

# Wireless Sensor Network Analog Input Nodes

## NI WSN-3202, NI WSN-3212 **NEW!**

- NI-WSN software provides easy network configuration and drag-and-drop LabVIEW programming
- Up to 3-year battery life
- 2.4 GHz, IEEE 802.15.4 radio
- Outdoor range up to 300 m with line of sight
- Four analog input channels
- Four bidirectional digital channels (input, sinking output, or sourcing output)
- Industrial ratings:
  - -40 to 70 °C operating temperature
  - 50 g shock, 5 g vibration



Model	Signal Type	Analog Input Channels	Resolution (bits)	Minimum Sample Interval (seconds)	Input Range(s)	DIO Channels	DIO Voltage Range (V)	Max DIO Sourcing (aggregate)	Additional Features
NI WSN-3202	Voltage	4	16	1	$\pm 10$ , $\pm 5$ , $\pm 2$ , $\pm 0.5$ V	4 (sinking or sourcing)	5 to 30	1 A	12 V, 20 mA sensor power output
NI WSN-3212	Thermocouple	4	24	2	$\pm 73$ mV	4 (sinking or sourcing)	5 to 30	500 mA	Support for J, K, R, S, T, N, B, E thermocouple types

Table 1. WSN Node Specifications

## Overview

National Instruments wireless sensor networks (WSNs) deliver low-power measurement nodes that offer industrial certifications, reliable networking, and optional weatherproof outdoor enclosures for long-term, remote deployments. The measurement nodes have direct sensor connectivity and a 2.4 GHz radio to wirelessly transmit data to the WSN Ethernet gateway. Each measurement node offers four analog input channels and four digital I/O channels that you can configure for input, sinking output, or sourcing output. The NI WSN-3202 has a minimum sample interval of one second, while the NI WSN-3212 has a minimum sample interval of two seconds, corresponding to maximum sample rates of 60 and 30 samples per minute, respectively.

## Power

You can power the NI WSN measurement nodes with four 1.5 V AA alkaline battery cells, with operation up to three years on battery power at one sample per minute, or with a 9 to 30 V supply of external power.

You can configure the four digital I/O channels for input, sinking output, or sourcing output. You must use an external power supply to provide sourcing output through the digital I/O channels, with a maximum total current output (aggregate on all channels) of 500 mA on the WSN-3212 and 1 A on the WSN-3202. The WSN-3202 also offers a 12 V, 20 mA sensor power output line that drives external sensors.

## Wireless Networking

The measurement nodes and the NI WSN-9791 Ethernet gateway communicate wirelessly using 2.4 GHz radios and the reliable NI WSN protocol based on IEEE 802.15.4. The network accommodates up to 36 nodes per gateway and provides an outdoor range of up to 300 m with line of sight. The gateway maintains a list of nodes (by serial number) that have been authorized for network access. When a node powers up, it scans for available networks, locates either a gateway or router node, and attempts to join. If the gateway has the node in its list, the node joins the network, downloads the latest configuration from the gateway, and begins its normal operation of acquiring measurement data and controlling digital I/O.

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## Mesh Networking

Gateways, routers, and end nodes work together to form a mesh network. Measurement nodes can operate as routers or end nodes, providing the flexibility to extend the range of your sensor network. When nodes are configured as routers, they can repeat messages from end nodes and extend network range while acquiring measurement data. Router nodes must remain on to send and receive data across the network, and should be powered with an external source such as a 9 to 30 V supply, solar panel, or larger battery.

## Software Overview

With NI-WSN software, you can easily configure your sensor network in the NI Measurement & Automation Explorer (MAX) configuration utility and quickly extract measurement data from your wireless sensor network with the LabVIEW graphical development environment.

## Network Configuration

MAX provides an intuitive user interface to add and remove measurement nodes and configure wireless settings. Upon connection, the WSN-9791 Ethernet gateway is autodetected under Remote Systems in MAX, and you can assign WSN nodes to the gateway by entering the node serial number. Upon power-up or reset, the nodes automatically connect to the assigned gateway. If a node is unable to connect, it executes a retry sequence with increasingly higher wait periods beginning with one minute between connect attempts and ending with 55 minutes between connect attempts. This preserves battery power if a gateway is offline.

MAX also provides an overview of the nodes connected to your network including their last communication time, battery status, and link quality. In addition, MAX offers an interface to set the wireless communication channel, configure the gateway IP address, and wirelessly update firmware on the measurement nodes.

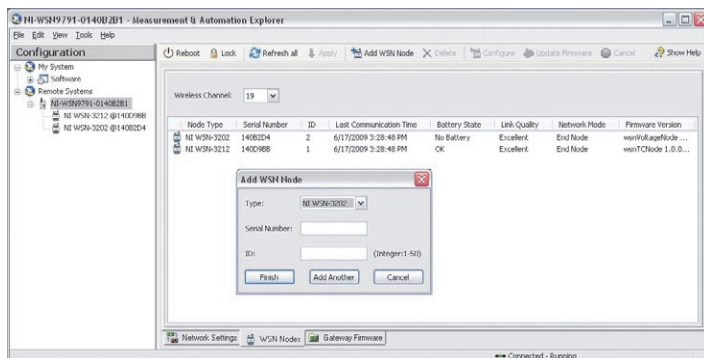


Figure 1. Network Configuration in MAX

## Programming

You can integrate your NI WSN measurement data directly into the LabVIEW graphical development environment. After adding the WSN Ethernet gateway to a LabVIEW project, the nodes configured with the gateway in MAX are automatically added underneath the gateway in the project, giving you instant access to their I/O and properties.

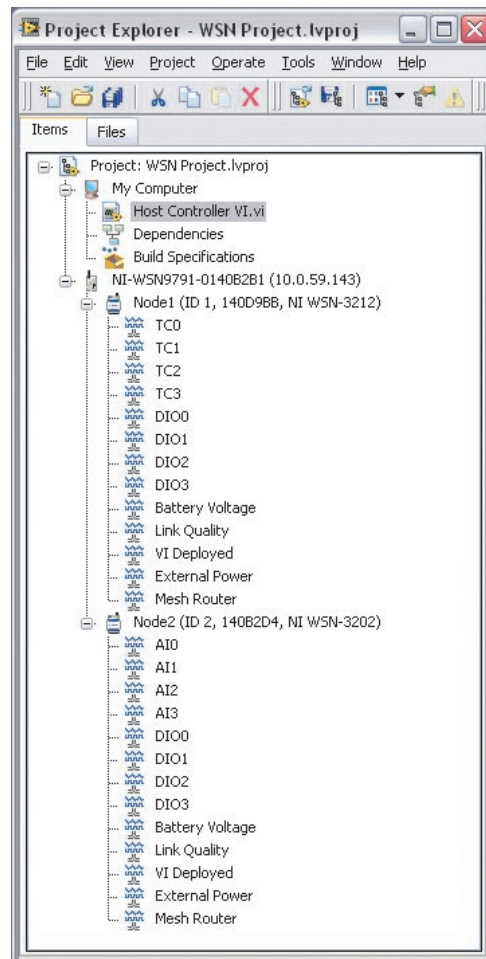


Figure 2. NI WSN System in the LabVIEW Project

Simply drag and drop I/O variables from a LabVIEW project to a LabVIEW block diagram for data extraction, analysis, and presentation.

## Wireless Sensor Network Analog Input Nodes

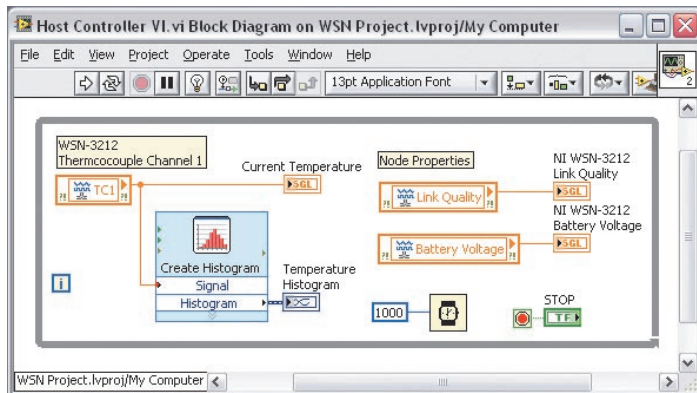


Figure 3. Extracting NI WSN Measurement Data Using LabVIEW

Using the drag-and-drop LabVIEW variables, you can monitor the analog and digital channels as well as other node attributes such as link quality, battery voltage, and whether a node is configured as a router or end node. The LabVIEW Project interface also offers access to node property configuration utilities. You can modify node sample intervals, define the analog and digital channel parameters, and provide aliases.

## NI WSN Applications and Architectures

With NI WSNs and access to the full breadth of NI platforms through LabVIEW, you have the flexibility to create simple, stand-alone wireless monitoring networks or completely integrated wired and wireless measurement solutions. In a simple architecture, as seen in Figure 4, the WSN measurement nodes acquire data and communicate wirelessly to the central gateway, which provides a wired Ethernet connection to a Windows or LabVIEW Real-Time host controller where you can log, analyze, process, and present your data.

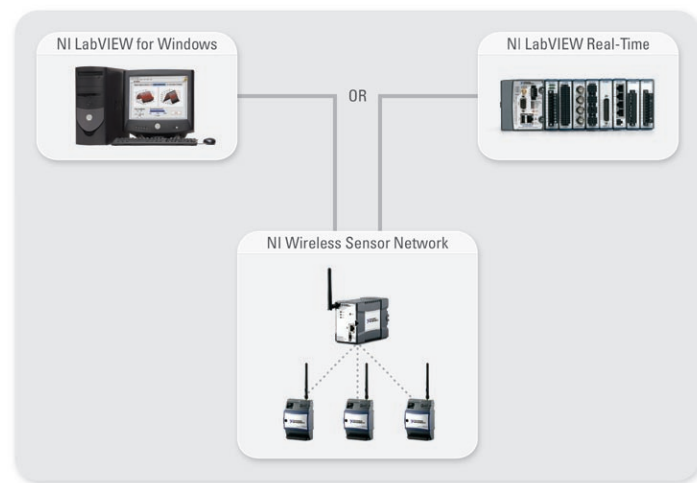


Figure 4. NI WSN systems provide flexible connectivity to Windows or LabVIEW Real-Time host controllers.

Furthermore, you can combine NI WSNs with other NI platforms to customize and enhance your measurement capabilities. You can complement your NI WSN with programmable automation controllers (PACs), vision systems, or even human machine interfaces (HMIs) to create a fully integrated solution that meets your unique application needs.

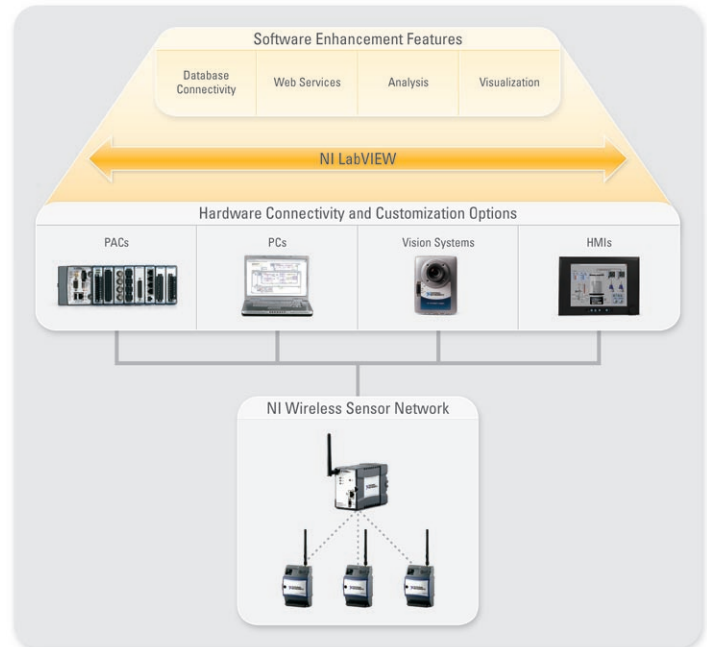


Figure 5. Customize and enhance your NI WSN system.

LabVIEW integration with NI WSNs delivers a common development environment for your applications as well as rapid programming, easy network configuration, and remote data access with LabVIEW Web services. You can also use other NI software such as DIAdem to conduct advanced data processing and analysis or the LabVIEW Datalogging and Supervisory Control Module for integrated event detection and alarming.

## Mechanical Information

The measurement node housing measures 5 by 3.3 by 1.5 in. (H by W by D), with the external antenna extending 4.25 in., resulting in a total height of 9.25 in. You can unscrew the faceplate of the measurement node to reveal the battery compartment, which holds four AA alkaline batteries and a reset button for manual reboots. Consult the user guide for detailed mechanical information.

# Wireless Sensor Network Analog Input Nodes

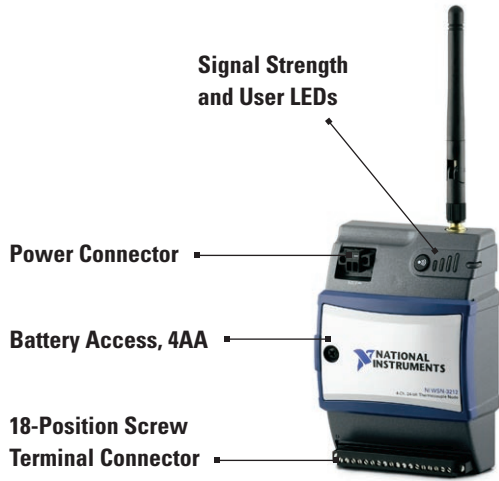


Figure 6. Measurement Node External Features

The nodes also offer screw terminals for direct sensor connectivity and signal-strength LEDs for network monitoring.

## Accessories

NI WSN accessories feature options for gateway and measurement node mounting as well as a weatherproof enclosure for outdoor use of the measurement nodes. Available mounting accessories include options to panel mount and DIN-rail mount WSN measurement nodes and gateways. The NI WSN-3281 magnetic panel mount kit provides easy setup and takedown on virtually any metal surface. For high shock and vibration applications, NI recommends a panel mounting configuration rather than DIN-rail.

Accessory	Description
NI WSN-3280	NI WSN node panel mount bracket with spring-loaded screw-locking mechanism and integrated strain relief
NI WSN-3281	NI WSN node magnetic panel mount bracket with spring-loaded screw-locking mechanism and integrated strain relief
NI WSN-3282	NI WSN DIN-rail mount kit for nodes or gateway (includes four screws)
NI WSN-3283	NI WSN panel mount plate for nodes or gateway (recommended for gateway) with additional four keyholes for mounting to wall in multiple orientations (includes four screws)

Table 2. Mounting Kits

The NI WSN-3291 is an outdoor, weatherproof enclosure for NI WSN measurement nodes. The enclosure features two I/O glands for routing power or sensor cables and is shipped with four I/O gland inserts and two I/O gland plugs so you can customize the glands for your application. The WSN-3291 offers an IP64 (Ingress Protection) rating to protect NI WSN measurement nodes for long-term, outdoor deployment.



Figure 7. Outdoor Enclosure with NI WSN Measurement Node (not included)

Accessory	Description
NI WSN-3291	IP64 outdoor enclosure for WSN measurement nodes
NI WSN-3292	Set of replacement I/O glands: two glands, four inserts, two plugs
NI WSN-3293	Additional I/O gland inserts (set of 5)

Table 3. Outdoor Enclosure and Accessories

You can choose from several power accessories that provide external power to the WSN Ethernet gateway or WSN measurement nodes.

Accessory	Description
Desktop Power Supply	This power supply provides 12 VDC power up to 1.25 A /15 W, and is rated for 0 to 70 °C. The supply terminates with a 2-position MINI-COMBICON connector that plugs directly into the WSN gateway or measurement nodes.
PS-5 Power Supply	This DIN-rail-mountable, 24 VDC power supply delivers up to 5 A of current and is rated for operation from -25 to 60 °C. Recommended for industrial installations.

Table 4. External Power Supplies

The connectivity accessories for NI WSN products include additional screw-terminal kits for the measurement nodes and a power connector backshell kit that contains a strain relief attachment for the two-position power connector on the Ethernet gateway and measurement nodes.

Accessory	Description
NI WSN-3284	Extra 18-position screw-terminal connectors for WSN-3202 – 2 top entry, 2 side entry – with labels
NI WSN-3285	Extra 18-position screw-terminal connectors for WSN-3212 – 2 top entry, 2 side entry – with labels
Power Connectors	Extra 2-position MINI-COMBICON power connectors – quantity 4
Power Connector Backshell	Strain relief attachment for the 2-position power connector on the measurement nodes and gateway; clips to the connector and includes a zip tie to hold the power cable in place

Table 5. Connectivity Accessories

# Wireless Sensor Network Analog Input Nodes

## Ordering Information

NI WSN Starter Kit (Americas).....	781080-01
NI WSN Starter Kit (Europe/Asia).....	781080-11

## Ethernet Gateway

NI WSN-9791 (Americas).....	780996-01
NI WSN-9791 (Europe/Asia).....	780996-11

## Programmable Measurement Nodes

NI WSN-3202 (Americas).....	780997-02
NI WSN-3202 (Europe/Asia).....	780997-12
NI WSN-3212 (Americas).....	780998-02
NI WSN-3212 (Europe/Asia).....	780998-12

## Nonprogrammable Measurement Nodes

NI WSN-3202 (Americas).....	780997-01
NI WSN-3202 (Europe/Asia).....	780997-11
NI WSN-3212 (Americas).....	780998-01
NI WSN-3212 (Europe/Asia).....	780998-11

## Power Accessories

Desktop supply.....	780703-01
U.S. power cord.....	763000-01
PS-5 industrial supply.....	778805-90

## Mounting Accessories

NI WSN-3280.....	780999-01
NI WSN-3281.....	781073-01
NI WSN-3282.....	781074-01
NI WSN-3283.....	781075-01

## Connectivity Accessories

NI WSN-3284.....	781076-01
NI WSN-3285.....	781077-01
Power connectors.....	780702-01
Power connector backshell kit.....	196375-01

## Outdoor Enclosure and Accessories

NI WSN-3291.....	780994-01
NI WSN-3292.....	195712-01
NI WSN-3293.....	195738-01

## BUY NOW

For complete product specifications, pricing, and accessory information, call 800 813 3693 (U.S.) or go to [ni.com/wsn](http://ni.com/wsn).

# Wireless Sensor Network Analog Input Nodes

## NI WSN-3202 Specifications

These specifications are typical for the range -40 to 70 °C unless otherwise noted.

» For complete WSN-3202 analog input node specifications, see the *NI WSN-3202 User Guide and Specifications* manual at [ni.com/manuals](http://ni.com/manuals).

### Analog Input Characteristics

Number of channels.....	4 single-ended channels
ADC resolution.....	16 bits
DNL.....	No missing codes guaranteed
INL.....	Refer to the Absolute Accuracy Formulas
Minimum sample interval.....	1 second
Input coupling.....	DC
Nominal input ranges.....	±10 V, ±5 V, ±2 V, ±0.5 V
Minimum over range.....	4%
Input impedance (at DC)	
Powered on.....	>1 GΩ
Powered off/overload.....	10 kΩ
Input bias current.....	3 nA
Crosstalk (at 1 kHz)	
Adjacent channels.....	>100 dB
Nonadjacent channels.....	>100 dB
Analog bandwidth.....	7 kHz
Overvoltage protection.....	±30 V (one channel only)

### AI Absolute Accuracy Tables and Formulas

The values in the following tables are based on calibrated scaling coefficients, which are stored in the onboard EEPROM.

Nominal Range (V)	Absolute Accuracy at Full Scale (mV) <sup>1</sup>	Random Noise $\Sigma(\mu V_{rms})$	Sensitivity <sup>2</sup> (μV)
±10	27.61	342	137
±5	16.61	172	68.5
±2	7.72	69	27.5
±0.5	1.95	18	7

<sup>1</sup>Absolute accuracy values at full scale on the analog input channels assume the device is operating within 45 °C of the last calibration and are valid for averaging 100 samples immediately following calibration. Refer to the Absolute Accuracy Formulas for more information.

<sup>2</sup>Sensitivity is the smallest voltage change that can be detected. It is a function of noise.

Table 6. Accuracy Summary

Nominal Range (V)	Residual Gain Error (ppm of Reading)	Gain Tempco (ppm/°C)	Residual Offset Error (ppm of Range)	Offset Tempco (ppm of Range/°C)	INL Error (ppm of Range)
±10	102	31	164	22	100
±5	137	41	240	22	100
±2	182	48	420	22	100
±0.5	160	50	300	24	100

Table 7. Accuracy Details

### Absolute Accuracy Formulas

$$\begin{aligned}
 \text{AbsoluteAccuracy} &= \text{Reading} \cdot \text{GainError} + \text{Range} \cdot \text{OffsetError} + \text{NoiseUncertainty} \\
 \text{GainError} &= \text{ResidualGainError} + \text{GainTempco} \cdot \text{TempChangeFromLastCal} \\
 \text{OffsetError} &= \text{ResidualOffsetError} + \text{OffsetTempco} \cdot \text{TempChangeFromLastCal} + \text{INL\_Error} \\
 \text{NoiseUncertainty} &= (3 \cdot \text{RandomNoise}) / \sqrt{\text{NumberOfReadings}} \quad \text{for a coverage factor of } 3\sigma \text{ and averaging } 100 \text{ points}
 \end{aligned}$$

Absolute accuracy at full scale on the analog input channels is determined using the following assumptions:

TempChangeFromLastCal = 45 °C  
 NumberOfReadings = 100  
 CoverageFactor = 3 σ

For example, on the 10 V range, the absolute accuracy at full scale is as follows:

$$\begin{aligned}
 \text{GainError} &= 10 \text{ V} \cdot (102 \text{ ppm} + 31 \text{ ppm} \cdot 45) = 14.97 \text{ mV} \\
 \text{OffsetError} &= 10 \text{ V} \cdot (164 \text{ ppm} + 22 \text{ ppm} \cdot 45 + 100 \text{ ppm}) = 12.54 \text{ mV} \\
 \text{NoiseUncertainty} &= 3 \cdot 342 \mu\text{V} / 100^{0.5} = 0.103 \text{ mV} \\
 \text{AbsoluteAccuracy} &= 27.61 \text{ mV}
 \end{aligned}$$

### Digital I/O

#### Static Characteristics

Number of channels.....	4 bidirectional, individually settable
Modes (configurable per channel).....	Drive High Only, Drive Low Only, Drive High and Low, and Tristate
Voltage range	
Input.....	0 to 30 V
Output (sourcing).....	5 to 30 V
Output current (sourcing or sinking).....	1 A max on any one channel, 1 A total for all four channels
Power-on output state.....	High impedance, tristate
DIO power supply voltage range.....	5 to 30 V
Digital input logic levels	
Input high range.....	1.65 to 30 V
Input low range.....	0 to 0.45 V
Input current	
0 V input.....	-160 μA
5 V input.....	125 μA
30 V input.....	220 μA

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## DIO output voltage drop

Sourcing.....	0.5 V at 0.1 A; 1.1 V at 1 A
Sinking.....	0.06 V at 0.1 A; 0.52 V at 1 A

## DIO overcurrent fuse

Maximum voltage.....	30 V
Hold current.....	1.1 A at 25 °C
Trip time.....	2.5 s at 5 A at 25 °C

## Dynamic Characteristics

### Output delay time

Sinking, 10 kΩ pull up.....	15 μs
Sourcing, 10 kΩ pull down .....	3.5 ms

## Power Requirements

**Caution:** Use the WSN-3202 with a 24 VDC, UL-listed, limited power source (LPS) supply. The power supply bears the UL listed mark, LPS. It must also meet any safety and compliance requirements for the country of use. Do not use rechargeable batteries.

The following power requirements specifications are typical at 25 °C.

## Battery Power

### Internal battery

Type.....	4 AA, alkaline only
Voltage range .....	3.6 to 7.5 V
Power consumption <sup>1</sup>	
60-second sample interval.....	0.5 mW at 6 V
1-second sample interval.....	13.3 mW at 6 V

### Battery life<sup>1</sup>

60-second sample interval .....	Up to 3 years
1-second sample interval .....	Up to 1 month

## External Power

External power .....	9 to 30 V
Power input mating connector.....	2-position MINI-COMBICON, Phoenix Contact part number: 1714977

### Power consumption

#### End node mode

60-second sample interval.....	16 mW at 24 V
1-second sample interval.....	33 mW at 24 V
Router mode <sup>2</sup> .....	300 mW at 24 V

<sup>1</sup>Device executing NI-WSN firmware. End node mode. Sensor power not used.

<sup>2</sup>Router connected directly to gateway. Routing messages for one end node at a one-minute sample interval.

# Wireless Sensor Network Analog Input Nodes

## NI WSN-3212 Specifications

These specifications are typical for the range -40 to 70 °C unless otherwise noted.

» For complete WSN-3212 thermocouple input node specifications, see the *NI WSN-3212 User Guide and Specifications* manual at [ni.com/manuals](http://ni.com/manuals).

### Analog Input Characteristics

Number of channels.....	Thermocouple input channels
ADC resolution.....	24 bits
Type of ADC.....	delta-sigma
Voltage measurement range.....	±73 mV
Common-mode range	
Channel-to-common.....	±700 mV
Common-mode rejection ratio (0 to 60 Hz)	
Channel-to-common.....	95 dB
Temperature measurement ranges	
Thermocouple types J, K, R, S, T, N and B.....	Works over temperature ranges defined by NIST
Thermocouple type E.....	-270 to 950 °C
Minimum sample interval.....	2 seconds
Input bandwidth (-3 dB).....	1 Hz
Noise rejection.....	65 dB min at 50/60 Hz
Overvoltage protection.....	±30 V between any input and common
Differential input impedance.....	20 MΩ
Input current.....	50 nA
Input noise.....	0.5 μV <sub>rms</sub>
Gain error.....	0.02% max at 25 °C, 0.03% typ at -40 to 70 °C, 0.1% max at -40 to 70 °C
Offset error (with autozero).....	11 μV typ, 12.5 μV max

### Digital I/O

#### Static Characteristics

Number of channels.....	4 bidirectional, individually settable
Modes (configurable per channel).....	Drive High Only, Drive Low Only, Drive High and Low, and Tristate
Voltage range	
Input.....	0 to 30 V
Output (sourcing).....	5 to 30 V
Output current (sourcing or sinking).....	500 mA max on any one channel, 500 mA total for all four channels
Power-on output state.....	High impedance, tristate
DIO power supply voltage range.....	5 to 30 V
Digital input logic levels	
Input high range.....	1.65 to 30 V

Input low range.....	0 to 0.45 V
Input current	
0 V input.....	-160 μA
5 V input.....	125 μA
30 V input.....	220 μA
DIO output voltage drop	
Sourcing.....	0.5 V at 0.1 A; 0.763 V at 0.5 A
Sinking.....	0.057 V at 0.1 A; 0.286 V at 0.5 A
DIO overcurrent fuse	
Maximum voltage.....	30 V
Hold current.....	1.1 A at 25 °C
Trip time.....	2.5 s at 5 A at 25 °C

### Dynamic Characteristics

Output delay time	
Sinking, 10 kΩ pull up.....	15 μs
Sourcing, 10 kΩ pull down.....	3.5 ms

### Power Requirements

**Caution:** Use the WSN-3212 with a 24 VDC, UL-listed, limited power source (LPS) supply. The power supply bears the UL-listed mark, LPS. It must also meet any safety and compliance requirements for the country of use. Do not use rechargeable batteries.

The following power requirements specifications are typical at 25 °C.

#### Battery Power

Internal battery	
Type.....	4 AA, alkaline only
Voltage range.....	3.6 to 7.5 V
Power consumption <sup>1</sup>	
60-second sample interval.....	0.4 mW at 6 V
2-second sample interval.....	7.4 mW at 6 V
Battery life <sup>1</sup>	
60-second sample interval.....	Up to 3 years
2-second sample interval.....	Up to 2 months

#### External Power

Voltage range.....	9 to 30 V
Power input mating connector.....	2-position MINI-COMBICON, Phoenix Contact part number: 1714977
Power consumption	
End node mode	
60-second sample interval.....	15 mW at 24 V
2-second sample interval.....	25 mW at 24 V
Router mode <sup>2</sup> .....	300 mW at 24 V

<sup>1</sup>Device executing NI-WSN firmware. End node mode. Sensor power not used.

<sup>2</sup>Router connected directly to gateway. Routing messages for one end node at a one-minute sample interval.

# Wireless Sensor Network Analog Input Nodes

## NI WSN-3202 and NI WSN-3212 Specifications

### Wireless Characteristics

Radio mode .....	IEEE 802.15.4
RF data rate.....	250 kbits/s
Indoor range .....	Up to 90 m
Outdoor range .....	Up to 300 m
Frequency band <sup>1</sup> .....	ISM 2.4 GHz (2400 to 2483.5 MHz)
Channels <sup>2</sup> .....	11 to 24

#### TX power

Version	Maximum Radio Output
Americas	+17 dBm max (50 mW)
Europe/Asia	+10 dBm max

Modulation type .....	DSSS (O-QPSK)
Receiver sensitivity.....	-102 dBm

#### Antenna

Connector.....	Female RP-SMA connector
VSWR.....	MAX.2.0
Impedance .....	50 Ω
Directivity.....	Omni
Nominal gain.....	1.5 dBi

<sup>1</sup>Due to regulations, the frequency bands depend on the country of operation.

<sup>2</sup>Due to regulations, the valid channels depend on country of operation.

### Physical Characteristics

Screw-terminal wiring .....	14 to 24 AWG wire
Torque for screw terminals .....	0.2 to 0.25 N•m
Dimensions.....	See the <i>NI WSN-32xx User Guide</i> manuals for device dimensions.
Weight.....	Approx. 242 g (8.5 oz)
Weight with antenna .....	Approx. 256 g (9 oz)

### Environmental

For outdoor use, mount the system in a suitably rated enclosure.

Operating temperature.....	-40 to 70 °C (IEC-60068-2-1 and IEC-60068-2-2)
Storage temperature .....	-40 to 85 °C (IEC-60068-2-1 and IEC-60068-2-2)
Operating humidity.....	10 to 90% RH, noncondensing (IEC-60068-2-56)
Storage humidity .....	5 to 95% RH, noncondensing (IEC-60068-2-56)
Maximum altitude.....	2,000 m
Pollution degree .....	2 (IEC 60664)

### Shock and Vibration

Operating vibration, random .....	5 g <sub>rms</sub> , 10 to 500 Hz (IEC 60068-2-64)
Operating shock .....	30 g, 11 ms half sine, 50 g, 3 ms half sine, 18 shocks at 6 orientations (IEC 60068-2-27)
Operating vibration, sinusoidal.....	5 g, 10 to 500 Hz (IEC 60068-2-6)

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### System Assurance Programs

NI system assurance programs are designed to make it even easier for you to own an NI system. These programs include configuration and deployment services for your NI PXI, CompactRIO, or Compact FieldPoint system. The NI Basic System Assurance Program provides a simple integration test and ensures that your system is delivered completely assembled in one box. When you configure your system with the NI Standard System Assurance Program, you can select from available NI system driver sets and application development environments to create customized, reorderable software configurations. Your system arrives fully assembled and tested in one box with your software preinstalled. When you order your system with the standard program, you also receive system-specific documentation including a bill of materials, an integration test report, a recommended maintenance plan, and frequently asked question documents. Finally, the standard program reduces the total cost of owning an NI system by providing three years of warranty coverage and calibration service. Use the online product advisors at [ni.com/advisor](http://ni.com/advisor) to find a system assurance program to meet your needs.

### Calibration Services

NI recognizes the need to maintain properly calibrated devices for high-accuracy measurements. We provide manual calibration procedures, services to recalibrate your products, and automated calibration software specifically designed for use by metrology laboratories. Visit [ni.com/calibration](http://ni.com/calibration).

### Repair and Extended Warranty

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