

## Integrated Laser Controller with Servo

The AOSense laser controller provides and ultra-low noise current and piezo drive for the laser, as well as efficient PWM-based TEC control, in a compact integrated package. The controller is powered by a single +5V input and operating using either the graphical user interface (GUI) provided by AOSense, or direct communication with the controller with an LVDS interface for serial commands. The controller includes fast modulation ports for the current and PZT, as well as a PZT monitor channel.

The controller utilizes a micro-controller which stores all needed settings and monitors relevant signals. Each laser head also includes a memory chip, allowing individual laser heads to contain information on safe operating ranges, best settings, and serial number. This allows any AOSense laser head to operate with any ILC controller. The GUI also allows control and monitoring of multiple lasers in one interface, as long as each controller has a USB port available.



### Features

- ⊗ **Miniature all in one ECDL controller and locking solution (ILC optional)**
- ⊗ **Fast PI<sup>2</sup>D current servo with lead-lag (>2 MHz), auxiliary PI PZT servo**
- ⊗ **Built-in DDS for PDH modulation/de-modulation (0.5-20 MHz)**
- ⊗ **Software selected gain, transfer function, actuators, and output range**
- ⊗ **Software selected mixer bypass for DC servo setups**
- ⊗ **Automated ramps and lock acquisition for atomic references and cavities**

## AOSense Laser Controller Specification

ILC Specifications		AOS-ILC-P-XXX	AOS-ILC-P-XXX-
Laser type	Compliance voltage	4 V (Red/IR)	7.5 V (Blue)
	Current polarity	-P: Positive (Cathode ground) -N: Contact us	
LD Current Source	Range	-100: 100 mA -200: 200 mA -500: 500 mA	-100: 100 mA -200: 200 mA -500: 200 mA
	Resolution	-100 10 $\mu$ A -200 10 $\mu$ A	-100 10 $\mu$ A -200 10 $\mu$ A
	Current noise	60 pA/ $\sqrt{\text{Hz}}$ 100 pA/ $\sqrt{\text{Hz}}$	110 pA/ $\sqrt{\text{Hz}}$ 200 pA/ $\sqrt{\text{Hz}}$
	Mod port coefficient	1 mA/V	1 mA/V
	Mod port input range	+/- 3.8 V (Zener diode limited)	
	Mod port BW, delay	DC-10 MHz, ~12 ns delay	
	RF mod BW, delay	~80 kHz - 40 MHz (cable dependent)	
	PZT Control	Range	120 V
Resolution		10 mV	
Voltage noise		< 500 nV/ $\sqrt{\text{Hz}}$	
Mod port coefficient		$V_{\text{PZT}} = -12.5 V_{\text{MOD}}$	
Mod port input range		+/-3.8 V (Zener diode limited)	
Mod port BW		DC-1 kHz (see transfer function)	
Monitor port coefficient		$-1/11 V_{\text{PZT}}$	
PZT/Current FFWD		Yes, variable gain and sign	
Temperature Control	TEC range	MCU interlocks at 10 and 45 °C. Try to operate above environment dew point.	
	TEC current range	800mA with wall wart, 1.2A with external power supply	
	Temperature resolution	1 mK	
Digital Control	User interface	Window GUI or virtual serial port	
	Control connector	USB	
	Memory (SN, safety limits, operation)	NVRAM, in controller	
Power and Size	Power supply	+5 V DC	
	Power consumption	6 W typical (10 W start)	
	Dimensions (L x W x H)	13.72 x 7.37 x 2.97 cm [5.4" x 2.9" x 1.17"]	

SILC Servo Specifications		AOS-SILC-P-200
Input configuration	AC Loop	PDH lock setup with built in mixer
	DC Loop	Mixer bypass to allow use in PLL, other locks
Primary Loop	Loop input	Mixer or amplified PD
	Loop output	LD current range control, PZT loop input
	Transfer function	PI <sup>2</sup> D
	Loop gain control	G= 0.7 to 150
	Integrators	Fast I2 & Slow PI corner controls with gain clamps
	PI corners	0.5-100 kHz
	Fast I2 corners	0.01-6 MHz
	Integrator gain clamps	1, 50, inf.
	Differentiator	PD corner control with gain clamp
	Differentiator corners	0.2-10 MHz
	Differentiator gain clamp	1-10
	Loop BW and delay	10 MHz, ~20 ns delay
	Loop output range	+/- 4 V
	Output range/gain control	Coarse and fine 0.037-1
PZT Loop	Loop input	Primary loop output
	Loop output	PZT range control
	Transfer function	PI
	Loop gain control	G= 0.001-1
	PI corners	0.03-20 kHz
	Gain clamp	1, 62.5, inf.
	Loop output max range	+/-4 V
	Output range/gain control	Coarse 0.1-1
	Sign control	Yes
LoopType	PI <sup>2</sup> D	Primary loop to LD current, PZT loop held in reset
	PI <sup>2</sup> D+ PZT	Dual actuator loop with current + PZT: Useful for fast locks with large DC gain and range. Useful for PZT only lock with full transfer function (LD mod off)
	PZT+P	Proportional gain in primary loop: useful for simple PZT locks with or without P feedback to LD current
	PI <sup>2</sup> D+TEC	PI <sup>2</sup> D lock with slow temperature servo for DC stability
	Custom parameters	Development mode

SILC Servo Specifications		AOS-SILC-P-200
Lock Modes	Scan	Laser sweep
	Off	Idle, no sweep, integrators held in reset
	Lock	Engage lock
Lock Acquisition	Automated lock	Starts automated scan and lock when lock mode
	Automated lock with relock	Attempts to relock if lock fails
	Manual lock	User controlled lock engage
Laser scans	Actuators	LD current or PZT
	Amplitude	10-100%
	Sign change	Yes
Output Monitor	Error signal (after primary gain stage)	100 Ohm, BW adjustable 0.01-20 MHz
	Photodiode monitor	100 Ohm, BW adjustable 0.01-20 MHz
	Select scope output	Ramp trigger, output mon, lock acquisition setup
DDS Synthesizer	Frequency	0.2-30 MHz
	Loop notch filters	20, 40 MHz
	RF out (Min/Max) to EOM	-30 dBm/+15 dBm
	Ref (Min/Max) to mixer	-30 dBm/+7 dBm
	Ref phase	0-360°
	Aux out (Min/Max)	-30 dB/+7 dBm
	Ref phase	0-360°
Lock automation	Lock acquisition method	User thresholds with peak counting
	Dual actuator lock	Staggered PZT gain increase after lock acquired
	Lock monitors	Integrators, PD signal thresholds, interrupt
Power and Size	Power supply (Min/Max)	+5.1/5.6 V DC
	Power consumption	7.5 W Typical (12.5 W Start)
	SILC Dimensions (L x W x H)	13.72x7.37x2.97 cm [5.4" x 2.9" x 1.17"]

