NI PXIe-5641R Specifications

Reconfigurable IF Transceiver

This document lists the specifications of the NI PXIe-5641R IF transceiver.

Specifications are warranted by design and under the following conditions unless otherwise noted:

- 10 minutes warm-up time
- Calibration cycle maintained
- Chassis fan speed set to High

Specifications indicated as maximum or minimum values describe the warranted, traceable product performance over ambient temperature ranges of 0 °C to 55 °C, unless otherwise noted.

Typical values describe useful product performance beyond specifications that are not covered by warranty and do not include guardbands for measurement uncertainty or drift. Typical values may not be verified on all units shipped from the factory. Unless otherwise noted, typical values cover the expected performance of units over ambient temperature ranges of 25 ±10 °C with a 90% confidence level, based on measurements taken during development or production.

Nominal values (or supplemental information) describe additional information about the product that may be useful, including expected performance that is not covered under *Specifications* or *Typical* values. Nominal values are not covered by warranty.

Specifications are subject to change without notice. Visit `ni.com/manuals` for the most current specifications and product documentation.

After installing NI-5640R instrument driver software (the instrument driver that is used with the NI PXIe-5641R), you can access all NI PXIe-5641R documentation, including the *NI IF Transceiver Getting Started Guide*, by navigating to **Start» All Programs»National Instruments»NI-5640R»Documentation**.

IF Input

Number of channels 2

ADC Resolution..... 14 bits

Sample rate ..... 30 MS/s to 100 MS/s

Full-scale input range..... +8.5 dBm peak at 10 MHz ± 1 dB typical (1.7 V_{pk-pk} sine, 0.60 V_{RMS})

Maximum input level without damage..... +24 dBm peak (10 V_{pk-pk} sine, 3.5 V_{RMS})

Input coupling ..... AC

Input impedance..... 50 Ω nominal

Input return loss ..... <–15 dB typical, 250 kHz to 80 MHz

Maximum DC input voltage without damage ..... 10 V

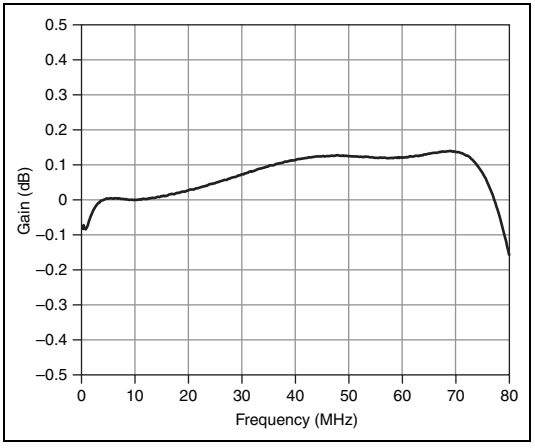

Figure 1. Measured Input Frequency Response (Passband)

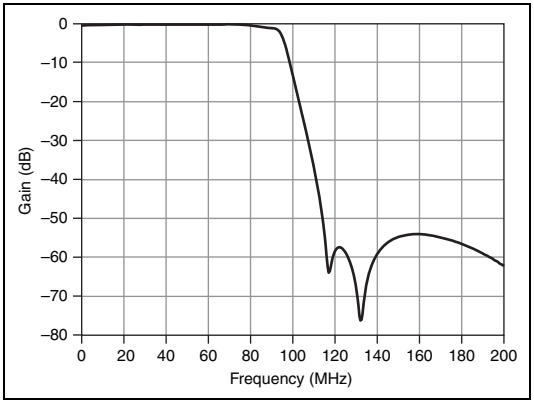

Figure 2. Measured Input Frequency Response (Broadband)

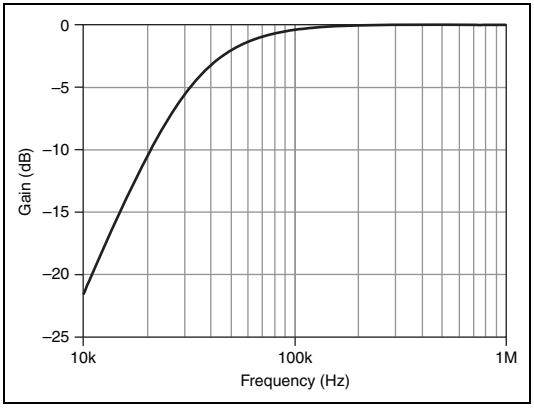

Figure 3. Measured Input Frequency Response (Low Frequency)

Average noise density .....–143 dBm/Hz typical

Signal-to-noise ratio .....>76 dB typical
(–1 dBfs at 68 MHz tone, bandwidth = 10 MHz)

Maximum instantaneous bandwidth .....20 MHz (limited by digital downconverter)

Passband flatness (referenced to 10 MHz) 250 kHz to 80 MHz .....<+0.33 dB, –0.55 dB typical

AC coupling cutoff frequency (–3 dB).....50 kHz typical

Input group delay variation .....10 ns peak-to-peak typical, 250 kHz to 80 MHz

Stopband rejection .....>50 dB typical at 120 MHz, referenced to 10 MHz

Channel-to-channel crosstalk

<40 MHz ..... <–70 dB typical

40 to 80 MHz..... <–60 dB typical

Phase Noise

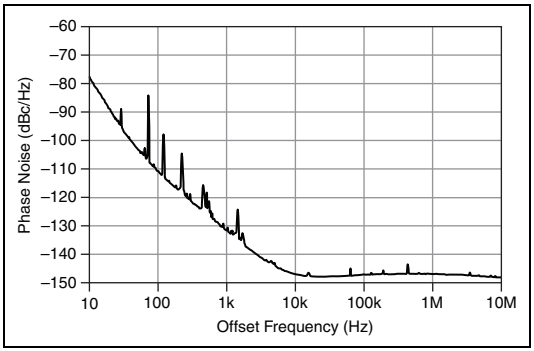

Figure 4. Measured Phase Noise (Carrier Frequency = 62.922 MHz)

Spectral Characteristics

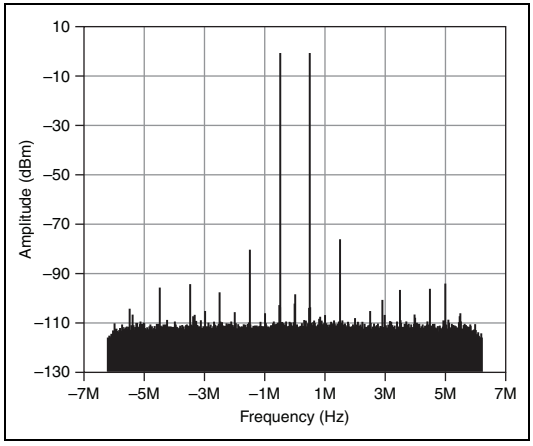

Figure 5. Measured Analog Input Two-Tone Intermodulation Distortion (IMD) (Center frequency at 70 MHz, Two Carriers at 70 MHz ± 0.5 MHz, 0 dBm Each)

Third-order intercept (TOI) ..... +38 dBm typical

Digital Downconverter (DDC) Characteristics

Number of channels ..... Up to 6 per ADC channel

DDC resolution ..... 16 bits for both I and Q data

Decimation ..... ÷4 to ÷4,096*

Tuning resolution ..... ADC clock/2^{32}
More information about the ADC is included in the *Timebase System* section.

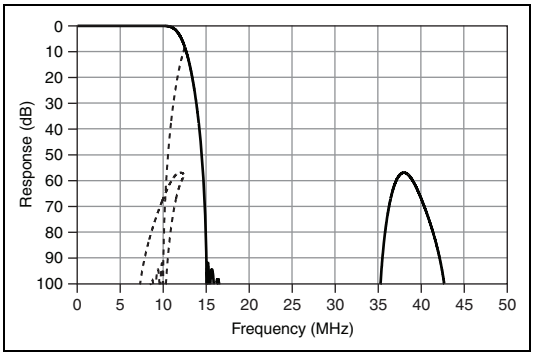

Figure 6. DDC Filter Performance, 20 MHz Span (Solid) and Aliasing After Decimation (Dashed)

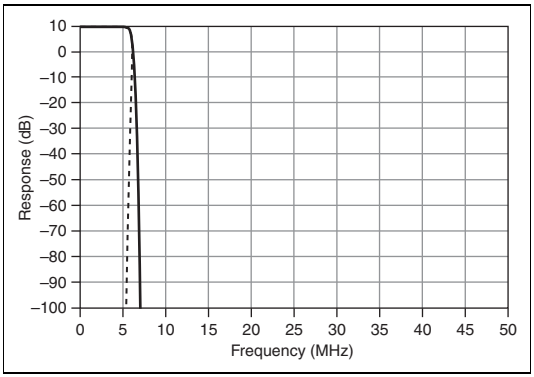

Figure 7. DDC Filter Performance, 10 MHz Span

Sample DDC filter performance plots use NI-5640R 1.3 instrument driver library example filter designs. Figure 6 depicts a 20 MHz span; Figure 7 depicts a 10 MHz span. The dark lines show the true response of the digital filter in the DDC. The dashed lines show the effect of aliasing after decimation. Notice that for a 10 MHz span, the DDC filter aliasing artifacts have virtually no impact; whereas for a full 20 MHz span, signals at frequency offsets near ±40 MHz can alias back up to –66 dBc within the ±10 MHz passband near the band edges.

IF Output

Number of channels 2

DAC Resolution ..... 14 bits

Sample rate ..... 30 MS/s to 200 MS/s

Output coupling ..... AC

Output impedance ..... 50 Ω nominal

Output return loss ..... <–15 dB typical, 250 kHz to 80 MHz

Maximum DC bias voltage without damage ..... 10 V

Average noise density ..... –153 dBm/Hz typical

Signal-to-noise ratio

+2 dBm output level ..... >69 dB typical

–4 dBm output level ..... >64 dB typical

Full-scale output range

CIC and inverse sinc ON ..... –4 dBm peak† at 10 MHz ± 1 dB typical (0.4 $V_{peak\text{-}to\text{-}peak}$ sine, 0.14 V_{RMS})

Filters off, uncompensated ..... +2 dBm peak† at 10 MHz ± 1 dB typical (0.8 $V_{peak\text{-}to\text{-}peak}$ sine, 0.28 V_{RMS})

Output protection ..... Indefinite duration short to ground

Maximum reverse power without damage ..... +24 dBm peak (10 $V_{pk\text{-}pk}$, 3.5 V_{RMS})

Passband flatness (referenced to 10 MHz) ..... <±1 dB typical, 250 kHz to 80 MHz (With CIC and sinc compensation filter ON)

AC coupling cutoff frequency (–3 dB) ..... 50 kHz typical

* Higher decimation is possible using LabVIEW FPGA, depending on performance requirements.

† Instrument driver enables CIC and inverse sinc compensation by default, and the compensation cannot be bypassed.

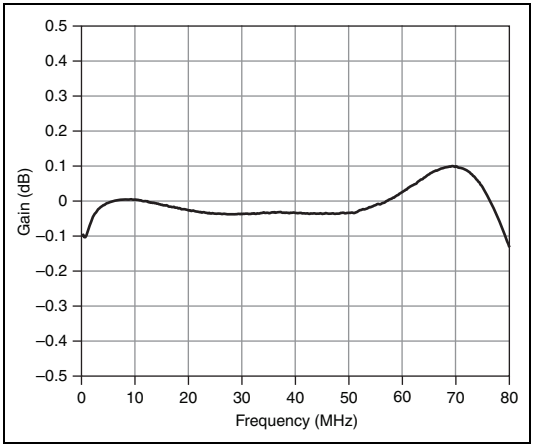

Figure 8. Measured Analog Output Passband Flatness (Referenced to 10 MHz)

Channel-to-channel crosstalk

<40 MHz.....<–70 dB typical

40 MHz to 80 MHz.....<–60 dB typical

Spectral Characteristics

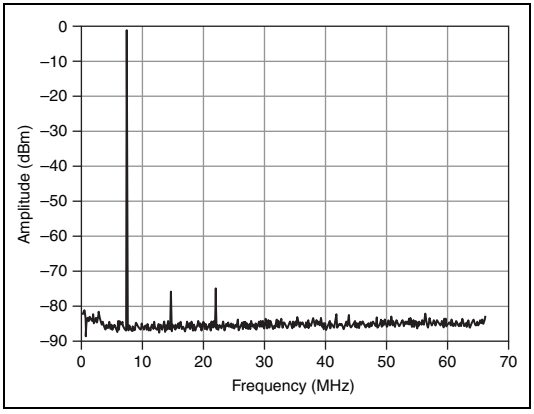

Figure 9. Measured Analog Output Single-Tone Distortion (Carrier Frequency = 7.36 MHz, Inverse Sync Filter OFF, Output Amplitude = –3 dBFS)

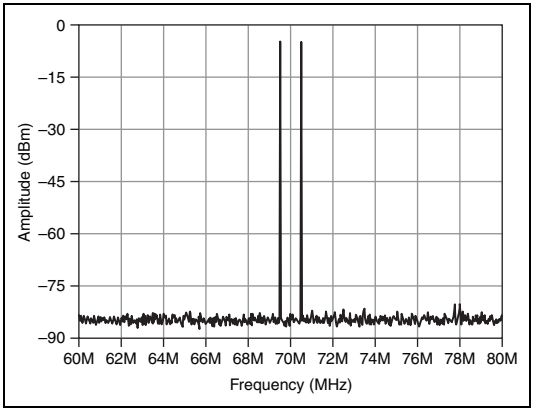

Figure 10. Measured Analog Output Two-Tone IMD (Center Frequency at 70 MHz, Carriers at 70 MHz ± 0.5 MHz, –5 dBm Each, Inverse Sync Filter ON)

Digital Upconverter (DUC) Characteristics

Number of channels..... 1 per DAC channel

DUC resolution..... 14 bits for both I and Q data

Interpolation..... 4× to 252×

Modulation bandwidth..... Up to 40 MHz

Tuning resolution..... DAC clock/2^{32} (For example, a 200 MHz clock results in a 46.6 millihertz (mHz) tuning resolution)

System Level Performance

System Level Modulation Quality

Conditions 8-QAM,
Symbol rate: 3.125 MHz,
PRN 9 sequence,
Power: –5 dBm
Filter alpha 0.22, Filter length 128, Root-raised Cosine

Modulation Error Ratio*

Carrier	Expected Performance
10 MHz	> 57 dB typical
40 MHz	> 54 dB typical
70 MHz	> 46 dB typical

Data Transfer Rate

(Using NI PXIe-1062Q chassis, NI PXIe-8130 controller, single-threaded, half-duplex transfer; Transfer rate is dependent upon controller and chassis hardware, software, and backplane usage)

NI PXIe-5641R to Host ..... 120 MB/s typical

Host to NI PXIe-5641R ..... 52 MB/s typical

Timebase System

Internal

Timebase frequency†..... 200 MHz ± 35 ppm, maximum

Minimum Sample clock divisor..... 2 for ADC, 1 for DAC

Supported divisors ..... 1, 2, 4, 8, and 16

External Clock/External Frequency Reference

Impedance..... 50 Ω nominal, AC-coupled

Input amplitude range

Sine wave ..... 0.63 V_{pk-pk} to 2.8 V_{pk-pk} (0 dBm to 13 dBm)

Square wave ..... 0.25 V_{pk-pk} to 2.8 V_{pk-pk}

Maximum input level without damage .....+24 dBm (10 V_{pk-pk}, 3.5 V_{RMS})

Maximum PLL lock time .....250 ms

External Reference clock range‡ ..... 1 MHz to 100 MHz in 1 MHz increments, ±100 ppm

External Sample clock range‡ .....30 MHz to 200 MHz

Trigger System

Modes .....Digital input, software

Sources

Using instrument driver .....TRIG, software

Using LabVIEW FPGA .....TRIG, RTSI <0..7> (mapped to PXIe_TRIG<0..7>), software

Slope

Using instrument driver .....Rising

Using LabVIEW FPGA .....Rising or falling

External Trigger Channel (TRIG)

Impedance .....10 kΩ nominal, DC-coupled

Range.....0 V to 3.3 V typical, 5 V tolerant

V_{IH} .....2.2 V, typical

V_{IL} .....0.95 V, typical

Overvoltage protection.....–3.5 V to + 8 V continuous

Maximum trigger frequency.....<10 MHz typical, system dependent

Input rise/fall time .....<10 ns/V typical

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* MER performance estimated using short (3 inch) loopback cables from output to input.

† Adjusted during calibration.

‡ The CLK IN connector on the NI PXIe-5641R can function as either a Reference clock input or a Sample clock input.

AUX I/O Connector

Number of digital lines.....7

I/O direction .....Pin-configurable

Input voltage range.....0 V to 3.3 V typical, 5 V tolerant

V_{IH} .....2.5 V typical

V_{IL} .....1 V typical

V_{OH} .....3.5 V typical, no load

V_{OL} .....0.1 V typical, no load

Overvoltage protection.....–0.5 to +5.5 V

Output type.....3.3 V CMOS

Output current.....±24 mA

Output impedance.....56 Ω

+5 V power output voltage.....5 V ±10%

+5 V power output current .....500 mA, ±150 mA typical, electronically fused

FPGA

Model.....Xilinx Virtex 5 SX95T

Logic cells 94,208

Multipliers/DSP blocks (18x18).....640

Block RAM .....8,784 (kbits max)

Maximum Power Requirements

+3.3 VDC	+12 VDC	Total Power
3 A	3 A	38.25 W

Physical Dimensions

NI PXIe-5641R module.....3U, One Slot, PXI Express Module 21.6 × 2.0 × 13.0 cm (8.5 × 0.8 × 5.1 in.)

Weight .....397 g (13.4 oz.)

I/O Connectors

Connector Name	Type	Function
AI CH <0..1>	SMA	Analog input terminals for the NI PXIe-5641R.
AO CH <0..1>	SMA	Analog output terminals for the NI PXIe-5641R.
CLK IN	SMB	Input terminal for an external Reference or Sample clock.
TRIG	SMB	Input or output terminal for device trigger signals.
DIO (AUX I/O)	9-pin DIN mini-circular	Input or output terminal for device digital I/O (DIO) channels.

Environment

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

Pollution Degree 2

Note The NI PXIe-5641R is intended for indoor use only.

Operating Environment

Ambient temperature range ..... 0 ºC to 55 ºC (Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2.)

Relative humidity range..... 10% to 90%, noncondensing (Tested in accordance with IEC 60068-2-56.)

Storage Environment

Ambient temperature range ..... –40 ºC to 70 ºC
(Tested in accordance with IEC 60068-2-1 and IEC 60068-2-2.)

Relative humidity range..... 5% to 95%, noncondensing
(Tested in accordance with IEC 60068-2-56.)

Shock and Vibration

Operating Shock ..... 30 g peak, half-sine, 11 ms pulse
(Tested in accordance with IEC 60068-2-27. Meets MIL PRF-28800F Class 2 limits.)

Random Vibration

Operating ..... 5 Hz to 500 Hz, 0.3 g_{rms}

Non-operating..... 5 Hz to 500 Hz, 2.4 g_{rms}
(Tested in accordance with IEC 60068-2-64. Nonoperating test profile exceeds the requirements of MIL PRF-28800F, Class 3.)

Safety

This product meets the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:

- IEC 61010-1, EN 61010-1
- UL 61010-1, CSA 61010-1

Note For UL and other safety certifications, refer to the product label or the *Online Product Certification* section.

Electromagnetic Compatibility

This product meets the requirements of the following EMC standards for electrical equipment for measurement, control, and laboratory use:

- EN 61326 (IEC 61326): Class A emissions; Basic immunity
- EN 55011 (CISPR 11): Group 1, Class A emissions
- AS/NZS CISPR 11: Group 1, Class A emissions
- FCC 47 CFR Part 15B: Class A emissions
- ICES-001: Class A emissions

Note For the standards applied to assess the EMC of this product, refer to the *Online Product Certification* section.

Note For EMC compliance, operate this product according to the documentation.

CE Compliance

This product meets the essential requirements of applicable European Directives as follows:

- 2006/95/EC; Low-Voltage Directive (safety)
- 2004/108/EC; Electromagnetic Compatibility Directive (EMC)

Online Product Certification

Refer to the product Declaration of Conformity (DoC) for additional regulatory compliance information. To obtain product certifications and the DoC for this product, visit `ni.com/certification`, search by model number or product line, and click the appropriate link in the Certification column.

Environmental Management

National Instruments is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial not only to the environment but also to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at `ni.com/environment`. This page contains the environmental regulations and directives with which NI complies, as well as other environmental information not included in this document.

Waste Electrical and Electronic Equipment (WEEE)

EU Customers At the end of their life cycle, all products *must* be sent to a WEEE recycling center. For more information about WEEE recycling centers and National Instruments WEEE initiatives, visit `ni.com/environment/weee.htm`.

电子信息产品污染控制管理办法 （中国 RoHS）

中国客户 National Instruments 符合中国电子信息产品中限制使用某些有害物质指令 (RoHS)。关于 National Instruments 中国 RoHS 合规性信息，请登录 `ni.com/environment/rohs_china`。
(For information about China RoHS compliance, go to `ni.com/environment/rohs_china`.)

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