Wireless Sensor Network Programmable Analog Input Measurement Nodes
NI WSN-3202, NI WSN-3212, NI WSN-3226

- Create a reliable network, with support for hundreds of nodes, to monitor your assets or environment
- Programmable with the LabVIEW Wireless Sensor Network (WSN) Module: Customize node behavior to extend battery life, increase sample rates, save data locally, and perform local analysis and DIO control
- NI-WSN software provides easy network configuration, drag-and-drop LabVIEW programming, and support for logging, alarming, and web-based data visualization
- Low-power operation, with up to 3-year battery life
- 2.4 GHz, IEEE 802.15.4 radio that provides up to 300m outdoor range
- Four analog input channels per measurement node
- Bi-directional digital channels, configurable for input, sinking output, or sourcing output (2-4 DIO channels per node)
- Industrial ratings: -40 to 70 °C operating temperature and 50 g shock, 5 g vibration

Overview
The National Instruments wireless sensor network (WSN) platform delivers low-power measurement nodes that offer industrial certifications, reliable networking, and optional weatherproof outdoor enclosures for long-term, remote monitoring applications. The measurement nodes have direct sensor connectivity and a 2.4 GHz radio to wirelessly transmit data to a WSN gateway. Each measurement node offers four analog input channels and two to four digital I/O channels that you can configure for input, sinking output, or sourcing output. With graphical LabVIEW software, you can easily configure your network, collect measurement data, trigger alarms through SMS or E-mail, and even view monitoring data within a web browser. With the NI LabVIEW Wireless Sensor Network (WSN) Module, you can customize the behavior of programmable NI WSN measurement nodes. Use this module to optimize node behavior for your application: customize sample and transmission rates, perform onboard analysis or data reduction, respond to digital value changes, perform local control of DIO lines, and even store data to flash memory.

Comparison Tables

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<th>Additional Features</th>
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<td>NI WSN-3202</td>
<td>Voltage</td>
<td>4</td>
<td>16</td>
<td>±10, ±5, ±2, ±0.5 V</td>
<td>4 (sinking or sourcing)</td>
<td>5 to 30</td>
<td>1 A</td>
<td>12 V, 20 mA sensor power output</td>
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<tr>
<td>NI WSN-3212</td>
<td>Thermocouple, Voltage</td>
<td>4</td>
<td>24</td>
<td>±73 mV</td>
<td>4 (sinking or sourcing)</td>
<td>5 to 30</td>
<td>500 mA</td>
<td>Support for J, K, R, S, T, N, B, E thermocouple types</td>
<td></td>
</tr>
<tr>
<td>NI WSN-3226</td>
<td>Voltage, Resistance/RTD</td>
<td>4</td>
<td>20</td>
<td>±10V, 400Ω, 4kΩ, 100kΩ</td>
<td>2 (sinking or sourcing)</td>
<td>5 to 30</td>
<td>1A</td>
<td>12V, 50mA sensor power output, 50/60Hz rejection, battery backup support</td>
<td></td>
</tr>
</tbody>
</table>
Application and Technology

Programmable WSN Measurement Nodes and the LabVIEW WSN Module

NI recommends the programmable versions of NI WSN measurement nodes. Using programmable nodes and the LabVIEW WSN Module, you can use graphical programming to customize node firmware and optimize node operation for your applications.

You can use LabVIEW WSN applications to extend battery life, perform onboard analysis or data reduction, and even programmatically control DIO lines in response to analog data or network status changes. The programmable nodes also deliver access to the node’s onboard flash memory, where you can store measurement data or other node parameters.

An example LabVIEW WSN application might be used to sample the analog inputs once an hour, store measurement data to flash, and transmit 24 data points at midnight each day. This same application could be used to turn on a relay or actuator if analog data rose above a specified threshold, such as turning on a fan if an acquired temperature was above a critical level. And since these applications are written in the LabVIEW graphical development environment, customizing node firmware is easy, without any need for low-level assembly or machine code knowledge. With the LabVIEW WSN Module, the custom applications are wirelessly downloaded to the node's onboard processor, where they can dictate sample and transmission rates, onboard data analysis, and how the node responds to network status changes or digital value changes.

Power

You can power the NI WSN measurement nodes with four 1.5V AA alkaline battery cells, delivering three-year battery-powered operation at a one minute sample interval. The NI WSN-3226 also supports 1.5V AA lithium cells. Each node features an external power port, so that you can provide line power, or use other forms of power such as solar or vibration energy harvesting. The NI WSN-3226 supports battery backup, meaning you can connect both external and battery power; the node will default to external power and automatically switch to battery power in the event the external power drops below a voltage threshold. The external power input should be used to power NI WSN nodes operating in router mode, which is a feature that you can enable in software to set up a self-healing mesh network of nodes. Router nodes increase density, distance, and redundancy in your wireless network.

Each node offers bi-directional 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 and WSN-3226. The WSN-3202 and WSN-3226 also feature a 12 V sensor power output line that can be used to drive external sensors.

Wireless and Mesh Networking

The measurement nodes and gateways 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, with access to 14 non-overlapping wireless channels, so that you can reliably configure 14 36-node networks (2,016 analog channels) in the same vicinity without sharing any wireless bandwidth. Each radio delivers an outdoor range of up to 300m with line of sight, and up to 100m indoors, performing reliably even in high EMI environments.

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 or density 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.

When a node powers up, it scans for available networks, locates either a gateway or router node, and attempts to join. When the node joins the network, it downloads the latest configuration from the gateway, and begins its normal operation of acquiring measurement data, controlling digital I/O, and transmitting data back to the gateway for processing, alarming, and visualization.

Software Overview

With NI-WSN software, you can easily configure your sensor network and quickly extract measurement data from your wireless sensor network with the LabVIEW graphical development environment.

NI WSN measurement nodes configured with a gateway are automatically added to your LabVIEW Project, giving you instant access to their I/O and properties. Simply drag and drop I/O variables from a LabVIEW project to a LabVIEW block diagram for data extraction, analysis, and presentation. 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. These properties allow you to intelligently maintain your network and choose the best locations for your measurement nodes. 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.
LabVIEW delivers a common development environment for all of your monitoring and control applications as well as rapid programming, easy network configuration, and open connectivity to a variety of third-party instruments and systems. And with a multitude of LabVIEW add-ons, you can visualize data in a web browser, conduct advanced data processing and analysis, or perform integrated event detection and alarming.

**Node Programming (LabVIEW WSN)**

You can customize the behavior of programmable NI WSN measurement nodes with the LabVIEW WSN Module. Use this module to perform custom analysis, extend battery life, and embed local decision making on NI WSN measurement nodes.

With the LabVIEW WSN Module, you can significantly increase the battery life of your NI WSN measurement nodes while increasing performance and flexibility. By default, a node transmits every acquired value back to the gateway at the specified sample interval; however, in many applications, it is sufficient to simply monitor a given input for a threshold crossing or average values over a period of time. In these applications, powering the radio to transmit every acquired sample uses excessive power and reduces battery life. With LabVIEW WSN, you can add intelligence to the node to transmit data only when required. Additionally, you can monitor battery voltage and network status as well as modify the sample interval of the node to optimize behavior for specific operating conditions.
This also helps you achieve higher sample rates by customizing how the node acquires and transmits data. Exact sample rates depend on how many channels you are sampling, the analysis performed on each sample, and how many samples are transmitted back to the host, but programmable WSN nodes can achieve faster sample rates than those noted in the specifications. Refer to the LabVIEW WSN Benchmarks white paper on NI Developer Zone for more information on increasing sample rates.

Using a subset of LabVIEW analysis functions and floating-point math operations, you can preprocess data acquired by NI WSN measurement nodes. A variety of analog and digital sensors can interface directly with these nodes, and you can use LabVIEW WSN to scale and convert raw sensor data into meaningful engineering units before transmitting.

With LabVIEW WSN, you can also embed intelligence on NI WSN measurement nodes, so decisions can be made autonomously without transmitting the stimulus and response to and from a host computer or embedded controller. You can use the digital output lines on an NI WSN measurement node to actuate relays and perform simple on/off control. For example, a programmed node can turn on a fan when a temperature threshold is exceeded, which reduces response time and increases reliability by removing the need for host interaction.

**NI WSN Applications and Architectures**

NI wireless sensor networks are ideally suited for long-term remote monitoring applications such as environmental monitoring, water quality monitoring, structural health monitoring, energy quality and consumption monitoring, transportation, and machine condition monitoring. NI WSN measurement nodes can withstand outdoor and industrial environments and reliably monitor assets or surroundings to provide enhanced visibility into the overall health of your systems or processes.

The NI WSN platform can function as a simple, standalone wireless monitoring system, or be combined with other hardware components to achieve a complete wired and wireless measurement and control system. Through LabVIEW, you can combine NI wireless sensor network devices with other NI platforms to customize and enhance your measurement capabilities. You can complement your NI WSN with embedded CompactRIO systems, vision systems, or even human machine interfaces (HMIs) to create a fully integrated solution that meets the unique needs of your application.

**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 batteries and a reset button for manual reboots. Consult the user guide for detailed mechanical information.

**Accessories**

NI WSN accessories include options for gateway and measurement node mounting as well as weatherproof enclosures for outdoor use of the measurement nodes and gateways. 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.
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 IP65 (Ingress Protection) rating to protect NI WSN measurement nodes for long-term, outdoor deployment.

Please view the WSN Accessories datasheet for a complete list of WSN mounting accessories, outdoor enclosures, backshell kits, and power supplies.

### Ordering Information

For a complete list of accessories, visit the product page on ni.com.

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<td><strong>Programmable Measurement Nodes</strong></td>
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<tr>
<td>NI WSN-3202 Analog Input Node (Americas)</td>
<td>780997-02</td>
<td>No accessories required.</td>
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<tr>
<td>NI WSN-3202 Analog Input Node (Europe/Asia)</td>
<td>780997-12</td>
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<td>NI WSN-3212 Thermocouple Input Node (Americas)</td>
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<tr>
<td>NI WSN-3212 Thermocouple Input Node (Europe/Asia)</td>
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<tr>
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<td>781295-02</td>
<td>No accessories required.</td>
<td></td>
</tr>
<tr>
<td>NI WSN-3226 Voltage/RTD Combination Node (Europe/Asia)</td>
<td>781295-12</td>
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<tr>
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<tr>
<td>NI WSN-3212 Thermocouple Input Node (Americas)</td>
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<tr>
<td>NI WSN-3212 Thermocouple Input Node (Europe/Asia)</td>
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<tr>
<td>NI WSN-3291 Measurement Node Enclosure</td>
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<td>No accessories required.</td>
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<tr>
<td>NI WSN-3294 Ethernet Gateway Enclosure</td>
<td>199975-01</td>
<td>No accessories required.</td>
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<td><strong>WSN Gateways</strong></td>
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<td>NI WSN-9791 Ethernet Gateway (Europe/Asia)</td>
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<td>NI 9792 Programmable WSN Gateway (Americas)</td>
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<td>NI WSN Starter Kit (Americas)</td>
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<tr>
<td>NI WSN Starter Kit (Europe/Asia)</td>
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### Support and Services

#### 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 to find a system assurance program to meet your needs.

#### Calibration

NI measurement hardware is calibrated to ensure measurement accuracy and verify that the device meets its published specifications. To ensure the ongoing accuracy of your measurement hardware, NI offers basic or detailed recalibration service that provides ongoing ISO 9001 audit compliance and confidence in your measurements. To learn more about NI calibration services or to locate a qualified service center near you, contact your local sales office or visit ni.com/calibration.

#### Technical Support

Get answers to your technical questions using the following National Instruments resources.

- **Support** - Visit ni.com/support to access the NI KnowledgeBase, example programs, and tutorials or to contact our applications engineers who are located in NI sales offices around the world and speak the local language.
Repair
While you may never need your hardware repaired, NI understands that unexpected events may lead to necessary repairs. NI offers repair services performed by highly trained technicians who quickly return your device with the guarantee that it will perform to factory specifications. For more information, visit ni.com/repair.

Training and Certifications
The NI training and certification program delivers the fastest, most certain route to increased proficiency and productivity using NI software and hardware. Training builds the skills to more efficiently develop robust, maintainable applications, while certification validates your knowledge and ability.

- Classroom training in cities worldwide - the most comprehensive hands-on training taught by engineers.
- On-site training at your facility - an excellent option to train multiple employees at the same time.
- Online instructor-led training - lower-cost, remote training if classroom or on-site courses are not possible.
- Course kits - lowest-cost, self-paced training that you can use as reference guides.
- Training memberships and training credits - to buy now and schedule training later.

Visit ni.com/training for more information.

Extended Warranty
NI offers options for extending the standard product warranty to meet the life-cycle requirements of your project. In addition, because NI understands that your requirements may change, the extended warranty is flexible in length and easily renewed. For more information, visit ni.com/warranty.

OEM
NI offers design-in consulting and product integration assistance if you need NI products for OEM applications. For information about special pricing and services for OEM customers, visit ni.com/oem.

Alliance
Our Professional Services Team is comprised of NI applications engineers, NI Consulting Services, and a worldwide National Instruments Alliance Partner program of more than 700 independent consultants and integrators. Services range from start-up assistance to turnkey system integration. Visit ni.com/alliance.

Detailed Specifications
These specifications are typical from –40 to 70 °C, and assume high rejection strength mode and 50/60 Hz filter rejection mode unless otherwise noted. Some specifications (such as sample interval and power consumption) can be optimized by customizing node behavior with the NI LabVIEW Wireless Sensor Network (WSN) Module Pioneer. Refer to the LabVIEW WSN Pioneer Performance Benchmarks document, at zone.ni.com for more information.

For the NI WSN gateway specifications, refer to the gateway documentation.

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<td>ADC resolution</td>
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<td>DNL</td>
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<td>Powerline filtering modes</td>
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<table>
<thead>
<tr>
<th>Normal mode rejection, filter characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filtering Strength</td>
</tr>
<tr>
<td>High rejection</td>
</tr>
<tr>
<td>Low power</td>
</tr>
</tbody>
</table>

Overvoltage protection ±30 VDC

Voltage Input

| Nominal range | ±10 VDC |
| Input impedance | 1 MΩx |
### Noise Accuracy
- **30 μVrms**

### Voltage Accuracy
- **Gain drift**: 11 ppm/°C
- **Offset drift**: 90 μV/°C

### Measurement Conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>Percent of Reading (Gain Error)</th>
<th>Percent of Range (Offset Error)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical, 25 °C, ±5 °C</td>
<td>±0.02%</td>
<td>±0.01% (±1 mV)</td>
</tr>
<tr>
<td>Maximum, –40 °C to 70 °C</td>
<td>±0.2%</td>
<td>±0.1% (±10 mV)</td>
</tr>
</tbody>
</table>

*Range equals 10 V*

### Resistance Input

<table>
<thead>
<tr>
<th>Nominal Range</th>
<th>Excitation Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 to 400 Ω</td>
<td>1 mA</td>
</tr>
<tr>
<td>20 to 4000 Ω</td>
<td>350 μA</td>
</tr>
<tr>
<td>250 to 100 kΩ</td>
<td>20 μA</td>
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</tbody>
</table>

### RTD Temperature Accuracy

<table>
<thead>
<tr>
<th>Range</th>
<th>Measurement Conditions</th>
<th>Typical (25 °C, ±5 °C)</th>
<th>Maximum, (–40 °C to 70 °C)</th>
<th>Temperature Drift</th>
<th>Noise</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pt100</td>
<td>~200 °C to 150 °C  &lt;br&gt; 150 °C to 850 °C</td>
<td>0.2 °C 0.3 °C  &lt;br&gt; 1 °C 2.7 °C</td>
<td>0.017 °C/°C  &lt;br&gt; 0.028 °C/°C</td>
<td>0.01 °Crms</td>
<td>0.2 °C 0.3 °C  &lt;br&gt; 0.7 °C 2 °C</td>
</tr>
<tr>
<td>Pt1000</td>
<td>~200 °C to 150 °C  &lt;br&gt; 150 °C to 850 °C</td>
<td>0.1 °C 0.2 °C  &lt;br&gt; 0.7 °C 2 °C</td>
<td>0.005 °C/°C  &lt;br&gt; 0.013 °C/°C</td>
<td>0.01 °Crms</td>
<td>0.01 °Crms</td>
</tr>
</tbody>
</table>

*Up to 5 m of 22 AWG copper leads, 5% lead length mismatch.*

### Resistance Accuracy

<table>
<thead>
<tr>
<th>Range</th>
<th>Measurement Conditions</th>
<th>Percent of Range (Offset Error)</th>
<th>Percent of Reading (Gain Error)</th>
<th>Typical Temperature Drift</th>
<th>Noise</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 Ω</td>
<td>Typical (25 °C, ±5 °C)</td>
<td>±0.02% (±0.08 Ω)  &lt;br&gt; Maximum (–40 °C to 70 °C)</td>
<td>±0.01%</td>
<td>±0.01%</td>
<td>±0.2%</td>
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<tr>
<td>4000 Ω</td>
<td>Typical (25 °C, ±5 °C)</td>
<td>±0.005% (±0.2 Ω)  &lt;br&gt; Maximum (–40 °C to 70 °C)</td>
<td>±0.01%</td>
<td>±0.01%</td>
<td>±0.15%</td>
</tr>
<tr>
<td>100 kΩ</td>
<td>Typical (25 °C, ±5 °C)</td>
<td>±0.005% (±5 Ω)  &lt;br&gt; Maximum (–40 °C to 70 °C)</td>
<td>±0.01%</td>
<td>±0.01%</td>
<td>±0.21%</td>
</tr>
</tbody>
</table>

*Up to 5 m of 22 AWG copper leads, 5% lead length mismatch.*

### Sensor Power

- **Voltage**: 12 V ±10%
- **Current**: 50 mA maximum
- **Protection**: Short circuit proof indefinitely, Overvoltage protection ±30 V

### Digital I/O

- **Number of channels**: 2
- **Power-on output state**: High impedance
<table>
<thead>
<tr>
<th>Digital Input</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DIO pin capacitance</strong></td>
<td>2000 pF</td>
</tr>
<tr>
<td><strong>Modes (configurable per channel)</strong></td>
<td>24V Sinking, 24V Sinking with Power Management, TTL Logic, Contact Closure</td>
</tr>
<tr>
<td><strong>Input voltage range</strong></td>
<td>0 to 30 VDC maximum</td>
</tr>
<tr>
<td><strong>Digital input logic level thresholds</strong></td>
<td></td>
</tr>
<tr>
<td><strong>TTL Logic and Contact Closure modes</strong></td>
<td></td>
</tr>
<tr>
<td>High level (ON) input voltage</td>
<td>≥2 V</td>
</tr>
<tr>
<td>Low level (OFF) input voltage</td>
<td>≤0.8 V</td>
</tr>
<tr>
<td><strong>24V modes</strong></td>
<td></td>
</tr>
<tr>
<td>IEC 1131-2 compatibility</td>
<td>Type 1 and 3</td>
</tr>
<tr>
<td>High level (ON) input voltage</td>
<td>≥10 V</td>
</tr>
<tr>
<td>High level (ON) input current</td>
<td>≥2 mA</td>
</tr>
<tr>
<td>High level (OFF) input voltage</td>
<td>≤6 V</td>
</tr>
<tr>
<td>Low level (OFF) input current</td>
<td>≤1 mA</td>
</tr>
<tr>
<td><strong>Input current</strong></td>
<td></td>
</tr>
<tr>
<td><strong>TTL Logic and Contact Closure modes</strong></td>
<td>≤375 μA at 30 V</td>
</tr>
<tr>
<td></td>
<td>≤110 μA at 5 V</td>
</tr>
<tr>
<td></td>
<td>≤80 μA at 3 V</td>
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<tr>
<td><strong>Contact Closure mode pull-up current</strong></td>
<td>≤175 μA through closed contact</td>
</tr>
<tr>
<td><strong>24V modes</strong></td>
<td>≤6.4 mA at 30 V</td>
</tr>
<tr>
<td></td>
<td>≤3.2 mA at 15 V</td>
</tr>
<tr>
<td><strong>Minimum detectable pulse width</strong></td>
<td></td>
</tr>
<tr>
<td><strong>TTL Logic mode</strong></td>
<td>30 μs</td>
</tr>
<tr>
<td><strong>24V modes</strong></td>
<td>30 μs</td>
</tr>
<tr>
<td><strong>Contact closure mode</strong></td>
<td>100 μs</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Digital Output</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modes (configurable per channel)</strong></td>
<td>Drive High (Sourcing), Drive Low (Sinking), Drive High and Low (Sinking and Sourcing), and 3V TTL Logic (Open-Controller with Pull-Up)</td>
</tr>
<tr>
<td><strong>DIO power supply voltage range (V_DIO_PWR)^1</strong></td>
<td>3 to 30 V</td>
</tr>
<tr>
<td><strong>Sourcing current (one channel)</strong></td>
<td>0.25 A maximum</td>
</tr>
<tr>
<td><strong>Sinking current (per channel)</strong></td>
<td>1 A maximum</td>
</tr>
<tr>
<td><strong>Output voltage</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Sourcing</strong></td>
<td>(&gt;\left(V_{\text{DIO}_\text{PWR}}-750 \text{ mV}\right) \text{ with } I_{\text{OUT}} &lt;0.25 \text{ A})</td>
</tr>
<tr>
<td><strong>Sinking</strong></td>
<td>(&lt;50 \text{ mV with } I_{\text{OUT}} &lt;1 \text{ A})</td>
</tr>
<tr>
<td><strong>3V TTL Logic mode pull-up</strong></td>
<td>(&gt;2 \text{ V with } I_{\text{OUT}} &lt;20 \text{ μA})</td>
</tr>
<tr>
<td><strong>DO protection</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Voltage</strong></td>
<td>+30 VDC maximum</td>
</tr>
<tr>
<td><strong>Reversed voltage</strong></td>
<td>None</td>
</tr>
<tr>
<td><strong>Short circuit (sourcing)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Trip current</strong></td>
<td>0.26 A minimum, 1.2 A maximum</td>
</tr>
<tr>
<td><strong>Trip time</strong></td>
<td>(&lt;250 \mu\text{s}, \text{ at } 1.2 \text{ A})</td>
</tr>
<tr>
<td><strong>Overcurrent (sinking)</strong></td>
<td>6.5 A maximum</td>
</tr>
</tbody>
</table>
### DO propagation delay

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sinking</td>
<td>150 μs</td>
</tr>
<tr>
<td>Sourcing</td>
<td>2.5 ms</td>
</tr>
</tbody>
</table>

### Node Resources for LabVIEW WSN

<table>
<thead>
<tr>
<th>Resource</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum sample interval</td>
<td>0.1 s</td>
</tr>
<tr>
<td>User flash size</td>
<td>188 Kbytes</td>
</tr>
<tr>
<td>Number of flash erase cycles per sector</td>
<td>100,000</td>
</tr>
</tbody>
</table>

### Wireless Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio mode</td>
<td>IEEE 802.15.4</td>
</tr>
<tr>
<td>RF data rate</td>
<td>250 Kbps</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td></td>
</tr>
<tr>
<td>Americas</td>
<td>Up to 300 m</td>
</tr>
<tr>
<td>International</td>
<td>Up to 150 m</td>
</tr>
<tr>
<td>Frequency band</td>
<td>ISM 2.4 GHz (2400 MHz to 2483.5 MHz)</td>
</tr>
<tr>
<td>Channels</td>
<td>11-24</td>
</tr>
<tr>
<td><strong>TX power</strong></td>
<td></td>
</tr>
<tr>
<td>Americas</td>
<td>+17 dBm maximum (50 mW)</td>
</tr>
<tr>
<td>International</td>
<td>+10 dBm maximum</td>
</tr>
<tr>
<td>Modulation type</td>
<td>DSSS (O-QPSK)</td>
</tr>
<tr>
<td>Receiver sensitivity</td>
<td>-102 dBm</td>
</tr>
<tr>
<td><strong>Antenna</strong></td>
<td></td>
</tr>
<tr>
<td>Connector</td>
<td>Female RP-SMA connector</td>
</tr>
<tr>
<td>VSWR</td>
<td>2.0 maximum</td>
</tr>
<tr>
<td>Impedance</td>
<td>50 Ω</td>
</tr>
<tr>
<td>Directivity</td>
<td>Omni</td>
</tr>
<tr>
<td>Nominal gain</td>
<td>1.5 dBi</td>
</tr>
</tbody>
</table>

### Power Requirements

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

#### Battery Power

*Caution* Do not use rechargeable batteries.

<table>
<thead>
<tr>
<th>Battery</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal battery</td>
<td>4 AA 1.5 V alkaline or lithium batteries</td>
</tr>
<tr>
<td>Recommended batteries</td>
<td>Energizer EN 91 AA, alkaline</td>
</tr>
<tr>
<td></td>
<td>Duracell MN1500 AA, alkaline</td>
</tr>
<tr>
<td></td>
<td>Energizer L91 AA, lithium</td>
</tr>
<tr>
<td>Battery operating temperature range</td>
<td></td>
</tr>
<tr>
<td>Energizer L91</td>
<td>-40 °C to 60 °C</td>
</tr>
<tr>
<td>Energizer E91</td>
<td>-18 °C to 55 °C</td>
</tr>
<tr>
<td>Duracell MN1500</td>
<td>-20 °C to 54 °C</td>
</tr>
<tr>
<td>Voltage range</td>
<td>3.6 to 7.5 V</td>
</tr>
<tr>
<td>Power consumption</td>
<td>2</td>
</tr>
<tr>
<td>Feature</td>
<td>Specification</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td><strong>Sleep mode</strong></td>
<td></td>
</tr>
<tr>
<td>60 second sample interval</td>
<td>0.5 mW</td>
</tr>
<tr>
<td>1 second sample interval</td>
<td>20 mW</td>
</tr>
<tr>
<td><strong>Battery life</strong></td>
<td></td>
</tr>
<tr>
<td>60 second sample interval</td>
<td>Up to 3 years</td>
</tr>
<tr>
<td>1 second sample interval</td>
<td>Up to 1 month</td>
</tr>
<tr>
<td><strong>External Power</strong></td>
<td></td>
</tr>
<tr>
<td>Caution: You must use a UL Listed ITE power supply marked LPS with the NI WSN-3226. The power supply must also meet any safety and compliance requirements for the country of use.</td>
<td></td>
</tr>
<tr>
<td>Voltage range</td>
<td>5 to 30 V</td>
</tr>
<tr>
<td>Power input mating connector</td>
<td>2-position mini-combicon, Phoenix Contact part number: 1714977</td>
</tr>
<tr>
<td><strong>Power consumption</strong></td>
<td></td>
</tr>
<tr>
<td>Sleep mode</td>
<td>1 mW</td>
</tr>
<tr>
<td>60 second sample interval</td>
<td>1 mW at 12 V</td>
</tr>
<tr>
<td>1 second sample interval</td>
<td>20 mW at 12 V</td>
</tr>
<tr>
<td>Router mode</td>
<td>200 mW at 12 V</td>
</tr>
<tr>
<td><strong>Physical Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td>Screw-terminal wiring</td>
<td>14 to 24 AWG wire</td>
</tr>
<tr>
<td>Torque for screw terminals</td>
<td>0.2 to 0.25 N · m</td>
</tr>
<tr>
<td>Dimensions</td>
<td>Refer to the NI WSN-3226 User Guide and Specifications for device dimensions</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 242 g (8.5 oz)</td>
</tr>
<tr>
<td>Weight with antenna</td>
<td>Approx. 256 g (9 oz)</td>
</tr>
<tr>
<td><strong>Calibration</strong></td>
<td></td>
</tr>
<tr>
<td>You can obtain the calibration certificate and information about calibration services for the NI WSN-3226 at ni.com/calibration.</td>
<td></td>
</tr>
<tr>
<td>Calibration interval</td>
<td>3 years</td>
</tr>
<tr>
<td><strong>Safety Standards</strong></td>
<td></td>
</tr>
<tr>
<td>This product is designed to meet the requirements of the following standards of safety for electrical equipment for measurement, control, and laboratory use:</td>
<td></td>
</tr>
<tr>
<td>- IEC 61010-1, EN 61010-1</td>
<td></td>
</tr>
<tr>
<td>- UL 61010-1, CSA 61010-1</td>
<td></td>
</tr>
<tr>
<td>Note: For UL and other safety certifications, refer to the product label or the Online Product Certification section.</td>
<td></td>
</tr>
<tr>
<td><strong>Hazardous Locations</strong></td>
<td></td>
</tr>
<tr>
<td>U.S. (UL)</td>
<td>Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, AEx nC IIC T4</td>
</tr>
<tr>
<td>Canada (C-UL)</td>
<td>Class I, Division 2, Groups A, B, C, D, T4; Class I, Zone 2, Ex nL IIC T4</td>
</tr>
<tr>
<td>Europe (DEMKO)</td>
<td>Ex nA nL IIC T4</td>
</tr>
<tr>
<td><strong>Safety Voltages</strong></td>
<td></td>
</tr>
<tr>
<td>Connect only voltages that are within these limits.</td>
<td></td>
</tr>
<tr>
<td>V terminal to C terminal</td>
<td>30 V maximum, Measurement Category I</td>
</tr>
<tr>
<td>Measurement Category I is for measurements performed on circuits not directly connected to the electrical distribution system referred to as MAINS voltage. MAINS is a hazardous live electrical supply system that powers equipment. This category is for measurements of voltages from specially protected secondary circuits. Such voltage measurements include signal levels, special equipment, limited-energy parts of equipment, circuits powered by regulated low-voltage sources, and electronics.</td>
<td></td>
</tr>
<tr>
<td>Caution: Do not connect the system to signals or use for measurements within Measurement Categories II, III, or IV.</td>
<td></td>
</tr>
</tbody>
</table>
**RF Safety Warning**

This product complies with FCC radiation exposure limits set for uncontrolled equipment and meets the FCC radio frequency (RF) Exposure Guidelines in Supplement C to OET65. This product generates and radiates radio frequency energy. To comply with the radio frequency radiation exposure guidelines in an uncontrolled environment, this equipment should be installed and operated with at least 20 cm between the radiator and the person’s body (excluding extremities: hands, wrists, feet, and legs).

This product complies with the European Council Recommendation (1995/519/EC) on the limitation of exposure of the general public to electromagnetic fields. Compliance was determined in accordance with the requirements in EN 50371.

**Environmental**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating temperature (IEC-60068-2-1 and IEC-60068-2-2)</td>
<td>-40 to 70 °C</td>
</tr>
<tr>
<td>Storage temperature (IEC-60068-2-1 and IEC-60068-2-2)</td>
<td>-40 to 85 °C</td>
</tr>
<tr>
<td>Operating humidity (IEC-60068-2-56)</td>
<td>10 to 90% RH, noncondensing</td>
</tr>
<tr>
<td>Storage humidity (IEC-60068-2-56)</td>
<td>5 to 95% RH, noncondensing</td>
</tr>
<tr>
<td>Pollution Degree (IEC 60664)</td>
<td>2</td>
</tr>
<tr>
<td>Maximum altitude</td>
<td>2,000 m</td>
</tr>
</tbody>
</table>

Indoor use only

**Shock and Vibration**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating vibration, random (IEC 60068-2-64)</td>
<td>5 g_{rms}, 10 to 500 Hz</td>
</tr>
<tr>
<td>Operating shock (IEC 60068-2-27)</td>
<td>30 g, 11 ms half sine, 50 g, 3 ms half sine, 18 shocks at 6 orientations</td>
</tr>
<tr>
<td>Operating vibration, sinusoidal (IEC 60068-2-6)</td>
<td>5 g, 10 to 500 Hz</td>
</tr>
</tbody>
</table>

**Electromagnetic Compatibility**

- **Caution** Electromagnetic interference can adversely affect the measurement accuracy of this product. The input/output terminals of this device are not protected for electromagnetic interference. As a result, this device may experience reduced measurement accuracy or other temporary performance degradation when connected cables are routed in an environment with radiated or conducted radio frequency electromagnetic interference. To limit radiated emissions and to ensure that this device functions within specifications in its operational electromagnetic environment, take precautions when designing, selecting, and installing measurement probes and cables.

This product is designed to meet the requirements of the following standards of EMC for electrical equipment for measurement, control, and laboratory use:

- EN 61326-2-1 (IEC 61326-2-1): 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

This product also meets the requirements of the following EMC standards for intentional radiators:

- EN 300 328
- EN 301 489-1 and EN 301 489-17
- FCC 47 CFR Part 15C
- IC RSS-210

- **Note** For EMC certification and additional information, refer to the product label or the Online Product Certification section.

**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 (EMC) Directive
- 1999/5/EC; Radio and Telecommunications Terminal Equipment (R&TTE) Directive

**Regulatory Information**

**United States**

This product complies with Part 15 of the FCC Rules. Operation is subject to these two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**Canada**
This product complies with Industry Canada RSS-210.

Cet appareil est conforme aux normes RSS210 d’Industrie Canada.

Europe-EU Declaration of Conformity

Marking by the above CE symbol on the label indicates compliance with the Essential Requirements of the R&TTE Directive of the European Union (1999/5/EC). This equipment meets the following conformance standards: EN 300 893, EN 300 328, EN 301 489-17, EN 60950.

Europe - Restrictions for Use of 2.4 GHz Frequencies in European Community Countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Restrictions and License Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>België/Belgique</td>
<td>For private usage outside buildings across public grounds over less than 300 m no special registration with IBPT/BIPT is required. Registration to IBPT/BIPT is required for private usage outside buildings across public grounds over more than 300 m. For registration and license please contact IBPT/BIPT.</td>
</tr>
<tr>
<td></td>
<td>Voor privé-gebruik buiten gebouw over publieke grond over afstand kleiner dan 300 m geen registratie bij IBPT/BIPT nodig; voor gebruik over afstand groter dan 300 m is wel registratie bij IBPT/BIPT nodig. Voor registratie of licentie kunt u contact opnemen met IBPT.</td>
</tr>
<tr>
<td></td>
<td>Dans le cas d'une utilisation privée, à l'extérieur d’un bâtiment, au-dessus d’un espace public, aucun enregistrement n’est nécessaire pour une distance de moins de 300 m. Pour une distance supérieure à 300 m un enregistrement auprès de l'IBPT est requise. Pour les enregistrements et licences, veuillez contacter l'IBPT.</td>
</tr>
<tr>
<td>Deutschland</td>
<td>License required for outdoor installations. Check with reseller for procedure to follow.</td>
</tr>
<tr>
<td></td>
<td>Anmeldung im Outdoor-Bereich notwendig, aber nicht genehmigungspflichtig. Bitte mit Händler die Vorgehensweise abstimmen.</td>
</tr>
<tr>
<td>France</td>
<td>Restricted frequency band: only channels 1 to 7 (2400 MHz and 2454 MHz respectively) may be used outdoors in France.</td>
</tr>
<tr>
<td></td>
<td>Bande de fréquence restreinte : seuls les canaux 1-7 (2400 et 2454 MHz respectivement) doivent être utilisés endroits extérieur en France. Vous pouvez contacter l'Autorité de Régulation des Télécommunications (<a href="http://www.art-telecom.fr">http://www.art-telecom.fr</a>) pour la procédure à suivre.</td>
</tr>
<tr>
<td>Italia</td>
<td>License required for indoor use. Use with outdoor installations not allowed.</td>
</tr>
<tr>
<td></td>
<td>E’ necessaria la concessione ministeriale anche per l’uso interno. Verificare con i rivenditori la procedura da seguire.</td>
</tr>
<tr>
<td>Nederland</td>
<td>License required for outdoor installations. Check with reseller for procedure to follow.</td>
</tr>
<tr>
<td></td>
<td>Licentie verplicht voor gebruik met buitenaantennes. Neem contact op met verkoper voor juiste procedure.</td>
</tr>
<tr>
<td>Japan</td>
<td>The certified radio equipment is embedded in this device.</td>
</tr>
</tbody>
</table>

Singapore

Taiwan R.O.C

EU Regulatory Statements

<table>
<thead>
<tr>
<th>Language</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Česky [Czech]</td>
<td>National Instruments tímto prohlašuje, _e tento NI WSN-3226 je ve shodě se základními po_adavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.</td>
</tr>
<tr>
<td>Dansk [Danish]</td>
<td>Undertegnede National Instruments erklærer herved, at fylgende udstyr NI WSN-3226 overholder de vçsentlige krav og hvirve relevante krav i direktiv 1999/5/EF.</td>
</tr>
<tr>
<td>English</td>
<td>Hereby, National Instruments, declares that this NI WSN-3226 is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC.</td>
</tr>
<tr>
<td>Español [Spanish]</td>
<td>Por medio de la presente National Instruments declara que el NI WSN-3226 cumple con los requisitos esenciales y cualesquiera otras disposiciones aplicables o exigibles de la Directiva 1999/5/CE.</td>
</tr>
</tbody>
</table>
Online Product Certification

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 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)

Battery Replacement and Disposal

Battery Directive After replacement, recycle the old battery. For information about the available collection and recycling scheme (and your nearest National Instruments Branch Office) or on Battery Directive compliance (Directive 2006/66/EC of the European Parliament and Council) in a particular EU country visit ni.com/company/citizenship/product.htm#battery.
1 Due to regulations, the frequency bands depend upon country of operation.
2 Device executing NI-WSN firmware. End node mode. AI0..3 configured in resistance mode.
3 Device executing NI-WSN firmware. AI0..3 configured in resistance mode.
4 Router connected directly to a NI WSN gateway. 1 second sample interval.
Pinouts/Front Panel Connections

NI WSN-3226 Pinout

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