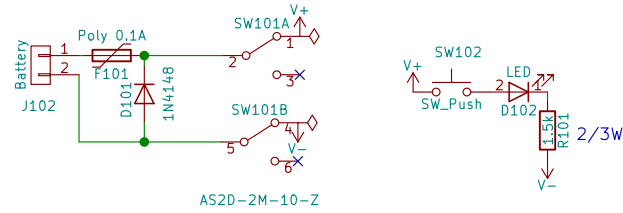
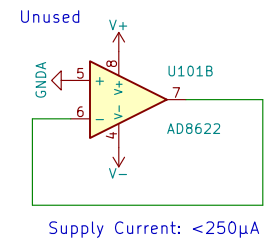
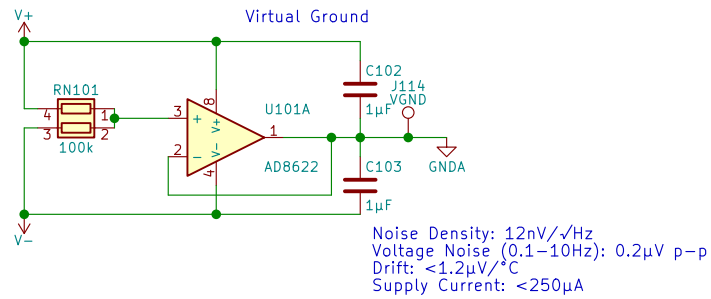
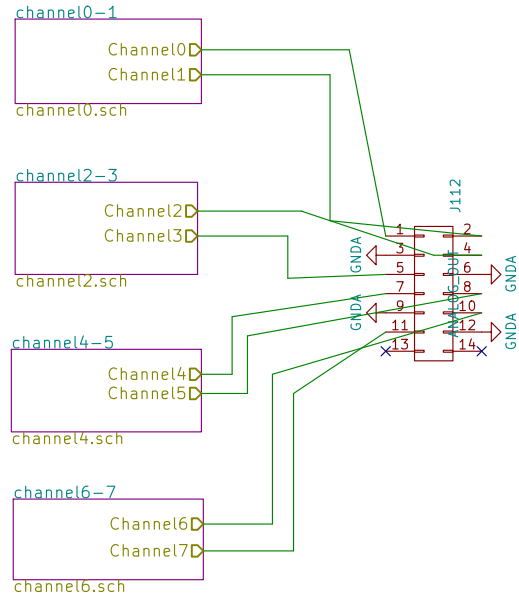


Battery Voltage: 5-30V  
Output is  $\pm V_{batt}/2$



- Mounting Holes
- ×1 J103
  - ×1 J104
  - ×1 J105
  - ×1 J106



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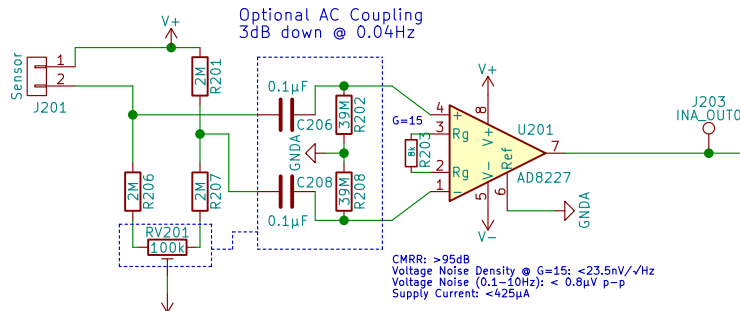
Monadnock Systems  
Cusack Lab; Brain and Mind Institute, UWO

Sheet: /  
File: bmi-8ch.sch

**Title: Polymer Sensor Amplifier**

Size: USLetter Date: 2017-04-04  
KiCad E.D.A. kicad 4.0.6

Rev: AB  
Id: 1/5



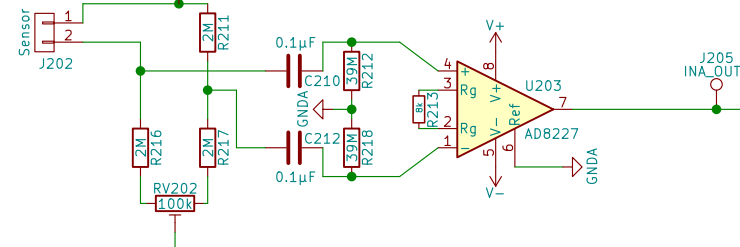
Optional AC Coupling  
3dB down @ 0.04Hz

For AC coupling: Populate as shown. Trim pot not required  
For DC coupling: Replace C206,C208 with 5 kOhm resistors.  
R202,R208 may be omitted. Trim pot required.  
Cut jumpers on pot footprint before installation.

CMRR: >95dB  
Voltage Noise Density @ G=15: <23.5nV/√Hz  
Voltage Noise (0.1-10Hz): < 0.8μV p-p  
Supply Current: <425μA

Chebyshev (0.26dB)  
Gain = 2V/V  
-3dB @ 195Hz  
-50dB @ 3.1kHz

Offset: <125μV  
Offset Drift: <1.3μV/°C  
Voltage Noise Density: 12nV/√Hz  
Voltage Noise (0.1-10Hz): 0.2μV p-p  
Supply Current: <250μA



Problems:

- USB-1208FS has fixed single-ended range of ±10V
- Drop in upgrade to USB-1608FS (16bit and variable range)
- Mitigated initially by running on 18V via two 9V batteries.
- R202, R208, R212, R218; 39M only available in thick film.
- More (slightly) 1/f noise and ±5% accuracy.
- AC coupling isn't optional in this design. Rhodri keen to try AC route first; add cost / complexity later if needed.

Assumptions:

- (Initial) DAQ is MCC USB-1208FS (available at BMI)
- 11-bit, max 6250 S/sec for each channel; sequential
- Target Bandwidth: 195Hz
- Sampling Rate 6240 S/s
- Sensor resistance 2MΩ
- Respiration motion changes sensor resistance by < ±10%
- Sensor resistance changes with handling; would require at least per-subject trimming if DC coupled.

Notes:

R203, R213: 0.1%  
Other R: 1%  
C205, C206, C207, C208, C209, C210, C211, C212: 50V NP0  
Bypass Caps: 50V X7R X5R

Open Questions:

- AC vs DC Coupling:
  - AC: no trimming, better UX, better tempco, cheaper
  - DC: captures all low-frequency signal that may be of interest
- Use chopper amps in signal path: Probably bad
  - Lower total noise for \*extremely\* small bandwidths (<5Hz?)
  - Lower offset (if DC coupled)

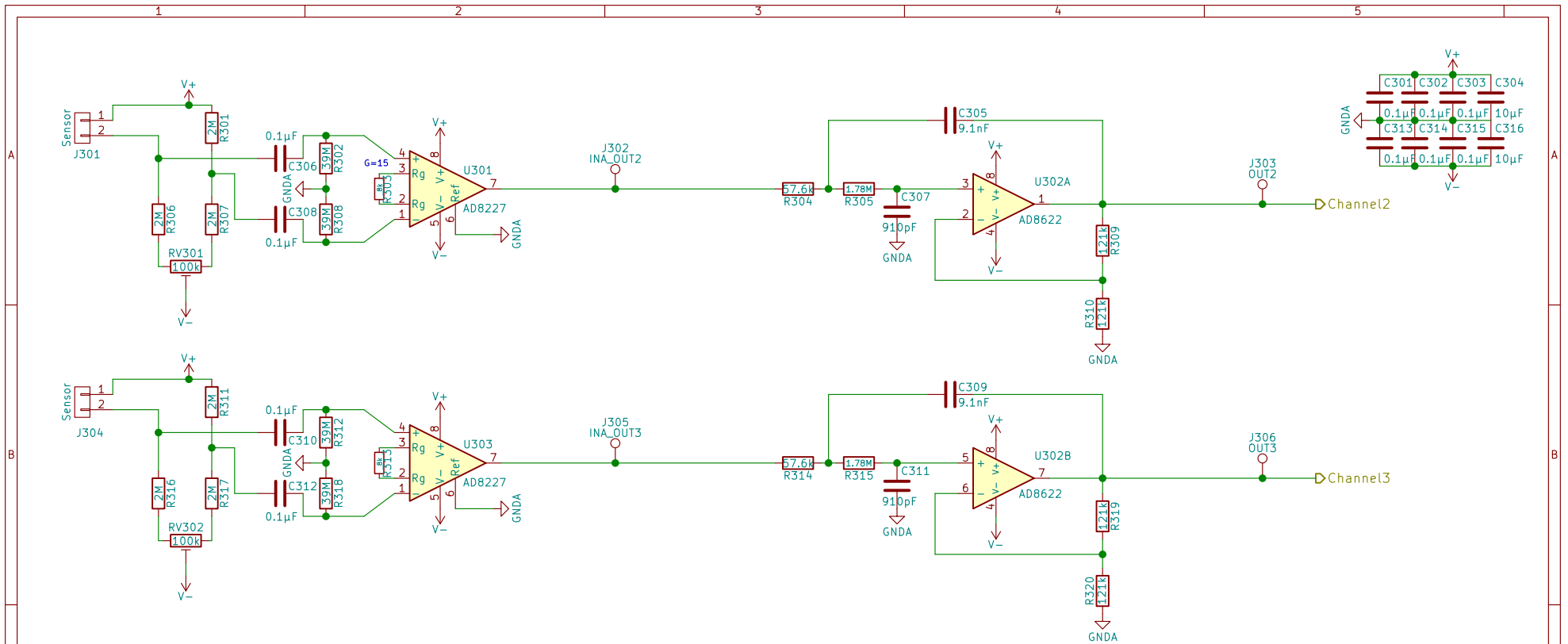
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Monadnock Systems	
Cusack Lab; Brain and Mind Institute, UWO	
Sheet: /channel0-1/ File: channel0.sch	
<b>Title: Input Channel 0 &amp; 1</b>	
Size: USLetter	Date: 2017-03-31
KiCad E.D.A. kicad 4.0.6	Rev: AB
	Id: 2/5



Notes:

- R303, R313: 0.1%
- Other R: 1%
- C305, C306, C307, C308, C309, C310, C311, C312: 50V NP0
- Bypass Caps: 50V X7R or X5R

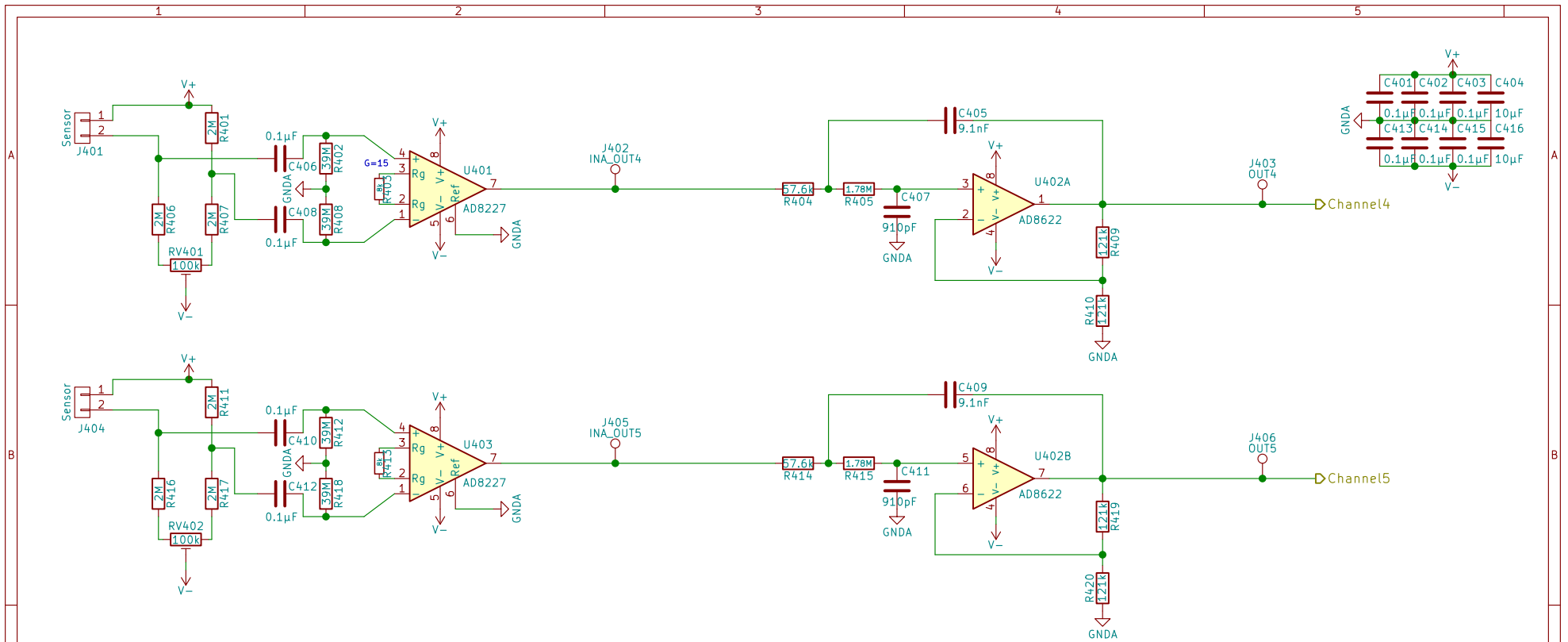
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Sheet: /channel2-3/ File: channel2.sch	
<b>Title: Input Channel 2 &amp; 3</b>	
Size: USLetter	Date: 2017-03-31
KiCad E.D.A. kicad 4.0.6	Rev: AB Id: 3/5



Notes:

- R403, R413: 0.1%
- Other R: 1%
- C405, C406, C407, C408, C409, C410, C411, C412: 50V NP0
- Bypass Caps: 50V X7R or X5R

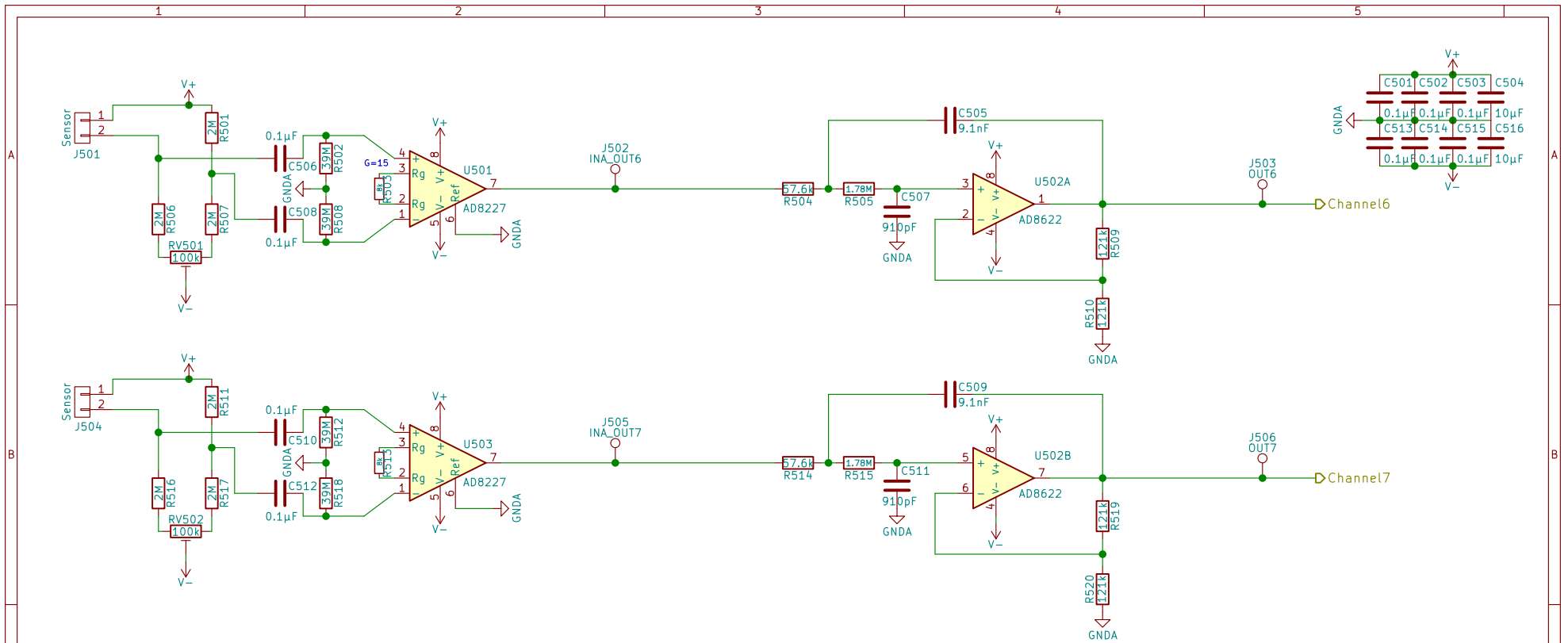
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Monadnock Systems	
Cusack Lab; Brain and Mind Institute, UWO	
Sheet: /channel4-5/ File: channel4.sch	
<b>Title: Input Channel 4 &amp; 5</b>	
Size: USLetter	Date: 2017-03-31
KiCad E.D.A. kicad 4.0.6	Rev: AB
	Id: 4/5



Notes:

- R503, R513: 0.1%
- Other R: 1%
- C505, C506, C507, C508, C509, C510, C511, C512: 50V NP0
- Bypass Caps: 50V X7R or X5R

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Monadnock Systems <b>Cusack Lab; Brain and Mind Institue, UWO</b>	
Sheet: /channel6-7/ File: channel6.sch	
<b>Title: Input Channel 6 &amp; 7</b>	
Size: USLetter	Date: 2017-03-31
KiCad E.D.A. kicad 4.0.6	Rev: AB Id: 5/5