MSE Laser Diode CW/Pulse Test System

Software Version 2.x

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Products Used:

LabVIEW version Runtime Engine and custom application software
- **NI-488.2 with NI GPIB card**
- **Tektronix TDS 210 O-Scope, ILX LDP-3811, custom light amplifier, and voltage monitoring circuits**

The challenge

Most laser diode test systems are inflexible, expensive, always semi-custom, and have long lead times. MSE has designed several such systems and now is standardizing with the system described here.
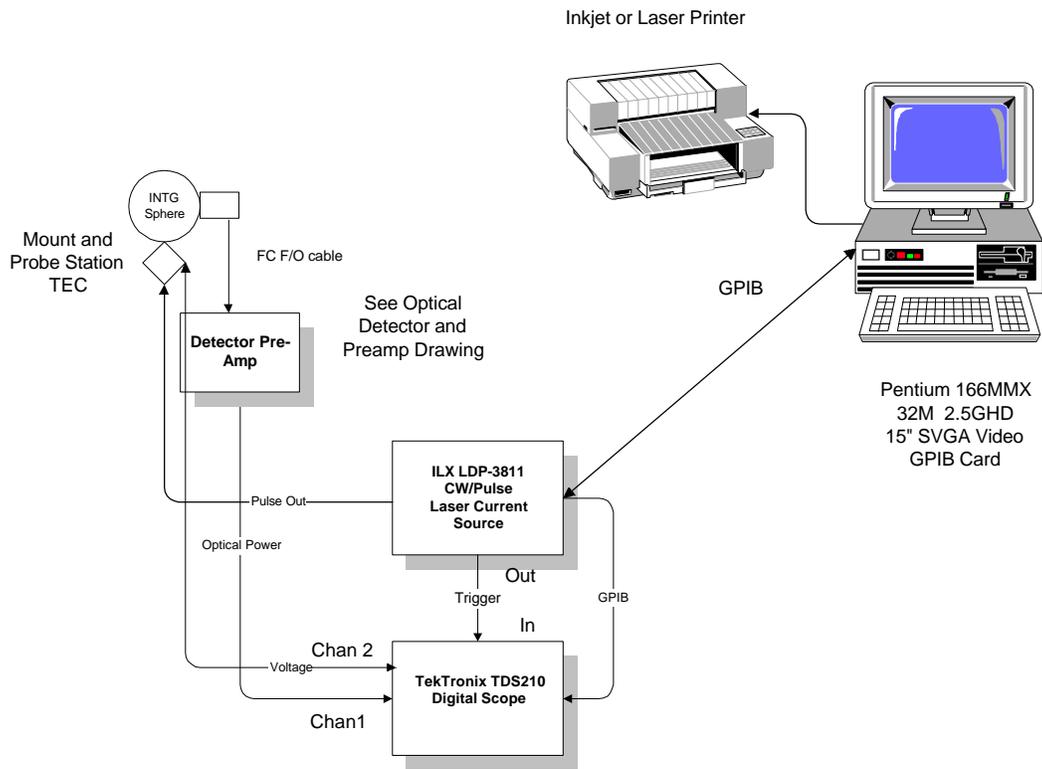
Introduction

Pulse testing of laser diodes can be accomplished with a pulse current source, a detector and pre-amp, and a digital scope or DAQ card.   Windows based LabVIEW GPIB is used to control the current source, read, and analyze the data.   Pulse properties are measured at the laser output at increasing current levels and a voltage (V/I), current, and a light output (L/I) plot established. Other pulse properties such as "droop", rise and fall times may be analyzed from the same data.   An L/I curve from CW data can be compared to pulsed data. A general discussion of methods and then a specific example of a typical system will be described.

General Information

Un-packaged lasers can be tested as chips or bars for acceptance testing prior to final packaging. Most laser packages add lenses, fiber optic connections, electrical connections, and thermal paths to the actual laser chip. For most devices configurations an integrating sphere is used to collect laser output from the raw device, a fiber, or a collimated laser diode.   The sphere collects all the light and averages it uniformly, allowing consistent measurements from what can be an uneven source.

In the case of un-packaged devices, probes may be required to contact laser inputs.   Most systems are semi-custom and require careful attention to impedance matching. It is important to consider electrical isolation with the laser and any heating or cooling devices. Standard semiconductor probe stations can be economical solutions for probing un-packaged devices.

Inkjet or Laser Printer

Mount and
Probe Station
TEC

INTG
Sphere

FC F/O cable

GPIB

See Optical
Detector and
Preamp Drawing

**Detector Pre-
Amp**

Pentium 166MMX
32M 2.5GHD
15" SVGA Video
GPIB Card

Pulse Out

Optical Power

**ILX LDP-3811
CW/Pulse
Laser Current
Source**

Out

Trigger

In

GPIB

Chan 2

Voltage

**TekTronix TDS210
Digital Scope**

Chan1

Laser Diode Test System Block Diagram

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Software

The program was written in the current version of LabVIEW for Windows and was supplied as Virtual Instruments (VI's) in PC run time for execution only compiled programs mode.   That is, the customer does not have to purchase LabVIEW to run the applications if he does not expect to edit the program. LabVIEW can manage and uses data from other DOS or Windows programs.

Each element of the software is modular and can be modified to suite the customer's specific requirements.

The program modules are:

• Main Sequence to manage testing, initialize all instruments, set calibrations constants from user input, and manage reporting all results and error conditions.

• Test Module to make all instrument settings and conduct the test.

- Analysis and Reporting Module calculates any secondary results and create plots and/or writes a data file for latter use.

The equipment list

- Laser CW/Pulse current source: ILX Lightwave LDP-3811
- Custom voltage monitoring and custom detector pre-amp hardware
- Tektronix TDS 210 Digital Oscilloscope with Comm module
- Labsphere Integrating sphere with calibrated detector
- Customer supplied laser mount
- MSE LabVIEW LDTS custom software

System Description

This system uses an Pentium 200MHz Wintel PC, NI-GPIB, a digital oscilloscope, a combination pulse and CW laser current sources, an integrating sphere, and a custom pre-amp and voltage monitoring circuit. The devices measured are mounted as small edge emitting chips custom mounted in a customer supplied test fixture.   The edge emitting laser is positioned in front of a 2 inch ID integrating sphere. A small opening in the sphere collects 100% of the elliptically shaped diverging laser beam.   The detector used in the sphere was calibrated from 400-1100nM every 25nM. The user can select the desired wavelength, range of current, the expected light output, and all plot scales. A voltage vs. current an a light output vs. current plots are combined onto one plot and scaled. The plot ranges can be adjusted after data is taken as long as measurements are within the acceptable ranges and not saturated.

A special feature of the system is that the GPIB instruments devices are entirely controlled by the LabVIEW program. No user settings are desired or compatible with the program operation. The internal statistical functions of the scope are optimized to increase the effective resolution of the scope for it's nominal 8-bit input by averaging the data.   Typically in an ideal system the resolution of sampled data is increased by the square root of the averaged samples. Averaging of both CW and pulse waveforms is done with the scopes internal routines. Multiple points are measured and averaged for each single data point measurement. Additionally timing measurements, delays, and pulse detection window functions are controlled by the program and not the user.

Analysis: The 2nd derivative of light vs. current curve reveals the corner current at which the laser produces laser light output.   The approximately linear zone above that point is analyzed for other factors common to this industry.   They are the slope of the line and current output at a specific power output.

The system requires about 1 second or each current test point.   The digital scope and latency of the current source required most of the data collection time. LabVIEW overhead for all other functions was insignificant compared to that of the external instruments. LabVIEW 5 was used for the development and the final version was shipped as an executable using the Application Builder for LabVIEW 5.

- A photo of a system
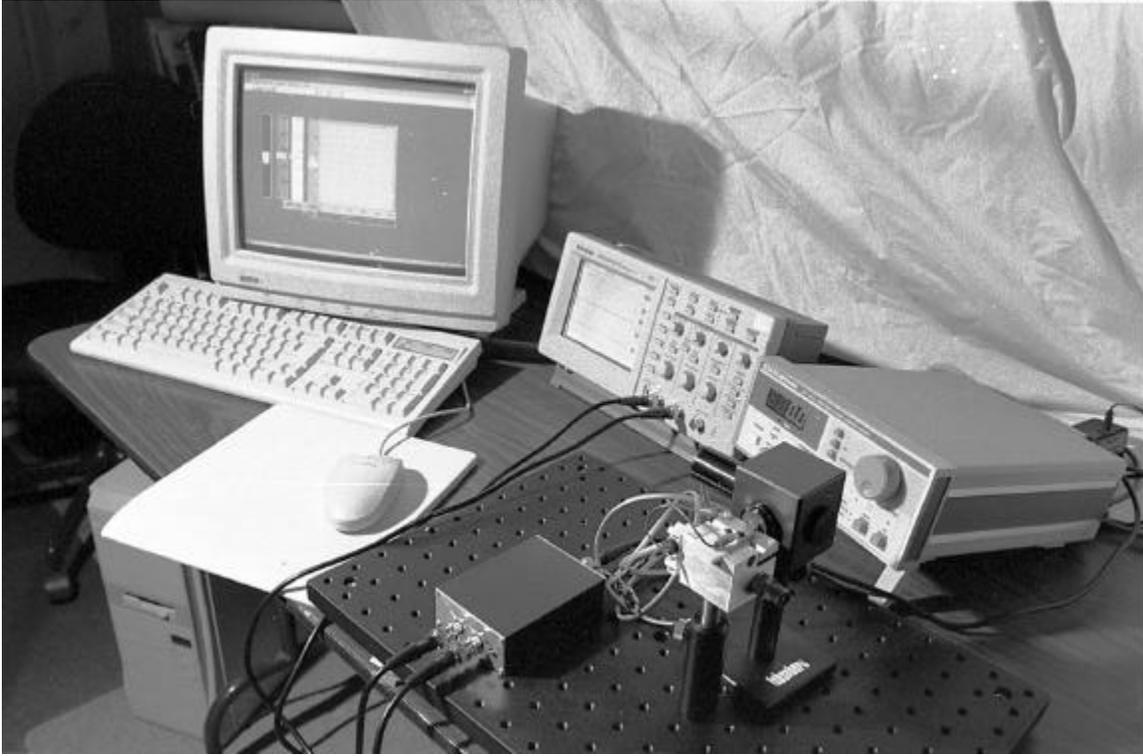
System Example: PC, Tek TDS 210 scope, ILX -LDP-3811, Custom Pre-amp, Laser mount, an Integrating sphere with detector (cube). Actual components may vary with your systems.   This is a photo of the original development system.   The Tek digital scope, ILX LDP-3811 CW/Pulse Laser Current Source, Voltage monitor, light pre-amp, laser mount, and integrating sphere assembly are shown.   A small optical plate supports the mounts and other mechanical components.

Software operation

Please reference the screen shot below. Please study all equipment modules and become familiar with their operation before attempting to operate the software.   Familiarity with Windows 95 operation (and program installation, for maintenance) is required to run the program. All drivers are pre-installed on the system delivered. An appendix will explain the installation and settings of the GPIB addresses.

Basic program flow:
1. Load the LVRT program to load the MSE Test software. Your version may be slightly different than the panel shot below.   You may also double click the current LabView MSE test module to start program operation.
2. The program will start and begin to run. LVRT controls are explained below:
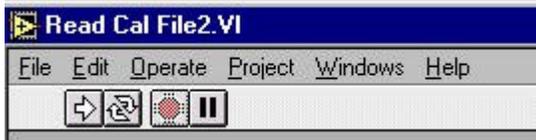
The arrow is RUN. The RED Button will stop the program. Other buttons are not to be used. Online control feature help is enabled with the HELP:Show Help checkmark. This buttons are not normally used.

3. The program when first run will check for connection to each GPIB instrument. An error will occur in there is an cabling error, Instrument problem, a system settings fault, or a GPIB address problem. All error sources may be found form equipment manual checklist.
4. Once the program is running a "ready to test" notice will appear.
5. Parameters are changed on the left side. Once desired test points are established. The TEST DEVICE Button begins the testing cycle.
6. Each control has online help (see above). Please study the function of each of these prior to running the test.

- Screen shot of the main LabVIEW control panel.
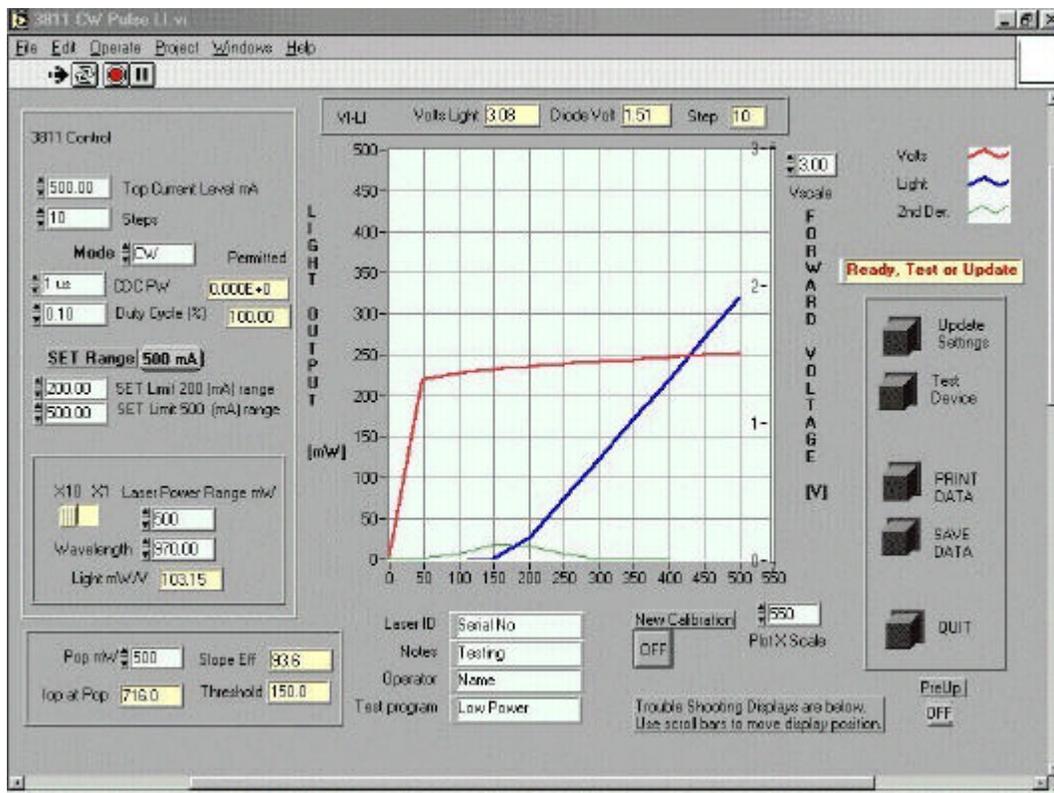
Main Control Panel (LabVIEW 5). User controls are white. Calculations are yellow.

7. After the test is complete the possible actions are retest, print LI VI P data as a plot and/or save the data to a spreadsheet file.
8. Below this screen (use scroll bar) are the trouble shooting screens. Some online help is available but these screens are for trouble shooting only.
9. Further information is available form MSE via email or by on site training.

A Data Plot of a hard copy test result.
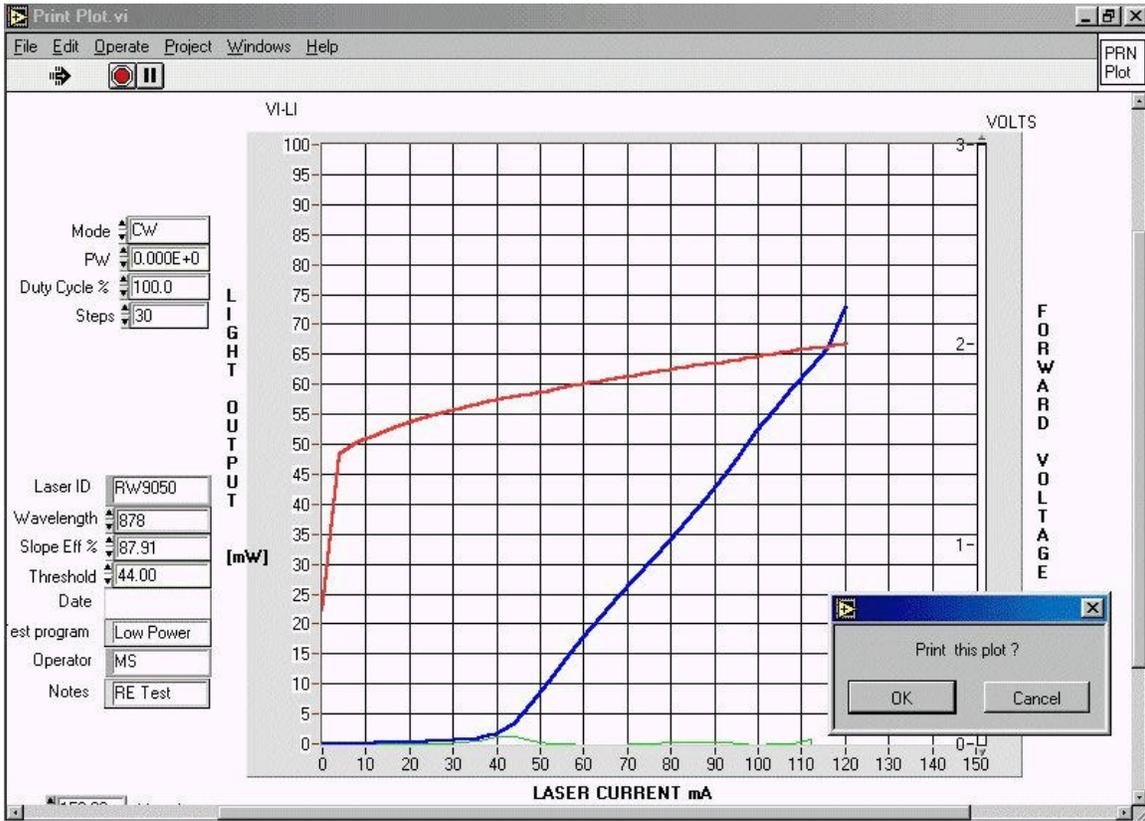
A separate screen ready to print for hard copy if desired. This sample may vary according to your system reporting requirements.

Conclusion

Systems like this are always semi-custom to meet the customers needs. MSE has developed a standard approach to laser diode testing with reusable software modules. Many other instrument options are available including other current sources, digital oscilloscopes, detector systems, and testing requirements. This design approach yields maximum flexibility and minimizes development time.