Design Goals:	INA214: 100 V/V	SBOA300–June 2018 Bidirectional Operation
IinMin = -5A	GAIN	100
IinMax = 5A	VoutMax	3
Vcm = 16.8V	CHG-Curr	5
VoutMin = 0.3	DSG-Curr	-5
VoutMax = 3	VSS	3.3
Vs = 3.3V	VREF	1.8
Vref = 2.5V	RES1	2.00E-3

CHG (0A to 5A): VOUTmin: 1.8 VOUTmax: 2.8	VOUT_MAX	2.8
DSG (0A to -5A): VOUTmin: 0.8 VOUTmax: 1.8	VOUT_MIN	0.8

ti_appnote_low-side-bidirectional-current-sensing_sboa300.pdf

Design Steps

1. Determine V_{ref} based on the desired current range:

   With a current range of –4A to 4A, then half of the range is below 0V, so set:

   $$V_{ref} = \frac{1}{2} V_s = \frac{5}{2} = 2.5V$$

2. Determine the desired shunt resistance based on the maximum current and maximum output voltage:

   To not exceed the swing-to-rail and to allow for some margin, use V_{outMax} = 4.5V. This, combined with maximum current of 4A and the V_{ref} calculated in step 1, can be used to determine the shunt resistance using the equation:

   $$R_1 = \frac{V_{outMax} - V_{ref}}{Gain \times I_{loadMax}} = \frac{4.5 - 2.5}{100 \times 4} = 5m\Omega$$

3. Confirm V_{out} will be within the desired range:

   At the maximum current of 4A, with Gain = 100V/V, R_1 = 5mΩ, and V_{ref} = 2.5V:

   $$V_{out} = I_{load} \times Gain \times R_1 + V_{ref} = 4 \times 100 \times 0.005 + 2.5 = 4.5V$$

   At the minimum current of 4A, with Gain = 100V/V, R_1 = 5mΩ, and V_{ref} = 2.5V:

   $$V_{out} = I_{load} \times Gain \times R_1 + V_{ref} = -4 \times 100 \times 0.005 + 2.5 = 0.5V$$

4. Filter cap selection:

   To filter the input signal at 1kHz, using R_1 = R_2 = 10Ω:

   $$C_1 = \frac{1}{2\pi(R_1 + R_2)F_{-3dB}} = \frac{1}{2\pi(10 + 10)1000} = 7.958 \times 10^{-6} \approx 8\mu F$$