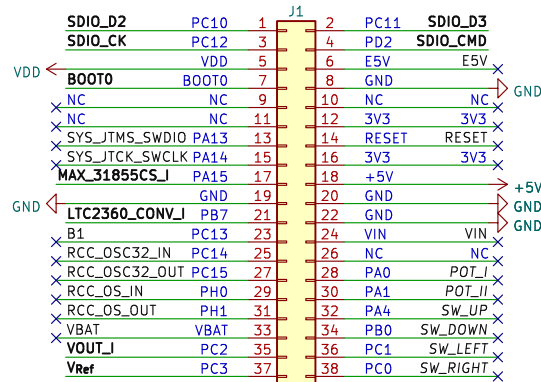
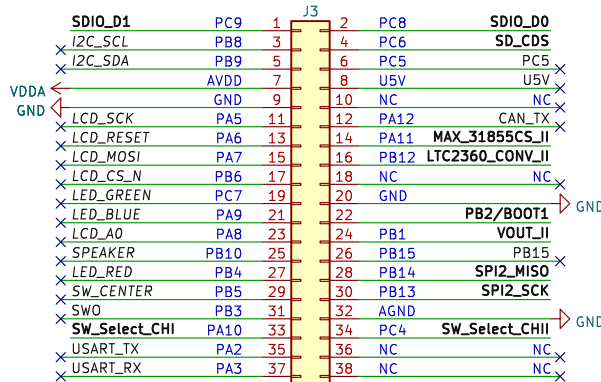


NUCLEO Thermocouple Extension Board

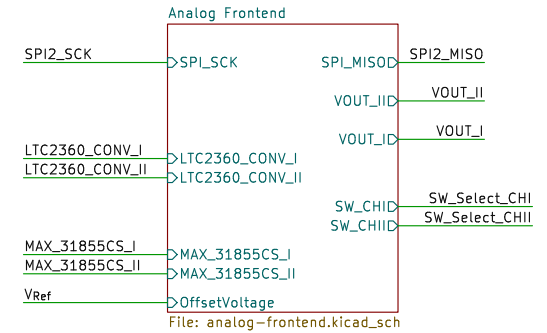
ST Morpho Connector



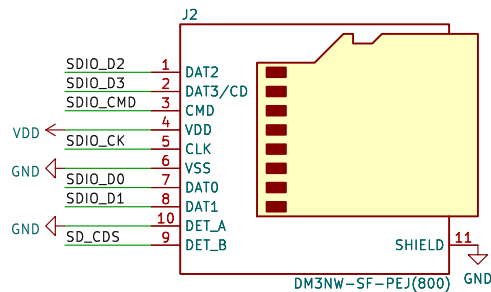
Pin used by MBED Shield
Pin used by NUCLEO Board
Pin used by Thermocouple



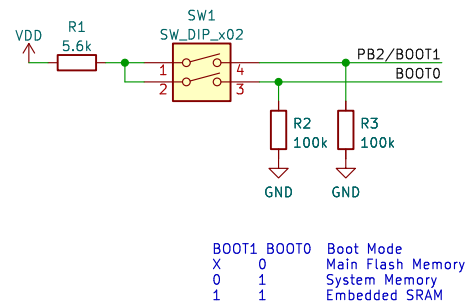
Thermocouple Interface



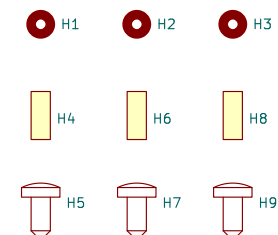
MicroSD Card Interface



Boot Configuration



Mechanical Parts



Fiducial



Power Nets



Sheet:
File: nucleo-analog-frontend.kicad_sch
Title: NUCLEO Thermocouple Expansion
Size: A4 Date: 2023-01-23 Rev: v1.0.0
KiCad E.D.A. kicad 7.0.11+dfsg-1build4 Id: 1/4

Thermocouple Interface

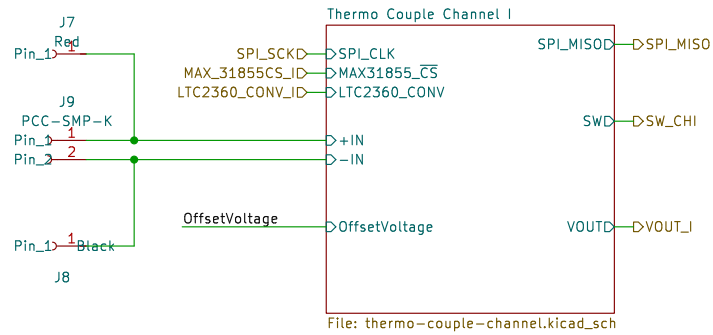
Type K Range:

- a) -50 ... 400°C (Testo 0602 0645)
- b) -50 ... 250°C (PeakTech TF-50)
- c) -40 ... 260°C (Fluke 80BK-A)

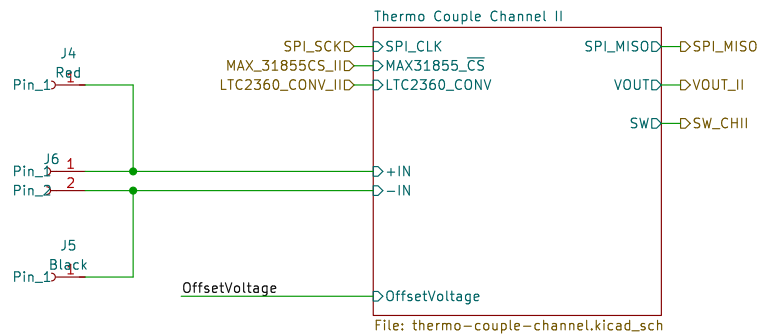
Type K Range:

- a) -1.899mV ... 16.397mV
- b) -1.899mV ... 10.153mV
- c) -1.527mV ... 10.561mV

Thermocouple Channel I

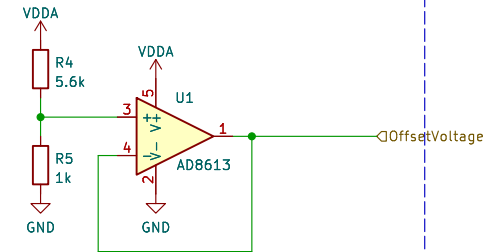


Thermocouple Channel II

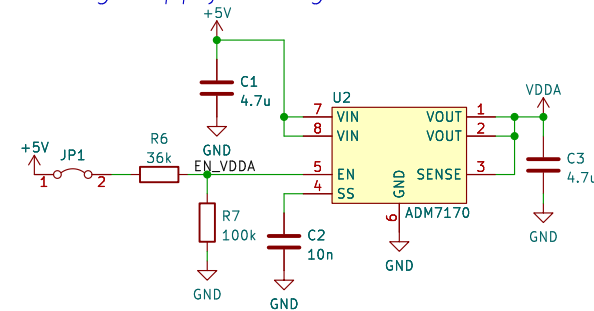


Offset Reference Voltage

Offset Voltage 0.5V



Analog Supply Voltage



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Sheet: Analog Frontend
File: analog-frontend.kicad_sch

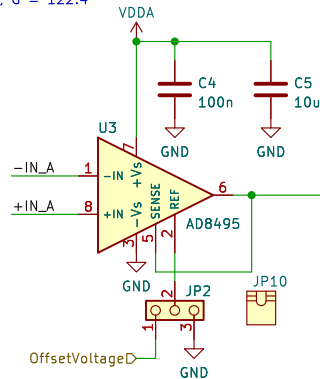
Title: NUCLEO Thermocouple Expansion

Size: A4 Date: Rev: v1.0.0
KiCad E.D.A. kicad 7.0.11+dfsg-1build4 Id: 2/4

Thermocouple Channel

Thermocouple Amplifier with Cold Junction Compensation

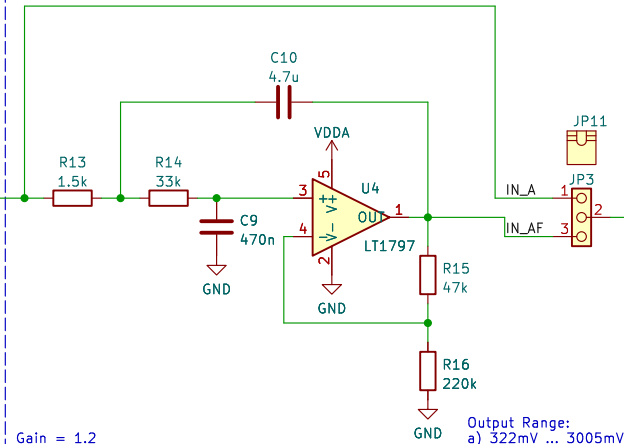
Fixed Gain for Type K, $G = 122.4$
Offset Voltage = 0.5V



Input Range:
a) -1.899mV ... 16.397mV
b) -1.899mV ... 10.153mV
c) -1.527mV ... 10.561mV

Output Range:
a) 268mV ... 2504mV
b) 268mV ... 1742mV
c) 314mV ... 1792mV

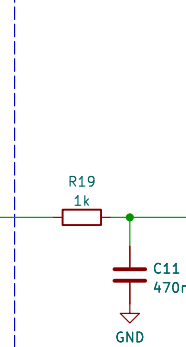
50Hz Filter / ADC Driver



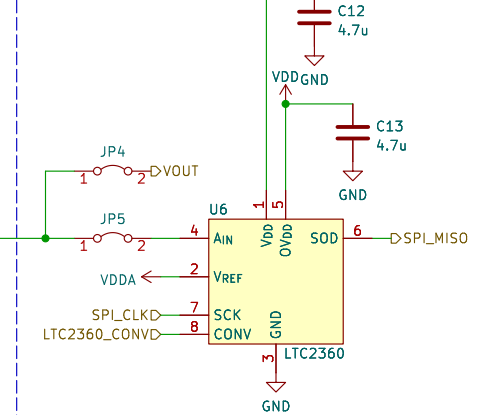
Gain = 1.2
 $f_c = 15 \text{ Hz}$
 $Q = 0.707$

Output Range:
a) 322mV ... 3005mV
b) 322mV ... 2090mV
c) 377mV ... 2150mV

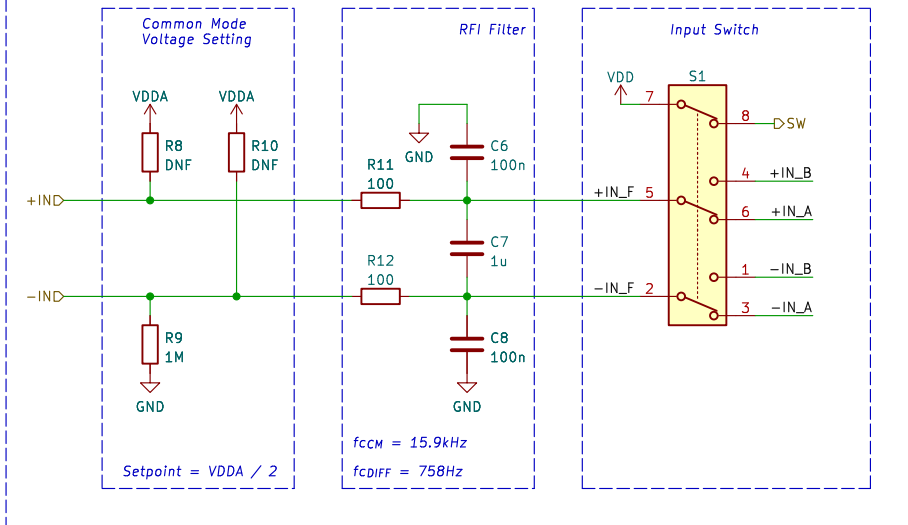
Charge Bucket



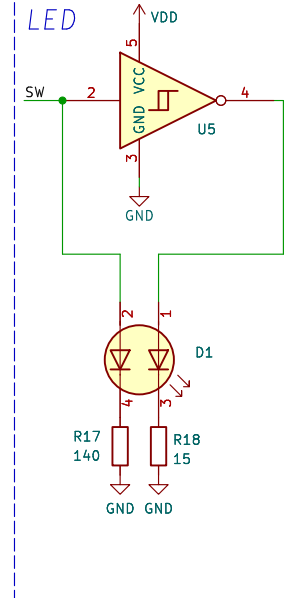
Analog Digital Converter



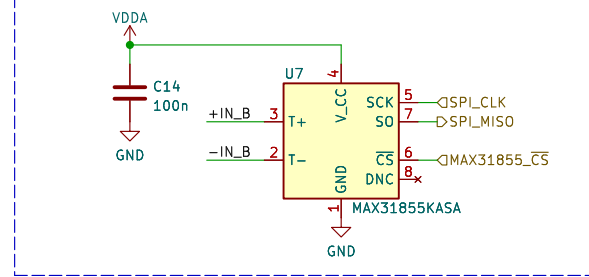
Input Filter



LED



Thermocouple to Digital Converter with Cold Junction Compensation



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Sheet: Thermo Couple Channel II
File: thermo-couple-channel.kicad_sch

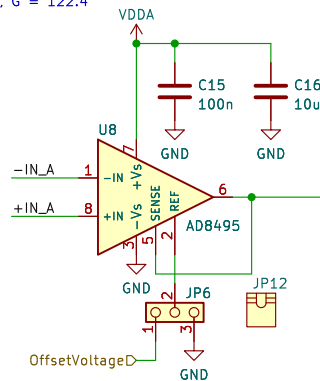
Title: NUCLEO Thermocouple Expansion

Size: A4	Date:	Rev: v1.0.0
KiCad E.D.A. kicad 7.0.11+dfsg-1build4		Id: 3/4

Thermocouple Channel

Thermocouple Amplifier with Cold Junction Compensation

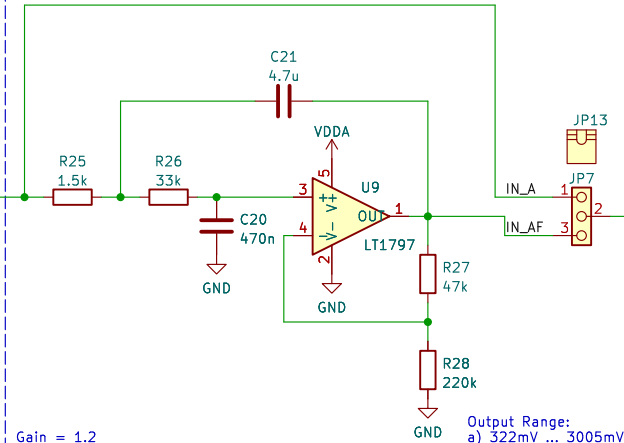
Fixed Gain for Type K, $G = 122.4$
Offset Voltage = 0.5V



Input Range:
a) -1.899mV ... 16.397mV
b) -1.899mV ... 10.153mV
c) -1.527mV ... 10.561mV

Output Range:
a) 268mV ... 2504mV
b) 268mV ... 1742mV
c) 314mV ... 1792mV

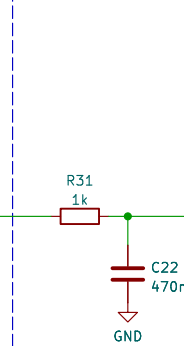
50Hz Filter / ADC Driver



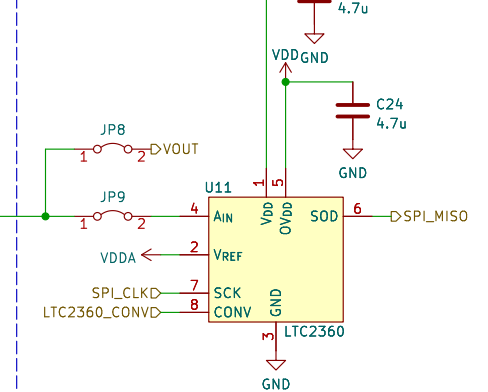
Gain = 1.2
 $f_c = 15$ Hz
 $Q = 0.707$

Output Range:
a) 322mV ... 3005mV
b) 322mV ... 2090mV
c) 377mV ... 2150mV

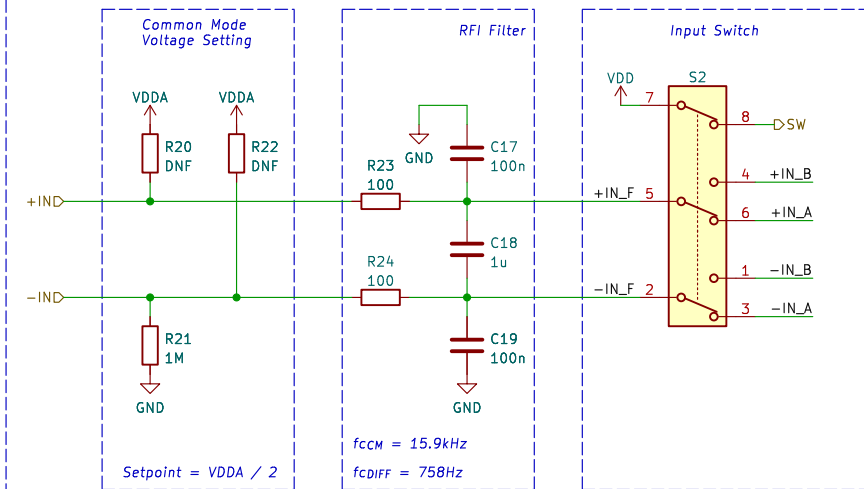
Charge Bucket



Analog Digital Converter



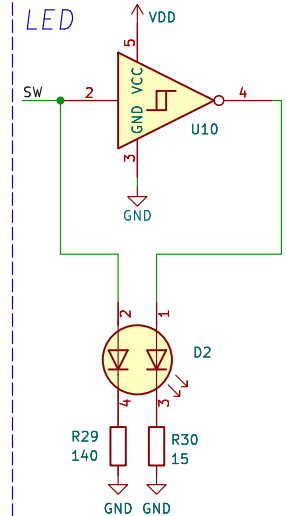
Input Filter



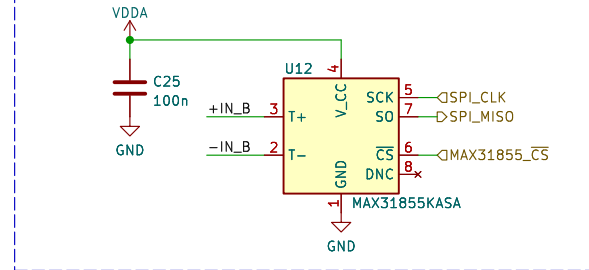
Setpoint = $V_{DDA} / 2$

$f_{CCM} = 15.9$ kHz
 $f_{CDIFF} = 758$ Hz

LED



Thermocouple to Digital Converter with Cold Junction Compensation



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Sheet: Thermo Couple Channel 1
File: thermo-couple-channel.kicad_sch

Title: NUCLEO Thermocouple Expansion

Size: A4	Date:	Rev: v1.0.0
KiCad E.D.A. kicad 7.0.11+dfsg-1build4		Id: 4/4