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[Livingston UK](#)
[Services](#)
[News](#)
[Contact](#)
[Help](#)

- ☐ **T&M Division**
- ☐ Computer Division

→ Industry News

- Analysers Help Ease Jitter Measurements
- Signal Analysis for WLAN development
- Gigabit Ethernet ramps field-test requirements
- Digitization triggers oscilloscope progress
- Storage Network Growth
- Testing Times
- Green Future Unveiled
- Driving The Fast Lane
- Testing Times for Telcos

- ☒ Home
- ☒ Help

Opto & Laser Europe - Digitization triggers oscilloscope pro

December 2003

Knowing how an electrical signal varies with time is crucial in many experiments. Jacqui Hewett reveals the criteria to consider when investing in an oscilloscope.

With an overwhelming number of products on the market, each boasting widely varying specifications, choosing the right oscilloscope can be a daunting task. And with price tags of anything up to €10,000, investing in the correct product for your application is essential. This month's Buyer's Guide provides some criteria to consider before approaching a sales engineer. In addition, it reveals some corners to avoid.

The basic function of an oscilloscope is to plot a graph of the voltage of an electrical signal against time. Today's oscilloscopes are mostly digital instruments and use analogue-to-digital converters to convert signal voltage into digital sample points. Although some vendors offer analogue products, digital oscilloscopes (DSOs) now have the lion's share of the market. For customers reluctant to abandon analogue technology, many digital scopes can simulate an analogue display.

State-of-the-art DSOs are based on silicon germanium (SiGe) technology. Originally used only for high-end scopes, this technology has gradually filtered down to low and medium-end devices. As such, the customer now benefits from a compact internal SiGe chip that can accurately acquire complex signals. The SiGe chip also boasts faster signal processing and the ability to acquire higher-frequency signals.

After speaking to several vendors, *Opto & Laser Europe* has drawn up some questions you should ask yourself before you make a purchase.

What range of frequencies do I need to measure?

This is the first and most important question to consider before buying an oscilloscope. The key information to be aware of are the range of frequencies that you are trying to measure, and whether the signal is repetitive or single-shot.

The frequency of the signal that you want to measure determines the "bandwidth" of the oscilloscope. In other words, the frequency range that an oscilloscope can measure accurately. Without adequate bandwidth, the oscilloscope will not be able to resolve high-frequency changes. To calculate the bandwidth you require, vendors suggest that you multiply the highest-frequency component of the signal by five. For example, to measure an 800MHz signal accurately requires an instrument with a bandwidth of around 4GHz.

The oscilloscope market can be divided into three different classes: low-end instruments that cover the 100-500MHz range; middle-of-the-range devices for 500MHz to 2GHz signals; and high-end DSOs that can measure from 2-7GHz.

What sample rate do I require?

All DSOs contain a sampling clock that plots the voltage of the incoming signal at a specific time. The sample rate is simply the number of data points that the instrument acquires per second. To accurately reconstruct a waveform, your DSO's sample rate should ideally be around 3-5 times the frequency of the signal. It is important to check whether the sampling rate changes when signals are acquired simultaneously on two or more input channels.

Low-end oscilloscopes are available with sample rates of around 100-500 megasamples per second (MS/s); mid-range products can sample 500MS/s - 2.5GS/s; and the higher-end products are c

sampling up to 20GS/s.

What internal memory size do I need?

The internal memory size goes hand-in-hand with the sample rate and the bandwidth; choosing an oscilloscope involves carefully balancing all three quantities. DSOs store samples in an internal memory. For a given sampling rate, the size of the internal memory determines the period over which the oscilloscope can acquire a signal before its memory is full. A high sample rate is worthless if there is insufficient memory in place to support it.

Vendors typically offer between 100kB and 1MB per channel, although products are available that offer 100MB per channel should your application demand it. Additional memory is an option that can be discussed with a sales engineer.

What resolution do I require?

Standard DSOs offer 8-bit resolution. This means that the vertical voltage axis on the display is divided into 256 intervals. For applications requiring higher resolution, precision oscilloscopes offering 12-bit or greater are available.

Can I incorporate my own signal analysis software?

Vendors now offer so-called custom DSOs, enabling users to integrate their own measurement parameters or analysis into their oscilloscope. Functions can be written in programs such as VBA, Matlab, Mathcad or Excel and seamlessly inserted into the instrument as a regular function. They can be used in conjunction with standard signal-analysis features.

How much should I pay?

An oscilloscope is an investment. It is important to consider your future needs as well as the requirements of your application. Generally speaking, the higher the bandwidth of the oscilloscope, the more expensive it is. The size of the screen also influences the overall cost. While the majority of oscilloscopes on today's market will have a colour LCD screen, sizes vary. Low-end scopes tend to have 5-6 inch diagonal displays, increasing to 8.4 inch diagonal for medium-range oscilloscopes and 10.4 inch for the high-end models.

Specifically, a basic, lightweight, portable commodity instrument will cost around €1000-5000. Medium-range oscilloscopes cost €5000-25,000, while top-of-the-range instruments can cost between €25,000 and €80,000.

Do I want an integrated printer?

Some DSOs come complete with an integrated colour printer that plots the signal stored in the memory. Alternatively, a printer can be attached to a DSO and data can be transferred and printed to a computer network. DSOs can also be controlled remotely across a network.

What warranties and support services do vendors offer?

The length of warranty offered varies substantially from one firm to another. While some vendors offer a one-year cover, others will offer up to three years as standard.

It is also crucial to look at the length of time for which the vendor guarantees support. It is important to shop around for the best deal - support can be guaranteed up to a maximum of seven years. A long-term support agreement ensures the company has the parts available to fix the product, even if they are no longer available to buy.

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