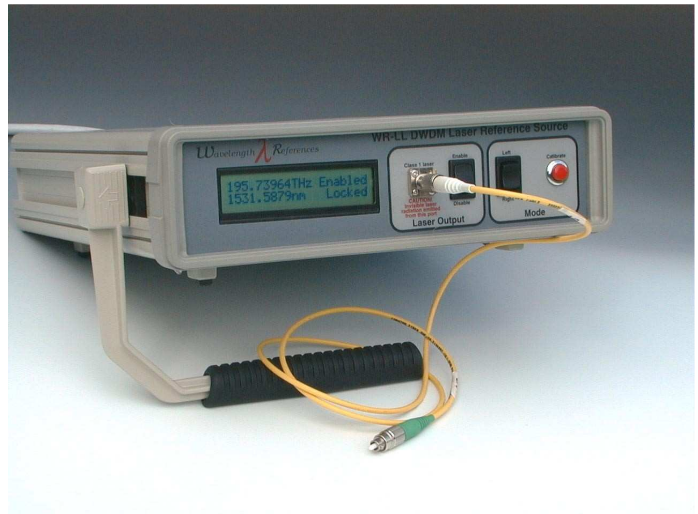
LL Series DWDM Reference Laser



The Wavelength References LL series locked laser is a distributed feedback laser that is locked to a molecular absorption line. These materials have been widely researched by NIST and others and form primary wavelength references in the DWDM band. The laser can be used as a physical standard frequency reference in the 1300 to 1610nm band. Several transitions and materials can be locked to, check for availability. Some lines allow for exact ITU grid wavelength. The unit is available in two basic versions.

The instrument version is a complete self-contained instrument with a metal housing, power supply and front panel status indicators. This version is intended as a laboratory standard for calibration/verification of optical equipment, or in scientific applications as a frequency standard.

The OEM version is a small circuit board that contains the absorption cell, the DFB laser, a microprocessor, and all the circuitry necessary to achieve and maintain lock. The OEM version is intended for use in optical equipment, such as a wavemeter, that require a precise internal reference.

Specification	Performance	Notes
Wavelengths available	1310nm to 1603nm	Check factory for availability of wavelengths. Exact selected ITU grids are available
Lock wavelength modes	Line center Left Lock Right Lock	Locks to the center of the absorption line. Locks on shorter wavelength side of absorption line. (Exact wavelength displayed on LCD display) Locks on longer wavelength side of absorption line. (Exact wavelength displayed on LCD display)
Wavelength Accuracy Acetylene lines	±0.0002nm ±0.0003nm ±0.0001nm (>10 sec averaging) ±0.00015nm	At 25°C ± 5°C left or right lock after self calibration At 25°C ± 5°C center lock after self calibration At 25°C ± 5°C average of right lock and left lock after self calibration
Wavelength Accuracy HF: 1300nm band HCN: 1550 band CO: L-band	Similar to acetylene but some variation please check with factory	
Wavelength Dither	<±0.05 picometer	P-P Typical, center lock only
Wavelength Accuracy Temperature Dependence	±0.005picometer/°C ±0.01picometer/°C	Center Lock or average of right and left lock Right or left lock
Short Term Stability	±0.05picometer ±6 MHz	Typical 1 hour at constant temperature (not including wavelength modulation when in center lock)
Side mode suppression	>35 dB	
Laser Linewidth	10 MHz	typical
Output power	-3dBm typical	
Output connector	FC/PC FC/APC SC/PC SC/APC Optional	
External Interface	RS232	
Output power stability	<±0.1dB	
Operating temperature range	0°C to +50°C	
Power Requirements	90-250VAC, 50/60Hz	Universal input

Features

- **Subpicometer absolute accuracy**
- **Reliable single longitudinal mode solid state diode laser**
- **Stable microprocessor based locking technique**
- **Autocalibration and diagnostic software onboard**
- **Compact and affordable**
- **Other gas species and wavelengths may be made available.**

Applications

- **Laboratory standard stable wavelength source in DWDM band**
- **Calibration/verification source for optical spectrum analyzer, wavemeter, or tunable laser**
- **On board reference source for wavemeter or other optical instrumentation**
- **Spectroscopy, trace gas, and pollution monitoring. We welcome inquiries into joint projects in this area.**

Wavelength λ References

Wavelength References
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NIST traceability

The question of NIST traceability often comes up when discussing a piece of calibration equipment. What constitutes traceability is not always clear. The locked laser is referenced to a fundamental molecular energy level. This transition frequency, under similar environmental conditions, is what it is and as such is not subject to the concept of traceability. This is what is called a physical standard i.e. a standard whose basic performance is not dependent on a calibration step or an error associated with the quality of construction. The reported value of the energy transition and environmental sensitivity still needs to be determined.

Many researchers have measured the precise wavelengths of absorption lines. HITRAN a worldwide database of high-resolution spectroscopy administered at the Harvard-Smithsonian Center for Astrophysics contains a wealth of information. Many transitions have been measured with a traceable accuracy of 1 part in 10^8 or better. A material that we often use, acetylene, has had its spectrum carefully analyzed. The line centers of this materials transitions have been measured many times; the most accurate measurements were made by Nakagawa, in a frequency comparison chain that can be traced back to the cesium standard. The reported accuracy is 1 part in 10^9. These measurements have been repeated and verified recently at NIST. The remarkable stability and small pressure shift and temperature dependence has been repeatedly verified.

The question might be asked: OK the line center is rock solid but how do you know you are locked to the actual line center? This has been done in several ways. The locked laser actually has built in two ways of determining the line center, center lock and the average of right and left lock (under the assumption of a simple single line transition without fine structure. (This is in fact the case for acetylene, hydrogen cyanide, hydrogen fluoride, and carbon monoxide. For methane some lines have close in structure so this cross check is not available). If these two numbers agree then we get added confidence that we are actually referencing off the true physical standard line center transition. The repeatability can also be measured. This can be done to a very high degree of accuracy by heterodyning. An ensemble of several lasers can be evaluated in pairs. Frequency variations of a few MHz can easily be determined. This is done on an ongoing basis at Wavelength References. We have also taken the laser to NIST in Boulder to have it measured against a wavemeter referenced to a NIST laboratory standard rubidium source. It performed exact to the limit of resolution of the wavemeter (0.1 picometer). Lawrence Livermore Labs has also evaluated and verified the lasers performance.

All these measurements point to the conclusion that the published specifications of the Wavelength References LL are met and if anything conservative.

References

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