Mammal Tracking Project - Current Meter Board Pins Used

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Primary Processor

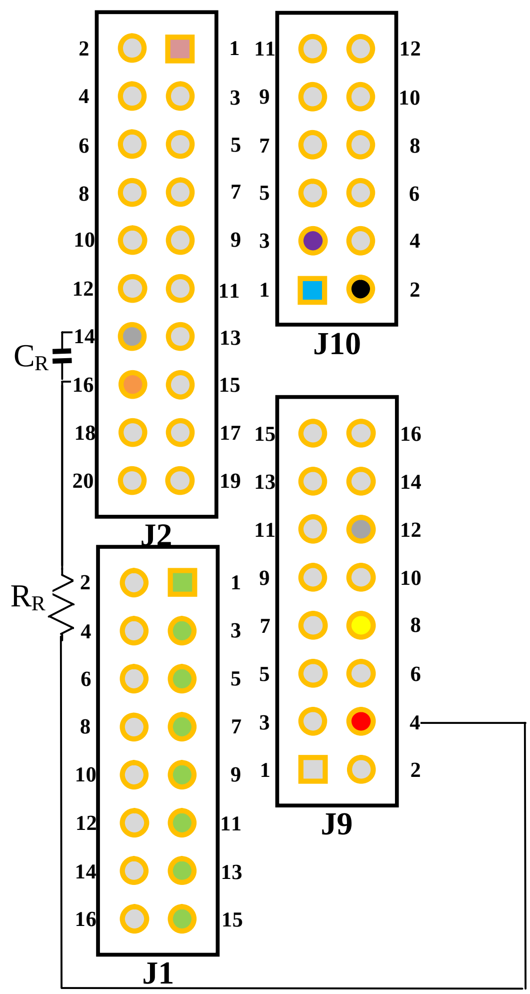
The primary processor of the project is a Freescale Kinetis L class microcontroller. The Freescale Freedom board used for this project uses a KL25 version of this processor. In the connection diagrams that follow the color silver indicates an empty hole, black indicates a pin without a connection to it, while other colors indicate the wire color or component connected to the pin.

Freedom Board Pins Used

The Current Meter Board (CMB) is powered by the USB connection through the OpenSDA port. It is connected to an external resistance network board that provides signal taps used to determine the current passing from a current source to its destination. The analog reference is smoothed by capacitor C_R and resistor R_R. The connections to the Current Meter Board are as follows:

1. Data In (Optional) — J1-1 to J1-15 odd
2. Data Out (Optional) — Sampling J2-1
3. AREF Capacitor Low — GND — J2-14
4. AREF Capacitor High — AREF — J2-16
AREF Resistor Low
5. CMB Power (Optional) — P3V3 — J9-08
6. AREF Resistor High — P3V3 — J9-04
7. Resistor Board Ground — GND — J9-12
8. Resistor Board V+ — PTE20 — J10-01
9. Resistor Board V- — PTE21 — J10-03

C_R = 1000 µF, R_R = 1000 Ω



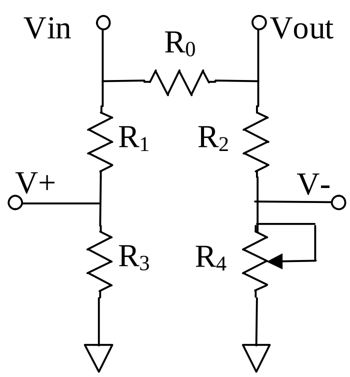
The Resistor Board is used to implement the resistor network and the pins needed to connect it to the Source, Destination, and Current Meter Board. The current through the R_0 resister is measured by determining the difference between V+ and V- assuming that the resistances of R_1 to R_4 are much higher than that of R_0.

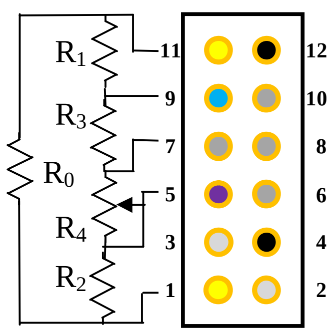
$$V+ = Vin \times R_3 / (R_1 + R_3) \quad \rightarrow \quad Vin = V+ \times (R_1 + R_3) / R_3$$
$$V- = Vout \times R_4 / (R_2 + R_4) \quad \rightarrow \quad Vout = V- \times (R_2 + R_4) / R_4$$
$$Iout = (Vin - Vout) / R_0 \quad \rightarrow$$
$$Iout = [V+ \times (R_1 + R_3) / R_3 - V- \times (R_2 + R_4) / R_4] / R_0$$

Resister R_0 is a 1 Ω resister. Resistor R_4 is calibrated by connecting the same voltage source, Vcal, across both Vin and Vout, then adjusting R_4 until V+ and V- have the same values. This results in:

$$V+ = Vcal \times R_3 / (R_1 + R_3) \quad \& \quad V- = Vcal \times R_4 / (R_2 + R_4)$$
$$Vcal \times R_3 / (R_1 + R_3) = Vcal \times R_4 / (R_2 + R_4) \quad \rightarrow \quad R_3 / (R_1 + R_3) = R_4 / (R_2 + R_4)$$
$$(R_1 + R_3) / R_3 = (R_2 + R_4) / R_4 \quad \rightarrow \quad Iout = [(V+ - V-) \times (R_1 + R_3) / R_3] / R_0$$

1.	Source Ground	GND	RB-10
2.	Source Vcc	Vin	RB-11
3.	CMB V+	V+	RB-09
4.	CMB Ground	GND	RB-08
5.	CMB V-	V-	RB-05
6.	Destination Ground	GND	RB-06
7.	Destination Vcc	Vout	RB-01





Resistor Board

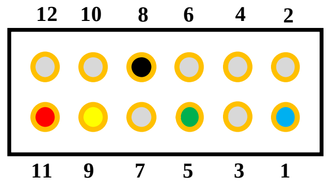
V+ must be less than AREF. If max V+ is (g × AREF):

$$g \times AREF / Vin = R_3 / (R_1 + R_3)$$
$$g \times AREF / Vin = 1 / (R_1 / R_3 + 1)$$
$$R_1 / R_3 = 1 / (g \times AREF / Vin) - 1$$
$$R1 = R3 \times [1 / (g \times AREF / Vin) - 1]$$

where g is a constant such as 0.9.

R4 = 2 × R3 to allow for it to be adjusted.

Calibrate using calibration cable:



RB Calibration Plugs

Connect blue to the red.
Apply power (3.3v) between red and black.
Adjust R_2 until voltage between yellow and green is 0.
Measure Vcal between red and black.
Measure V+cal between yellow and black.

Disconnect red and black from power and ground.
Disconnect blue from red.
Set power to 0.3v or less.
Connect red to power, blue to ammeter, and ammeter to ground.
Measure Ical through ammeter and $V_L$cal between red and blue.
Calculate calibration factor for this Resistor Board:

$$CF = (Vcal / V{+}cal) / (V_Lcal / Ical)$$

$$Iout = (V+ - V-) \times CF$$