

HC-SR04

Sensors / Ultrasonic

Turn an echo pulse into distance, with the level shifting that matters.

01 Four connections

VCC / GND

5 V supply / common ground for the standard HC-SR04.

TRIG

MCU output; send a HIGH pulse of at least 10 microseconds.

ECHO

Pulse-width output. Standard 5 V module needs level shifting into 3.3 V GPIO.

02 Measurement

Sequence

TRIG low -> 10 us high -> low -> time ECHO high. Leave at least 60 ms between triggers.

Formula

$\text{distance_cm} = \text{echo_us} \times 0.0343 / 2$ (speed of sound near 20 deg C).

Range

Nominal 2-400 cm; soft, small or angled surfaces can return poor echoes.

Timeout

Set a finite timeout (~30 ms). A zero/timeout means no valid measurement, not zero distance.

03 3.3 V connection

Divider

ECHO -> 1 kohm -> GPIO node -> 2 kohm -> GND gives about 3.33 V from 5 V.

Validate

Use a rated level shifter if supply/tolerance may exceed GPIO limits. Check trigger compatibility.

Before you power on

Never connect the standard 5 V ECHO output directly to an ESP32 or Pico input.

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Datasheets & further reading

HC-SR04 datasheet

<https://cdn.sparkfun.com/datasheets/Sensors/Proximity/HCSR04.pdf>