Requirements / Specification Document

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

TITLE: Superconducting Qubit Control System

Requesting Laboratory / Division / Group:

Communications Technology Laboratory
Quantum Communications Division
Scalable Quantum Computing Group (676.01)

General Statement of Need:

The National Institute of Standards and Technology (NIST), along with the Superconductive Electronics Group (676.01) is developing superconducting quantum bit ("qubit") as a potential standard test instrument. The testing of this standard qubit requires shaped microwave signals generated by an Arbitrary Waveform Generator (AWG) that can generate signals in the 4-6 GHz frequency range signals has at least 12 bits of resolution and it has the capacity of digitizing the down converted readout signals for active feedback control. The cavity readout pulses will be in the 7-10 GHz range We wish to purchase a new arbitrary waveform generator to facilitate the development and testing of our qubit reference system.

Item Specifications and Quantities:

Item 1:	Superconducting Qubit Control System	
Quantity:	1 EACH	
Specifications:		
	1	The arbitrary waveform generator (AWG) superconducting qubit control system must have at least 8 independent output channels (read from different memory sections) with output frequencies of up to 10 GHz and a baseband frequency of at least 400 MHz bandwidth
	2.a	Baseband frequency 400 MHz per channel.
	2.b	Max RF power must exceed 0 dBm
	3	Ability to choose between at least 65536 voltage levels (16-bit) for each sample
	4	Peak-to-peak maximum voltage of at least 500 mV into 50Ω for each output
	5	Ability to take and deliver a clock and fast trigger signal.
	6	10 Digital output channels
	7	At least 2 analog input channels with a range of at least 10 GHz
	7.1	Input channels bandwidth of at least 400 MHz
	7.2	At least 12 bit resolution
	8	Real-Time Capabilities for active feedback control of the output channels with a maximum feedback latency of 700 ns for both digital and analog.
	9	Self-contained and powered using standard 120Vac / 60 Hz wall power.
	10	Rack mountable
	11	Be an established commercial product with multiple units operating successfully in the field. Experimental, prototype, or custom items are not acceptable.
	12	Shall be a new (not refurbished or reconditioned) item covered by the original manufacturer's full warranty with service provided by that manufacturer's U.S.-based service organization. The use of "gray market" components not authorized for sale in the U.S. by the proposer is not acceptable.

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: 676.01 325 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: SME 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: 1
☒ On-Site
☐ Off-Site Location: [Enter Location(s)]
Is Trainee Travel Required: NO

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 Either an in-person or zoom session for training of the usage of the equipment. NOTE: TPOC shall be coordination POC.
Warranty ☐ N/A	Base Manufacturer Warranty is acceptable Warranty Length: What is included? ☐ Labor ☐ Parts ☐ Travel ☐ Cost and Liability for Returns ☐ Other ☐ 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.