

The truth about test and measurement

M. Simon, Technical Contributor

Everything a designer needs to know about test and measurement



Test and measurement starts with standards. You have to have standards for mass, distance, charge, and time (plus a few others) so all standards refer back to those fundamental unit standards. But you don't measure volts in units of amps, kilograms, meters, and seconds, that requires something more convenient (i.e. measuring volts in volts).

Space starts with time

Time is the unit that can be measured most accurately. If you have the lab and the equipment, you can "easily" get parts in ten to the fourteenth, which means you gain or lose a second every 3 million years or so. The best labs are now up to parts in the ten to eighteenth.

With that kind of accuracy, the standard volt is defined in terms of a Josephson junction and a microwave input frequency. Length is defined as a number of wavelengths of light. By 2014, the unit of mass will be defined in terms of Planck's Constant, which is defined in terms of seconds and meters. Of course, meters are defined by seconds and the speed of light.

We have moved from a system of measured units to a system of defined units, but a lot of measurements were needed along the way.

Testing mind sets

That still leaves your test item on the bench with problems. Is it a prototype or a production test? The mind sets for these are very different. Anyone with an R&D problem is trying to make the product work. On the other end, the production test people are (or should be) trying to make the product fail to better armor it. Very few people can wear both hats at the same time.

What kind of oscilloscope do you need?

R&D will be looking to measure voltages (always start the testing with the power supplies) and then they can use an oscilloscope to see if the power supplies are

The truth about test and measurement

Published on Electronic Component News (<http://www.ecnmag.com>)

noisy. For that kind of work both analog and digital scopes will work fine. Where digital scopes come into their own is as a rudimentary protocol analyzer. Where they miss out is in finding glitches that come between samples. To reduce the odds of missing glitches, your oscilloscope should sample at least three times faster than the highest frequency of interest. For example, if you are looking for glitches on pulses with one nanosecond rise times you should be sampling at least three times in that nanosecond (and better would be ten times. Alternatively, you could use an oscilloscope that had a response out to a gigahertz. The fidelity may not be good at high frequencies, but the chances are you will see the wiggle if you know what you are looking for.

How the circuit responds to runt pulses is one of those things in the digital domain. In the analog domain you are more concerned with frequency response, current flows, and voltage drops. It is not that you don't care in the digital domain, it is just that in the digital domain, millivolts are not usually a concern. In the analog domain they are generally a concern. One other critical issue in the digital domain is transmission line effects. They're particularly important with fast signal transitions or high frequency signal and high frequency is relative. One MHZ is high frequency, if your system covers a mile. On a circuit board one foot on a side that would be a low frequency when considering transmission line effects (unless it is delivered as pulses.)

Code and the product developer

What else is the developer going to run into? Code problems. Back in the old days when buses were exposed, you used logic analyzers to see how your code was working in a system. Most of that sort of thing is now handled internally by the JTAG Interface. But other than signal purpose descriptions, JTAG is not standard and every manufacturer does it differently. Focus on finding equipment that supports the processor you will use.

Production test

Production test is a whole different animal. Not because you are measuring with different fundamentals. Length, mass, time, and the number of electrons per second in the amp haven't changed enough to worry about during development. What is different about production test is that its costs are measured and that means time is important. A voltmeter that produces four readings a second may be adequate if it is being read by a human operator. But you might like something ten or a hundred times faster if that voltage reading is a bottleneck in a test program run by a machine.

Production tester development

Final test time is also constrained in another way. No matter how much time is allocated for test equipment development at the beginning of a program that time will be cut--sometimes drastically-- by other slippages in the program. The best way to beat that is to start early (if you can) and be prepared to design bridge boards to adapt standard test equipment to special requirements. A quick turn circuit board house, along with a designer who can turn such circuits quickly, are very handy when you have to do the impossible.

The truth about test and measurement

Published on Electronic Component News (<http://www.ecnmag.com>)

Staying calibrated

Simple standards on site are good way to do sanity checks on your test equipment. Voltage standards good to a tenth of a percent, resistors of similar quality, and oscillators good to better than one part per million are not difficult or exceedingly expensive to obtain. However, if you are going to do things according to a plan with regular calibration, you need to develop a relationship with a calibration shop.

Don't forget to inspect their operations and look for is timing accuracy to within one part of ten to the twelfth when needed. That can be obtained fairly easily from GPS. Even somewhat subpar equipment one part in ten to the eleventh should be easily obtainable. When evaluating a calibration facility, look at how comprehensive their reports are. Do they say just "calibrated" or do they say things like: "Framistator voltage: 1.561 volts (acceptable values 1.510 to 1.580 volts), Calibration instrument: Fuge Voltmeter Serial #xxxx, last calibrated 16May2013, Tester: CBG". If calibration issues are important to you the more extensive documentation of the second example may have value for you.

Final test

The most elusive test is the test of the market. In order to have a chance at meeting that test you must have product standards and test to those standards. And those standards must be based on other standards all the way back to the primary standards. The best chance you have of meeting THEIR standards is by first meeting YOUR own.

Source URL (retrieved on 03/07/2014 - 7:09am):

<http://www.ecnmag.com/articles/2013/07/truth-about-test-and-measurement>