Ettus USRP X410 Specifications

Contents

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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)[1]
	2 iPass+ zHD (cabled PCIe Gen3 x8)[2]
	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

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.

- **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 °C ± 5 °C unless otherwise noted.

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]
iPass+ zHD	2 × 4 lanes
	PCIe Gen3x8[4]
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[5]	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[6]	<23 dBm
TX/RX settling time	0.3 µs [7]
TX gain settling time	1 µs
Gain range[8]	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]	-146 dBm/Hz

TX Measurements

Figure 2. TX EVM Bathtub Curves: 5GNR, UL, FDD, SISO, 100 MHz BW, 30 kHz SCS, 256 QAM, 23 °C± 5 °C
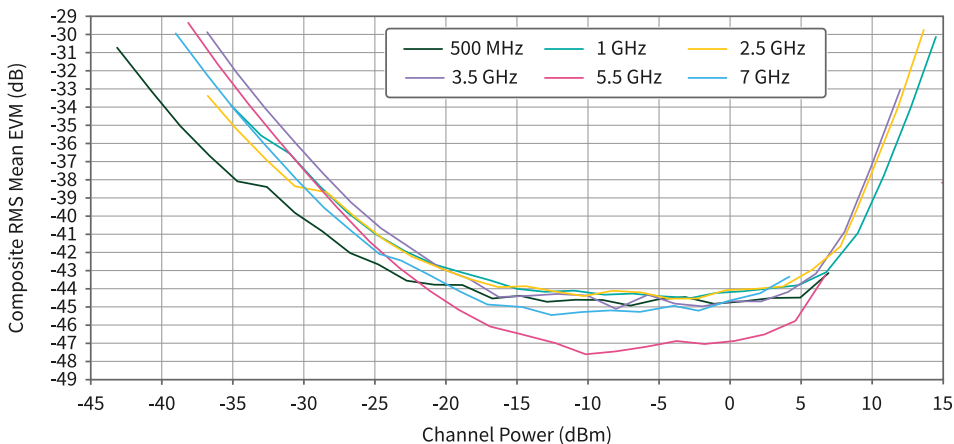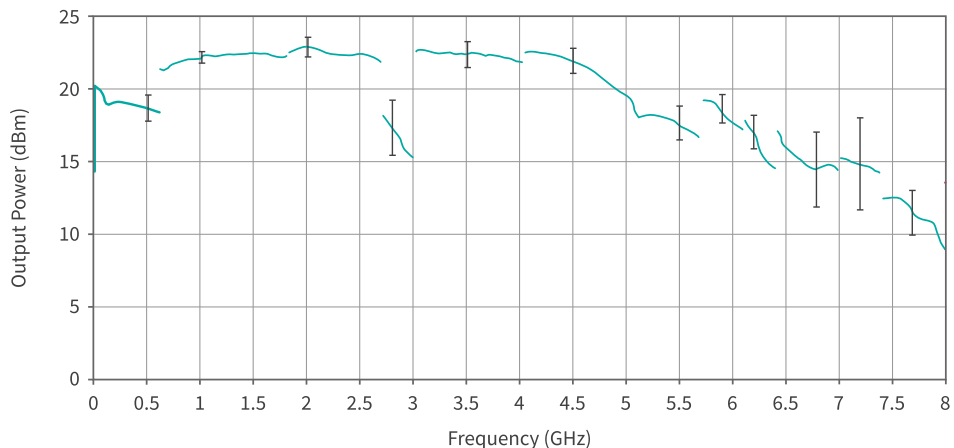

Figure 2. TX Maximum Output Power: 0 dBFS CW, Maximum Gain Setting, 23 °C± 5 °C

> **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 range[10]

≤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

> **(!) 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

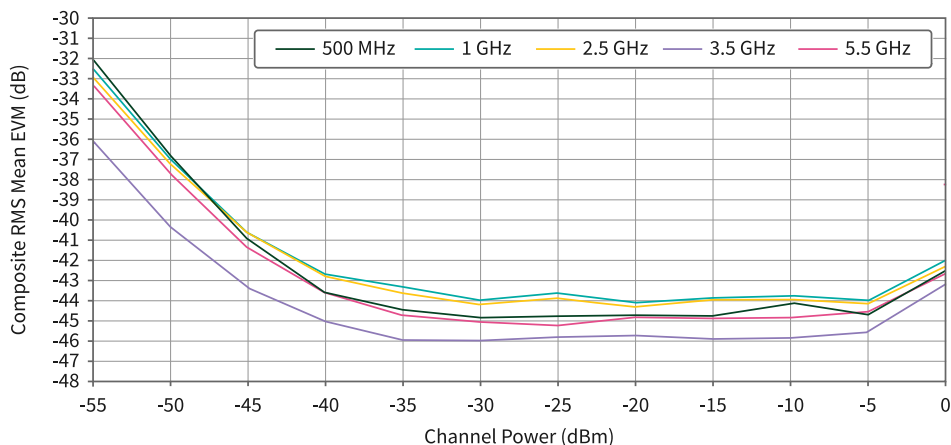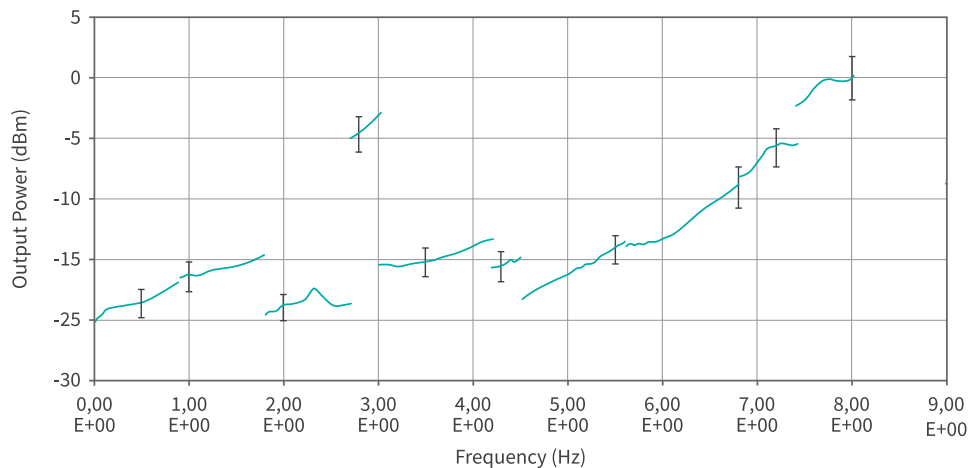Figure 4. RX EVM Bathtub Curves: 5GNR, UL, FDD, SISO, 100 MHz BW, 30 kHz SCS, 256 QAM, 23 °C± 5 °C

Figure 4. 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[11]

OCXO (not locked to GPS)[12]	2.5 ppm
OCXO (locked to GPS)	5 ppb

Active antenna

Voltage	3.3 V
Power	0.19 W

Power

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

Voltage range	12 V ± 5%
Current	16 A, maximum
Power	200 W, maximum

> ⊘ **Notice** The power supply must also meet any safety and compliance requirements for the country of use.

> ✎ **Note** NI recommends using the Ettus USRP X410 with the provided power supply (part number 723704-01). Contact NI if a replacement is needed.

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   2.5 kg (5.5 lb)

Environment

Operating temperature range   0 °C to 55 °C

Maximum altitude   2,000 m (800 mbar) (at 25 °C ambient temperature)

Relative humidity range   10% to 90%, noncondensing

Pollution Degree   2

Indoor use only.

[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.

[3] 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.

[4] This feature is supported in the LabVIEW FPGA Toolflow.

[5] The applicable maximum value depends on the sample rate selected in software.

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

[7] This settling time applies to the TX/RX switch.

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

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

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

[11] **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.

[12] Factory default accuracy. Contact NI if your application requires tuning the OCXO output frequency.