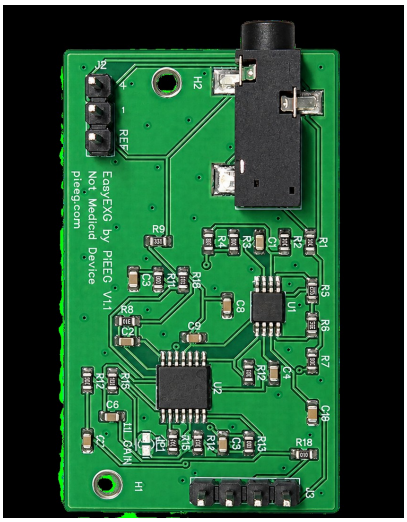
PRODUCT DATASHEET · BIO-SIGNAL SENSOR · ANALOG FRONT END

One Board for Muscle, Heart, Eyes and Brain

EasyEXG is a single-channel bio-signal amplifier for EMG, ECG, EOG and EEG. Plug in a standard 3-lead electrode cable, connect three wires to any microcontroller with an ADC (Arduino, ESP32, STM32, Raspberry Pi Pico) and read the signal with analogRead(). A TI INA333 instrumentation amplifier and a TI OPA4388 quad op-amp give 221× or 1 048× gain, a 0.16–501 Hz band and an active driven-right-leg reference.



EasyEXG V1.1, top side

1 ch	221× / 1 048×	0.16–501 Hz	3.3 / 5 V	46 × 26
Differential + REF/DRL	Gain, set by JP1	Bandwidth (−3 dB)	Supply, max 5.5 V	mm, 2-layer PCB

01 OVERVIEW

Features

- **Four signals, one board:** EMG, ECG, EOG and EEG; only the jumper and electrode positions change.
- **Low-noise chain:** INA333 (CMRR ≥ 100 dB) → 0.16 Hz high-pass → 500 Hz 2nd-order low-pass.
- **Driven right leg:** REF is actively driven to VCC/2, which removes most 50/60 Hz hum.
- **Two electrode inputs:** 3.5 mm TRS jack for snap cables, or a 3-pin 2.54 mm header for loose wires.
- **Any MCU:** one analog output resting at VCC/2; runs from 3.3 V or 5 V.
- **Open hardware:** schematic, Gerbers, BOM, STEP/STL and code on GitHub (CC BY-NC 4.0).

Measures

- **EMG:** muscle activity, 0.1–5 mV
- **ECG:** heartbeat (Lead I), 0.5–2 mV
- **EOG:** eye movement and blinks, 0.1–1 mV
- **EEG:** frontal brain waves and alpha, 10–50 µV

Works with

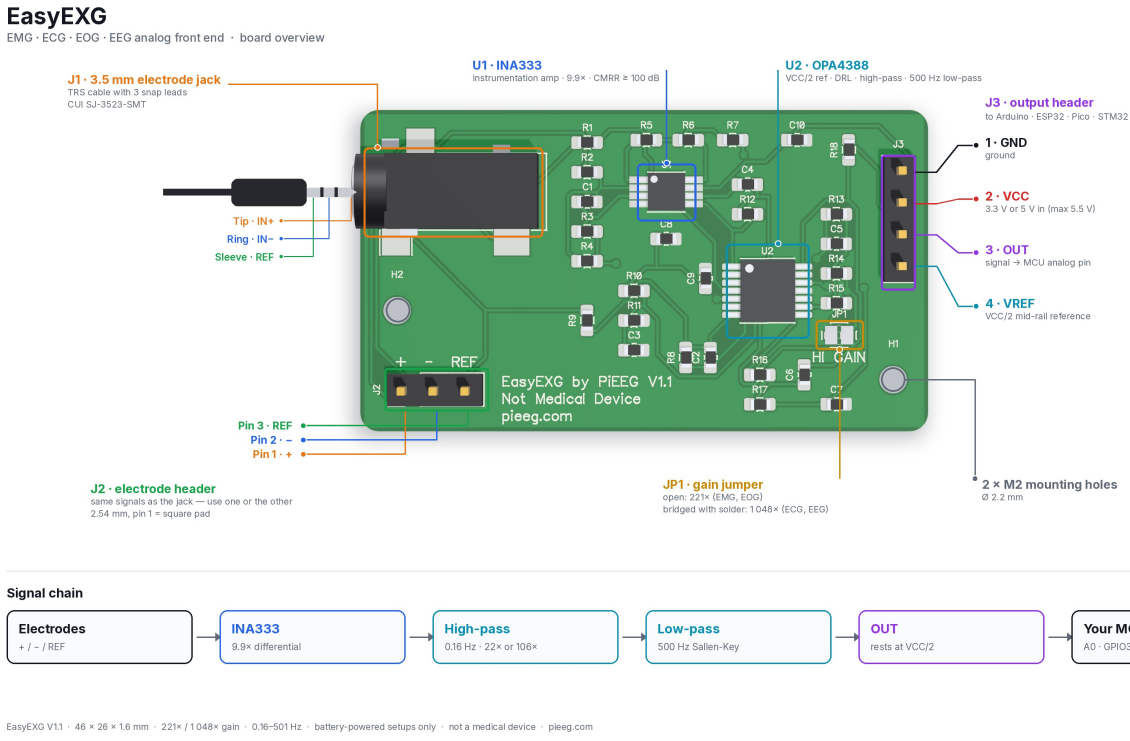
- Arduino UNO R4 WiFi, UNO, Nano, Mega
- ESP32, ESP8266
- Raspberry Pi Pico (Arduino-Pico core)
- STM32 (Arduino core) and any MCU with an ADC

02 SPECIFICATIONS

SIGNAL	
Channels	1 differential input (IN+, IN−) plus REF / driven right leg
Total gain	221× with JP1 open (EMG, EOG) · 1 048× with JP1 bridged (ECG, EEG)
Bandwidth (−3 dB)	0.16–501 Hz; low-pass 500 Hz, 2nd-order Sallen-Key (Q = 0.73)
Instrumentation amp	TI INA333, gain 9.9×, CMRR ≥ 100 dB
Op-amp	TI OPA4388 quad: VCC/2 reference, driven right leg, high-pass + gain, low-pass
Output	1 analog signal on J3 pin 3, rests at VCC/2 with no input

POWER AND INTERFACES	
Supply	3.3 V or 5 V (use the MCU ADC voltage), absolute max 5.5 V
DRL current limit	390 kΩ, about 13 µA into the body at 5 V
Electrode inputs	J1: 3.5 mm TRS jack (CUI SJ-3523-SMT) · J2: 3-pin 2.54 mm header
Output header	J3: 4-pin 2.54 mm (GND, VCC, OUT, VREF)
Isolation	None. Battery operation is required while electrodes are on a person

03 BOARD OVERVIEW



Connectors, ICs, gain jumper and the signal chain (from the V1.1 design files)

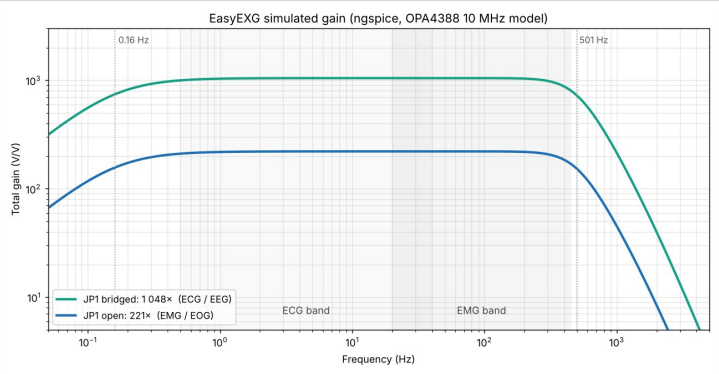
04 GAIN AND INPUT RANGE

JP1	Use	Total gain	Band (−3 dB)	Max input 5 V	Max input 3.3 V
Open (as shipped)	EMG, EOG	221×	0.16–501 Hz	10.9 mV	7.2 mV
Bridged (solder)	ECG, EEG	1 048×	0.16–501 Hz	2.3 mV	1.5 mV

05 SIGNAL CHAIN

Stage	Part	Function	Gain
1	INA333 (U1)	Instrumentation amplifier, G = 1 + 100 kΩ / 11.2 kΩ	9.9×
2	OPA4388 (U2C)	0.16 Hz high-pass + non-inverting gain (JP1 selects the gain)	22× / 106×
3	OPA4388 (U2D)	500 Hz 2nd-order Sallen-Key low-pass (Q = 0.73)	1×
—	OPA4388 (U2A)	Mid-supply reference VREF = VCC/2	—
—	OPA4388 (U2B)	Driven right leg (DRL), 390 kΩ current limit	—

06 FREQUENCY RESPONSE



- Simulated in ngspice with a 10 MHz OPA4388 model.
- Blue: JP1 open, 221×. Green: JP1 bridged, 1 048×.
- Flat from 0.16 Hz to 500 Hz; steep roll-off above 500 Hz.
- The 0.16 Hz high-pass keeps the true ECG shape; the low-pass covers the whole EMG band (20–450 Hz).
- DRL loop stable, at most 2 dB peaking around 1.3–1.5 kHz.

07 TYPICAL SIGNALS AND SETTINGS

Signal	Size at electrodes	JP1 / gain	View filter	Sample rate	What you see
EMG	0.1–5 mV	Open · 221×	20–240 Hz	500–1000 Hz	Bursts while the muscle works
ECG	0.5–2 mV	Bridged · 1 048×	0.5–40 Hz	250–500 Hz	P, QRS, T about once a second
EOG	0.1–1 mV	Open · 221×	0.1–10 Hz	100–250 Hz	Steps with eye moves, blink spikes
EEG	10–50 µV	Bridged · 1 048×	1–40 Hz	250 Hz	10 Hz alpha grows, eyes closed

08 MECHANICAL AND ORDERING

Board	46.0 × 26.0 × 1.6 mm, corner radius 1.5 mm, 2-layer FR-4, parts on top only
With jack nose	48.0 × 26.0 mm (the jack sticks out 2.0 mm on the left)
Mounting	2 × M2 holes (Ø 2.2 mm), 40.2 mm apart
In the box	1 × EasyEXG board. Microcontroller, electrode cable, electrodes and wires are not included
Buy	Elecrow · pieeg.com/store/easyexg

09 RELATED DOCUMENTS

Doc. No.	Document	Contents
EXG-DS-001	Product Datasheet	Overview, specifications, gain and input range, signal chain
EXG-MD-002	Mechanical & Dimensional Drawing	Outline, holes, connector positions, heights
EXG-PCB-003	PCB Technical Information	Stack-up, layers, drill table, BOM, design files
EXG-PIN-004	Connections & Electrodes	J1 / J2 / J3 pinout, MCU wiring, electrode placement
EXG-QSG-005	Quick Start, Safety & Troubleshooting	First signal in six steps, safety rules, fixes
EXG-SW-006	Software Guide	USB and Wi-Fi sketches, EasyEXG Studio, CSV, packet format

NOT A MEDICAL DEVICE · BATTERY ONLY

EasyEXG has no patient isolation. While electrodes are on a person, the board and everything cabled to it run from a power bank or a laptop on battery with the charger unplugged. For research and education only.