
Ettus USRP

X410

Specifications

2024-11-25



Contents

Ettus USRP X410 Specifications..... 3

Ettus USRP X410 Specifications

Key Specifications

RF capabilities	<p>4 TX, 4 RX, independently tunable</p> <p>Superheterodyne architecture</p> <p>1 MHz to 7.2 GHz, tunable up to 8 GHz</p> <p>Up to 400 MHz bandwidth per channel</p>
Processing system (PS)	<p>Quad Core ARM Cortex-A53 (1200 MHz)</p> <p>4 GB DDR4</p>
Programmable logic (PL)	<p>FPGA: RFSoc ZU28DR</p> <p>2 × 4 GB DDR4</p>
Software	<p>UHD version 4.1 or later</p> <p>RFNoC</p> <p>GNU Radio</p> <p>C/C++</p> <p>Python</p> <p>OpenEmbedded Linux on A53</p> <p>NI-USRP 20.8 or later</p> <p>LabVIEW 2020 or later</p> <p>LabVIEW FPGA 2020 or later</p>

Synchronization	<p>REF IN (clock reference input)</p> <p>PPS IN (PPS time reference)</p> <p>TRIG IN/OUT</p> <p>GPSDO included</p> <p>OCXO included</p>
Digital interfaces	<p>2 QSFP28 (10/100 GbE, Aurora)¹</p> <p>2 iPass+ zHD (cabled PCIe Gen3 x8)²</p> <p>Ethernet (1 GbE to PS)</p> <p>2 USB-C (USB to PS, Console/JTAG)</p> <p>2 HDMI (GPIO)</p>
Power, form factor	<p>12 V DC, 16 A maximum</p> <p>Half-wide RU</p> <p>28.5 cm × 22.2 cm × 4.4 cm</p>

Definitions

Warranted specifications describe the performance of a model under stated operating conditions and are covered by the model warranty.

Characteristics describe values that are relevant to the use of the model under stated operating conditions but are not covered by the model warranty.

1. 100 GbE is supported in the UHD Toolflow. Aurora streaming is supported in the LabVIEW FPGA Toolflow. Support for these capabilities is not available in UHD 4.1. It will be added in a subsequent release.
2. This feature is supported in the LabVIEW FPGA Toolflow.

- **Typical** specifications describe the performance met by a majority of models.
- **Nominal** specifications describe an attribute that is based on design, conformance testing, or supplemental testing.

Specifications are **Characteristics** unless otherwise noted.

Conditions

Specifications are valid at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ unless otherwise noted.

Controller

Processing System

CPU	Quad Core ARM Cortex-A53 (1200 MHz)
Memory	4 GB DDR4, 2.4 GT/s
NVM ³	32 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
------	--------------------------------------

3. Module assembly H and earlier has an NVM of 16 GB. All other module assemblies have an NVM of 32 GB.

Memory	2 × 4 GB DDR4, 2.4 GT/s
SD-FEC	8 dedicated SD-FEC cores
QSFP28	2 × 4 lanes 10/100 GbE, Aurora ⁴
iPass+ zHD	2 × 4 lanes PCIe Gen3x8 ⁵
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 ⁶	491.52 MSps
	500.00 MSps

4. 100 GbE is supported in the UHD Toolflow. Aurora streaming is supported in the LabVIEW FPGA Toolflow. Support for these capabilities is not available in UHD 4.1. It will be added in a subsequent release.
5. This feature is supported in the LabVIEW FPGA Toolflow.
6. The applicable maximum value depends on the sample rate selected in software.

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 ⁷	<23 dBm
TX/RX settling time	0.3 μ s ⁸
TX gain settling time	1 μ s
Gain range ⁹	60 dB, nominal

7. Maximum output power varies by frequency. See the subsequent TX Measurements section for additional information.

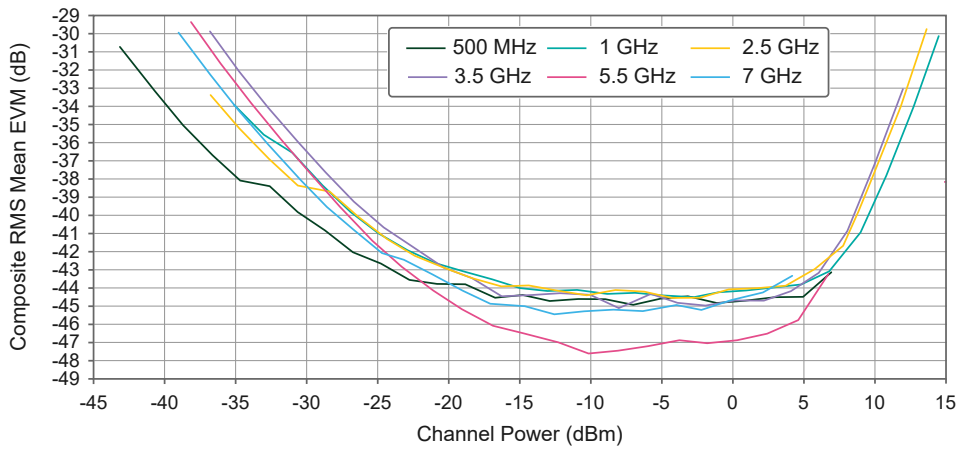
8. This settling time applies to the TX/RX switch.

9. The output power resulting from the gain setting varies over the frequency band and among devices.

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) ¹⁰	-146 dBm/Hz

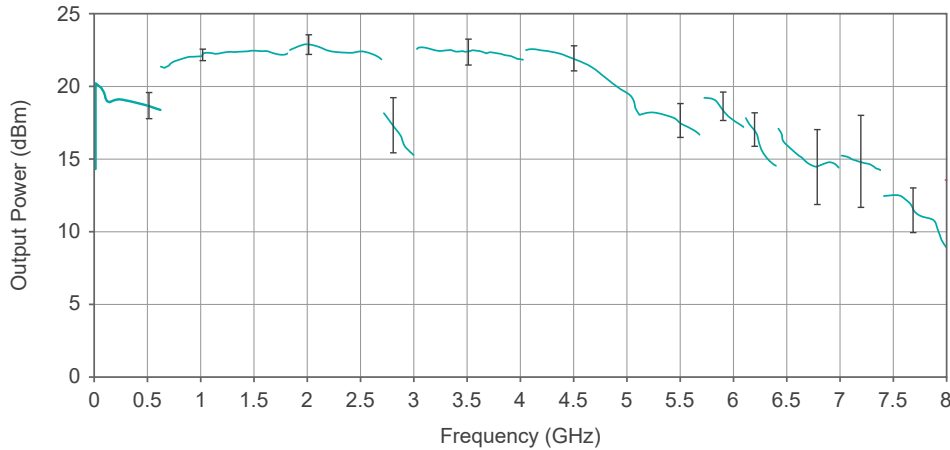
TX Measurements

Figure 1. TX EVM Bathtub Curves: 5GNR, UL, FDD, SISO, 100 MHz BW, 30 kHz SCS, 256 QAM, 23 °C± 5 °C



10. Measured at the TX gain setting required to reach 0 dBm output power with 0 dBFS baseband signal.

Figure 1. TX Maximum Output Power: 0 dBFS CW, Maximum Gain Setting, 23 °C± 5 °C



Note The previous figure depicts the average TX maximum output power based on 4 units with 16 channels total measured at 18 °C, 23 °C, and 28 °C. The bars represent 80% confidence intervals at selected frequencies.

Receiver

Number of channels	4
Frequency range	1 MHz to 7.2 GHz, tunable up to 8 GHz
Frequency step	<1 Hz
Gain range¹¹	
≤500 MHz	38 dB, nominal
>500 MHz	60 dB, nominal

11. The received signal amplitude resulting from the gain setting varies over the frequency band and among devices.

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



Notice It is sometimes necessary to use attenuation when connecting multiple Ettus USRP X410 devices or when creating a loopback connection to avoid damaging the hardware.

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

RX Measurements

Figure 1. RX EVM Bathtub Curves: 5GNR, UL, FDD, SISO, 100 MHz BW, 30 kHz SCS, 256 QAM, 23 °C± 5 °C

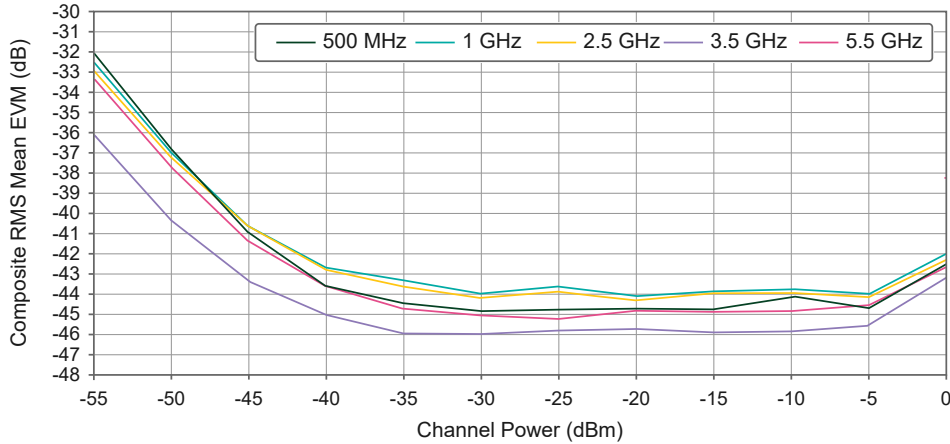
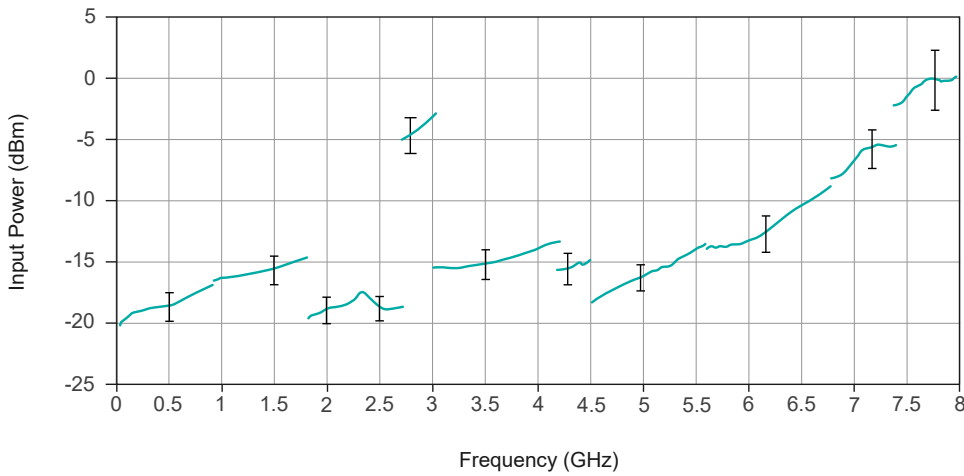


Figure 1. RX Input Power to Reach 0 dBFS: CW Input, 30 dB Gain Setting, 23 °C± 5 °C



Note The previous figure depicts the average RX input power to reach 0 dBFS based on 4 units with 16 channels total measured at 18 °C, 23 °C, and 28 °C. The bars represent 80% confidence intervals at selected frequencies.

GPS Disciplined Oscillator (GPSDO)

Frequency accuracy ¹²	
OEXO (not locked to GPS) ¹³	2.5 ppm
OEXO (locked to GPS)	5 ppb

Active antenna	
Voltage	3.3 V
Power	0.19 W
Frequency band(s)	L1, C/A 1.574 GHz

Power



Notice The protection provided by this product may be impaired if it is used in a manner not described in this document.

Voltage rating	12 V
Frequency rating	DC
Current/power rating	7 A to 16 A (bitfile dependent)
Power supply	190 W, minimum



Caution The product must be powered with an AC adapter offered by NI that meets the power requirements for the product and has appropriate safety certification marks for country of use.

Physical Characteristics

Dimensions

Enclosure	26.7 cm × 22.2 cm × 4.4 cm (10.5 in. × 8.7 in. × 1.7 in.)
-----------	---

- Frequency accuracy** is based on oven-controlled crystal oscillator (OCXO) vendor specifications and is not measured. Alternatively, you can incorporate an external reference source to provide a more precise frequency Reference Clock and to achieve better frequency accuracy.
- Factory default accuracy. Contact NI if your application requires tuning the OCXO output frequency.

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)

Ventilation Clearance and Cooling

This product is designed to operate on a bench or in an instrument rack. Fan vents are located at the back of the product. Standard airflow provision of the product is set up as front to back cooling with option to change the airflow direction in the interest for directing back to front cooling using a fan cartridge accessory.

Adequate clearance is required at the front and back of the product and surrounding equipment, inclusive of indiscriminate heat generating devices, and any potential air flow blockages must be maintained to ensure proper cooling.

Minimum cooling clearances	51 mm (2 in.) at the front and back
----------------------------	-------------------------------------



Note Benchtop and rack mount applications may require additional cooling clearances for optimal airflow and to reduce any unexpected hot air recirculation in either direction of the air inlet fans.

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

Indoor use only.

Environmental Standards

This product meets the requirements of the following environmental standards for electrical equipment.

- IEC 60068-2-1 Cold
- IEC 60068-2-2 Dry heat
- IEC 60068-2-78 Damp heat (steady state)
- IEC 60068-2-64 Random vibration
- IEC 60068-2-27 Shock



Note To verify marine approval certification for a product, refer to the product label or visit ni.com/certification and search for the certificate.

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