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NI R Series Intelligent DAQ Specifications

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

Analog Input (NI 783*x*R/784*x*R/785*x*R Only)

Input Characteristics

Number of channels

NI 7830R 4

NI 7831R/7833R/7841R/7842R/7851R/7852R/7853R/7854R 8

Input modes ..... DIFF, RSE, NRSE (software-selectable; selection applies to all channels)

Type of ADC ..... Successive approximation

Resolution ..... 16 bits, 1 in 65,536

Conversion time

NI 783*x*R/NI 784*x*R ..... 4 µs

NI 785*x*R ..... 1 µs

Maximum sampling rate

NI 783*x*R/784*x*R ..... 200 kS/s (per channel)

NI 785*x*R ..... 750 kS/s (per channel)

Input impedance

Powered on ..... 10 GΩ in parallel with 100 pF

Powered off/overload ..... 4.0 kΩ min

Input signal range ..... ±10 V

Input bias current

NI 783*x*R ..... ±2 nA

NI 784*x*R/785*x*R ..... ±5 nA

Input offset current

NI 783*x*R ..... ±1 nA

NI 784*x*R/785*x*R ..... ±5 nA

Input coupling ..... DC

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 783*x*R

Nominal Range (V)		Absolute Accuracy							Relative Accuracy	
		% of Reading			Noise + Quantization (µV)				Resolution (µV)	
Positive Full Scale	Negative Full Scale	24 Hours	1 Year	Offset (µV)	Single Point	Averaged	Temp Drift (%/°C)	Absolute Accuracy at Full Scale (±mV)	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.

NATIONAL INSTRUMENTS™

Nominal Range (V)		Absolute Accuracy							Relative Accuracy	
		% of Reading			Noise + Quantization (µV)				Resolution (µV)	
Positive Full Scale	Negative Full Scale	24 Hours	1 Year	Offset (µV)	Single Point	Averaged	Temp Drift (%/°C)	Absolute Accuracy at Full Scale (±mV)	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 783*x*R.....±3 LSB typ, ±6 LSB max

NI 784*x*R/785*x*R .....±1 LSB typ, ±3 LSB max

DNL

NI 783*x*R.....–1.0 to +2.0 LSB max

NI 784*x*R/785*x*R .....±0.4 LSB typ, ±0.9 LSB max

No missing codes

NI 783*x*R.....16 bits typ, 15 bits min

NI 784*x*R/785*x*R .....16 bits guaranteed

CMRR, DC to 60 Hz .....–86 dB

Dynamic Characteristics

Bandwidth

NI 783*x*R

Small signal (–3 dB).....650 kHz

Large signal (1% THD).....55 kHz

NI 784*x*R/785*x*R

Small signal (–3 dB).....1 MHz

Large signal (1% THD).....500 kHz

Settling Time

Device	Step Size	Accuracy		
		16 LSB	4 LSB	2 LSB
NI 783*x*R	±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 784*x*R/ 785*x*R	±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

Analog Output (NI 783*x*R/784*x*R/785*x*R Only)

Output Characteristics

Output type ..... Single-ended, voltage output

Number of channels

NI 7830R 4

NI 7831R/7833R/7841R/7842R/7851R/7852R/7853R/7854R 8

Resolution ..... 16 bits, 1 in 65,536

Update time ..... 1.0 µs

Maximum update rate ..... 1 MS/s

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				
Positive Full Scale	Negative Full Scale	24 Hours	1 Year	Offset (µV)	Temp Drift (%/°C)	
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 °C of internal calibration temperature and ±10 °C of external or factory calibration temperature. Temp Drift applies only if ambient is greater than ±10 °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 783*x*R ..... 1.25 Ω

NI 784*x*R/785*x*R ..... 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 µs	6.2 µs	7.2 µs
±2.0 V	2.2 µs	2.9 µs	3.8 µs
±0.2 V	1.5 µs	2.6 µs	3.6 µs

Slew rate ..... 10 V/µs

Noise ..... 150 μV_{rms}, DC to 1 MHz

Glitch energy at midscale transition ..... ±200 mV for 3 µs

Digital I/O

Number of channels

- NI 781*x*R 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 µA

Power-on state ..... Programmable, by line

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

Protection

- Input
  - NI 781*x*R/783*x*R ..... –0.5 to 7.0 V, single line
  - NI 784*x*R/785*x*R ..... –20.0 to 20.0 V, single line
- Output ..... Short-circuit (up to eight lines may be shorted at a time)

Minimum pulse width

- Input ..... 25 ns
- Output ..... 12.5 ns

Minimum sampling period ..... 5 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 × 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 × 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 × 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 × 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 × 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 × 18 multipliers) 64
- Embedded block RAM ..... 4,608 kbits

Timebase ..... 40, 80, 120, 160, or 200 MHz

Timebase reference sources

NI PCI-781*x*R/783*x*R ..... Onboard clock only

NI PXI-78*xx*R ..... 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-78*xx*R only) ..... Adds 350 ps peak-to-peak jitter

Additional frequency-dependent peak-to-peak jitter

NI 781*x*R/783*x*R

40 MHz ..... None

80 MHz ..... 400 ps

120 MHz ..... 720 ps

160 MHz ..... 710 ps

200 MHz ..... 700 ps

NI 784*x*R/785*x*R

40 MHz ..... None

80 MHz ..... 460 ps

120 MHz ..... 172 ps

160 MHz ..... 172 ps

200 MHz ..... 152 ps

Calibration (NI 783*x*R/784*x*R/785*x*R 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/$\sqrt{1{,}000\ \text{h}}$

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

Bus Interface

PXI (NI PXI-78*xx*R only) ..... Master, slave

PCI (NI PCI-781*x*R/783*x*R only) .... Master, slave

Power Requirement

+5 VDC (±5%)[1]

NI 781*x*R ..... 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 784*x*R/785*x*R ..... 0.5 A

–12 V

NI 784*x*R/785*x*R ..... 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 784*x*R/785*x*R only)** The NI 784*x*R/785*x*R 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-781*x*R/783*x*R.....17 cm by 11 cm (6.7 in. by 4.3 in.)

NI PXI-78*xx*R .....16 cm by 10 cm (6.3 in. by 3.9 in.)

Weight

NI PCI-781*x*R/783*x*R.....112 g

NI PXI-78*xx*R .....152 g

I/O connectors

NI 781*x*R.....Four 68-pin female high-density VHDCI type

NI 7830R.....Two 68-pin female high-density VHDCI type

NI 783*x*R/784*x*R/785*x*R.....Three 68-pin female high-density VHDCI type

Maximum Working Voltage (NI 783*x*R/784*x*R/785*x*R 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 783*x*R/784*x*R/785*x*R for connection to signals in Measurement Categories II, III, or IV.

Environmental

The NI 78*xx*R is intended for indoor use only.

Operating Environment

NI 781*x*R .....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-78*xx*R 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 78*xx*R 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 78*xx*R 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`.

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Device Pinouts

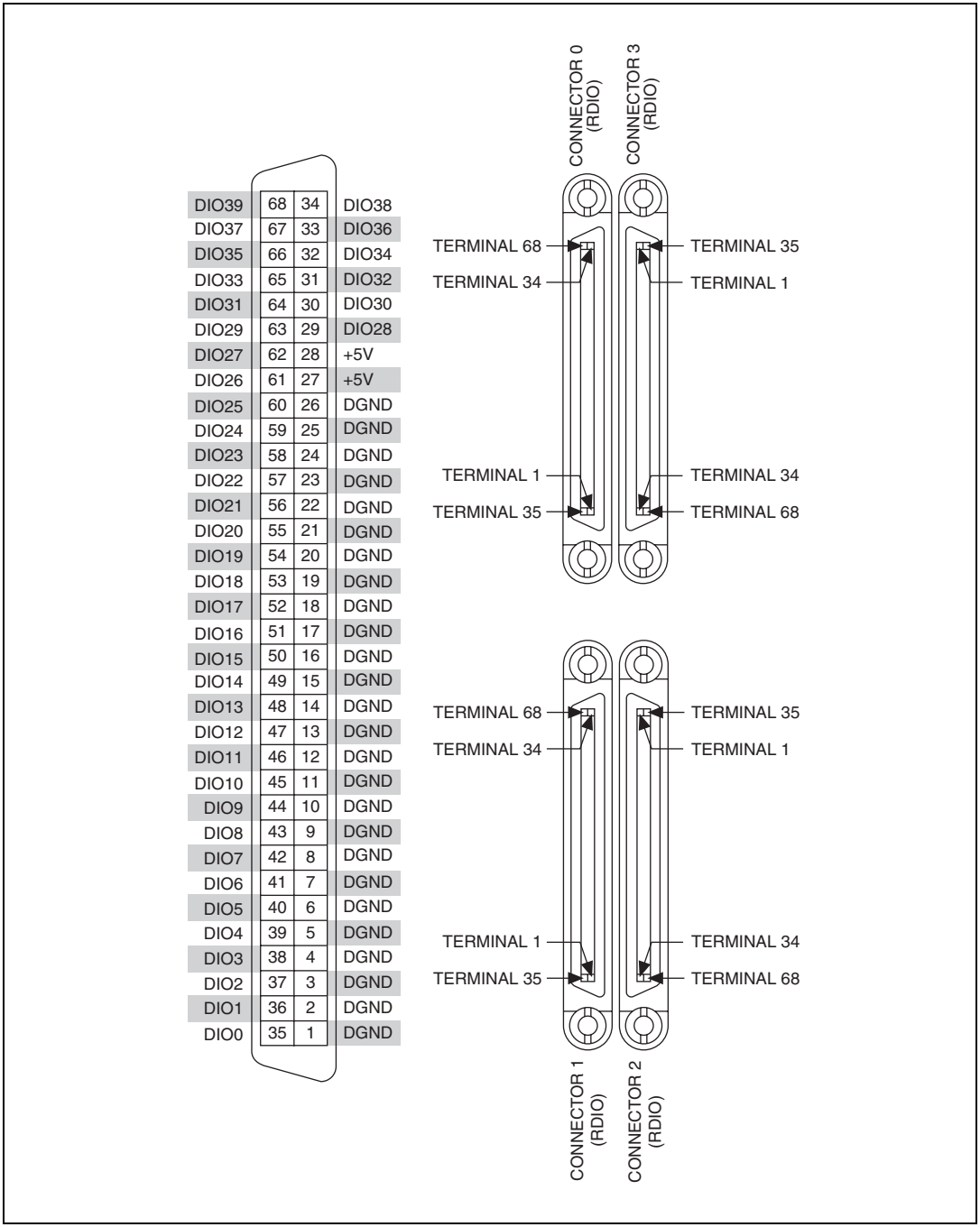


Figure 1. NI 781*x*R Connector Pin Assignments and Locations

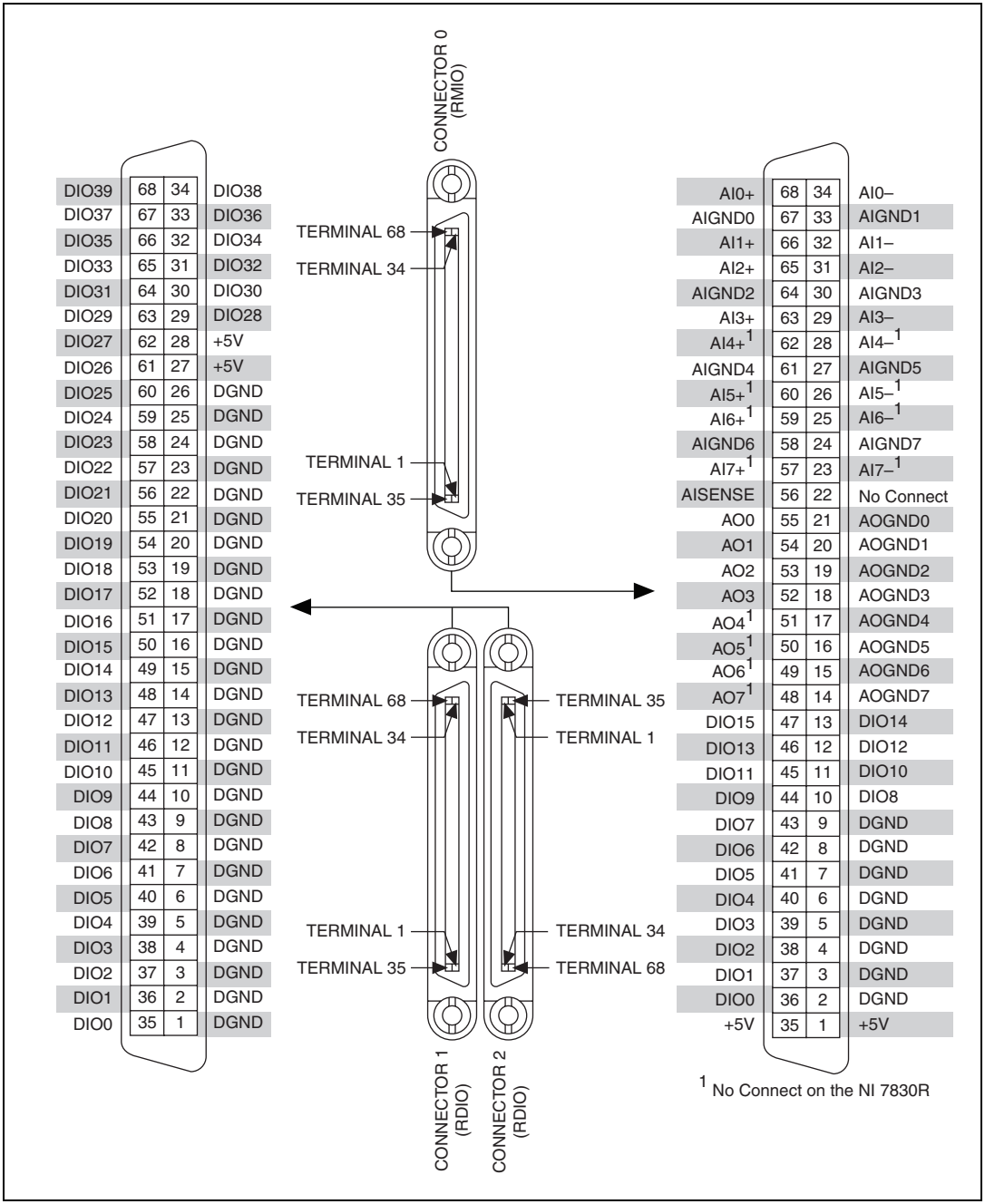


Figure 2. NI 783*x*R/784*x*R/785*x*R Connector Pin Assignments and Locations

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