

NI R Series Intelligent DAQ Specifications

This document lists the specifications of the NI 781xR/783xR/784xR/785xR. These specifications are typical at 25 °C unless otherwise noted.

Analog Input (NI 783xR/784xR/785xR Only)

Input Characteristics

Number of channels		Input impedance	
NI 7830R	4	Powered on	10 GΩ in parallel with 100 pF
NI 7831R/7833R/7841R/7842R/ 7851R/7852R/7853R/7854R	8	Powered off/overload	4.0 kΩ min
Input modes	DIFF, RSE, NRSE (software-selectable; selection applies to all channels)	Input signal range	±10 V
Type of ADC	Successive approximation	Input bias current	
Resolution	16 bits, 1 in 65,536	NI 783xR	±2 nA
Conversion time		NI 784xR/785xR	±5 nA
NI 783xR/NI 784xR	4 μs	Input offset current	
NI 785xR	1 μs	NI 783xR	±1 nA
Maximum sampling rate		NI 784xR/785xR	±5 nA
NI 783xR/784xR	200 kS/s (per channel)	Input coupling	DC
NI 785xR	750 kS/s (per channel)	Maximum working voltage (signal + common mode)	Inputs should remain within ±12 V of ground
		Overvoltage protection	
		Powered on	±42 V
		Powered off	±35 V
		Data transfers	DMA, interrupts, programmed I/O

Accuracy Information

NI 783xR

Nominal Range (V)		Absolute Accuracy						Relative Accuracy		
		% of Reading		Offset (μV)	Noise + Quantization (μV)		Temp Drift (%/°C)	Absolute Accuracy at Full Scale (±mV)	Resolution (μV)	
Positive Full Scale	Negative Full Scale	24 Hours	1 Year		Single Point	Averaged			Single Point	Averaged
10.0	-10.0	0.0496	0.0507	2,542	1,779	165	0.0005	7.78	2,170	217

Note: Accuracies are valid for measurements following an internal calibration. Averaged numbers assume dithering and averaging of 100 single-channel readings. Measurement accuracies are listed for operational temperatures within ±1 °C of internal calibration temperature and ±10 °C of external or factory-calibration temperature.

Nominal Range (V)		Absolute Accuracy							Relative Accuracy	
		% of Reading		Offset (μV)	Noise + Quantization (μV)		Temp Drift (%/°C)	Absolute Accuracy at Full Scale (±mV)	Resolution (μV)	
		24 Hours	1 Year		Single Point	Averaged			Single Point	Averaged
10.0	-10.0	0.0186	0.0228	1,591	1,029	91.6	0.0005	3.97	1,205	121

Note: Accuracies are valid for measurements following an internal calibration. Averaged numbers assume dithering and averaging of 100 single-channel readings. Measurement accuracies are listed for operational temperatures within ±1 °C of internal calibration temperature and ±10 °C of external or factory-calibration temperature.

DC Transfer Characteristics

INL

NI 783xR±3 LSB typ, ±6 LSB max
 NI 784xR/785xR±1 LSB typ, ±3 LSB max

DNL

NI 783xR-1.0 to +2.0 LSB max
 NI 784xR/785xR±0.4 LSB typ,
 ±0.9 LSB max

No missing codes

NI 783xR16 bits typ, 15 bits min
 NI 784xR/785xR16 bits guaranteed

CMRR, DC to 60 Hz-86 dB

Settling Time

Device	Step Size	Accuracy		
		16 LSB	4 LSB	2 LSB
NI 783xR	±20.0 V	7.5 μs	10.3 μs	40 μs
	±2.0 V	2.7 μs	4.1 μs	5.1 μs
	±0.2 V	1.7 μs	2.9 μs	3.6 μs
NI 784xR/785xR	±20.0 V	2.1 μs	4.2 μs	8 μs
	±2.0 V	1.3 μs	1.6 μs	1.8 μs
	±0.2 V	0.8 μs	1.1 μs	1.2 μs

Crosstalk-80 dB, DC to 100 kHz

Dynamic Characteristics

Bandwidth

NI 783xR
 Small signal (-3 dB)650 kHz
 Large signal (1% THD)55 kHz
 NI 784xR/785xR
 Small signal (-3 dB)1 MHz
 Large signal (1% THD)500 kHz

Analog Output (NI 783xR/784xR/785xR Only)

Output Characteristics

Output type	Single-ended, voltage output	Resolution.....	16 bits, 1 in 65,536
Number of channels		Update time	1.0 μ s
NI 7830R	4	Maximum update rate.....	1 MS/s
NI 7831R/7833R/7841R/7842R/ 7851R/7852R/7853R/7854R	8	Type of DAC.....	Enhanced R-2R
		Data transfers.....	DMA, interrupts, programmed I/O

Accuracy Information

Nominal Range (V)		Absolute Accuracy				Absolute Accuracy at Full Scale (mV)
		% of Reading		Offset (μ V)	Temp Drift (%/ $^{\circ}$ C)	
Positive Full Scale	Negative Full Scale	24 Hours	1 Year			
10.0	-10.0	0.0335	0.0351	2366	0.0005	5.88
Note: Accuracies are valid for analog output following an internal calibration. Analog output accuracies are listed for operation temperatures within ± 1 $^{\circ}$ C of internal calibration temperature and ± 10 $^{\circ}$ C of external or factory calibration temperature. Temp Drift applies only if ambient is greater than ± 10 $^{\circ}$ C of previous external calibration.						

DC Transfer Characteristics

INL.....	± 0.5 LSB typ, ± 4.0 LSB max
DNL.....	± 0.5 LSB typ, ± 1 LSB max
Monotonicity.....	16 bits, guaranteed

Voltage Output

Range	± 10 V
Output coupling	DC
Output impedance	
NI 783xR	1.25 Ω
NI 784xR/785xR.....	0.5 Ω
Current drive	± 2.5 mA
Protection	Short-circuit to ground
Power-on state.....	User configurable

Dynamic Characteristics

Settling time

Step Size	Accuracy		
	16 LSB	4 LSB	2 LSB
± 20.0 V	6.0 μ s	6.2 μ s	7.2 μ s
± 2.0 V	2.2 μ s	2.9 μ s	3.8 μ s
± 0.2 V	1.5 μ s	2.6 μ s	3.6 μ s

Slew rate.....	10 V/ μ s
Noise.....	150 μ V _{rms} , DC to 1 MHz
Glitch energy at midscale transition.....	± 200 mV for 3 μ s

Digital I/O

Number of channels

NI 781xR.....	160
NI 7830R.....	56
NI 7831R/7833R/7841R/7842R/ 7851R/7852R/7853R/7854R	96

Compatibility.....TTL

Digital logic levels

Level	Min	Max
Input low voltage (V_{IL})	0.0 V	0.8 V
Input high voltage (V_{IH})	2.0 V	5.5 V
Output low voltage (V_{OL}), where $I_{OUT} = -4$ mA	—	0.4 V
Output high voltage (V_{OH}), where $I_{OUT} = 4$ mA	2.4 V	—

Output current

Source	4.0 mA
Sink	4.0 mA

Input leakage current..... ± 10 μ A

Power-on stateProgrammable, by line

Data transfers.....DMA, interrupts,
programmed I/O

Protection

Input

NI 781xR/783xR.....	-0.5 to 7.0 V, single line
NI 784xR/785xR	-20.0 to 20.0 V, single line

OutputShort-circuit
(up to eight lines may be
shorted at a time)

Minimum pulse width

Input	25 ns
Output	12.5 ns

Minimum sampling period5 ns

Reconfigurable FPGA

NI 7811R/7830R/7831R

FPGA type.....	Virtex-II V1000
Number of flip-flops.....	10,240
Number of 4-input LUTs.....	10,240
Number of 18 \times 18 multipliers ...	40
Embedded block RAM.....	720 kbits

NI 7813R/7833R

FPGA type.....	Virtex-II V3000
Number of flip-flops.....	28,672
Number of 4-input LUTs.....	28,672
Number of 18 \times 18 multipliers ...	96
Embedded block RAM.....	1,728 kbits

NI 7841R/7851R

FPGA type.....	Virtex-5 LX30
Number of flip-flops.....	19,200
Number of 6-input LUTs.....	19,200
Number of DSP48 slices (25 \times 18 multipliers).....	32
Embedded block RAM.....	1,152 kbits

NI 7842R/7852R

FPGA type.....	Virtex-5 LX50
Number of flip-flops.....	28,800
Number of 6-input LUTs.....	28,800
Number of DSP48 slices (25 \times 18 multipliers).....	48
Embedded block RAM.....	1,728 kbits

NI 7853R

FPGA type.....	Virtex-5 LX85
Number of flip-flops.....	51,840
Number of 6-input LUTs.....	51,840
Number of DSP48 slices (25 \times 18 multipliers).....	48
Embedded block RAM.....	3,456 kbits

NI 7854R

FPGA type.....	Virtex-5 LX110
Number of flip-flops.....	69,120
Number of 6-input LUTs.....	69,120
Number of DSP48 slices (25 \times 18 multipliers).....	64
Embedded block RAM.....	4,608 kbits

Timebase	40, 80, 120, 160, or 200 MHz
Timebase reference sources	
NI PCI-781xR/783xR	Onboard clock only
NI PXI-78xxR	Onboard clock, phase-locked to PXI 10 MHz clock
Timebase accuracy,	
onboard clock	±100 ppm, 250 ps peak-to-peak jitter
Phase locked to PXI 10 MHz	
Clock (NI PXI-78xxR only)	Adds 350 ps peak-to-peak jitter
Additional frequency-dependent peak-to-peak jitter	
NI 781xR/783xR	
40 MHz	None
80 MHz	400 ps
120 MHz	720 ps
160 MHz	710 ps
200 MHz	700 ps
NI 784xR/785xR	
40 MHz	None
80 MHz	460 ps
120 MHz	172 ps
160 MHz	172 ps
200 MHz	152 ps

Calibration (NI 783xR/784xR/785xR Only)

Recommended warm-up time	15 minutes
Calibration interval	1 year
Onboard calibration reference	
DC level	5.000 V (±3.5 mV) (actual value stored in flash memory)
Temperature coefficient	±5 ppm/°C max
Long-term stability	±20 ppm/ $\sqrt{1,000}$ h



Note Refer to *Calibration Certificates* at ni.com/calibration to generate a calibration certificate for the NI 78xxR.

Bus Interface

PXI (NI PXI-78xxR only)	Master, slave
PCI (NI PCI-781xR/783xR only)	Master, slave

Power Requirement

+5 VDC (±5%) ¹	
NI 781xR	9 mA typ
NI 7830R/7831R	330 mA typ
NI 7833R	364 mA typ
NI 7841R/7851R	125 mA typ
NI 7842R/7852R	136 mA typ
NI 7853R	460 mA typ
NI 7854R	484 mA typ
+3.3 VDC (±5%) ²	
NI 7811R	650 mA typ
NI 7813R	850 mA typ
NI 7830R/7831R	462 mA typ
NI 7833R	727 mA typ
NI 7841R/7851R	525 mA typ
NI 7842R/7852R	604 mA typ
NI 7853R	640 mA typ
NI 7854R	843 mA typ
+12 V	
NI 784xR/785xR	0.5 A
-12 V	
NI 784xR/785xR	0.25 A

+5V terminal	
Connector 0	0.5 A max
Connector 1	0.5 A max
Connector 2	0.5 A max
All connectors	1.5 A max ³

To calculate the total current sourced by the digital outputs, use the following equation:

$$\sum_{i=1}^j \text{current sourced on channel } i$$

Power available at I/O connectors...4.50 to 5.25 VDC at 1 A total, 250 mA per I/O connector pin

¹ Does not include current drawn from the +5 V line on the I/O connectors.

² Does not include current sourced by the digital outputs.

³ (NI 784xR/785xR only) The NI 784xR/785xR has a user-replaceable socketed fuse that opens when current exceeds the current specification. Refer to the *R Series Intelligent DAQ User Manual*, available at ni.com/manuals, for information about fuse replacement.

Physical

Dimensions (not including connectors)

NI PCI-781xR/783xR.....	17 cm by 11 cm (6.7 in. by 4.3 in.)
NI PXI-78xxR	16 cm by 10 cm (6.3 in. by 3.9 in.)

Weight

NI PCI-781xR/783xR.....	112 g
NI PXI-78xxR	152 g

I/O connectors

NI 781xR.....	Four 68-pin female high-density VHDCI type
NI 7830R.....	Two 68-pin female high-density VHDCI type
NI 783xR/784xR/785xR.....	Three 68-pin female high-density VHDCI type

Maximum Working Voltage (NI 783xR/784xR/785xR Only)

Maximum working voltage refers to the signal voltage plus the common-mode voltage.

Channel-to-earth ±12 V, Measurement
Category I

Channel-to-channel ±24 V, Measurement
Category I



Caution Do not use the NI 783xR/784xR/785xR for connection to signals in Measurement Categories II, III, or IV.

Environmental

The NI 78xxR is intended for indoor use only.

Operating Environment

NI 781xR 0 °C to 55 °C,
Tested in accordance with
IEC-60068-2-1 and
IEC-60068-2-2.

NI 7830R, NI 7831R

40 MHz or 80 MHz timebase 0 °C to 55 °C,
Tested in accordance with
IEC-60068-2-1 and
IEC-60068-2-2.

NI 7833R/7841R/7842R/7851R/7852R/7853R/7854R

40 MHz timebase 0 °C to 55 °C,
Tested in accordance with
IEC-60068-2-1 and
IEC-60068-2-2.

80 MHz timebase 0 °C to 55 °C except the
following: 0 °C to 45 °C
when installed in an
NI PXI-1000/B or
NI PXI-101X;
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.

Altitude 2,000 m at 25 °C ambient
temperature

Storage Environment

Ambient temperature range -20 °C to 70 °C
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.



Note Clean the device with a soft, non-metallic brush. Make sure that the device is completely dry and free from contaminants before returning it to service.

Shock and Vibration (for NI PXI-78xxR Only)

Operational shock	30 g peak, half-sine, 11 ms pulse Tested in accordance with IEC-60068-2-27. Test profile developed in accordance with MIL-PRF-28800F.
Random vibration	
Operating	5 Hz to 500 Hz, 0.3 g _{rms}
Nonoperating	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

The NI 78xxR is designed to meet 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, CAN/CSA-C22.2 No. 61010-1



Note Refer to the product label, or visit ni.com/certification, search by model number or product line, and click the appropriate link in the Certification column for UL and other safety certifications.

Electromagnetic Compatibility

The NI 78xxR is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326 EMC requirements; Minimum Immunity
- EN 55011 Emissions; Group 1, Class A
- CE, C-Tick, ICES, and FCC Part 15 Emissions; Class A



Note For EMC compliance, operate this device with shielded cabling.

CE Compliance

This product meets the essential requirements of applicable European Directives, as amended for CE marking, as follows:

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



Note Refer to the Declaration of Conformity (DoC) for this product for any additional regulatory compliance information. To obtain 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）



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Device Pinouts

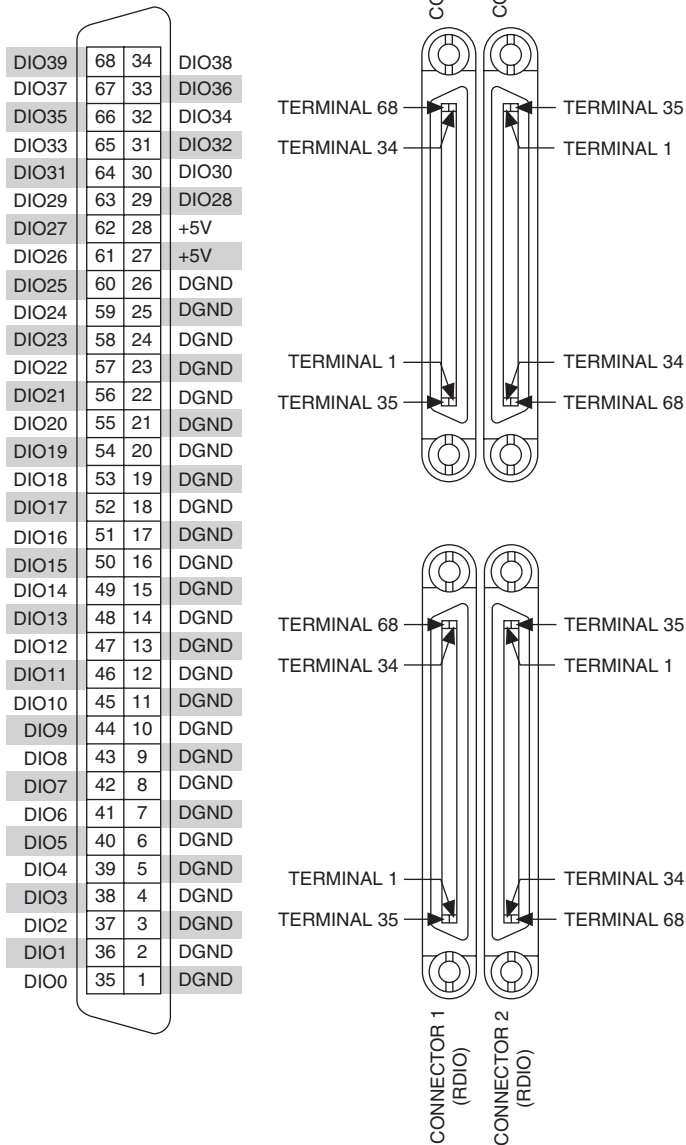
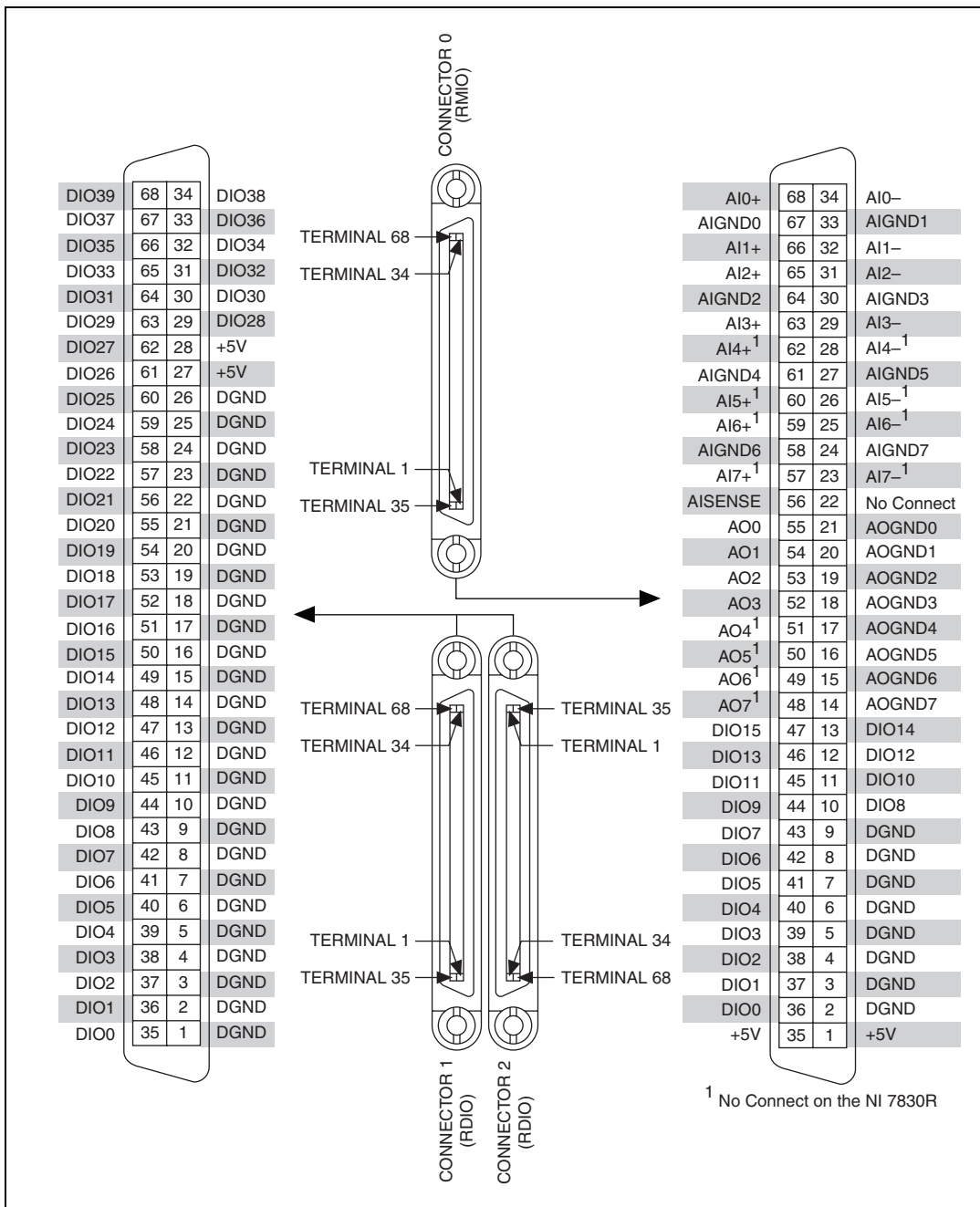


Figure 1. NI 781xR Connector Pin Assignments and Locations



¹ No Connect on the NI 7830R

Figure 2. NI 783xR/784xR/785xR Connector Pin Assignments and Locations

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