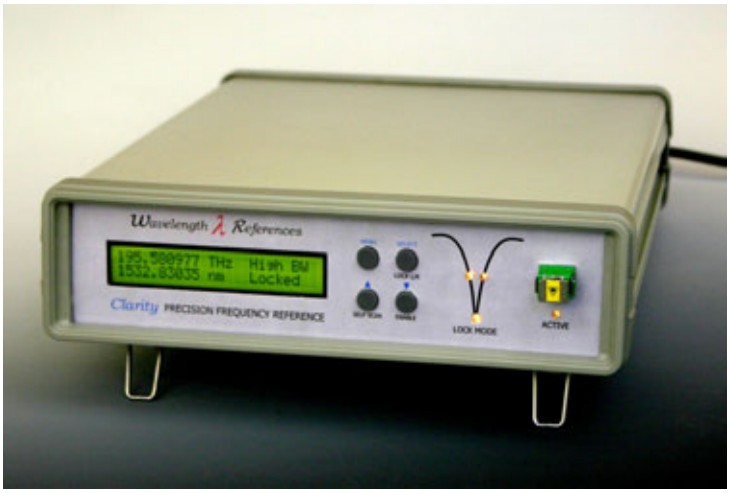
# Clarity™
## Precision Frequency Standard




**The Wavelength References Clarity Precision Frequency Standard locks a laser emission to a molecular absorption line. The instrument drives a DFB laser in a unique configuration that creates superb frequency stability. The laser can be used as a physical standard frequency reference in the 1300nm to 2400nm region. The Clarity Frequency Standard can lock to many transitions and materials, consult the factory for specific wavelengths.**

**The output frequency can be locked to either side of the absorption line with controllable frequency offset. For maximum stability, the output frequency can be locked to the line center. Unlike competitive lasers this unique design provides frequency stability over all measurement intervals, even very long ones.**

**We offer custom board only designs for OEM applications that have very attractive price, form factor, and power dissipation.**

| Specification | Performance | Notes |
|---|---|---|
| Wavelengths Available | 1300nm to 2400nm | Consult factory for availability of wavelengths |
| Lock Wavelength Modes | Side Lock<br>Center Lock | Locks on either side of absorption line. (Exact wavelength displayed on LCD display)<br>Locks to the center of the absorption line |
| Wavelength Adjustment | ±50 MHz | Side lock only, exact wavelength displayed |
| Absolute Accuracy | ±0.1ppm | Acetylene locked laser, typical at 25°C ± 5°C after 20 minute warm up and self scan |
| Wavelength Repeatability | ±2MHz | Typical at 25°C |
| Wavelength Short Term Stability | <0.5MHz RMS | Side lock at 25°C after 20 minute warm-up, 0.001 sec to 1000 sec |
| Allan Deviation | $<1x10^{-10}$<br>$<5x10^{-11}$ | Typical 100 seconds all lock modes<br>Typical 1000 seconds center lock |
| Wavelength Modulation Artifacts | none | Locking process does not introduce intentional wavelength modulation |
| Output Power Stability | <±0.1% | Typical at 25°C |
| Locking Loop Bandwidth | 50 Hz | |
| Side Mode Suppression | >35 dB | |
| Laser Linewidth | 4MHz<br><1MHz<br><50KHz | Typical low power option<br>High power option<br>Special order |
| Output Power | 0.5mW typical<br>40mW | <br>High power option |
| Optical Output | SMF28 fiber SC/APC<br>Panda PM | Standard<br>Available for high power option |
| External Interface | RS232 | |
| Operating Temperature Range | 0°C to +50°C | |
| Power Requirements | 90-250VAC, 50/60Hz<br>0.5 amp | Universal input |

## Features

- **Sub-picometer absolute accuracy, traceable to a physical constant**
- **Highest stability, $5x10^{-11}$ Allan deviation**
- **Compact, rugged and affordable**
- **Software controlled scanning of absorption line**
- **High power and custom options available**
- **Multiple locking modes and wavelength adjustment**

## Applications

- **Laboratory standard stable wavelength source in the IR region**
- **Calibration/verification source for optical spectrum analyzer, wavemeter, or tunable laser**
- **Sensing systems, gas detection**
- **Spectroscoptic research**
- **Lidar**

Wavelength λ References Inc

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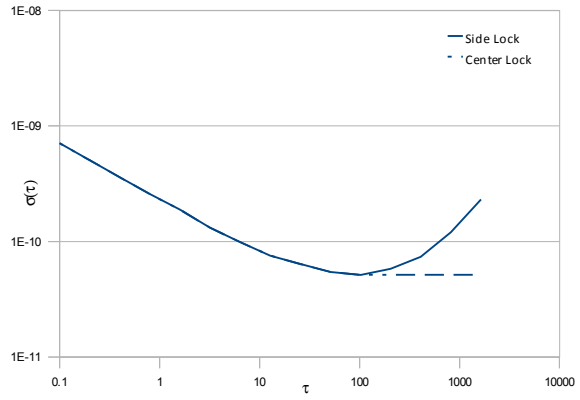
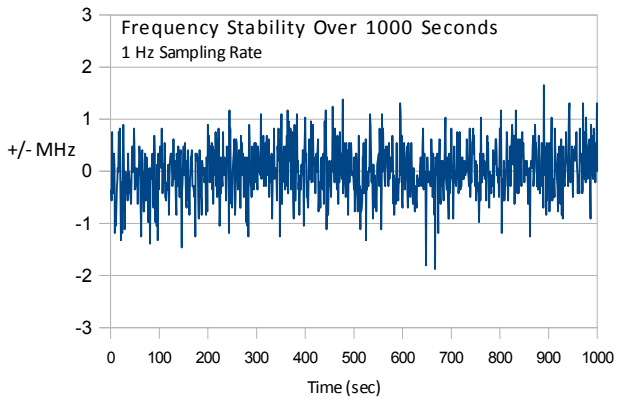



The Clarity laser Allan variance is shown for side lock and center lock modes. Noise floor is 5 x $10^{-11}$ for an averaging time of 100 sec. Measurements were taken in a non-temperature controlled lab environment over a 24 hr time period. Laser self-calibrated once at the start of the experiment and maintained locked emission along the C-12 Acetylene P9 line (1530.3718 nm center).




The Clarity laser frequency over a 1000 second interval is shown above. This measurement is taken at constant temperature with a 10KHz bandwidth. The Clarity design uses a unique architecture that steers the laser frequency using the gas cell in a dual loop configuration with long term reproducibility of +/- 2MHz .

## Laser Phase Noise, Linewidth, and Frequency Stability

The Clarity-PFR laser wavelength is referenced to a fundamental physical constant, the vibrational rotational energy level of a specific molecular gas. These molecular energy levels show remarkable insensitivity to environment such as temperature, time, or electromagnetic fields. They are for example much more stable than spectroscopic discharge lamps or gas lasers as even a stabilized HeNe laser. The Consultive Committee for Length has specified C13 acetylene lines as a primary international standard definition of the meter. NIST has developed a number of SRMs based on molecular lines as primary wavelength standards for telecommunications DWDM systems. The reproducibility of the acetylene locked Clarity laser's average wavelength is +/- 2MHz with the absolute long term accuracy specified at +/-0.1pm.

The parameters of laser wavelength stability, phase noise and linewidth all refer to the frequency fluctuations of the laser, but over different time scales. For a precise definition of laser linewidth the measurement time interval must be specified. For this number to match the integrated phase noise the corresponding low frequency cutoff must be specified. DFB lasers typically exhibit a 1/f frequency noise characteristic up to about 1 MHz and a white phase noise after this. A generally accepted definition of linewidth would include phase noise components above about 1Khz. With this definition most low power communication DFB lasers have a line width of 3-5MHz while special high power versions can exhibit line widths of <1MHz.

The Clarity-PFR uses a dual loop configuration that locks the laser wavelength to the side or center of a molecular absorption line. This is done in a way that introduces no intentional laser wavelength modulation and very stable output power. The locking loop bandwidth is about 50Hz so phase noise components at <50Hz are tracked out, but those above this are passed. This provides suburb stability in the average laser wavelength. This loop bandwidth, however, has little effect on the laser linewidth. We offer three linewidth options: 4MHz typical, <1MHz guaranteed, and <50KHz by special order.

## Ordering Information:

Example:
Clarity-PFR-1530-OPT1

Explanation:

| | |
|---|---|
| PFR | Stands for Precision Frequency Reference. Please consult factory for other offerings, for example, linewidth narrowing. |
| 1530 | The laser wavelength in nm. Standard versions are:<br>1530nm locked to the P9 line of C12 acetylene<br>1540nm locked to the P16 line of C13 acetylene<br>1312nm locked to hydrogen fluoride<br>Note, however, that other wavelengths may be available from 1300nm to 2.4 microns, please consult factory. |
| OPT1 | 0.5 mW output power and <4MHz linewidth |
| OPT2 | 40mW output power and <1MHz linewidth |
| OPT(X) | This designation is for custom configurations for the product. We encourage requests. Examples of custom options are: PM output, board level product for OEM, and laser line width to as low as 50KHz |