How accurate is your current measurement?

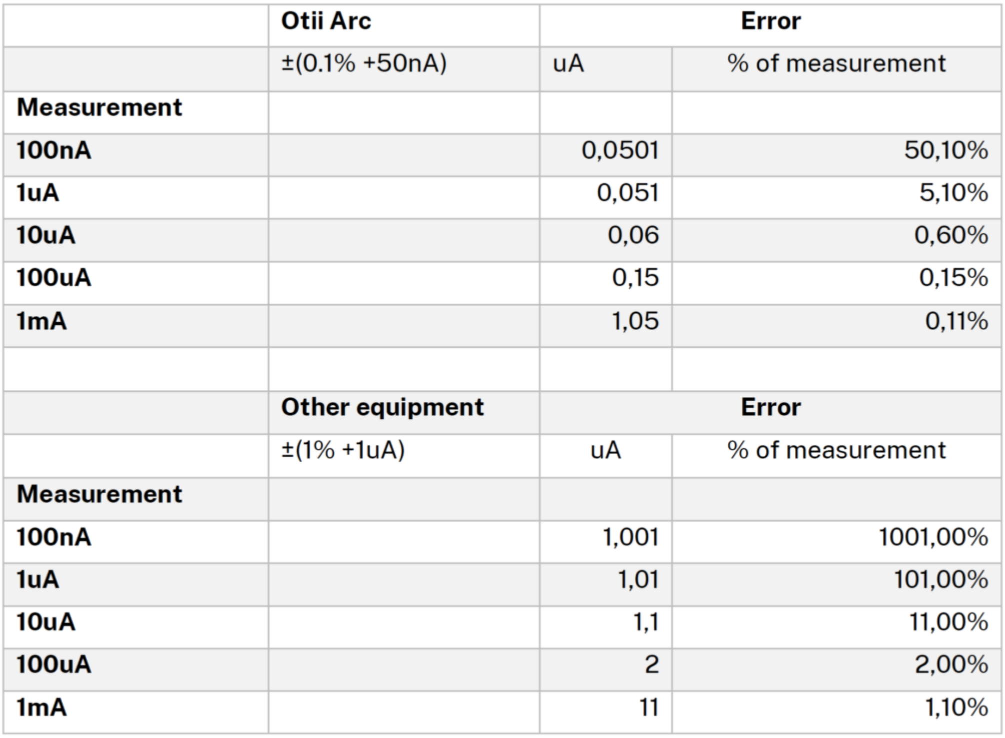
When it comes to instruments for current measurements, you should always be able to find information about how accurate the measurements will be. You will find this in the terms of ±(gain error + offset error), ±(X% + Y), which means that your measurement value can be offset by an error of Y and have a percentual error X.

The accuracy for the main channel for low currents of Otii Arc is ±(0.1% +50nA). So, what does that mean when it comes to the real measurements? How does this affect the measurement accuracy? Let us compare the Otii Arc accuracy with another measurement instrument with a quite common accuracy of ±(1% +1uA).

Interpreting the data sheet

Let say you want to measure a sleep current of 1uA.
When measuring with Otii Arc you can get the following result 1uA± 51nA (0.1% of 1uA is 1nA and then add 50nA = 51nA). If you use the other measurement instrument then the measurement can show 1uA ± 1uA (1% of 1uA is 10nA and then add 1uA = 1010nA). If you want an accurate measurement of the sleep current of 1uA and you measure between 0uA to 2uA it is obvious that this is not very useful.

To highlight this here is a table showing the absolute error (uA) together with the percentage error for different current measurements:

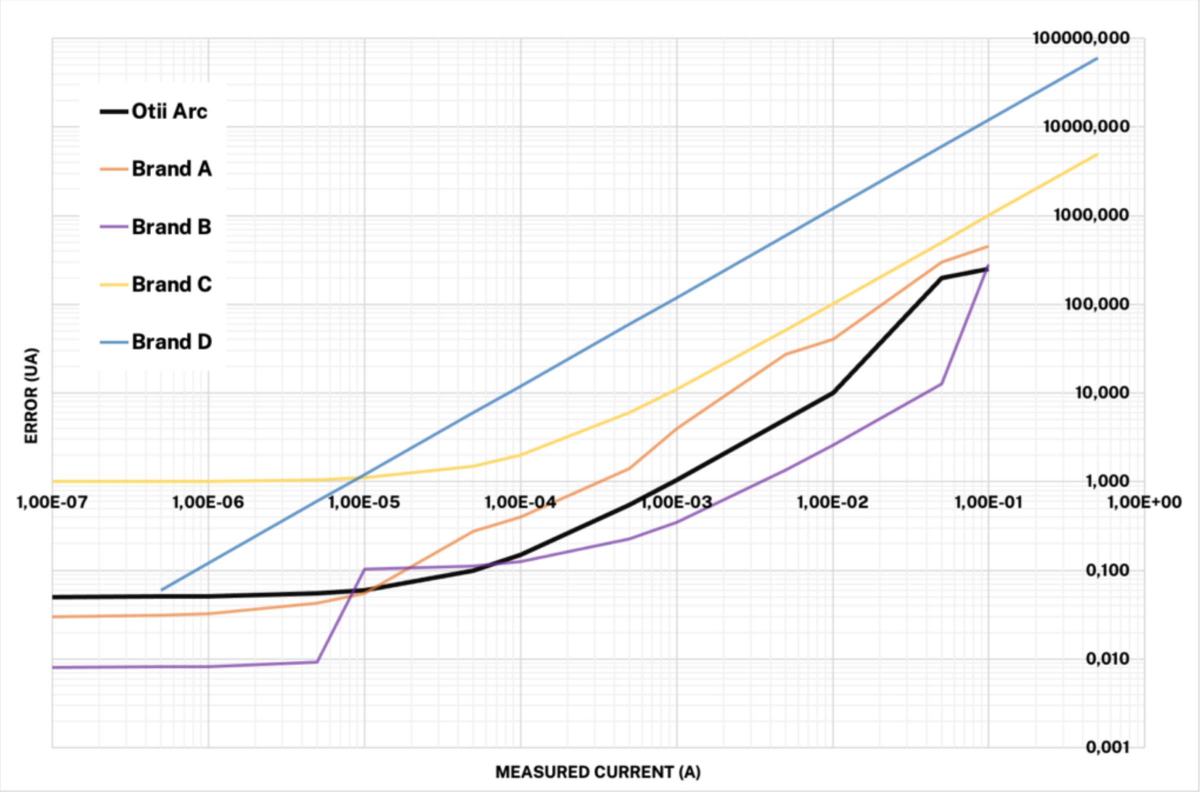


	Otii Arc	**Error**	
	±(0.1% +50nA)	uA	% of measurement
Measurement			
100nA		0,0501	50,10%
1uA		0,051	5,10%
10uA		0,06	0,60%
100uA		0,15	0,15%
1mA		1,05	0,11%
	Other equipment	**Error**	
	±(1% +1uA)	uA	% of measurement
Measurement			
100nA		1,001	1001,00%
1uA		1,01	101,00%
10uA		1,1	11,00%
100uA		2	2,00%
1mA		11	1,10%

Table 1. Expected absolute errors when measuring current with instruments with two different measurement accuracies.

Look across the whole measurement range

The accuracy for any instrument is usually specified for specific ranges of measurements. This means that you could get great accuracy for a small range of currents measured but also very inaccurate measurements for other ranges. Here is an example of the measurement errors across a wider range of current measurements, for a number of instruments on the market (the data is taken from the available datasheets):



So, you need to know your short and long-term needs when it comes to the accuracy in measurements. Consider all the ranges in the datasheet to understand how precise an instrument is. In some cases, you will need a precision instrument and will have to pay a lot for that one great feature (purple curve). This is usually what traditional lab instruments offer. On the other hand if you go really cheap, you also need to accept the inadequate performance (blue curve). In other cases, reasonable accuracy works and you can go for instrument that offers great accuracy for a wide measurement range as well as more diverse features that can also help you in other aspects of energy optimization.

Measure with high dynamic range

In order to support a large measurement range (from nA to A) most measurement equipment uses some form of auto-ranging. A regular DMM (digital multimeter) will typically switch to the next higher range when an overload condition occurs. During the switchover time, the measurements will either be unavailable or incorrect which makes it difficult to monitor highly dynamic loads where sleep currents may very well be in the single-digit uA range and operational currents in the hundreds of mA range.

Precision DMMs typically use relays to switch different shunts in and out of the measurement which takes considerable time to switch. Other solutions exist where solid-state switches are used instead but the same basic problem exists there as well. As the actual measurements are typically performed using a single analog to digital converter the values measured during shunt switching will be unreliable. There are several ways to mitigate this.
One is to try to estimate the switchover time and simply just ignore the samples taken during that time and create new samples using data from before and after the switchover. A better way is to have a higher-range measurement already in place using a second shunt, measuring in parallel with the lower range using a second separate AD converter which allows the instrument to immediately switch over to the higher range while the lower one is being switched out, without any lost samples. This is the principle used in Otii Arc, so you will not lose any samples during measurement range switching.

Having the three points in mind will help you pick the right tool for your development project and avoid yet another pitfall in getting that low current consumption of your device.

For more current ranges for Otii Arc and how it compares to other instruments on the market, check out the tech spec. Or book a tech session with our product expert here!