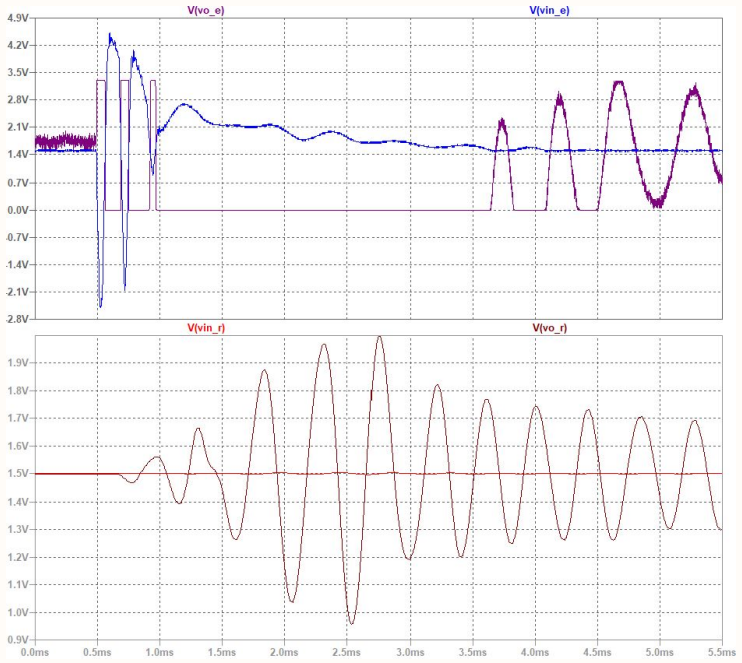
Contitioning circuit theorical frequency response



Respuesta en frecuencia teórica, con el modelo UniversalOpAmp, cable con 700 pF y R del piezo 2 MOhm

¿Afecta en algo la fase?

Time behavior



Signal conditioning theoreticals

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Designer's signature	Sheet title: **Signal Conditioning Theoreticals**		
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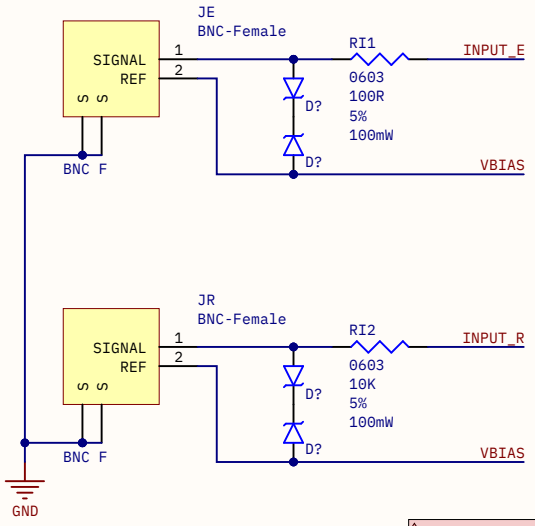
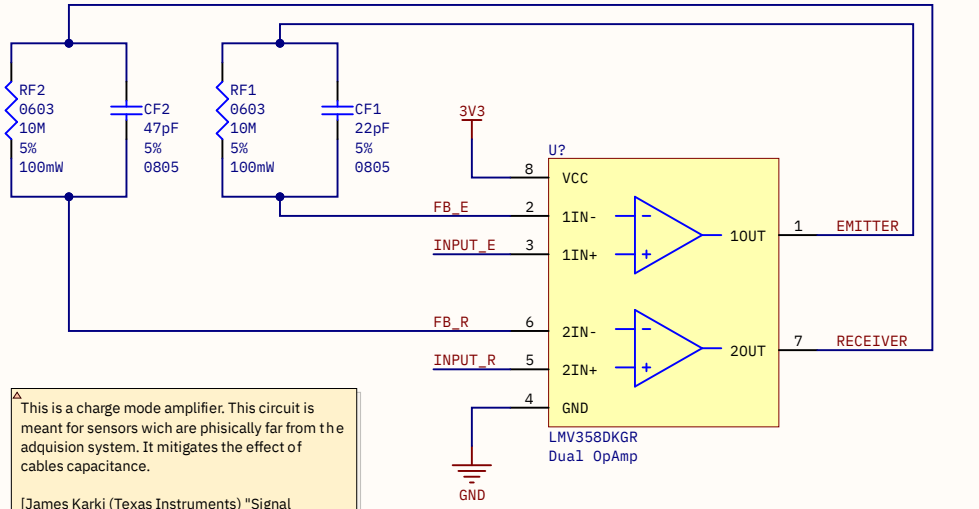
Emitter signal will be in the range of 15V100V and need to be clipped. Then, the OpAmp will amplificate by perceived by the instrument as a flank; whereas receiver signal will be amplified without clipping.
This OpAmp have its own ESD protection.

Las trazas de la señal deberían cumplir la adaptación a 50 Ohm



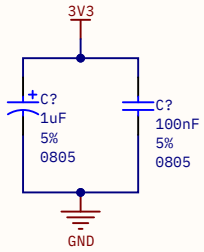
Aguanta bien el voltaje DC transmitido a través de un cable largo de hasta 8 metros? Es conveniente usar un raíl de un LDO en lugar de un DCDC?



This is a charge mode amplifier. This circuit is meant for sensors wich are phisically far from the adquision system. It mitigates the effect of cables capacitance.

[James Karki (Texas Instruments) "Signal Conditioning Piezoelectric Sensors". Application Report SLOA033A. September 2000]

Bypass caps for the OpAmp, should be physically close to it.



Signal conditioning circuit

Signal comes from piezoelectric sensors and need to be converted from charge to voltage. Tree sensors that have been used for this project proved to generate upto -100 volts peak, so it needs clipping

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Supervisor's signature	Project title: **TIK_HandheldSystem.PrjPcb**	
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