Using the Agilent U2701A USB Oscilloscope with the Raman Spectrometer Laser System

Case Study

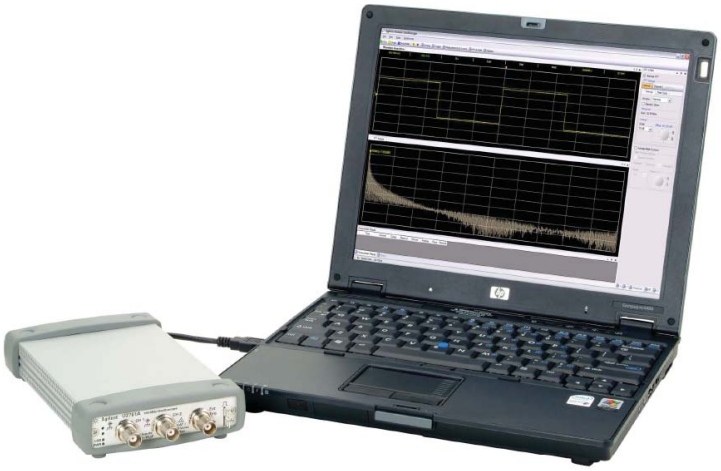

Figure 1. The Agilent U2701A USB Oscilloscope connected to a laptop computer ready for the diagnostic test

Introduction

A leading spectrometer systems company is the world's leading supplier for the compact and solution oriented Raman Spectrometer systems. This company manufactures material identification products for commercial, law enforcement, and academic markets. They deliver Raman Spectrometer systems that are microscope based, bench top, and portable. These instruments shine laser light on a sample and identifies the material based on the spectra of the returned light.

This company has many of the same challenges that all electronics companies face today; how to develop a technically sophisticated product, manufacture it, and support the product over its lifetime in the field. Agilent Technologies provides a family of USB instruments which facilitates the development of portable test solutions for these types of products.

The output characteristics of the laser system directly influence the measurement performance of the Raman Spectrometer system. The laser source is stabilized and controlled by dedicated electronics. This combination of a control system and a laser source delivers monochromatic light with the necessary narrow spectral width and frequency stability.

The design and troubleshooting demands of this type of complex control system requires the ability to analyze the characteristics of the light output, and to observe the electronic stabilization circuits while they are operating. In the past, the collection of optical and electronic instruments, together with the computing infrastructure required to make these measurements, would result in very large control systems. This type of enormous assembly would have required that any diagnosis of the laser system to occur within the lab. This restriction would make on-site troubleshooting of the customer problems impossible, make manufacturing line problem analysis difficult, and add product development delays when performing off-site testing.

With available modern computing technology and downsized test instrumentation, one of the production engineers of this company has developed a portable laser system diagnostic tool. This tool is based on a laptop computer, a portable Fabry-Perot interferometer, and an Agilent U2701A USB Oscilloscope. This tool allows for precision diagnosis of the laser system at any location (with electrical power). The combination of a portable instrument and a laptop computer allows the entire laser diagnostic tool to be fitted in a small travel case. This company is now able to diagnose their instrument laser system whether the instrument is located across the building in the manufacturing area, across several states at a remote testing site, or across the world at a customer's site.

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A Portable Diagnostic Tool Is Made Available

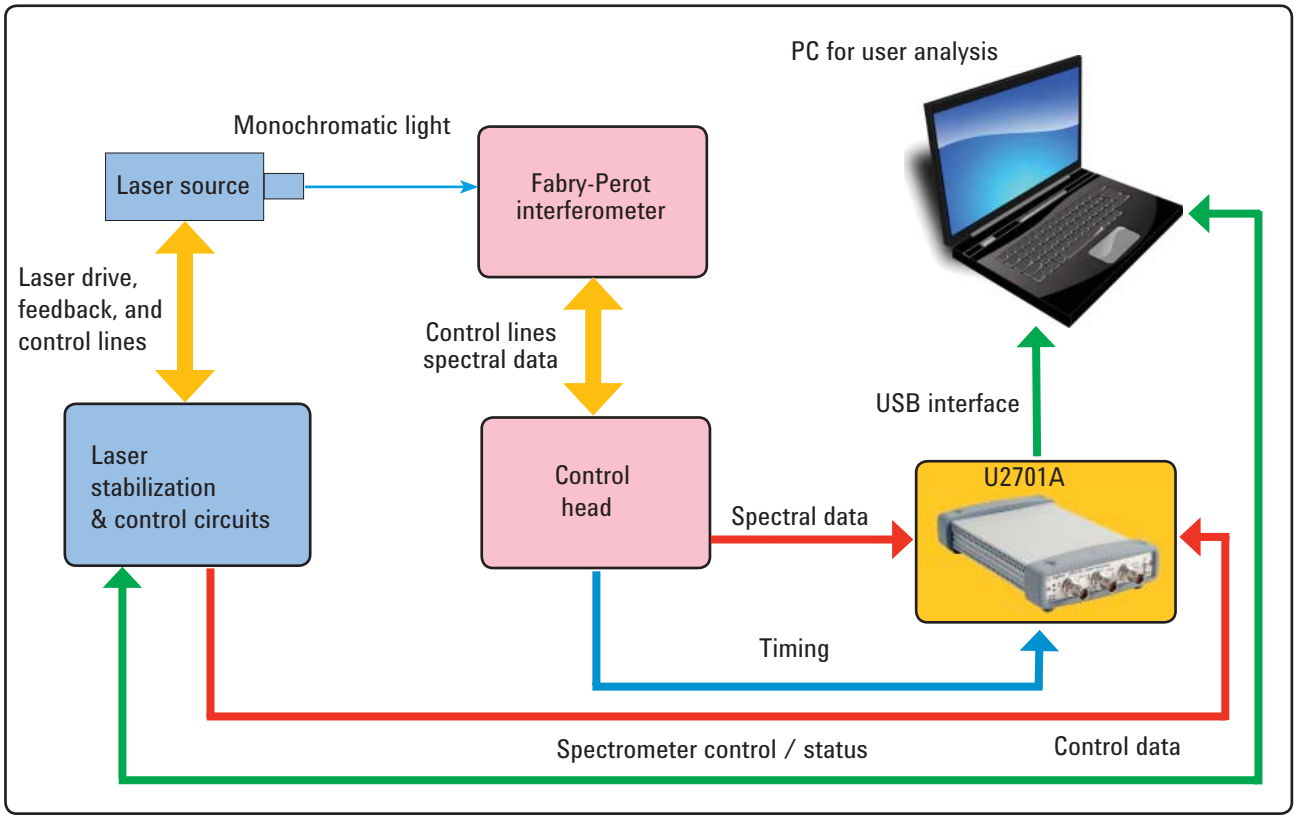

Figure 2. Simplified laser diagnostic tool block diagram (light weight, transportable, highly accurate)

When used, the Interferometer is operated with the control head by the engineer who is diagnosing the laser system. The laser control head provides the required ramp voltage for tuning the cavity in the interferometer. It also provides the signal conditioning and amplification for the detector so that the U2701A oscilloscope can directly measure a voltage which represents the intensity at a given time.

The synchronization capability of the laser control head allows for the mapping of a ramp time to a laser frequency. The net effect is that the oscilloscope presents a trace which shows intensity versus optical frequency. These signals are represented in the above diagram by the spectral data and timing arrows. The combination of the U2701A oscilloscope and the interferometer with its control head allows direct measurement of the spectral width, and the stability of the monochromatic light.

A PC is used to communicate with the spectrometer while diagnosis is in progress. The PC has access to the internal operations of the spectrometer. The engineer is able to configure the spectrometer for different operating states, and modify internal control parameters. The control data signals are typically low voltage signals which indicate the status of the laser stabilization and control circuits. These signals are associated with the temperature control of the laser source, and the control of the energizing current for the laser. These signals range from millivolt error signals to several volt output drive signals, and have frequencies from almost DC for thermal control loops, to several MHz for noise signals.

In addition to all the above measurements, the U2701A oscilloscope is also used for general purpose electronic measurements on the spectrometer. It is used to monitor internal communication signals, verify analog circuit performance, and to investigate noise issues. These measurements rely on the analog measurement envelope of the U2701A and the “easy to use” front panel functionality delivered on the laptop computer by the Agilent Measurement Manager (AMM) Scope software.

The combination of the optical interferometer, a PC, and the U2701A USB oscilloscope has allowed this company to build a portable, light weight, and highly accurate system for laser diagnosis. The production engineer offered the following summary of how he uses the system:

“When needed, I just throw it in a box and go to the other sites. The U2701A fits in a small travel case with my other critical equipment. Being able to readily move the instrument is a plus, and I need my laptop anyway.“

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