LB1005 High-Speed Servo Controller

FLEXIBLE, EASY-TO-USE, P-I CONTROLLER

Applications

- Frequency and amplitude stabilization of lasers
- Atom/ion trapping, including BEC
- Frequency metrology
- Quantum optics
- Laser synchronization

New Focus™
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The LB1005 High-Speed Servo Controller makes stabilizing the frequency or amplitude of lasers easy and intuitive. And, unlike competitive products currently available, the LB1005 Servo Controller is a one-box solution - no expensive external chassis required. This high-speed proportional integral (P-I) controller has an intuitive front panel for the independant control of the P-I corner frequency, overall servo gain, and low-frequency gain limit. This flexibility allows the user to cascade a pair of LB1005 units to, for instance, provide a very tight lock on a diode laser. One controller can be tuned to eliminate high frequency noise via the current modualtion input. A second controller can respond to the low frequency components of the same error signal to eliminate drift and acoustic perturbations. The LB1005 is ideal for demanding applications including atom, ion, or molecule trapping, Bose-Einstein condensation, frequency metrology, quantum optics, and the high-speed stabilization, synchronization, and control of lasers.

WAVELENGTH LOCKING WITH THE LB1005 SERVO CONTROLLER

While narrow-linewidth lasers are used throughout atomic, molecular, and optical physics, their short-term wavelength stability is often not adequate for many applications without active stabilization. Feedback (or servo) control forces a system, such as a laser, to stay actively "locked" to a desired value, e.g., a specific wavelength - automatically correcting for external disturbances that might cause the system to deviate from the desired value.

The New Focus LB1005 High-Speed Servo Controller provides critical signal-processing electronics for performing the feedback control. In the case of wavelength locking, an error signal is generated by transmitting a portion of the laser output through a wavelength reference such as a gas cell or etalon. Any wavelength instability is converted to an amplitude charge that can be detected by a photodetector. The resulting error signal is filtered by the LB1005 Servo Controller to form a control signal that is sent back to the laser. (Figure 1)

The LB1005 Servo Controller consists of three stages of analog electronics processing: Input Stage, Filter Stage, and Output Stage. (Figure 2) The Filter Stage is the most important because it sets the behavior of the system. The user controls three important filter parameters that impact the stability of the system, and how well the actual output matches the desired value (P-I corner, Proportional Gain, and Low Frequency Gain Limit).

Differential inputs that are auto-terminated if not used, a sensitive, low-noise offset for lock point selection, and an error monitor output make the Input Stage flexible. The Output Stage not only provides the correction signal, but also control over the amplitude of the correction signal to match the input to the laser being locked. Sweep input, span, and center adjustments make it easy to find the desired lock point and a TTL "Integrator Hold" and modulation inputs allow for more advanced locking techniques not available in competitors' models. Simply Better™.

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Wavelength Locking with the LB1005

The wavelength of narrow-linewidth tunable lasers drifts due to floor vibrations, small temperature drifts, and even acoustic noise from people talking in the vicinity of the laser. By using the piezoelectric transducer input to the laser controller, you can shift the laser wavelength so that it always stays fixed on the stable resonance line shape of the sample gas, regardless of possible external disturbances.

To acquire lock, find the locking point by adjusting Sweep Center and Sweep Span (and sometimes Offset Adjust). Upon locating the locking point, the Acquire switch is used to turn on the fedback control. The Sweep Span is then turned OFF, and the Gain can be adjusted to optimize servo control.

LB1005 Specifications

Specifications	Value
Input Voltage Noise	<10 nV/√ Hz
Input Impedance	1 MΩ
Input/Output Voltage	±10 V
Bandwidth	>10 MHz
Adjustable Gain	-40 to +40 dB
Adjustable P-I Corner Frequency Range	10 Hz to 1 MHz
Integrator Hold	TTL Triggered

Gain and P-I corner are independently adjustable.

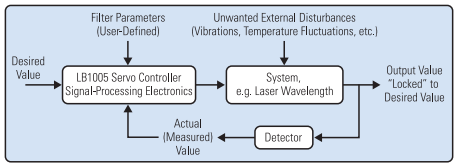


Figure 1. Schematic of a general feedback control loop.

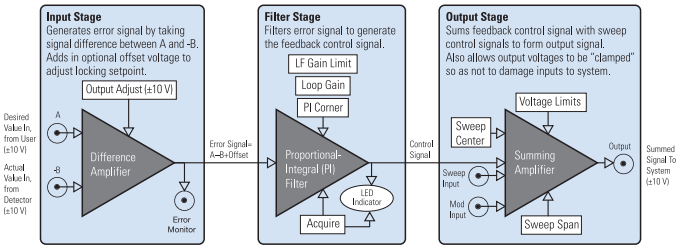
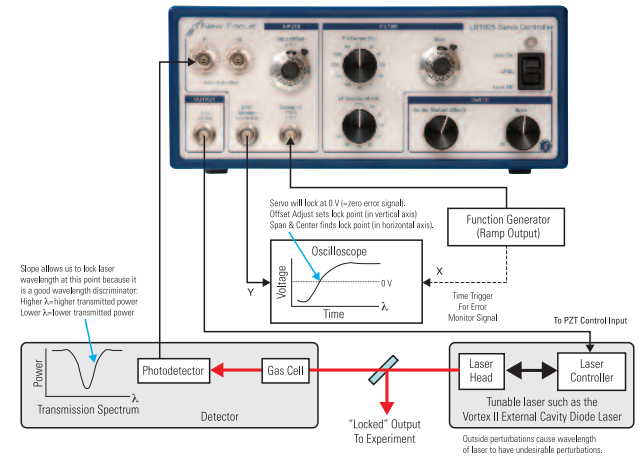
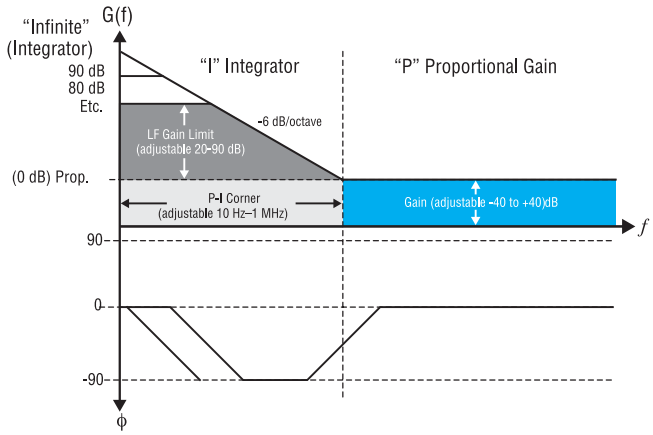


Figure 2. LB1005 High-Speed Servo Controller architecture.





Proportional-Integral Filter Gain profile with Low-Frequency Gain Limit. Independently adjustable gain and P-I corner frequency provide a high degree of flexibility.

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DS-031301 (9/14)