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Bio-ExG: Multi-biosignal Amplifier System design 01

CMSIS *STM32 CMSIS DSP Library*

BioAmp EXG Pill is a small and elegant Analog Front End (AFE) board for BioPotential signal acquisition

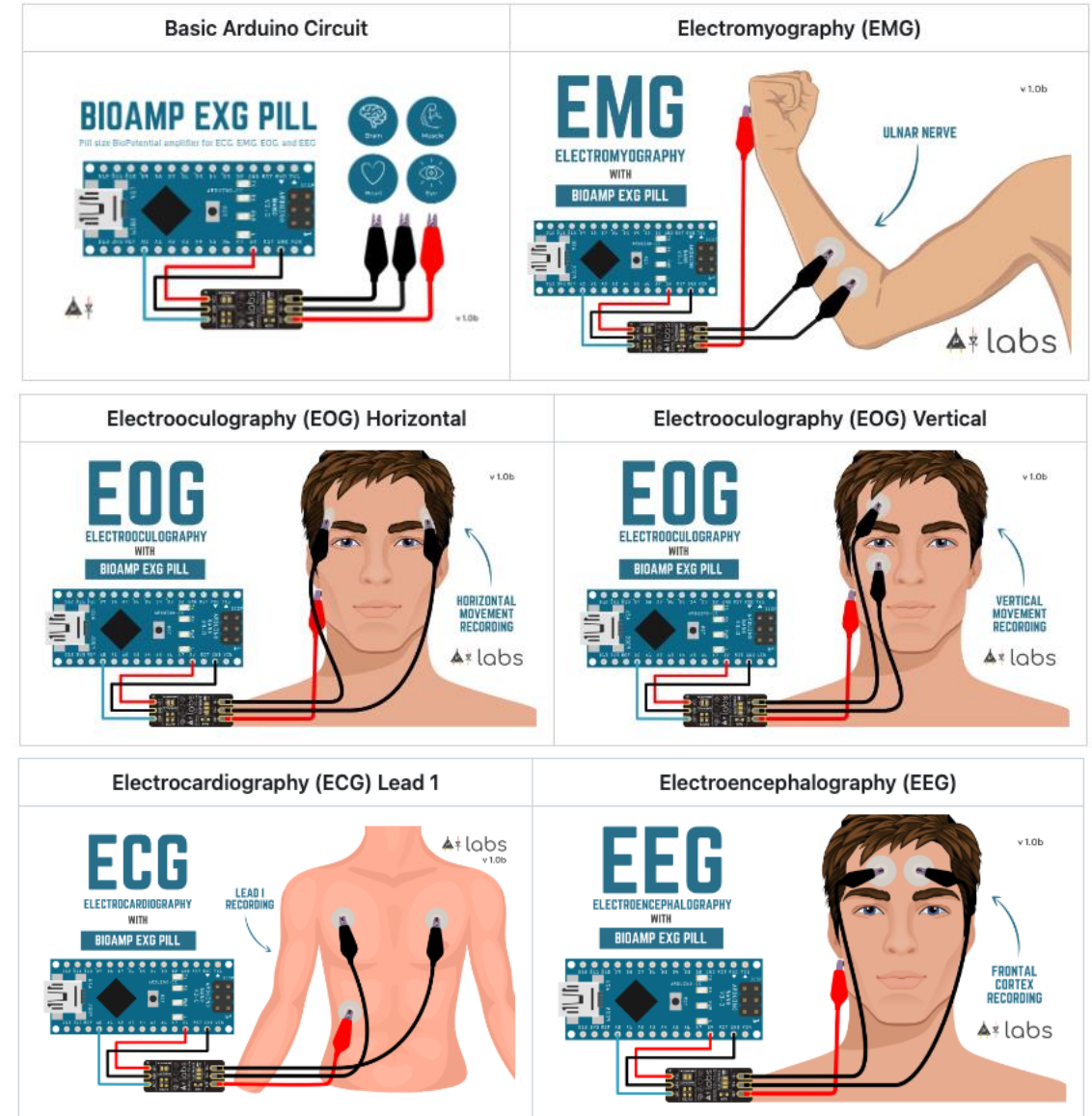www.crowdsupply.com/upside-down-labs/bioamp-exg-pill

Category Bioelectronics   Version 1.0b   Intro YouTube   Support Project Crowd Supply   Documentation hackaday.io   PCB OSH Park
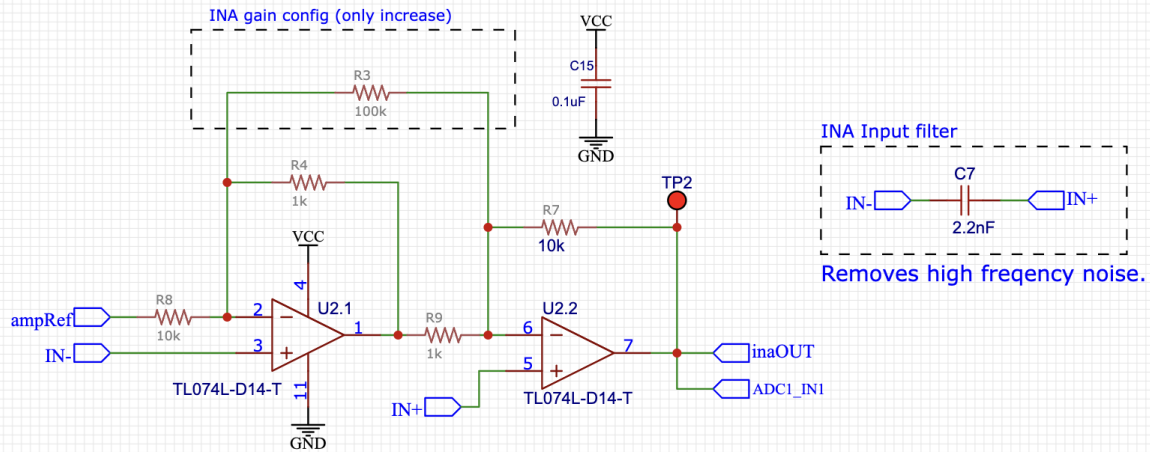
BioAmp EXG Pill is a small (2.54 X 1.00 cm) and elegant Analog Front End (AFE) board for BioPotential signal acquisition that you can use with any 5v Micro Controller Unit (MCU) with an ADC. It is capable of recording publication grade BioPotential signals like ECG, EMG, EOG, and EEG without the inclusion of any dedicated Hardware/Software filter, see BioAmp EXG Pill v0.7 intro video for more info. The v1.0 of BioAmp EXG pill provides even more flexibilty with configuration option for Gain, BandPass, Filter, and Electrodes.

BioAmp EXG Pill
http://bit.ly/BioAmp-EXG-Pill

v 0.7

Basic Arduino Circuit

Electromyography (EMG)

Electrooculography (EOG) Horizontal

Electrooculography (EOG) Vertical

Electrocardiography (ECG) Lead 1

Electroencephalography (EEG)

❑ BioAmp ExG-KKU

NUCLEO 64 CONNECTOR

USART3_TX, USART3_RX, I2C_SCL, I2C_SDA, BUZZER, GND

U1.1 / U1.2

ADC1_IN0, ADC1_IN1, ADC1_IN4, ADC1_IN8, ADC1_IN10, ADC1_IN6, ADC1_IN9

ADC1_IN2/3 (PA2/3): ST-LINK UART2
ADC1_IN5(PA5) : LD2(Nucleo USR LED)
ADC1_IN0 : Ch01
ADC1_IN1 : Ch02
ADC1_IN4 : Ch03
ADC1_IN6 : Ch04
ADC1_IN8 : Ch05
ADC1_IN7 : Ch06
ADC1_IN9 : Ch07
ADC1_IN10 : Ch08

UART2(STLink)

POWER
R1 470, LED1, GND

R2 10k, NRST, SW1 SW2 RESET, C3 1uF
ITS-1105_DIP ITS-1105_SMD

I2C — I2C_SCL, I2C_SDA, J7

USART3 — USART3_TX, USART3_RX, J1

Sample Package Footprint
C1 1u RAD-0.3, C2 1u RAD-0.2, C4 1u RAD-0.1, C5 0.1u C1206, C6 0.1u C0805

(a) Pre-Amplifier(IA)

INA gain config (only increase)
R3 100k, C15 0.1uF, GND

INA Input filter
IN- C7 2.2nF IN+
Removes high frequency noise.

R4 1k, R7 10k, TP2, R8 10k, U2.1, U2.2, R9 1k, ampRef, IN-, inaOUT, ADC1_IN1, IN+, TL074L-D14-T

Instrumentation Amp (INA)

Create solder joint on J3 to narrow the Band Pass freqnecy range
Default: Wide input frequency band, use when recording EMG, EOG
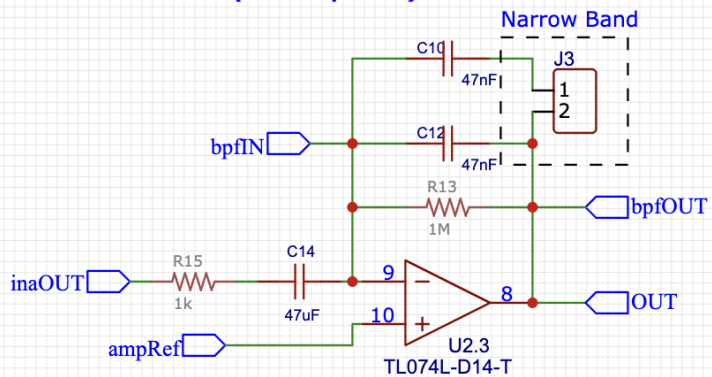Configured: Narrow input frequency band, use for EEG, EOG, and ECG

(b) Filtering and Post-Amplifier

1000x Gain (Bandpass)
Narrow Band
C10 47nF, C12 47nF, J3, bpfIN, R13 1M, inaOUT, R15 1k, C14 47uF, ampRef, U2.3, TL074L-D14-T, bpfOUT, OUT

Band Pass Filter Configuration (BPFC)
미부착(DNP)
bpfIN C13 BPFC_C bpfOUT
R14 BPFC_R

* C8 (BPFC_C) & R3 (BPFC_R) on the back side of the PCB can be used to configure the bandpass filter.
* Use them to configure output Gain (decrease) & Band (frequency range).

Power(Vcc)Selection
+5V J6 +3.3V, VCC

Power Supply Noise Filtering
C8 4.7uF, C9 1u, GND

Header pins / Connectors
TP1, ADC1_IN0, J4, OUT, J9, GND
J5 CON_TERMINAL_BLOCK_03-5MM, IN-, DRL, IN+

Electrode reference
Electrode config
IN- R5 1M, J2, R6 1M, IN+, DRL

Bridge all three pads of the solder jumper to configure for 2 Electrode operations instead of the 3 electrodes
Note: 2 electrodes will give noisier output than 3 electrodes!

Amp Ref + Driven Right Leg (DRL)
VCC, R10 10k, U2.4, ADC1_IN4, ampRef, C11 220nF, R12 10k, R11 1k, DRL, TL074L-D14-T, GND

TITLE:	Bioamp ExG Experiment Brd.[KKU-BME]	REV: 1.0
BIMSRL	Company: KKU-BIMSRL	Sheet: 1/1
	Date: 2023-12-01 Drawn By: jwlee95	

(a) Pre-Amplifier(IA)

INA gain config (only increase)

R3 100k

C15 0.1uF
VCC
GND

INA Input filter

C7 2.2nF

IN-   IN+

Removes high freqency noise.

R4 1k

VCC

R7 10k

TP2

U2.1
TL074L-D14-T

R8 10k
ampRef
IN-

R9 1k

U2.2
TL074L-D14-T

inaOUT
ADC1_IN1

IN+

GND

Create solder joint on J3 to narrow the Band Pass freqnecny range
Default: Wide input frequency band, use when recording EMG, EOG
Configured: Narrow input frequency band, use for EEG, EOG, and ECG

* Problem Statements:

1. 증폭단(Pre-amplifier)의 주파수에 따른 Gain/Phase응답은 어떻게 측정할 수 있는가?.
2. 이론적으로 예측한 Frequency response와 실제로 측정한 결과와의 비교는 어떻게 되는가?
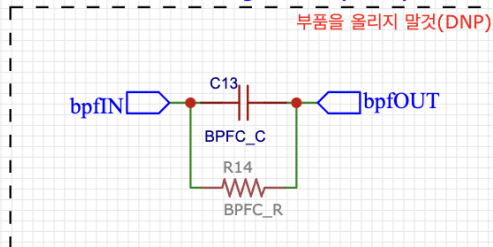3. R3저항의 영향은 무엇인가? 실제 측정한 결과를 기반으로 비교해 보자.

(주어진 회로에 대하여 회로 방정식을 세우고 분석한 결과를 반드시 포함시키기 바람.)

(b) Filtering and Post-Amplifier

1000x Gain (Bandpass)

Narrow Band

C10 47nF
J3
1
2

bpfIN
C12 47nF

R13 1M

bpfOUT

inaOUT
R15 1k
C14 47uF

U2.3
TL074L-D14-T

ampRef

OUT

Band Pass Filter Configuration (BPFC)

부품을 올리지 말것(DNP)

bpfIN
C13
BPFC_C
R14
BPFC_R
bpfOUT

* C8 (BPFC_C) & R3 (BPFC_R) on the back side of the PCB can be used to configure the bandpass filter.
* Use them to configure output Gain (decrease) & Band (frequency range).

의공종합설계및실습2 (8274)