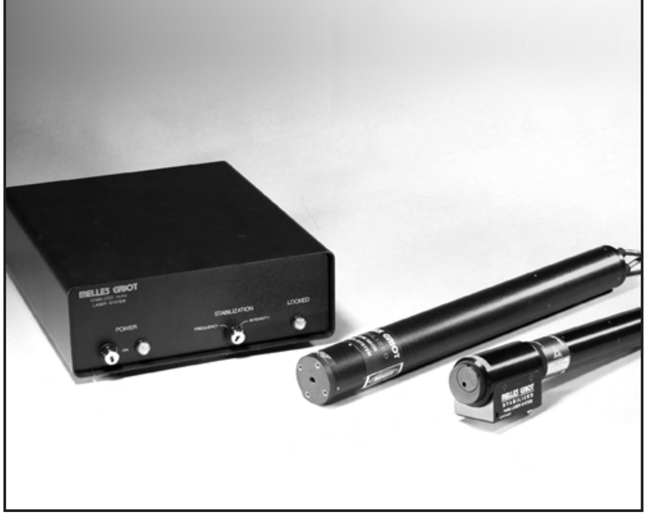


Stabilized Helium Neon Laser Systems

Melles Griot stabilized helium neon laser systems are ideal for such applications as metrology, interferometry, and surface defect inspection, which require a single, invariant frequency. These single-longitudinal-mode systems have a coherence length measured in kilometers, and they exhibit excellent power stability for long periods of time. They permit highly repeatable, highly accurate measurements with superb resolution. The output is an economical and reliable calibration reference and a well-defined low-noise frequency source for fiber optic and diode laser testing.

- 1-MHz frequency stability at 473.61254 THz
- <0.2% power fluctuation over 8 hours
- Frequency tunable over 300 MHz
- >5000:1 polarization

METHODS OF FREQUENCY STABILIZATION

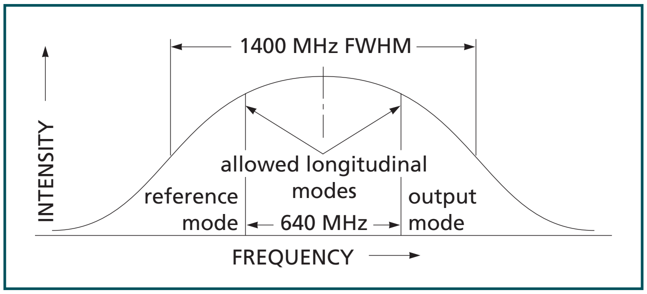
The basic laser used in the Melles Griot stabilized helium neon laser systems produces two orthogonally polarized longitudinal modes (as shown in the figure on this page). As the laser cavity length changes, the modes move through the gain curve, changing in both frequency and amplitude. The two modes are separated into two beams by polarization components, and their amplitudes are compared electronically. The cavity length is then adjusted to maintain the proper relationship between the modes. Only one beam is allowed to exit the system. Melles Griot uses two different techniques to stabilize frequency: the comparison method (aka frequency stabilization) and the slope method (aka intensity stabilization).

In the comparison method, the ratio of intensity of the two orthogonal beams is measured and is kept constant. This ratio, which is independent of output power, precisely determines the output frequency of the beam. By adjusting this ratio, the output frequency can be swept approximately 300 MHz, while maintaining a 1-MHz linewidth.

In the slope method, only the intensity of the output beam is monitored, and a feedback loop adjusts the cavity length to maintain constant power. Because of the steep slope of the laser gain curve, variations in frequency cause an immediate and significant change in output power. The frequency is held constant by adjusting the laser cavity to maintain constant output power.

Since amplitude and frequency are closely coupled, both laser frequency and amplitude are very stable using either method. Nonetheless, a change in laser frequency will always result in a change in output power, and an intentional change in output power will always result in a change of frequency.

The comparison method is the most accurate frequency control scheme. Since it is measuring the amplitude of the two modes and is centering them precisely around the peak of the gain curve, which is essentially an invariant, the frequency is unaffected by the long-term power drift caused by aging or other factors. On the other hand, the slope method of frequency control significantly simplifies the control electronics, allows a more compact package, and is used in the Melles Griot self-contained laser system. In the near and medium terms, both methods produce the same result, but if long-term frequency drift (days, months) is the prime consideration, the comparison method, used in the Melles Griot systems for research, is the best choice.



632.8-nm helium neon gain curve showing two orthogonally polarized modes

APPLICATION NOTE

Comparing Stabilization Methods

Melles Griot stabilized helium neon lasers use two different stabilization techniques.

The comparison method (aka frequency stabilization) is best when long-term (days) frequency stability is required.

The slope method (aka intensity stabilization) provides excellent short-term (hours) frequency stability. It is the best choice when power stability is critical.

Stabilized Helium Neon Laser Systems for Research

- Nominal frequency at 473.61254 THz
- Two stabilized modes (slope and comparison)
- Complete systems, power supply/controller included
- CE compliant version available

The 05 STP 901, 05 STP 903, and 05 STP 905 systems are designed primarily for laboratory and research use. These systems can be operated in either the "frequency-stabilized mode" (comparison method) or the "intensity-stabilized mode" (slope method). The laser head and power supply/controller include the controls needed for monitoring and controlling laser power and frequency. Frequency and power can be changed electronically by applying a dc voltage (10 MHz/V in frequency-stabilization mode, −2%/V in power-stabilization mode).

Do you need . . .

POWER AND ENERGY METERS

The 13 PEM 001/J power meter is the ideal choice for measuring the output power and stability of a wide variety of lasers.

- Measures cw power from 10 μW to 2 W with 10 μW resolution
- Calibrated from 200 nm to 20 μm
- Includes thermopile detector head

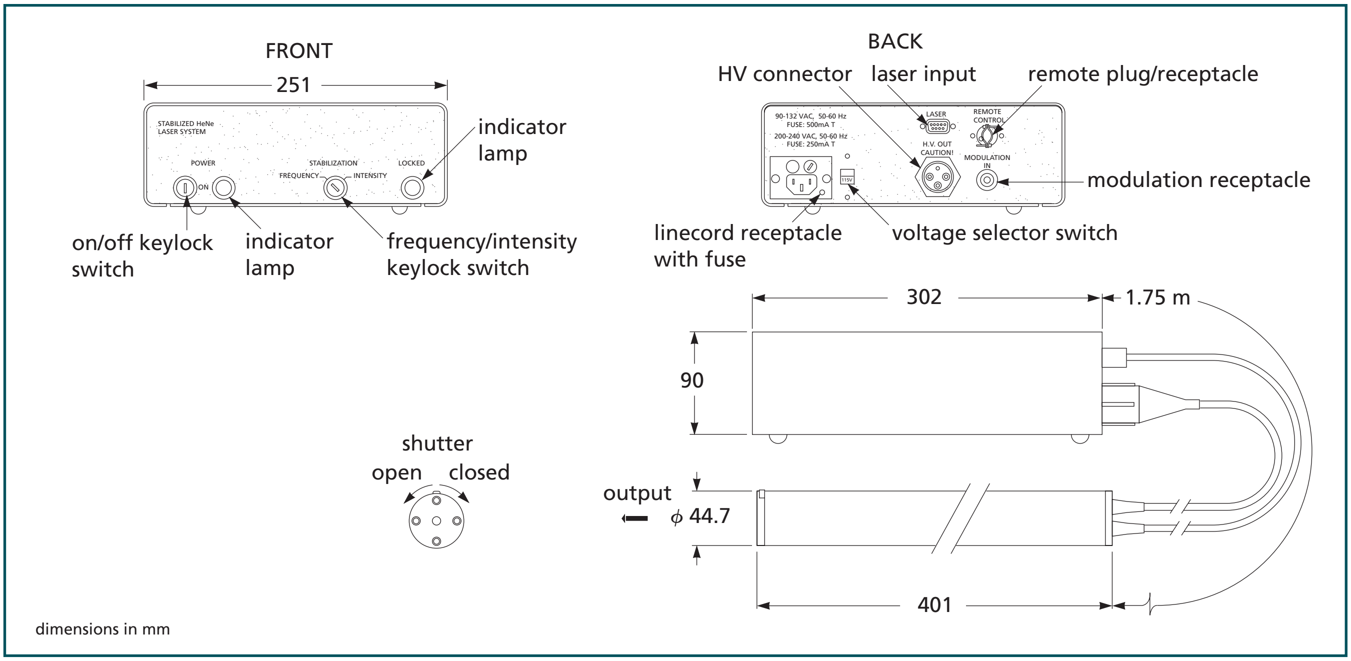
For the complete line of Melles Griot power meters go to chapter 47.

SPECIFICATIONS: STABILIZED HELIUM NEON LASER SYSTEMS FOR RESEARCH

Output Power (cw): 1.0 mW
Wavelength: 632.8 nm
Transverse Mode: TEM_{00}
Beam Diameter (1/e^2): 0.50 mm
Far-Field Divergence (1/e^2): 1.60 mrad
Polarization: Linear >1000:1 extinction ratio
Noise (rms): <0.05%
Frequency Stability (1 min/1 hr/8 hrs):
  Frequency-Stabilized Mode: ±0.5/±2.0/±2.0 MHz
  Intensity-Stabilized Mode: ±3.0/±5.0/±5.0 MHz
Power Stability (1 min/1 hr/8hrs):
  Frequency-Stabilized Mode: 1.0% rms
  Intensity-Stabilized Mode: ±0.1%/±0.2%/±0.2% rms
Frequency Offset:
  Frequency-Stabilized Mode: ±150 MHz
  Intensity-Stabilized Mode: ±50 MHz
Temperature Dependence (frequency-stabilized mode):
  0.5 MHz/°C
Time to Lock: <30 minutes
Lock Temperature Range: 10°C to 30°C
Input Frequency: 50–60 Hz
CDRH Class: IIIa
IEC Class: 3B
CE Compliance: Compliant (230-Vac version only)

Stabilized Helium Neon Laser Systems for Research

Input Voltage	PRODUCT NUMBER
115 Vac	05 STP 901
230 Vac (CE compliant)	05 STP 903
100 Vac	05 STP 905



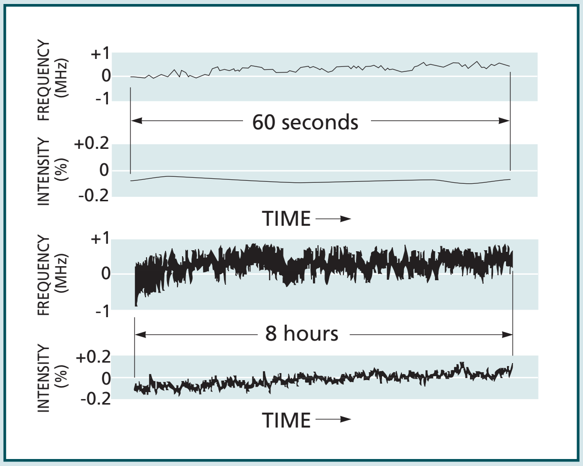
05 STP 901/903/905 stabilized helium neon laser and controller

APPLICATION NOTE

Measuring Frequency Stability

By heterodyning the Melles Griot laser's output with the output from a Zeeman-stabilized laser and observing the variation of the resulting beat frequencies, the combined drift of the two lasers can be measured. The results will be no better than the sum of the two instabilities and will, therefore, provide a conservative verification of the Melles Griot laser's performance level.

The charts illustrate the frequency-stability performance of a typical 05 STP 901 stabilized HeNe laser system over one minute and over an eight-hour typical workday. The laser can be cycled over a 20°C temperature range without mode hopping.



05 STP 901 short- and long-term frequency stability

Compact, Stabilized Helium Neon Lasers

- Extremely compact
- Rapid warm-up to frequency lock (<10 minutes)
- Complete system, includes power supply
- Class II and Class IIIa (IEC Class 2 and 3B) systems available
- CE compliant

The 25 STP 910 and 25 STP 912 are laser systems sets which include the power supply, laser, and frequency controller in a very small package. The patented frequency adaptor allows frequency locking within 10 minutes, convenient for both the OEM and end user. The 25 STP 910 is a CDRH Class II (IEC Class 2) system and is limited to less than 1–mW output. The 25 STP 912 is a CDRH Class IIIa (IEC Class 3B) system. Both power and frequency can be manually adjusted.

These systems are ideal for use in systems and applications with space constraints or with fast response-time requirements.

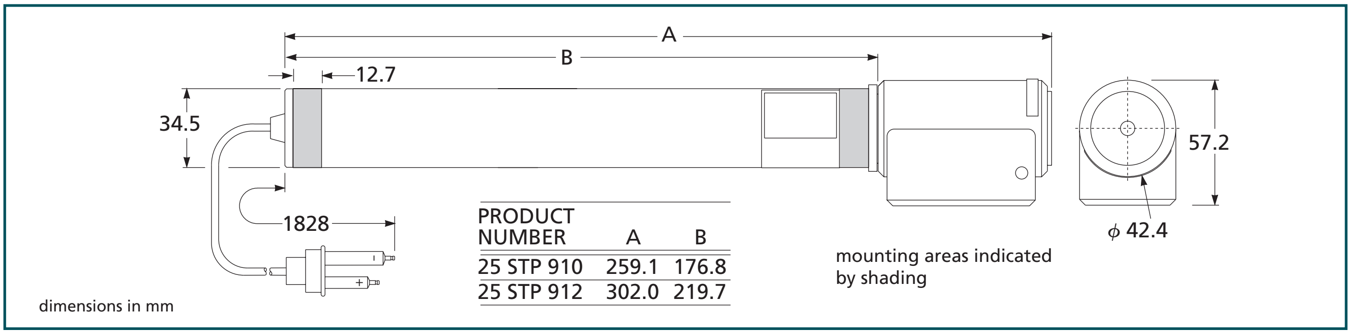
Compact, Stabilized Helium Neon Lasers

cw Output Power (mW)	Beam Diameter ($1/e^2$) (mm)	Beam Divergence ($1/e^2$) (mrad)	Safety Classification CDRH Class	IEC Class	PRODUCT NUMBER*
0.5	0.48	1.70	II	2	25 STP 910
1.0	0.54	1.50	IIIa	3B	25 STP 912

**Add the appropriate suffix to the product number to indicate input voltage: -461 for 100 Vac, -249 for 115 Vac, -230 for 230 Vac, or -240 for 240 Vac.*

SPECIFICATIONS:
COMPACT, STABILIZED HELIUM NEON LASERS

Wavelength: 632.8
Transverse Mode: TEM_{00}
Polarization: Linear >5000:1 extinction ratio
Noise (rms): 0.1%
Noise Frequency: 30 Hz to 10 MHz
Frequency Stability (1 min/1 hr/8 hrs): ±1.0/±2.0/±3.0 MHz
Power Stability (1 min/1 hr/8hrs): ±0.2%
Frequency Tunability (Blue Side):
25 STP 910: 50–600 MHz
25 STP 912: 400–600 MHz
Temperature Dependence: 0.5 MHz/°C
Time to Lock: <10 minutes
Lock Temperature Range: 15°C to 30°C
Input Voltage:
100 Vac, 115 Vac, 230 Vac, or 240 Vac ±10% (specify)
Input Frequency: 50–60 Hz
CE Compliance: Compliant (230-Vac versions only)
Recommended ac Power Supply:
25 STP 910: 05 LPL 900-040
25 STP 912: 05 LPL 901-040



25 STP 910/912 compact stabilized helium neon laser head dimensions