Measurement of the output power stability of a fiber optic light source.

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How does one measure the power stability of a light source and what are common pitfalls ?

This application note describes how to setup the measurement with the OP500 series of power meter modules. The data acquisition is controlled by a computer that runs the OPL5 application software. The measurement results are illustrated with real-life data of a 980nm laser source.

Why is source stability of interest ?

To measure insertion loss of optical components two measurements are taken, a reference measurement and a measurement that includes the device under test. Power fluctuations between the two measurements will add to the systematic error of the measurement. For this reason the fiber optic sources that are used for insertion loss measurements have to operate at a sufficient high stability. That way the fluctuations of the sources are relatively small compared to the actual loss measured. The standards (IEC61300) recommend a stability of the test equipment of <0.05dB or 1% of the attenuation/loss to be measured.

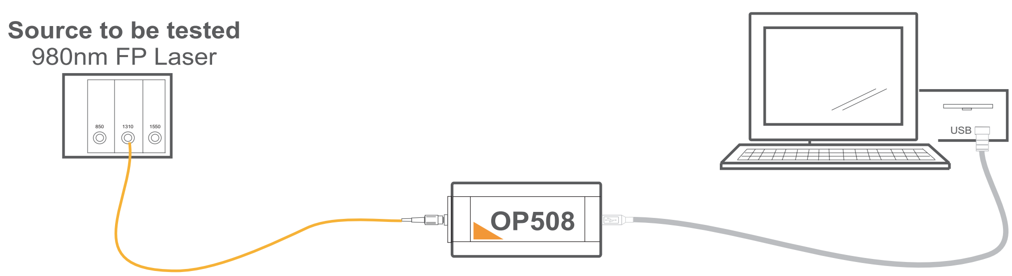
Any data logging fiber optic power meter can be used to measure source stability as long as the following requirements are met:

- the wavelength range of the photodetector matches the wavelength of the source (SI detector for 500nm..1100nm, InGaAs or Ge detector for 830nm to 1650nm).
- the output power level of the source cannot exceed the sensitivity range of the optical power meter.
- the measurement accuracy and resolution of the optical power meter should exceed the expected source stability. Usually a 0.01dB resolution/accuracy is sufficient to quantify stability <0.05dB.

For long-term stability measurements special care needs to be given to the test setup in order to eliminate external influences that impair and falsify the stability data.

- Use only fiber optic cables with high quality and clean connectors. Specifically when measuring narrow line-width sources (for example DFB) reflections at connector interfaces can cause fabry-perot effects.
- Use the appropriate core size and type of cable.
- Secure measurement cables. Movement of fibers can cause changes in power readings. Bending a cable more or less induces additional loss. Moving fiber loops can change the polarization of light. Cables are easily moved by people walking by or forced air from air condition vents.

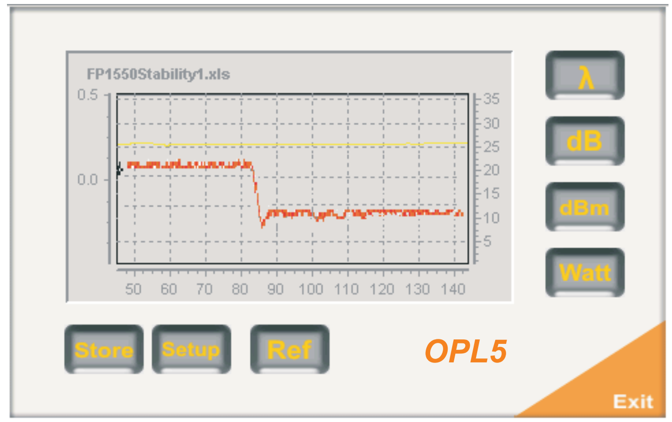
Measurement Setup



The equipment required for a single channel stability test setup are: Pentium III (or better computer), USB cable, OP500 Series Power Meter Module (OP508 shown), OPL5 application software, the appropriate fiber cable and the source to be tested.

To command the data logging a PC based application software is needed. Either the OPL5 is run or a similar program is executed. If the OPL5 is used it is setup in data logging mode. The acquired data (absolute, relative power level as well as ambient temperature) is directly written to a EXCEL data file. The screen shot (right) shows the application with the graphing enabled.

Other methods to capture power readings from an optical power meter (it must have remote control capability) are the National Instruments Labview 6/7 environment or home grown VB6, VB.NET, C++, or Delphi windows applications. OptoTest provides for a DLL interface to the OP500 series that allows any of the above.

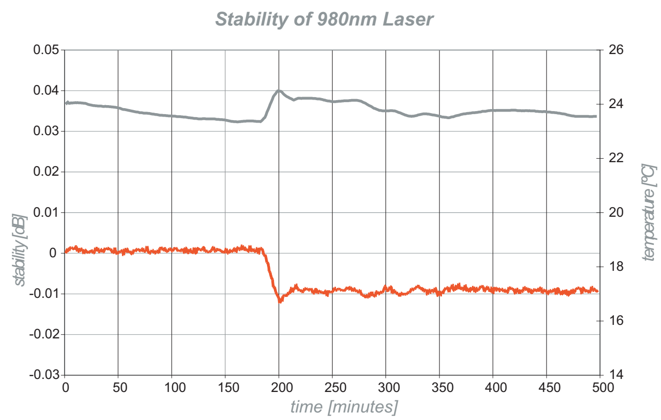


Test Example

For the purpose of illustration a 980nm FP laser is tested. This sample laser happens to exhibit a temperature dependancy that is nicely captured by this 500 minute test run.

To capture this data the OPL5000 application is configured to acquire a power meter reading and temperature reading every 60 seconds. The captured data is directly written cell by cell into a XLS spreadsheet.

The resulting chart to the right illustrates the temperature step of approx 1ºC causing a power drop of 0.01 dB.



Common Pitfalls

To measure source stability, or the stability of any device, some precaution has to be taken:

- the power meter stability is better than the expected stability of the device under test, typically <0.01dB. Power levels not to saturate the power meter.
- use high performance cables such as HPR reference cables and double check cleanliness.
- clean routing of the fiber, no bends tighter than 2" radius (5cm), tape the fiber gently that there is no possible movement from passer-by or forced airflow.

Product discussed in this application note

The OP500 series of fiber optics power meter modules offers a very cost effective solution to measure the stability of light sources. Specifically for long term measurements that occupy the test equipment for an extensive period of time, usually 12 hours or longer, one doesn't want to tie up or invest in the multi-function, high priced bench top test equipment (such as Agilent's 8163Series or EXFO's PM1100).

OP508 Fiber Optic Power Sensor

OP510 Optical Power Meter with bargraph display

OPL5 Power Meter application with datalogging

HPR High Performance Reference Cable