Why do we need a power analyser? Can't I just measure power with a high speed DAQ card?

POWER ANALYZER?	DAQ CARD?
	

I took a deep breath, gathered my thoughts and proceeded to explain why he really does need a power analyser and explained why DAQ card is not going to satisfy his requirements as a motor drive test facility performing serious power measurements that they should be willing to "put their name on".

Here were my answers, in no particular order;

5 key reasons why a you need a power analyser, and why an "off the shelf" DAQ card will let you down;

1. Traceability, traceability, traceability!

   Making a measurement requires two ingredients….. Accuracy and Traceability. No matter how accurate your DAQ card may seem to be, without adequate proof of such accuracy the DAQ card data is meaningless. N4L invest hugely in our calibration facility which enables us to validate our accuracy specification throughout the **entire frequency range** of the instrument. This is a vital ingredient for meaningful power measurements and why an off the shelf DAQ card, for which there is no traceable (to ISO17025) verification of its accuracy is not suitable for a laboratory power measurement environment. If a measurement performed by the lab is ever questioned by a customer or competitor, how are they meant to explain the validly of their DAQ based measurements? Where is their proof?

2. Uncertainty of voltage/current measurement?

   DAQ cards tend to have low voltage inputs, therefore a voltage attenuator and current shunt/transducer will be required to measure the raw signals on the DUT. A big question should be – What is the uncertainty of measurement once the attenuator/current shunt + interconnecting leads and DAQ card are connected together? A power analyser solution from N4L can be calibrated "end-to-end", this includes any external attenuators and current transducers giving the user a single accuracy figure to work out their uncertainties from.

3. You should NEVER multiplex power measurements…. ever!

Many DAQ cards implement multiplexing, this is a process in which each input channel of the card is sequentially sampled, one after the other. This means that voltage and current waveforms are not sampled at the same instance in time, causing lag and phase shifting errors. This is a huge disadvantage to the DAQ card approach and a true power analyser will simultaneously sample all input channels (that is 14 channels if you include 6x Voltage, 6x Current + Torque and Speed) at the same time.

4. Real time processing, with no gap

N4L have gone to great lengths to design a signal chain that is able to continuously sample the input waveforms without a single gap in the measurement. As one acquisition window ends the signal chain is ready to output the results from the completed window and then accept the next sample in the next acquisition window. N4L PPAs are able to perform 99.9% of the mathematics required to compute the various power parameters such as Vrms, Irms, Wrms, CF, peak, PF etc etc in between samples. Samples are processed, results are accumulated and the raw sample is then disposed of in time for the next sample to be processed. This means that buffering of huge numbers of samples is not required and the signal chain is always ready for the next sample to arrive – this is TRUE NO GAP ANALYSIS that a PC just is not setup to perform. DAQ card based systems are not able to perform this type of acquisition, a DAQ based system will acquire large amounts of samples and store them in a buffer, once the buffer is full the samples are transferred in "blocks" or "chunks" of data to the PC. This comes with two main problems… 1: The buffer size is finite and will eventually fill up, so for long acquisition windows (required when the motor frequency is low) the sample rate will need to be reduced. 2: Once the window ends, there will be a huge amount of mathematics required in order to compute the Vrms, Irms, Wrms etc as the mathematics is not being performed on a "sample-by-sample basis. The only way to complete the mathematics is to pause the acquisition of data and run the necessary algorithms…. This is what is known as GAPPED measurement, not true real-time gapless analysis and should NEVER be used for power analysis.

5. Hidden specifications that will "bite you" later on

Specifications such as CMRR (Common mode rejection ratio) can cause huge problems in the real world which is extremely noisy. CMRR is defined in dB and represents the ability of the voltage/current channel to reject any "common signal present on both of the inputs", this is particularly important when measuring voltage drop across a current shunt which is "bouncing" up and down (the common voltage potential of the channel with respect to ground) on top of a PWM waveform. N4L power analysers can reduce the common voltage by 150dB, leaving only the differential voltage (caused by current flow through the resistive shunt) to be measured. DAQ cards have no concept of CMRR, this is not a primary design consideration as DAQ cards are intended to be general purpose inputs where the common mode rejection isn't top priority during the design stage. As such, common mode rejection is typically <50dB which will manifest itself as a differential voltage measurement error across a current shunt in a real world motor drive application – ie. Current measurement error!