

LCB Analog Board

Mods for Li-Cor PAR Sensor LI-192

Design Notes

9 Aug 12 ecm create

Sensor

Li-Cor PAR Sensor specs: 4 uA per 1000 uE/s/m², +/- 5%. About 10uA full scale.

0 ohm load (transimpedance amp) nominal, 1034 ohm load used by Li-Cor logger.
2k load probably OK → 20mV full scale.

Requirements

Accuracy full scale: 5% Stability full scale: 1% over temperature
Resolution: 0.01% of full scale (100 ppm)
Sample Rate: 2.5 Hz

Design Notes

Stock LCB-Analog diff amp (U19) uses bipolar LT6014 for lowest noise (200 nV in 0.1-10 Hz). LT6014 has restricted input range of 1V-2.1V, also noticeable input bias current of 250 pA. Substitute CMOS LTC6078, already used elsewhere on board, to get input range 0-3.3V, input bias 1 pA, also input clamp diodes.

A/D full scale differential input is +/-2.500V, allowable absolute input range 0-3.3V.

Float sensor input to 1.25V (ideally to 1.65V) to maximize input range. Split the load (shunt) resistance in half and connect center to 1.25V source. Sensor will appear as a floating current source with balanced output voltage developed across load resistor; common-mode noise should be rejected.

Use load resistance 2.00k (two each 1.00k), full scale output 20 mV. Resistor value error will appear as full scale error (can be calibrated out). Resistor balance (ratio error and ratio drift) and will appear as CM offset, should be rejected by diff amp and A/D. Resistor value drift will appear as full scale drift.

Re-scale diff amp gain to 101 by using 100k/1k divider network instead of stock 10k/1k. 20mV input x 101 = 2.02 V full scale into A/D.

Errors, drift, and noise: LTC6078 (AIMS8 grade) input offset ~25 uV, drift ~0.7 uV/Deg, no spec on match. 50 uV / 20 mV = 0.25% offset error (can be calibrated out). 1.4 uV / 20 mV = 70 ppm/deg drift (can't be calibrated out). Noise 1 uV p-p → 50 ppm

noise (can't be calibrated out). Depending on noise environment, 100 ppm change in sensor output should be detectable, but drift over temperature will likely exceed 100 ppm.

Generate 1.25V CM voltage for sensor by changing R39 to a 10k/10k divider, and re-wiring U18A as a follower. Remove R40, blue-wire K1 pin 3 to pin 14.

For load (shunt) resistor, connect two 1.00k resistors in series between K1-13 and K1-4. Blue-wire midpoint to 1.25V CM source at K1-3. (If better stability is needed, possibly use 680 ohm resistors from R40, should have 10 ppm tempco.)

Change R44 and R45 from 10k/1k to 100k/1k divider network.

Change U19 from LT6014 to LTC6078.