

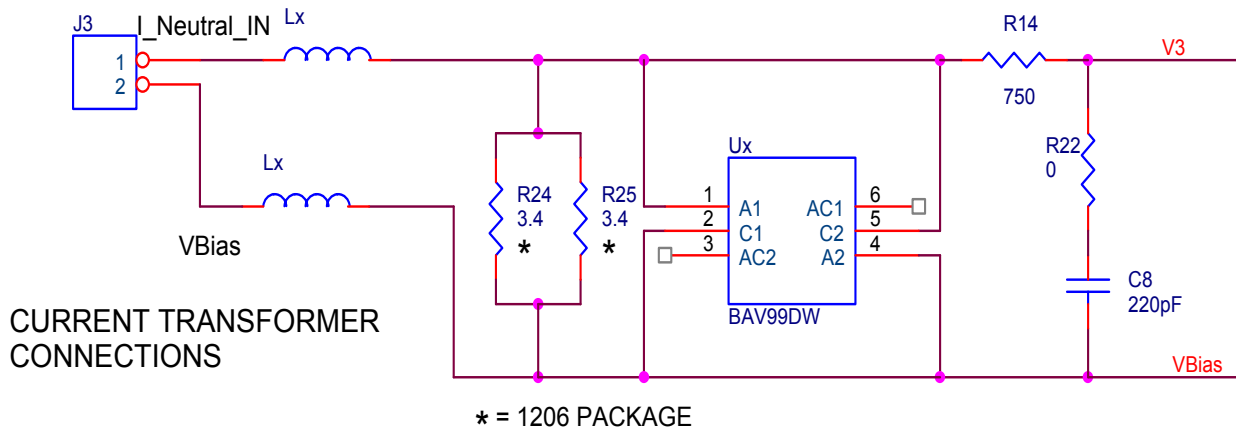
Neutral Current Measurement

The ability to measure Neutral Currents is a key feature to enable the user to enhance tamper detection techniques. The current demo board firmware has the capability to measure Neutral Currents using the Compute Engine (CE) Firmware. All that is required is a minor modification to the existing demo board and firmware, which will be discussed below.

To measure Neutral Currents, a 4th current input channel needs to be created to be used along with the existing three voltage and three current inputs (VA, VB, VC, IA, IB, IC). The Neutral Current measurement can be implemented using the existing 71M6513 demo board with minor hardware and firmware modifications as given below:

Hardware Modifications:

- a. The Neutral Current input can be connected to the 71M6513 Auxiliary input V3 (pin 86)
- b. Analog Auxiliary input V3 is measured with respect to VBias (pin 81)
- c. The input circuit for Neutral Current measurement is to be added as shown in the figure below:



Firmware Procedure for Measuring Neutral Current

1. The Neutral Current measurement is performed by acquiring the auxiliary input data from the V3 pin (pin 86).
2. The analog data measured is referenced to the VBIAS pin (pin 81).
3. Analog input V3 data can be read using the MUX_ALT mode bit in the I/O memory.
4. The TERIDIAN Demo Code revision 3.04 accesses the MUX_ALT mode once a second.
5. To acquire Neutral Current with a higher number of samples the existing Demo Board firmware has been modified with an MPU register named *ALT_MUX_RATE*.
6. The modified firmware stores the *ALT_MUX_RATE* at MPU RAM (XRAM) location 0x0F, and the value is configurable using the `)f=xx` command via the serial interface.
7. The default value for the *ALT_MUX_RATE* is 2520. The multiplexer is driven once in 2520 samples to acquire the auxiliary data from the Temperature and V3 inputs. The default sampling rate for the auxiliary data is 1Hz. The resulting sampling rate is $2520/ALT_MUX_RATE$.
8. If *ALT_MUX_RATE* is set to 10 then the auxiliary data is sampled at every 10th sample and thereby the auxiliary data sample rate is 252 Hz.
9. The Minimum value for *ALT_MUX_RATE* is 10. That is 252Hz is the maximum recommended sample rate.

The Data collected for several *ALT_MUX_RATE* settings is given below:

S. No	Applied Current	Neutral Current <i>ALT_MUX_RATE</i> = 10 (252Hz)	Neutral Current <i>ALT_MUX_RATE</i> = 25 (100Hz)	Neutral Current <i>ALT_MUX_RATE</i> = 50 (51Hz)
1	200	200.66	201.150	202.335
2	150	150.63	150.778	150.824
3	100	99.820	99.765	100.221
4	50	49.859	49.760	49.333
5	25	24.889	24.861	24.951
6	10	10.042	10.134	10.193
7	5	4.988	5.132	5.155
8	2.5	2.486	2.459	2.535
9	1	1.036	1.067	1.071
10	0.5	0.564	0.581	0.592
11	0.25	0.324	0.328	0.334

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