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**PXI-7854**

# NI R Series Multifunction RIO Specifications

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

Français	Deutsch	日本語	한국어	简体中文
<a href="http://ni.com/manuals">ni.com/manuals</a>				

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

### Input Characteristics

Number of channels	Input impedance
NI 7830R ..... 4	Powered on ..... 10 G $\Omega$ in parallel with 100 pF
NI 7831R/7833R/7841R/7842R/ 7851R/7852R/7853R/7854R ..... 8	Powered off/overload ..... 4.0 k $\Omega$ min
Input modes ..... DIFF, RSE, NRSE (software-selectable; selection applies to all channels)	Input signal range ..... $\pm 10$ V
Type of ADC ..... Successive approximation	Input bias current
Resolution ..... 16 bits, 1 in 65,536	NI 783xR ..... $\pm 2$ nA
Conversion time	NI 784xR/785xR ..... $\pm 5$ nA
NI 783xR/NI 784xR ..... 4 $\mu$ s	Input offset current
NI 785xR ..... 1 $\mu$ s	NI 783xR ..... $\pm 1$ nA
Maximum sampling rate	NI 784xR/785xR ..... $\pm 5$ 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 $\pm 12$ V of ground
	Overvoltage protection
	Powered on ..... $\pm 42$ V
	Powered off ..... $\pm 35$ V

## 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
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.

NI 784xR/785xR

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
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 783xR ..... 16 bits typ, 15 bits min  
 NI 784xR/785xR ..... 16 bits guaranteed

CMRR, DC to 60 Hz ..... -86 dB

## 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

## 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

# 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 $\mu$ 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

## Accuracy Information

Nominal Range (V)		Absolute Accuracy				Absolute Accuracy at Full Scale (mV)
		% of Reading		Offset ( $\mu$ 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  $\pm 1$   $^{\circ}$ C of internal calibration temperature and  $\pm 10$   $^{\circ}$ C of external or factory calibration temperature. Temp Drift applies only if ambient is greater than  $\pm 10$   $^{\circ}$ C of previous external calibration.

## DC Transfer Characteristics

INL .....	$\pm 0.5$ LSB typ, $\pm 4.0$ LSB max
DNL .....	$\pm 0.5$ LSB typ, $\pm 1$ LSB max
Monotonicity .....	16 bits, guaranteed

## Voltage Output

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

## Dynamic Characteristics

Settling time

Step Size	Accuracy		
	$\pm 16$ LSB	$\pm 4$ LSB	$\pm 2$ LSB
$\pm 20.0$ V	6.0 $\mu$ s	6.2 $\mu$ s	7.2 $\mu$ s
$\pm 2.0$ V	2.2 $\mu$ s	2.9 $\mu$ s	3.8 $\mu$ s
$\pm 0.2$ V	1.5 $\mu$ s	2.6 $\mu$ s	3.6 $\mu$ s

Slew rate .....	10 V/ $\mu$ s
Noise .....	150 $\mu$ V <sub>rms</sub> , DC to 1 MHz
Glitch energy at midscale transition .....	$\pm 200$ mV for 3 $\mu$ 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 V	0.4 V
Output high voltage ( $V_{OH}$ ), where $I_{OUT} = 4$ mA	2.4 V	3.3 V

Output current

Source .....	4.0 mA
Sink .....	4.0 mA

Input leakage current..... $\pm 10$   $\mu$ A

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

Protection

Input

NI 781xR/783xR.....	-0.5 to 7.0 V, single line
NI 784xR/785xR .....	-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 $\times$ 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 PCIe-784xR/785xR .....	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
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## Phase locked to PXI 10 MHz

Clock (NI PXI-78xxR only).....	Adds 350 ps peak-to-peak jitter
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## 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](http://ni.com/calibration) to generate a calibration certificate for the NI 78xxR.

## Bus Interface

PCI/PCIe/PXI .....	Master, slave
Data transfers.....	DMA, interrupts, programmed I/O
Number of DMA channels .....	3

## Power Requirement

+5 VDC (±5%) <sup>1</sup>	
NI 781xR.....	9 mA typ
NI 7830R/7831R.....	330 mA typ
NI 7833R.....	364 mA typ
NI PXI-7841R/7851R .....	125 mA typ
NI PXI-7842R/7852R .....	136 mA typ
NI 7853R.....	460 mA typ
NI 7854R.....	484 mA typ

+3.3 VDC (±5%) <sup>2</sup>	
NI 7811R.....	650 mA typ
NI 7813R.....	850 mA typ
NI 7830R/7831R.....	462 mA typ
NI 7833R.....	727 mA typ
NI PCIe-7841R/7851R .....	847 mA typ
NI PCIe-7842R/7852R .....	984 mA typ
NI PXI-7841R/7851R .....	525 mA typ
NI PXI-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 PXI-784xR/785xR .....	0.25 A

+5V terminal	
Connector 0.....	0.5 A max <sup>3</sup>
Connector 1.....	0.5 A max <sup>3</sup>
Connector 2.....	0.5 A max <sup>3</sup>
All connectors .....	1.5 A max <sup>3,4</sup>

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

<sup>2</sup> Does not include current sourced by the digital outputs.

<sup>3</sup> (NI PCIe-78xxR only) Total maximum terminal current for all connectors is 100 mA unless disk drive connector is attached.

<sup>4</sup> (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 *NI R Series Multifunction RIO User Manual*, available at [ni.com/manuals](http://ni.com/manuals), for information about fuse replacement.

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

## Physical

Dimensions (not including connectors)

NI PCI-781xR/783xR.....	17 cm by 11 cm (6.7 in. by 4.3 in.)
NI PCIe-784xR/785xR.....	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 PCIe-784xR/785xR.....	127 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

Disk drive power connector

(PCIe devices) .....Standard ATX peripheral connector (not serial ATA)

## 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 PCI/PXI-7833R	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.
NI PXI-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.
NI PCIe-7841R/7842R/7851R/7852R	40 MHz or 80 MHz timebase ..... 0 °C to 40 °C, 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

NI PCI/PXI-781xR/783xR .....	-20 °C to 70 °C, tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.
NI PCIe-784xR/785xR .....	-20 °C to 70 °C, tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.
NI PXI-784xR/785xR .....	-40 °C to 70 °C, tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.
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 <sub>rms</sub>
Nonoperating .....	5 Hz to 500 Hz, 2.4 g <sub>rms</sub> , 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, CSA 61010-1



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

## 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 (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 device with shielded cabling.

## 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](http://ni.com/certification), search by model number or product line, and click the appropriate link in the Certification column.

## Environmental Management

NI is committed to designing and manufacturing products in an environmentally responsible manner. NI recognizes that eliminating certain hazardous substances from our products is beneficial to the environment and to NI customers.

For additional environmental information, refer to the *NI and the Environment* Web page at [ni.com/environment](http://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](http://ni.com/environment/weee.htm).

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# Device Pinouts

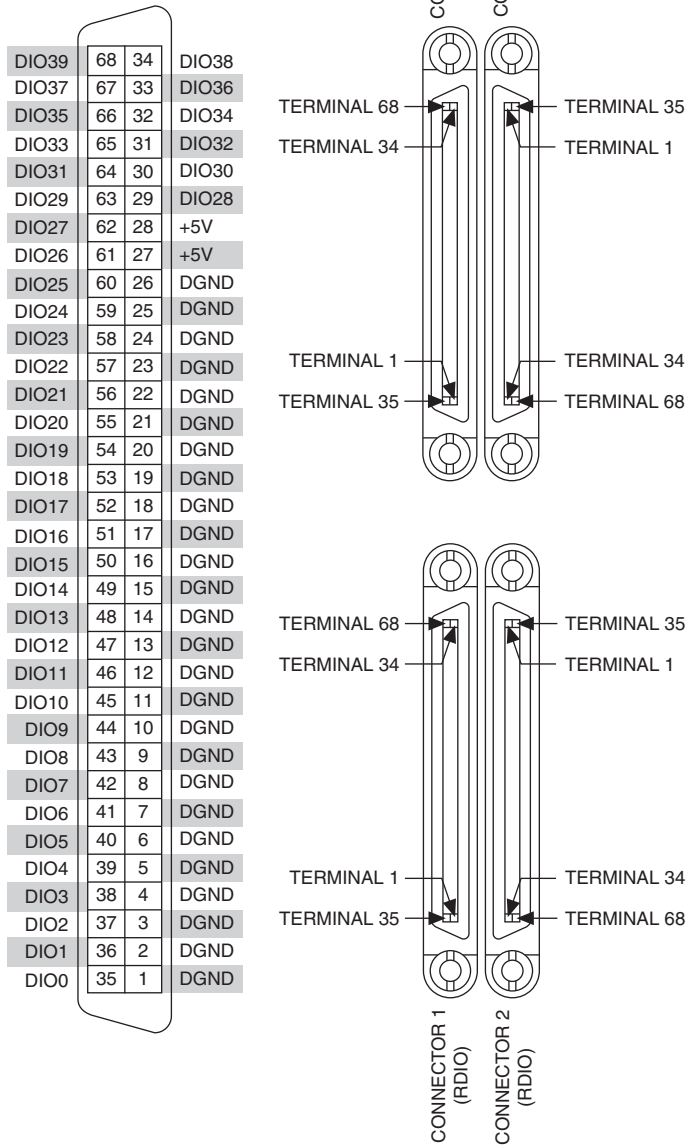
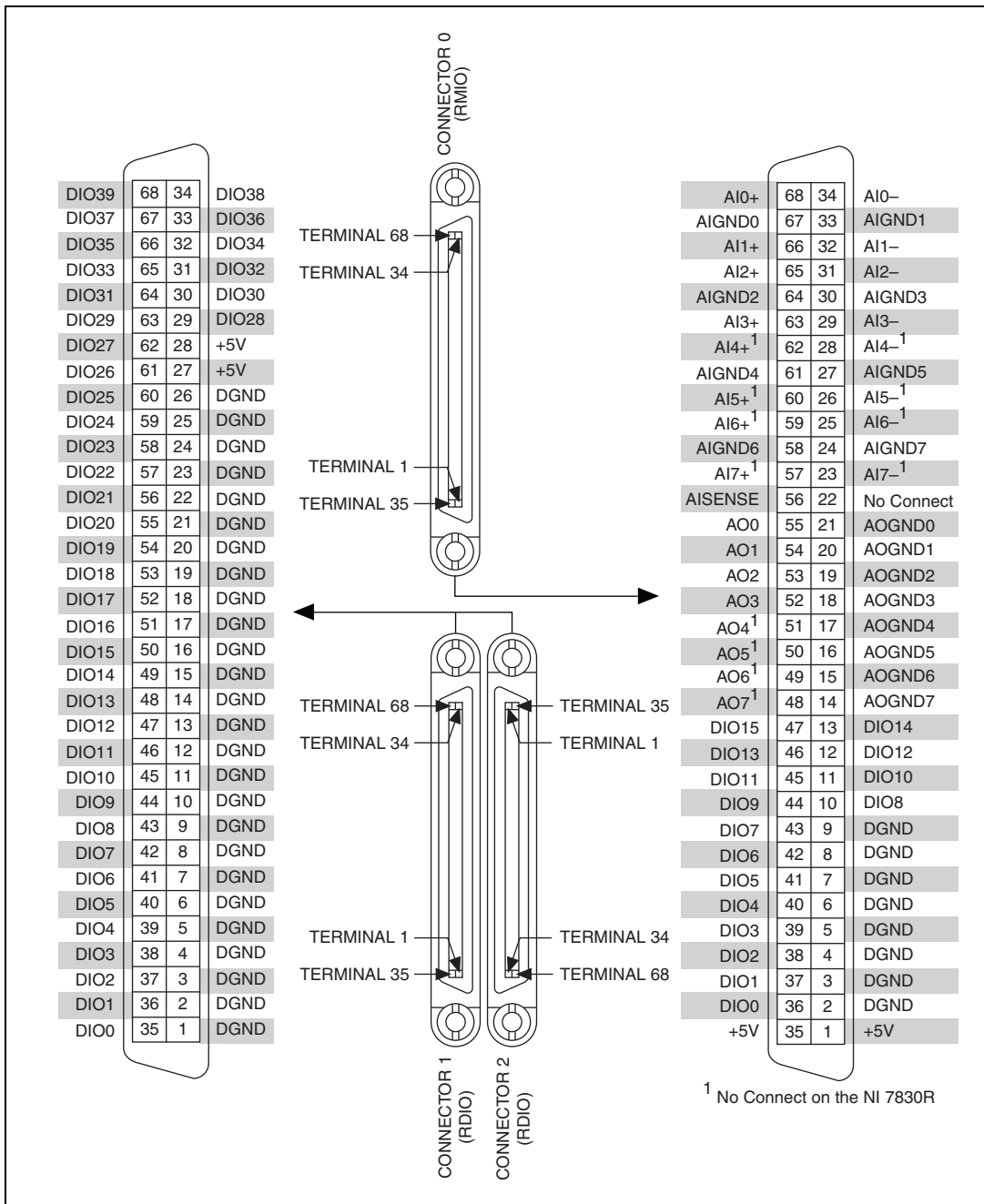


Figure 1. NI 781xR Connector Pin Assignments and Locations



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

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