Annex no 1

**Detailed description of the subject of the order**

**Name:** programmable radio (software-defined radio) with delivery

One new programmable radio that meets the following requirements:

|  |  |
| --- | --- |
| **Key Specifications** | |
| RF capabilities | 4 TX, 4 RX, independently tunable  Superheterodyne architecture  1 MHz to 7.2 GHz, tunable up to 8 GHz  Up to 400 MHz bandwidth per channel |
| Processing system (PS) | Quad Core ARM Cortex-A53 (1200 MHz)  4 GB DDR4 |
| Programmable logic (PL) | FPGA: RFSoC ZU28DR  2 × 4 GB DDR4 |
| Software | UHD version 4.1 or later  RFNoC  GNU Radio  C/C++  Python  OpenEmbedded Linux on A53  NI-USRP 20.8 or later  LabVIEW 2020 or later  LabVIEW FPGA 2020 or later |
| Synchronization | REF IN (clock reference input)  PPS IN (PPS time reference)  TRIG IN/OUT  GPSDO included  OCXO included |
| Digital interfaces | 2 QSFP28 (10/100 GbE, Aurora)  2 iPass+ zHD (cabled PCIe Gen3 x8)  Ethernet (1 GbE to PS)  2 USB-C (USB to PS, Console/JTAG)  2 HDMI (GPIO) |
| Power, form factor | 12 V DC, 16 A maximum  Half-wide RU  28.5 cm × 22.2 cm × 4.4 cm |

**Controller**

**Processing System**

|  |  |
| --- | --- |
| CPU | Quad Core ARM Cortex-A53 (1200 MHz) |
| Memory | 4 GB DDR4, 2.4 GT/s |
| NVM | 16 GB eMMC (Pseudo SLC) |
| RJ45 | 1 GbE host connection |
| USB-C | USB to PS (USB 2.0)  USB Console/JTAG |

**Programmable Logic**

|  |  |
| --- | --- |
| FPGA | Xilinx RFSoC XCZU28DR Speed Grade -1 |
| Memory | 2 × 4 GB DDR4, 2.4 GT/s |
| SD-FEC | 8 dedicated SD-FEC cores |
| QSFP28 | 2 × 4 lanes  10/100 GbE, Aurora[[3]](https://www.ni.com/docs/en-US/bundle/ettus-usrp-x410-specs/page/specs.html#note-d670e442) |
| iPass+ zHD | 2 × 4 lanes  PCIe Gen3x8[[4]](https://www.ni.com/docs/en-US/bundle/ettus-usrp-x410-specs/page/specs.html#note-d670e461) |
| GPIO | 2 HDMI  12 I/O lines per connector  Maximum data rate 100 Mbps  Selectable I/O voltage (3.3 V, 2.5 V, or 1.8 V) |
| Trigger | SMA: Trigger In/Out (3.3 V I/O voltage) |

**Baseband**

|  |  |
| --- | --- |
| Maximum I/Q sample rates | 491.52 MSps  500.00 MSps |
| Number of available channels | 4 |
| ADC resolution | 12 bit |
| DAC resolution | 14 bit |

**RF**

**Transmitter**

|  |  |
| --- | --- |
| Number of channels | 4 |
| Frequency range | 1 MHz to 7.2 GHz, tunable up to 8 GHz |
| Frequency step | <1 Hz |
| Maximum output power | <23 dBm |
| TX/RX settling time | 0.3 μs [[7]](https://www.ni.com/docs/en-US/bundle/ettus-usrp-x410-specs/page/specs.html#note-d670e662) |
| TX gain settling time | 1 μs |
| Gain range | 60 dB, nominal |
| Gain step | 1 dB, nominal |
| **TX phase noise, 1 GHz carrier frequency, 23 °C, nominal** | |
| 1 kHz offset | -91 dBc/Hz |
| 10 kHz offset | -101 dBc/Hz |
| 100 kHz offset | -103 dBc/Hz |
| Maximum instantaneous real-time bandwidth | 400 MHz |
| Average noise density (23 °C, 10 MHz to 8 GHz)[[9]](https://www.ni.com/docs/en-US/bundle/ettus-usrp-x410-specs/page/specs.html#note-d670e791) | -146 dBm/Hz |

**Receiver**

|  |  |
| --- | --- |
| Number of channels | 4 |
| Frequency range | 1 MHz to 7.2 GHz, tunable up to 8 GHz |
| Frequency step | <1 Hz |
| **Gain range** | |
| ≤500 MHz | 38 dB, nominal |
| >500 MHz | 60 dB, nominal |
| Gain step | 1 dB, nominal |
| **Maximum input power, damage level** | |
| ≤3 GHz | +14 dBm continuous |
| >3 GHz | +17 dBm continuous, +20 dBm for up to 5 minutes |
| Maximum operating power | 0 dBm |
| RX gain settling time | 0.3 μs |
| **Noise figure** | |
| 500 MHz to 3.1 GHz | 8 dB |
| 3.1 GHz to 6 GHz | 6.5 dB |
| 6 GHz to 8 GHz | 9 dB |
| Input IP3, 0 dBm input, full scale | +12 dBm |
| Maximum instantaneous real-time bandwidth | 400 MHz |

**GPS Disciplined Oscillator**

|  |  |
| --- | --- |
| **Frequency accuracy** | |
| OCXO (not locked to GPS) | 2.5 ppm |
| OCXO (locked to GPS) | 5 ppb |
| **Active antenna** | |
| Voltage | 3.3 V |
| Power | 0.19 W |
| Frequency band(s) | L1, C/A 1.574 GHz |
| Voltage rating | 12 V |
| Frequency rating | DC |
| Current/power rating | 7 A to 16 A (bitfile dependent) |
| Power supply | 190 W, minimum |

**Physical Characteristics**

**Dimensions**

|  |  |
| --- | --- |
| Enclosure | 26.7 cm × 22.2 cm × 4.4 cm (10.5 in. × 8.7 in. × 1.7 in.) |
| Enclosure and connectors | 28.5 cm × 22.2 cm × 4.4 cm (11.2 in. × 8.7 in. × 1.7 in.) |
| Weight | 2.7 kg (6 lb) |

**Environment**

**Environmental Characteristics**

|  |  |
| --- | --- |
| Operating temperature range | 0 °C to 55 °C |
| Storage temperature range | -40 °C to 71 °C |
| Maximum altitude | 2,000 m (800 mbar) (at 25 °C ambient temperature) |
| Operating humidity range | 10% to 90%, noncondensing |
| Storage humidity range | 5% to 95%, noncondensing |
| Pollution Degree | 2 |

**Shock and Vibration**

|  |  |
| --- | --- |
| Operating vibration | 5 Hz to 500 Hz, 0.3 g RMS |
| Non-operating vibration | 5 Hz to 500 Hz, 2.4 g |
| RMS operating shock | 30 g, half-sine, 11 ms pulse |
| Non-operating shock | 50 g, half-sine, 11 ms pulse |