Engineer's Notebook

Oscilloscopes

Tips on Application, Selection and Use

Next to the multimeter, the oscilloscope ("scope") is the most widely used instrument in the servicing and design of electrical/electronic products. It senses and indicates via waveform display on a graphical screen dynamic electronic signals or transient events in the medium- to high-speed frequency range, up to around 200 MHz.

Oscilloscopes

Applications

Scopes are remarkably versatile and are used extensively in troubleshooting and service work on motor drives, control systems, and any type of electronic or communications equipment. They are widely used for monitoring power lines to detect surges, drops, noise, harmonics, or other disturbances. Scopes also have many applications in quality assurance (QA) testing on components and subsystems and for verifying performance expectations in product design and development.

How to Choose a Scope

Digital or Analog Design

If you want to view single-shot events or transients, or if you need to record waveforms on paper or to a PC, you will need a digital storage scope. Digital storage speed and technology have advanced to the point that these scopes can nearly duplicate the performance of analog units on repetitive signals. However, if you work only with repetitive signals and do not require documentation, an analog scope may be all you need. They typically are less expensive than digital models with comparable specifications.

Portable vs. Bench Type

If you're going to be working in the field, choose a portable. Today's hand held scopes have the speed and power of benchtop instruments, with the convenience of battery power. You should also consider a portable if you need to make floating measurements (the ground is attached to a voltage source), since it doesn't share ground reference with your power system. Therefore, the risk of shorting—and the resulting damage to your scope or injury to the operator—is reduced.

If all of your work will be at the bench, go with a benchtop scope. The CRTs (cathode ray tubes) are unsurpassed for visibility, and the will be familiar to any experienced scope user.

Bandwidth

One of the main considerations in selecting a scope, since it is directly related to the equipment or system to be tested. As a general rule of thumb, nominal bandwidth should be at least twice the dominant frequency of the signal being observed. For example, if you need to observe signals at 30 MHz, you should select a scope of at least 60 MHz. If much of your work is on high-frequency equipment, buy all the bandwidth you can afford—you'll probably need it before long.

Sample Rate

This pertains to digital scopes and is the number of samples the scope is capable of capturing in one second, given in megasamples/second (MS/s). In observing rapid or highly unstable signals, the faster the sample rate, the more accurate the presentation of fine details. Generally, sample rate should be at least three to five times the fastest single-shot event you want to view; e.g., if you're observing events at 10 MHz, the scope's sample rate should minimally be 30 MS/s.

Automated Measurements

Today's scopes often feature built-in measurement functions that are activated at the touch of a button. These typically include rise time, frequency, period, amplitude, and others. As many as 20 automated measurements, or more, are generally offered. If you use a scope to make measurements, you should seriously consider purchasing one with these automated functions.