Requirements / Specification Document

NIST National Institute of Standards and Technology U.S. Department of Commerce

TITLE: Lock-In Electronics

Requesting Laboratory / Division / Group:

Communications Technology Laboratory
Radio Frequency Technology Division
RFTD HQ Group (672.00)

General Statement of Need:

The requested digital lock-in amplifier system shall provide high-sensitivity phase-sensitive detection and real-time digital signal processing to support electro-optic sampling (EOS), carrier-envelope-offset (fCEO) detection, frequency-comb stabilization, and traceable waveform metrology applications. The system shall support demodulation and measurement of low-level optical and electrical signals with high dynamic reserve, low noise, and stable phase detection over a frequency range extending to at least tens of megahertz. The instrument shall include multiple simultaneous demodulators, integrated proportional-integral-derivative (PID) controllers, synchronized data acquisition, and advanced digital filtering capabilities to enable closed-loop laser stabilization, optical frequency referencing, and precision measurement of ultrafast electrical and optical waveforms. The system shall provide flexible external triggering, high-speed data streaming, and software interfaces compatible with automated laboratory control and long-term measurement operation. The lock-in amplifier is required to support development of SI-traceable electro-optic waveform measurements, frequency-comb-based metrology, optical-to-electrical signal characterization, and advanced feedback control architectures used in ultrafast photonics and timing applications.

Item Specifications and Quantities:

Item 1:	Very High Frequency Lock-in (VHFLI) Amplifier	
Quantity:	1 EACH	
Specifications:	1.1	**Frequency Range** DC to 50 MHz demodulation bandwidth.
	1.2	**Input Channels** Two independent analog input channels.
	1.3	**Demodulators** One dual-phase demodulator (X, Y, R, θ) per channel.
	1.4	**Signal Generators** One integrated signal generator per channel.
	1.5	**Dynamic Reserve** High dynamic reserve for low-level signal detection.
	1.6	**Data Acquisition** Real-time DSP with continuous data streaming.
	1.7	**Feedback Control** Integrated PID controllers for closed-loop feedback.
	1.8	**Software and Connectivity** LabOne software with Ethernet and USB interfaces.
	1.9	**Measurement Functions** Simultaneous amplitude, phase, in-phase, and quadrature measurements with digital filtering.

Item 2:	Multi-Demodulator	
Quantity:	1 EACH	
Specifications:	2.1	Extends the total number of demodulators from 2 to 8.
	2.2	Extends the total number of internal oscillators from 2 to 8.
	2.3	Supports simultaneous multi-frequency lock-in measurements.
	2.4	Enables parallel phase-sensitive detection at multiple harmonics or modulation frequencies.
	2.5	Provides independent configuration of each demodulator.
	2.6	Supports concurrent amplitude, phase, in-phase (X), and quadrature (Y) measurements across all demodulators.
	2.7	Allows synchronized operation of multiple demodulators and oscillators.
	2.8	Compatible with real-time data acquisition and streaming. Integrated within the LabOne software environment.
	2.9	Supports advanced electro-optic sampling (EOS), frequency-comb stabilization, multi-tone measurements, and waveform

	metrology applications.
2.10	Fully compatible with the VHFLI Very High Frequency Lock-In Amplifier platform.

Vendor Requirements

1. Possess at time of award/contracting an Export Control Classification Number (ECCN).
2. Possess at time of award/contracting a Unique Entity Identification Number (UEI) which registration is listed as "Active" on the GSA System for Award Management (SAM.gov).

Procurement Support Information and Ancillary Services:

Section	Requirements/Specifications
Planning Considerations ☒ N/A	☐ List any visits required to allow potential vendors to see site specific constraints. [Explain Requirements.] ☐ US citizen required on-site (foreign nationals require pre-registration 30 days prior to visit.) ☐ Vendor Representative On-Site more than three (3) days. ☐ Other Considerations: [List other considerations to ensure an accurate quote.]
Shipping & Delivery ☐ N/A	Shipping Address: ☒ NIST-Boulder Mail Stop: 672.00 325 Broadway Boulder, CO 80305 Shipping Criteria: ☐ Partial Delivery Acceptable ☐ [Enter Shipping and Delivery information by item.] ☐ Direct Delivery to OU Building Required [Explain Need for Requirement] Building /Room Number: [Enter Building/Room Number] ☐ Building has Loading Dock Containerization Preference: [Enter Container Type] Other Requirements: [List Any Other Requirement] Delivery Date Criteria: ☒ Delivery Shall Be Competed No Later Than: 60 days ARO ☐ Delivery Shall Be Made No Earlier Than: Click or tap to enter a date. ☐ Scheduled Deliveries: Item Number / Due Date ☐ Other: [List Other Shipping, Delivery or Special Requirements.]
Electronic Media ☐ N/A	[Enter Electronic Media Requirements by Item.] ☐ Software ☒ Electronic Manuals ☐ License Key ☐ Other: [List Any Other Electronic Media Requirements] ☐ US Government Email Address for Software Delivery: [Enter Address]
Installation ☒ N/A	[Enter Installation Requirements by Item] ☐ Vendor Technician on Site ☐ Rigging ☐ Uncrating / Unpackaging ☐ Removal of Packaging Material ☐ Equipment Set Up ☐ Start-Up Services ☐ Turnkey Installation ☐ Other: [Enter Details] NOTE: TPOC shall be the coordination POC.

Facility / Utility Considerations
☒ N/A

[List Site Specific Utility Considerations by Item]

☐ OFPM Work Order Numbers
[List Work Order Numbers]

☐ Power Available
Voltage: [Enter voltage] (V)
Maximum Current: [Enter max current draw] (A)
Phase: [Choose Phase]
Frequency: [Typically 60Hz] (Hz)
NEMA Plug Type: [Enter Plug Type] (i.e.: NEMA L5-20P)
Environment: [Choose Environment]
Other Power Considerations:
[List Any Other Power Considerations.]

☐ Utility Connections:
[List Relevant Available Utilities, Pressure(s) and Flowrate(s).]

☐ Other Considerations:
[List Other Considerations to Ensure an Accurate Quote.]

Inspection and Acceptance
☐ N/A

[Inspection Requirements Per Item (Who, When, What, Where)]

☒ On-Site
☒ Acceptance Not Expected to Exceed 7 Business Days
☐ Acceptance Expected to Exceed 7 Business Days:
[Duration]
☐ Inspection and Acceptance Plan:
[Explanation]
☐ Other:
[Enter Other Requirements]

Training
☒ N/A

Training Requirements (Who, When, What, Where)

☐ Number of Trainees: [Enter Number of Trainees]
☐ On-Site
☐ Off-Site Location: [Enter Location(s)]
Is Trainee Travel Required: [Choose Answer]

Scope of Training
☐ Operation ☐ Maintenance ☐ Troubleshooting
☐ Safety ☐ Other
[Enter Other Scope of Training Requirements]

☐ Training Materials to be Provided by Government:
[Describe Materials]
☐ Training Materials to be Provided by Vendor:
[Describe Materials]
☐ Other
[Enter Other Training Requirements]

NOTE: SME shall be coordination POC.

Warranty
☐ N/A

Base Manufacturer Warranty is acceptable
Warranty Length: 12 months

What is included?
☐ Labor ☐ Parts ☐ Travel
☐ Cost and Liability for Returns
☐ Other
[Enter Other Requirements]
☐ 1 Option Period
☐ 2 Option Periods
☐ 3 Option Periods
☐ 4 Option Periods (Maximum)

Calibration
☒ N/A

[Describe Calibration Requirements Per Item]
Calibration Plan Length: [i.e. 3 - Years]
What is Included?
☐ Labor ☐ Spare Parts ☐ Consumables
☐ Travel ☐ Cost and Liability for Shipment
☐ Software Updates ☐ Manuals
☐ Other
[Enter Other Requirements]
☐ Requirements:
[Enter Requirements] (i.e.: On-Site Within 72 hours, etc.)
☐ 1 Option Period
Length: [i.e. 1 – Year / 6 - Months]
☐ 2 Option Periods
☐ 3 Option Periods
☐ 4 Option Periods (Maximum)

Maintenance ☒ N/A	[Describe Maintenance Requirements Per Item] Maintenance Plan Length: [i.e. 3 - Years] What is Included? ☐ Labor ☐ Spare Parts ☐ Consumables ☐ Travel ☐ Cost and Liability for Shipment ☐ Software Updates ☐ Manuals ☐ Other [Enter Other Requirements] ☐ Requirements: [Enter Requirements] (i.e.: On-Site Within 72 hours, etc.) ☐ 1 Option Period Length: [i.e. 1 – Year / 6 - Months] ☐ 2 Option Periods ☐ 3 Option Periods ☐ 4 Option Periods (Maximum)
Government Furnished Material / Equipment ☒ N/A	List Any Government Furnished Material / Equipment Per Item] ☐ Samples for Testing ☐ Equipment which will leave Government Site Description: [Enter Description] Serial Number: [Enter Serial Number] NIST Property Number: [Enter NIST Property Number] ☐ Other: [Enter Other Details]
Travel ☒ N/A	[Describe any Travel Requirements Per Item] ☐ Explain: [Enter Justification / Requirement] ☐ Other: [Enter Other Requirements] NOTE TO VENDOR: To the maximum extent possible, include travel requirement estimates as part of pertinent sections above (Installation, Maintenance, Repair, etc.). Otherwise, Travel will be a separate line item, reimbursable per the Federal Travel Regulation.