

Multifunction Reconfigurable I/O Specifications

(Formerly known as the NI R Series Multifunction RIO Specifications)

This document lists the specifications of the PCI/PXI-7811, PCI/PXI-7813, PCI/PXI-7830, PCI/PXI-7831, PCI/PXI-7833, PCIe/PXI-7841, PCIe/PXI-7842, PCIe/PXI-7851, PCIe/PXI-7852, PXI-7853, and PXI-7854 devices. These specifications are typical at 25 °C unless otherwise noted.

Français	Deutsch	日本語	한국어	简体中文
ni.com/docs				

Conventions

The following conventions appear in these specifications:

NI 78xx.....	Refers to PCI/PXI-7811, PCI/PXI-7813, PCI/PXI-7831, PCI/PXI-7833, PCIe/PXI-7841, PCIe/PXI-7842, PCIe/PXI-7851, and PCIe/PXI-7852 devices.	NI 783x.....	Refers to PCI/PXI-7831 and PCI/PXI-7833 devices.
NI 781x	Refers to PCI/PXI-7811 and PCI/PXI-7813 devices.	NI 784x.....	Refers to PCIe/PXI-7841 and PCIe/PXI-7842 devices.
		NI 785x.....	Refers to PCIe/PXI-7851 and PCIe/PXI-7852 devices.

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

Input Characteristics

Number of channels		Conversion time	
NI 7830.....	4	NI 783x/NI 784x	4 μs
NI 7831/7833/7841/7842/ 7851/7852/7853/7854.....	8	NI 785x	1 μs
Input modes.....	DIFF, RSE, NRSE (software-selectable; selection applies to all channels)	Maximum sampling rate	
Type of ADC	Successive approximation	NI 783x/784x.....	200 kS/s (per channel)
Resolution	16 bits, 1 in 65,536	NI 785x	750 kS/s (per channel)



Input impedance
 Powered on10 G Ω in parallel with
 100 pF
 Powered off/overload.....4.0 k Ω min

Input signal range ± 10 V

Input bias current
 NI 783x ± 2 nA
 NI 784x/785x..... ± 5 nA

Input offset current
 NI 783x ± 1 nA
 NI 784x/785x..... ± 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

Accuracy Information

NI 783x

Nominal Range (V)		Absolute Accuracy						Relative Accuracy		
		% of Reading		Offset (μ V)	Noise + Quantization (μ V)		Temp Drift (%/ $^{\circ}$ C)	Absolute Accuracy at Full Scale (\pm mV)	Resolution (μ V)	
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 $^{\circ}$ C of internal calibration temperature and ± 10 $^{\circ}$ C of external or factory-calibration temperature.

NI 784x/785x

Nominal Range (V)		Absolute Accuracy						Relative Accuracy		
		% of Reading		Offset (μ V)	Noise + Quantization (μ V)		Temp Drift (%/ $^{\circ}$ C)	Absolute Accuracy at Full Scale (\pm mV)	Resolution (μ V)	
Positive Full Scale	Negative Full Scale	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 $^{\circ}$ C of internal calibration temperature and ± 10 $^{\circ}$ C of external or factory-calibration temperature.

DC Transfer Characteristics

INL

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

DNL

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

No missing codes

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

CMRR, DC to 60 Hz -86 dB

Dynamic Characteristics

Bandwidth

NI 783x
 Small signal (-3 dB) 650 kHz
 Large signal (1% THD) 55 kHz
 NI 784x/785x
 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 783x	± 20.0 V	7.5 μ s	10.3 μ s	40 μ s
	± 2.0 V	2.7 μ s	4.1 μ s	5.1 μ s
	± 0.2 V	1.7 μ s	2.9 μ s	3.6 μ s
NI 784x/ 785x	± 20.0 V	2.1 μ s	4.2 μ s	8 μ s
	± 2.0 V	1.3 μ s	1.6 μ s	1.8 μ s
	± 0.2 V	0.8 μ s	1.1 μ s	1.2 μ s

Crosstalk -80 dB, DC to 100 kHz

Analog Output (NI 783x/784x/785x 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 7830	4	Maximum update rate	1 MS/s
NI 7831/7833/7841/7842/ 7851/7852/7853/7854	8	Type of DAC	Enhanced R-2R

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 783x	1.25 Ω
NI 784x/785x	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 781x	160
NI 7830	56
NI 7831/7833/7841/7842/ 7851/7852/7853/7854	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 ± 10 μ A

Power-on state Programmable, by line

Protection

Input

NI 781x/783x	-0.5 to 7.0 V, single line
NI 784x/785x	-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 7811/7830/7831

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 7813/7833

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 7841/7851

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 7842/7852

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 7853

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 7854

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

PCI-781x/783x	Onboard clock only
PCIe-784x/785x	Onboard clock only
PXI-78xx	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 (PXI-78xx only)	Adds 350 ps peak-to-peak jitter
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Additional frequency-dependent peak-to-peak jitter

NI 781x/783x	
40 MHz	None
80 MHz	400 ps
120 MHz	720 ps
160 MHz	710 ps
200 MHz	700 ps
NI 784x/785x	
40 MHz	None
80 MHz	460 ps
120 MHz	172 ps
160 MHz	172 ps
200 MHz	152 ps

Calibration (NI 783x/784x/785x 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 78xx.

Bus Interface

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

Power Requirement

+5 VDC (±5%)¹

NI 781x	9 mA typ
NI 7830/7831	330 mA typ
NI 7833	364 mA typ
PXI-7841/7851	125 mA typ
PXI-7842/7852	136 mA typ
NI 7853	460 mA typ
NI 7854	484 mA typ

+3.3 VDC (±5%)²

NI 7811	650 mA typ
NI 7813	850 mA typ
NI 7830/7831	462 mA typ
NI 7833	727 mA typ
PCIe-7841/7851	847 mA typ
PCIe-7842/7852	984 mA typ
PXI-7841/7851	525 mA typ
PXI-7842/7852	604 mA typ
NI 7853	640 mA typ
NI 7854	843 mA typ

+12 V

NI 784x/785x	0.5 A
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-12 V

PXI-784x/785x	0.25 A
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+5V terminal

Connector 0	0.5 A max ³
Connector 1	0.5 A max ³
Connector 2	0.5 A max ³
All connectors	1.5 A max ^{3,4}

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 (PCIe-78xx only) Total maximum terminal current for all connectors is 100 mA unless disk drive connector is attached.

⁴ (NI 784x/785x only) The NI 784x/785x has a user-replaceable socketed fuse that opens when current exceeds the current specification. Refer to the *Multifunction Reconfigurable I/O User Manual*, available at ni.com/docs, 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)

PCI-781x/783x.....	17 cm by 11 cm (6.7 in. by 4.3 in.)
PCIE-784x/785x.....	17 cm by 11 cm (6.7 in. by 4.3 in.)
PXI-78xx.....	16 cm by 10 cm (6.3 in. by 3.9 in.)

Weight

PCI-781x/783x.....	112 g
PCIE-784x/785x.....	127 g
PXI-78xx.....	152 g

I/O connectors

NI 781x.....	Four 68-pin female high-density VHDCI type
NI 7830.....	Two 68-pin female high-density VHDCI type
NI 783x/784x/785x.....	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 783x/784x/785x 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 783x/784x/785x for connection to signals in Measurement Categories II, III, or IV.

Environmental

The NI 78xx is intended for indoor use only.

Operating Environment

NI 781x.....	0 °C to 55 °C, tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.
NI 7830, NI 7831	40 MHz or 80 MHz timebase 0 °C to 55 °C, tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.
PCI/PXI-7833	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 PXI-1000/B or PXI-101X, tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.
PXI-7841/7842/7851/7852/7853/7854	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 PXI-1000/B or PXI-101X, tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.
PCIE-7841/7842/7851/7852	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

PCI/PXI-781x/783x	-20 °C to 70 °C, tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.
PCIe-784x/785x	-20 °C to 70 °C, tested in accordance with IEC-60068-2-1 and IEC-60068-2-2.
PXI-784x/785x.....	-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 range5% 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 PXI-78xx 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 78xx 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 78xx 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, 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. 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.)

Device Pinouts

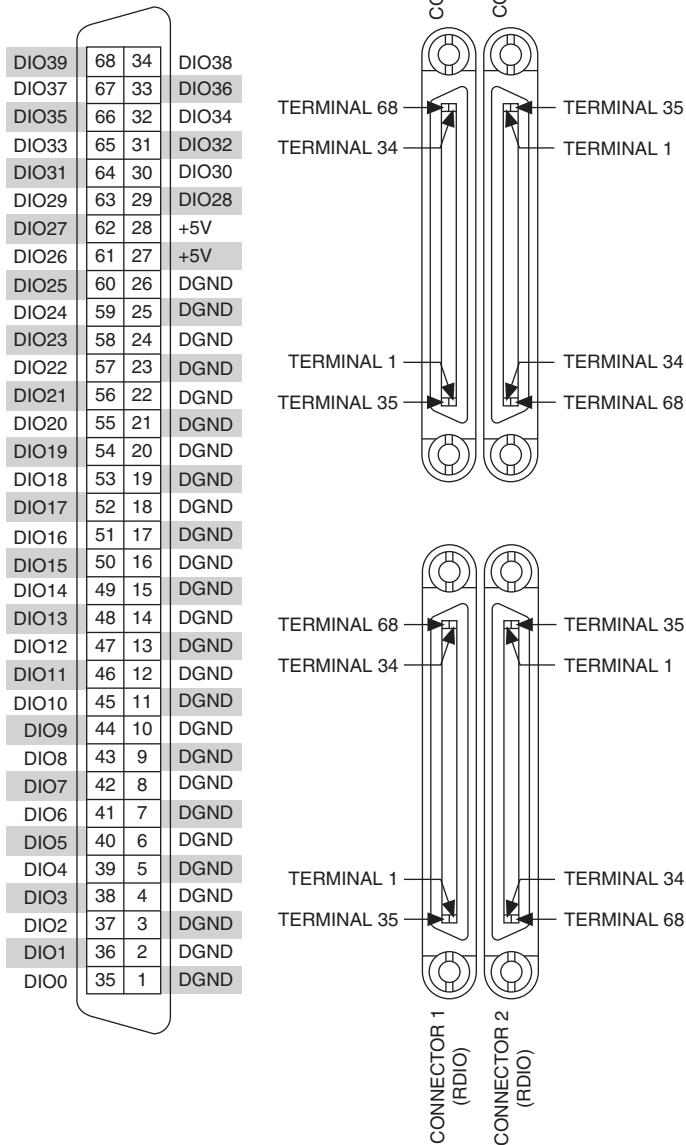


Figure 1. NI 781x Connector Pin Assignments and Locations

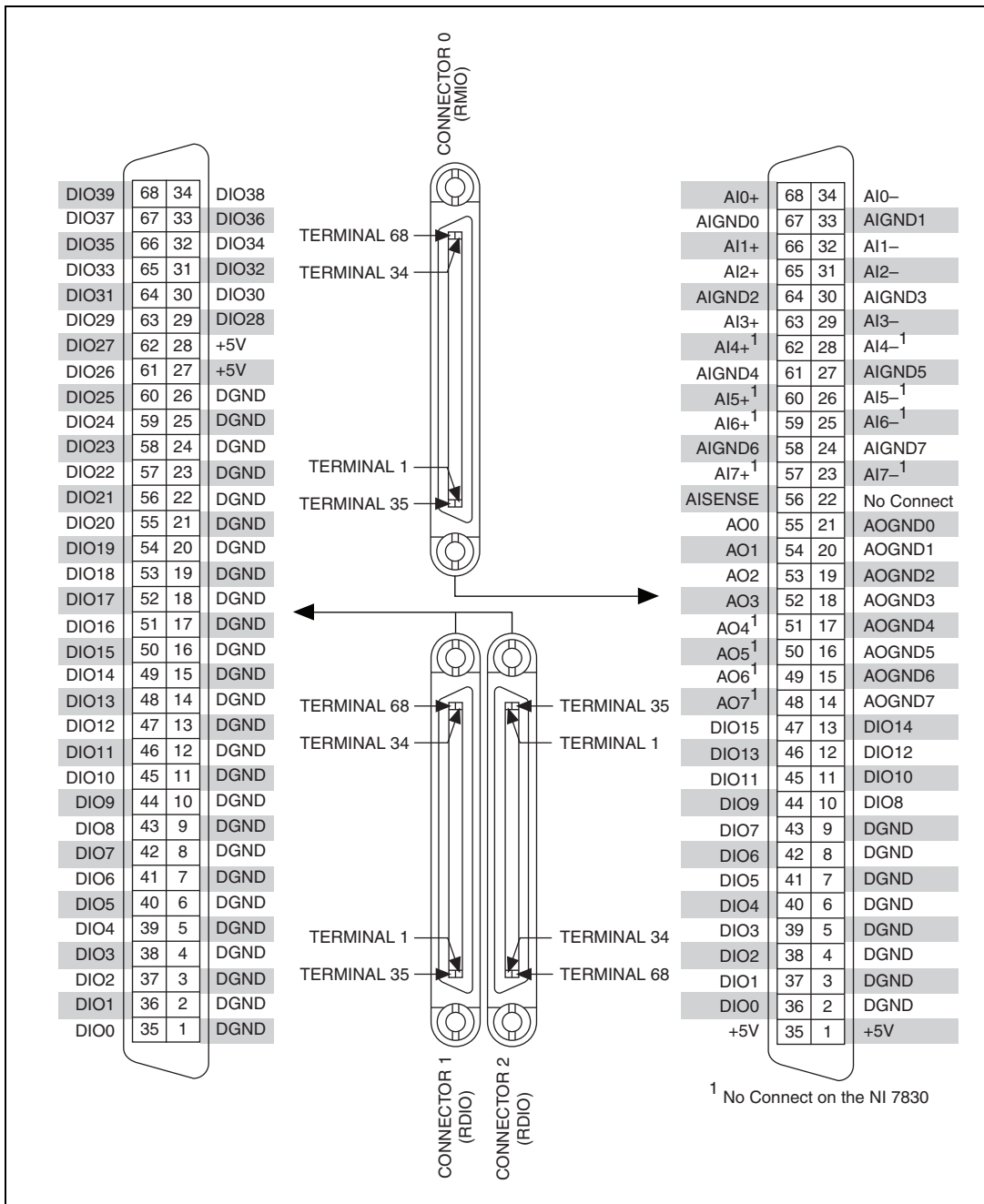


Figure 2. NI 783x/784x/785x Connector Pin Assignments and Locations

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