



Contract code SU739000HO2024084

Technical specifications for contract the provision a set of basic instrumentation in the sub-terahertz frequency domain for a communication laboratory

By submitting a tender, the participating bidders accept the technical specifications established herein, which are considered the minimum compulsory requirements.

Any proposal that does not comply with the minimum requirements set out in these technical specifications will be excluded from the procurement procedure.

1. Subject of the contract or need of the contracting authority

The purpose of these technical specifications is to establish the particular conditions that will govern the provision a set of basic instrumentation in the sub-terahertz frequency domain for a communication laboratory.

2. Activities and functions of participating bidders

Bidders must take on the following functions:

- Deliver the equipment at the designated UPC facilities located in Barcelona, Spain
- Provide the necessary elements for the operation of the equipment.

The tenders submitted by participating bidders must cover all the activities and functions mentioned in these technical specifications and in the special conditions for public contracts, all of which are compulsory for a tender to be admitted.

3. Compulsory general technical requirements of the provision and/or performance criteria or functional requirements of the provision

Bidders must have the sufficient technical, material and qualitative means and human resources to carry out the tasks that are the subject of this contract.

The service regulated in these specifications must meet, at a minimum, the following technical requirements, without prejudice to the award criteria:

- **A) One (1) Vector Network Analyzer with the following minimum requirements:**
 - A1- Four ports with ruggedized 2.92 mm connector
 - A2- Operation frequency range from 10 MHz to 43.5 GHz.



- A3- Direct Access to the receive/Sources for each port (overpass of port directional couplers).
- A4-Generator power linearity with an output power of -40 dBm to +10 dBm over the entire frequency range and without power calibration: 0.2 dB typical.
- A5-Directivity and source match in the range of 10 MHz to 40 GHz: >6 dB (specified) and >10 dB (typical) (without correction)
- A6-Accuracy in transmission measurements: 0.07 dB and 2°, specified for transmission coefficients between 0 and -30 dB, in the range of 40 GHz to 43.5 GHz (measured)
- A7-Accuracy in reflection measurements: 0.22 dB and 1.5°, at 0 dB reflection level, in the range of 40 GHz to 43.5 GHz (measured)
- A8- The equipment must include 6 internal and independent coherent phase sources.
 - 4 internal sources for the RF ports from 10 MHz to 43.5 GHz adjustable in amplitude and phase.
 - 2 additional LO sources, one up to 43.5 GHz and one up to 26.5 GHz, at least one of them with an externally available output and adjustable in amplitude and phase. It allows measurements of mixers and group delay, as well as Phase arrays
- A9- The equipment must be prepared and include the option to perform measurements as a spectrum analyzer.
- A10- Stimulation of the 4 sources in true differential mode (180° phase output) that allows avoiding the use of external baluns and stimulating the DUTs with real differential signal.
- A11- The equipment must include the hardware options for LO output and IF inputs to extend the frequency range up to 400 GHz using external converters.
- A12- External frequency reference inputs: BNC from 1 MHz to 50 MHz and SMA from 100 MHz/1 GHz
- A13 -Following the current energy efficiency guidelines, the equipment must not exceed 600 W of maximum power consumption.
- A14 -The weight must be less than 30 kg, to facilitate transport between different laboratories and setups.
- A15- The equipment must be new. No demo or refurbished equipment is accepted.



With the following accessories:

- A-16 4 RF Cables of 50 Ohm with 2.92 mm(f) -2.92 mm(m) connectors covering the instrument frequency range and minimum length of 610 mm
- A17 4 RF cables of 50 Ohm with 2.92 mm(f) - 2.92 mm(m) connectors that cover the instrument's frequency range and minimum length of 910 mm
- A18 The equipment must add 4 additional 2.92 mm(m) - 2.92 mm(f) transitions
- **B) Set of frequency range extenders with the following minimum requirement**
 - B1- The set must include two transmitter/receiver units that must be able to cover the frequency range from 110 GHz to 400 GHz. The required frequency range can be covered with different units.

The bidder must meet the following requirements

- B2- The operation of the frequency range extenders must be compatible with the Vector Network Analyzer of point A.
- B3- They will include a control interface type USB or similar to connect the extenders to the VNA and automatically recognize (plug and play) the extenders, allowing establishing the frequency, appropriate calibration and protection of the input voltage of the converters in an automatic way.
- B4- Variable output power through a manual adjustable mechanical attenuator integrated in the extender: 0 dB to 40 dB
- B5- The required power supply to operate at least 2 frequency extenders must be supplied.
- B6- At least 2 power supply cables of minimum length of 2 m must be supplied.
- B7- At least 4 RF cables of 50 Ohms, 3.5mm(f)-3.5mm(m), DC to 26.5 GHz with minimum length of 1,5 m

The following accessories must be provided to cover the full frequency range from 110 GHz to 400 GHz, that is a full set of accessories must be provided for each frequency extender with the appropriate waveguide dimensions.

- B8- 2 waveguide straight sections minimum length 1"
- B9- 2 waveguide 90° twists minimum length 1"
- B10- 2 conical horn antennas with 20 dB gain



- **C) One (1) vector signal analyzer with the following minimum requirements**
- C1 Frequency range from 2 Hz to 67 GHz
- C2 Frequency reference accuracy per year: $\pm 1 \times 10^{-7}$
- C3 Temperature drift: $\pm 1 \times 10^{-7}$
- C4 Initial accuracy after calibration: $\pm 1 \times 10^{-8}$
- C5 Bandwidth resolution from 1 Hz to 10 MHz
- C6 Compression level at 1 dB for two tones at the input of the mixer, without preamplifier: +15 dBm up to 3 GHz, +10 dBm from 3 GHz to 8 GHz, and +7 dBm for frequencies above 8 GHz
- C7 Resolution bandwidths of 1 Hz to 10 MHz in steps of 1/2/3/5
- C8 Third-order intercept point (TOI): Up to 1 GHz, +25 dBm (+30 dBm typical)
- C9 Equipment noise level at 1 Hz RBW without activated preamplifier and without noise cancellation:
 - YIG preselector on:
 - -119 dBm from 49 GHz to 50 GHz
 - -138 dBm from 50 GHz to 55 GHz
 - -134 dBm from 55 GHz to 62 GHz
 - -130 dBm from 62 GHz to 67 GHz
 - YIG preselector off:
 - -122 dBm from 49 GHz to 50 GHz
 - -138 dBm from 50 GHz to 55 GHz
 - -134 dBm from 55 GHz to 62 GHz
 - -130 dBm from 62 GHz to 67 GHz
 - Equipment noise level at 1 Hz RBW with activated preamplifier of 30 dB, without noise cancellation, and with YIG preselector on:
 - -154 dBm from 50 GHz to 52 GHz
 - -152 dBm from 52 GHz to 54 GHz
 - -150 dBm from 54 GHz to 62 GHz
 - -147 dBm from 62 GHz to 67 GHz
- C10 Able to drive external mixers for upper frequency extension
- C11 Internal preamplifier with 30 dB minimum gain covering the frequency range from 100 KHz to 67 GHz.
- C12 Set of external mixers allowing the extend the frequency range of operation from 60 GHz to 325 GHz.
- C13 The weight must be less than 24 kg, to facilitate transport between different laboratories and setups.



- C14 Following the current energy efficiency guidelines, the equipment must not exceed 320 W of maximum power consumption.
- C15 User interface: Control of all equipment functions in local mode with integrated touch screen and keyboard in the equipment itself.
- C16 The equipment must be new. No demo or refurbished equipment is accepted.

- **D) Two (2) Frequency synthesizers with the following minimum requirements**
- D1 Frequency range from 8 kHz to 40 GHz
- D2 RF output connector: PC 2.92 mm female
- D3 Frequency error after factory calibration: $<1 \times 10^{-7}$
- D4 Minimum peak power (PEP) specified output power range:
 - 8 kHz to 100 kHz: -90 dBm to +5 dBm
 - 100 kHz to 200 kHz: -110 dBm to +5 dBm
 - 200 kHz to 1 MHz: -127 dBm to +8 dBm
 - 1 MHz to 80 MHz: -127 dBm to +13 dBm
 - 80 MHz to 18 GHz: -127 dBm to +14 dBm
 - 18 GHz to 40 GHz: -127 dBm to +13 dBm
- D5 Phase noise specified at a 20 kHz offset from the carrier, at a level of 10 dBm and measured with a 1 Hz bandwidth filter:
 - f=100 MHz: <-142 dBc, (-150 dBc typical)
 - f=1 GHz: <-126 dBc, (-132 dBc typical)
 - f=2 GHz: <-120 dBc, (-126 dBc typical)
 - f=3 GHz: <-116 dBc, (-123 dBc typical)
 - f=4 GHz: <-114 dBc, (-120 dBc typical)
 - f=6 GHz: <-110 dBc, (-117 dBc typical)
 - f=10 GHz: <-106 dBc, (-112 dBc typical)
 - f=20 GHz: <-100 dBc, (-106 dBc typical)
 - f=40 GHz: <-94 dBc, (-100 dBc typical)
- D6 Maximum reflected input power supported from a 50 Ω source: 0.5 W. Protection through mechanical relay in case of overloading.
- D7 Maximum DC voltage permitted: 1 V
- D8 USB connector for external devices such as mouse, keyboard, power sensors, data exchange.
- D9 Integrated 5" touch screen in the equipment for visualization and control of the equipment.
- D10 The equipment must add 2 additional 2.92 mm(m) – 2.92 mm(f) transitions



- D11 The weight must be less than 11 kg, to facilitate transport between different laboratories and setups.
- D12 Following the current energy efficiency guidelines, the equipment must not exceed 140 W of maximum power consumption.
- D13 The equipment must be new. No demo or refurbished equipment is accepted.
- **E) Digital oscilloscope with the following minimum requirements**
 - E1 Four channels with Impedance of each channel: 50 ohms and 1 Mohm
 - E2 Maximum frequency of operation 6 GHz
 - E3 Sampling rate 20 Gsamples/s
 - E4 Minimum memory digital channel 200 PTs/channel
 - E5 Real time acquisition velocity > 1.000.000 Wfm/s
 - E6 Minimum vertical resolution without software magnification with full bandwidth at 50 ohms and 1 Mohm: 1 mV/div.
 - E7 Maximum vertical resolution with full bandwidth at 50 ohms: 1 V/div, and at 1 Mohm: 10 V/div.
 - E8 Isolation between channels at all vertical scales and bandwidths:
 - 1. ≤ 2 GHz: >60 dB
 - 2. >2 GHz ≤ 4 GHz: >50 dB
 - 3. >4 GHz ≤ 6 GHz: >40 dB
 - E9 The equipment must be delivered with 8 passive probes of 500 MHz, 10:1, 1 M Ω , 9.5 pF, max.400V
 - E10 The weight must be less than 11 kg, to facilitate transport between different laboratories and setups.
 - E11 Following the current energy efficiency guidelines, the equipment must not exceed 450 W of maximum power consumption.
 - E12 The equipment must be new. No demo or refurbished equipment is accepted.
- Deliver the equipment at the designated UPC facilities located in Barcelona, Spain
- The equipment must comply with the EMC and Safety regulations of the European Union.
- Deliver all the listed accessories.



- Delivery time of less than 5 months.

4. System for monitoring and controlling the execution of the specifications

The contractor must appoint a person who will be entrusted with managing the execution of the contract, who must guarantee the quality of the subject of the contract and deal directly with any issues related to the normal development of the tasks indicated herein with the interlocutor designated by the contracting authority.

5. Technical documents to be provided by successful bidder

The technical specifications proposed by the bidding company in its tender will become obligatory conditions that must be fulfilled during the execution of the contract if the bidding company is awarded the contract.

The person in charge of the contract

Jordi Romeu Robert

Barcelona, at the date of the signature