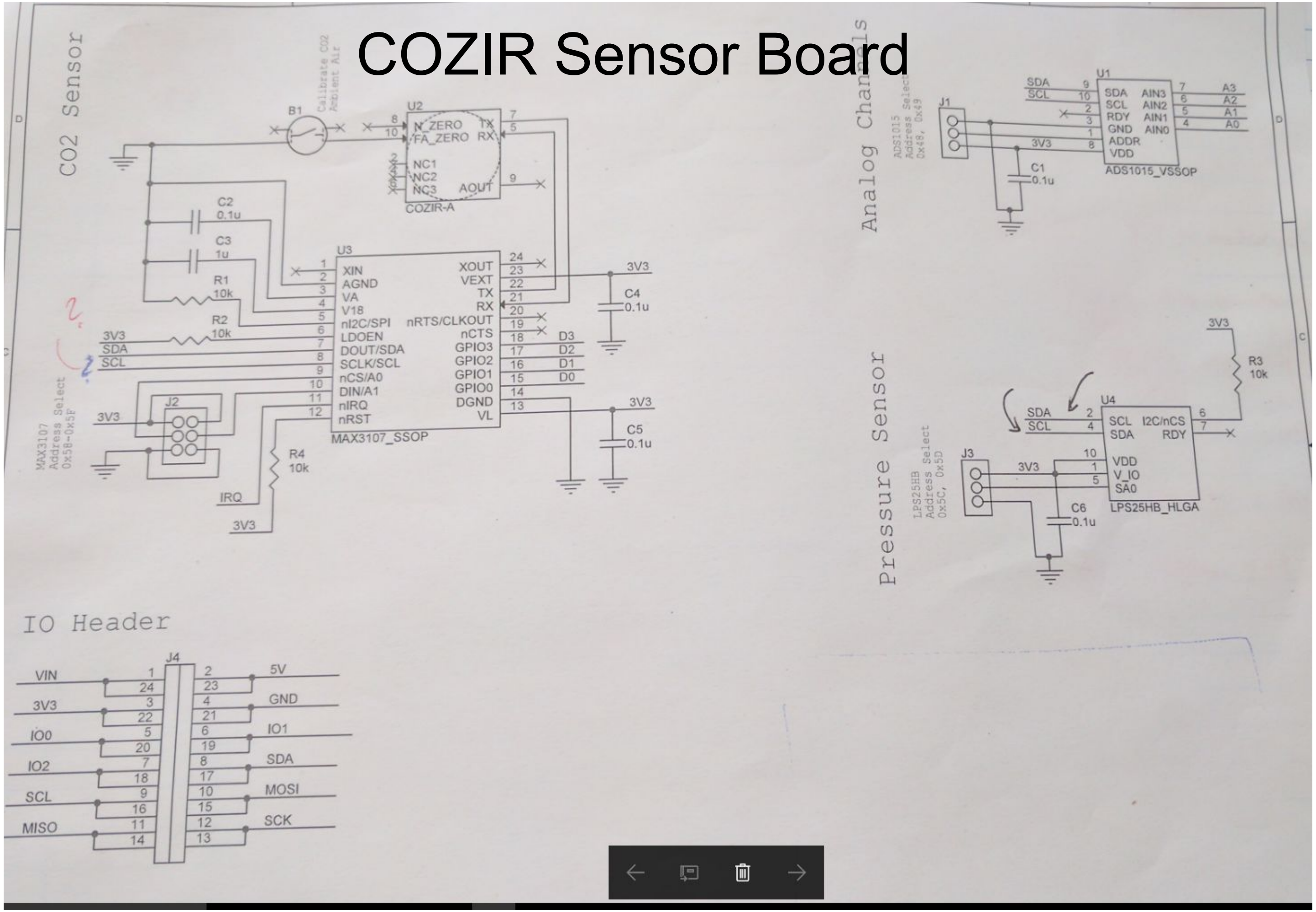
Sensor Board

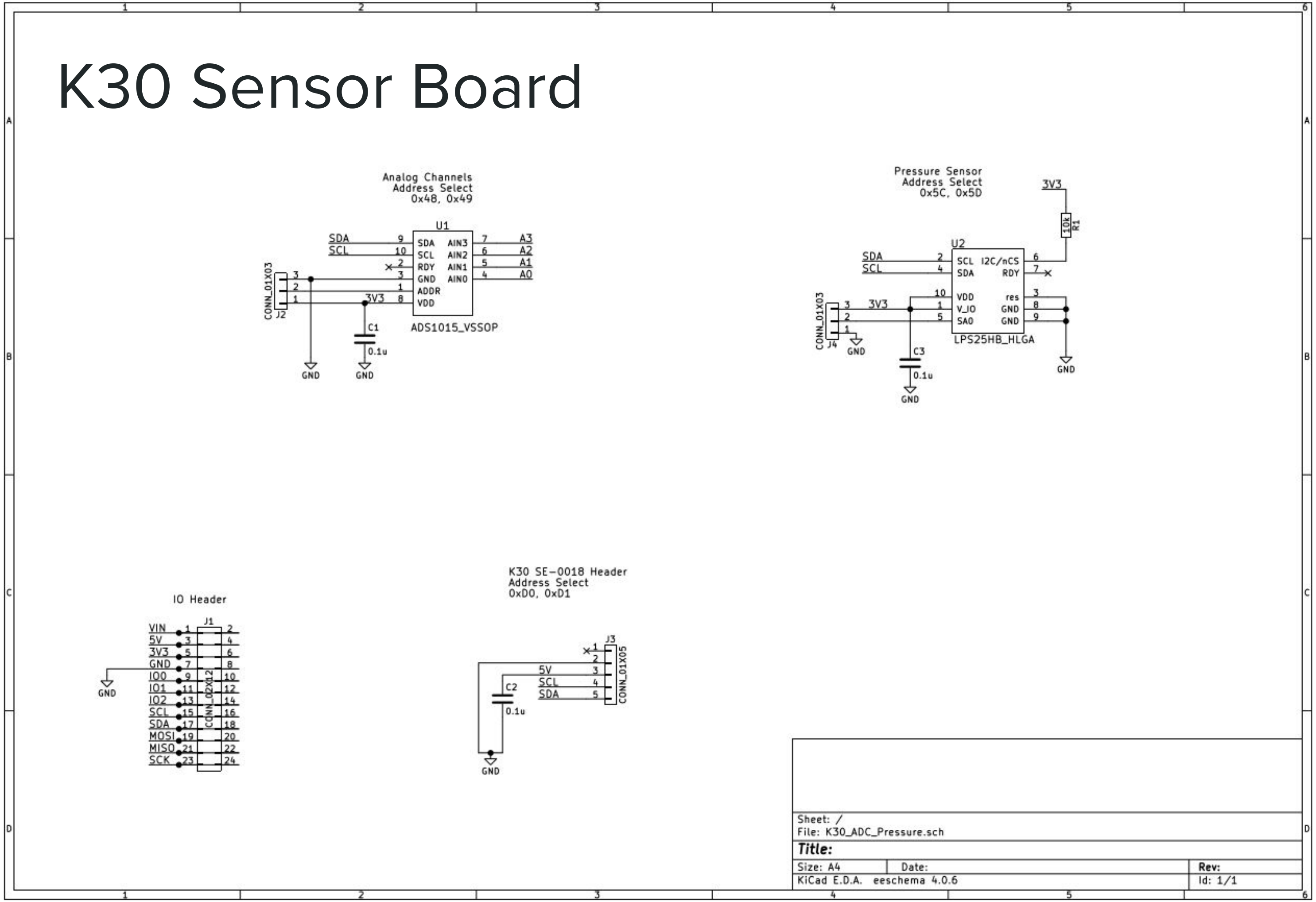
CO2 Sensors

COZIR	K30
• Ultra low power, 1.5mA average • Sensor is housed • Up to 10,000 ppm measurement • 2 measurements / second • Accuracy +- 50 ppm • Serial communication 	• 40mA average • Exposed board • Up to 10,000 ppm • 0.5 measurements / second • Accuracy +- 30 ppm • I2C communication 

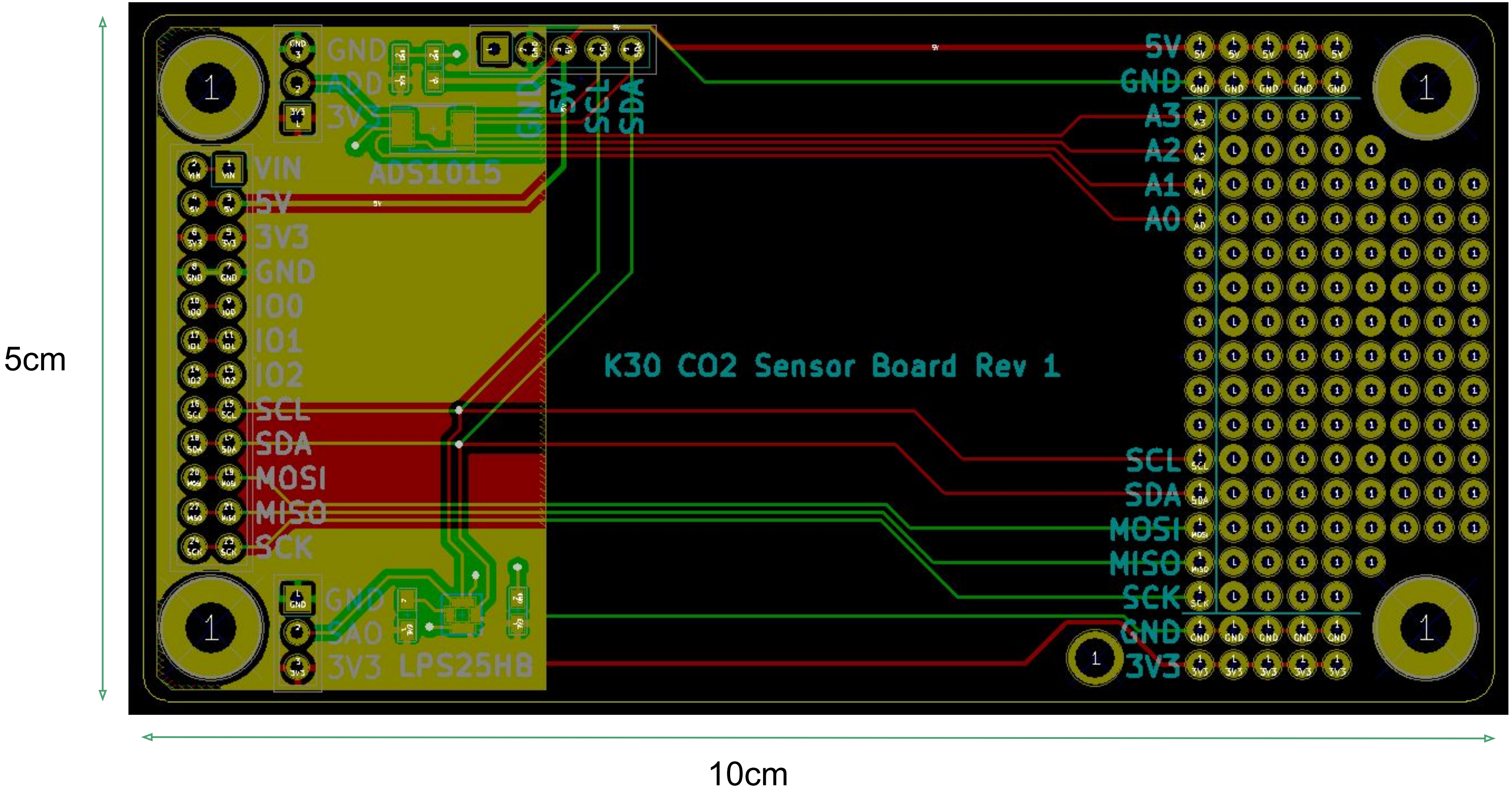
COZIR Sensor Board



K30 Sensor Board

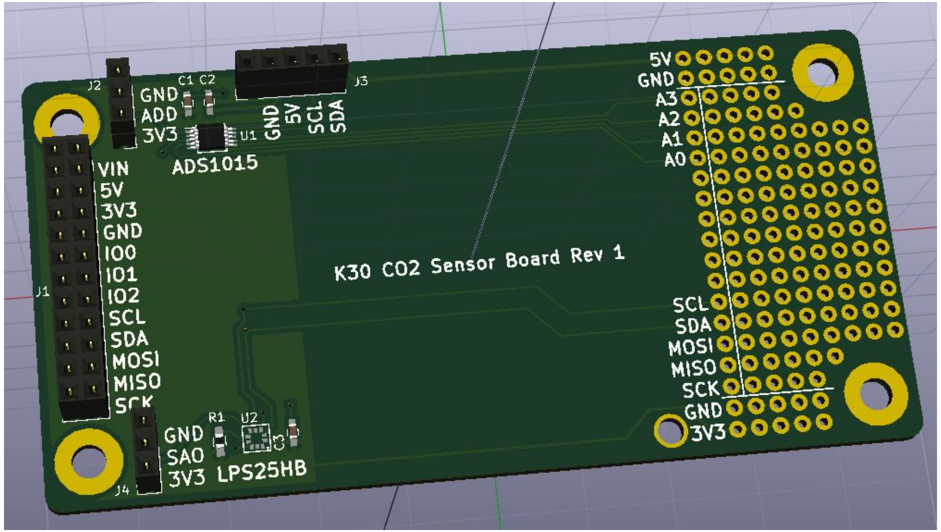


K30 PCB



5cm
10cm
K30 CO2 Sensor Board Rev 1
ADS1015
LPS25HB
GND
ADDR
3V3
5V
SCL
SDA
VIN
IO0
IO1
IO2
MOSI
MISO
SCK
SAO
A3
A2
A1
A0

K30 PCB - 3D View



Moving Forward

- Source components from DigiKey etc.
- Order more K30 boards
- Manufacture 1st Revision ➔ OSH Park
- Assemble unit

Solar Power

➔ Renewable, off grid, and portable

System power consumption

- 5 watt average (5V @ 1A)
- 2A peak current when transmitting through skywire

5W x 24 hours = average 120Wh / day

Battery Bank Sizing

- 120Wh/day of energy used by the system
- Assuming ambient temperature (21 C)
- Battery banks are 12 V
- Calculations assume 50% discharge for optimal battery life
- Capacity should be ~1.5-2 times capacity stated below for sub zero temperatures

Days without sun	Capacity Needed	Total energy capacity
1	24 Ah	288 Wh
2	48 Ah	575 Wh
3	72 Ah	862 Wh

LiFePO4

- Popular in vehicle applications
- Stable and safer if damaged compared to common LiCoPO4
- >10 year lifetime, 2000 cycles
- 3.2V nominal until exhausted (can simplify voltage regulation circuitry)
- 70% apparent capacity at -20C [1]
- **Impractical charge rates below freezing (0.02-0.05C) [2], would need a thermal blanket or insulation**

Sealed Lead-Acid

- Big and sluggish, takes a long time to fully charge (70% in 5-8 hours)
- 70% retention capacity after 5 years @ 20 Celsius
- **Can charge at 0.3C between –20°C to 50°C [2]**

[2] http://batteryuniversity.com/learn/article/charging_at_high_and_low_temperatures

Solar Panel Sizing

- Worst case in Toronto is December [2]
- 11 days with no sun
- 2.5 hrs average sun per day

➔ 120Wh / 2.5h = **48 Watt solar panel**

If we account for a 30% loss due to inefficiencies,

➔ 48W * 1.3 = **62.4 Watt solar panel**

Station: Toronto, ON, Canada | Latitude: 43.7° | Longitude: -79.4° | Altitude: -9999 m

Sun

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Total hours bright sunshine	88	110	156	185	229	256	276	241	188	148	84	75
Days with measurable bright sunshine	21	21	24	26	28	28	30	30	27	27	20	19
Extreme daily bright sunshine hours	9	10	12	13	15	15	14	14	12	10	10	9
Date	Jan 22 1989	Feb 20 1972	Mar 27 1973	Apr 22 1975	May 30 1996	Jun 26 1999	Jul 19 1997	Aug 04 1972	Sep 01 1986	Oct 20 1986	Nov 04 1975	Dec 01 1971

- Best case in July, 9.2 hrs average sun = 13 watt panel (17 watt with inefficiencies)

[2] https://www.theweathernetwork.com/forecasts/statistics/suncloud/cl6158350/caon0696

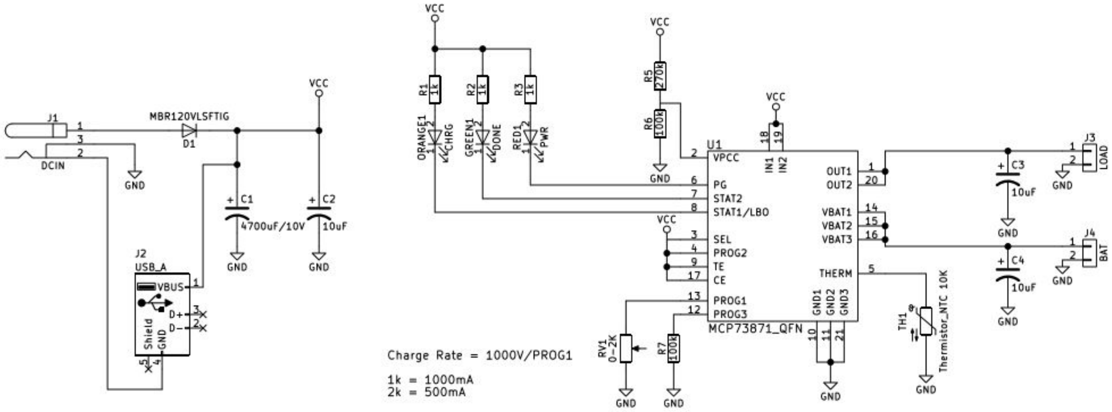
In the short term...

- Focus on getting the system onto the road
- This could mean using LiPo batteries (doesn't charge well below freezing) and smaller solar panels for now
- Source solar panel(s), charger, and batteries
- Charger can be off-the-shelf or custom

In the long term...

- Could use panels and road side power, take power from roadside lines if panel does not produce enough. Could reduce size of battery and solar panel
- Determine ways to reduce power
- Reduce hours of operation of system (5AM - 12PM)

Custom Charger Idea 1 - MCP73871



- MCP73971 System load sharing chip
- Can only supply 1 A to battery and load
- Could double up

Custom Charger Idea 2 - LT3652

- Employs MPPT (Maximum power point tracking), which adjusts the panel voltage to match the battery charge voltage for maximum power.
- 5-32V input, 2A charge rate
- Accommodates LiPo, LiFePO4, and SLA