User's Manual

WSN-100 INDUSTRIAL WIRELESS RELAY SET

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Contents

Introduction

The *WSN-100 Wireless Relay Set* is a ruggedly built wireless solution for connecting two dry-contact sensor inputs to two remote relay outputs in an industrial environment. By eliminating the need for wire and conduit between the floats or operator switch and the process controller, the *WSN-100* can save labor and material costs when compared to traditional wired installations.

The system consists of two units – a sensor input transmitter and a relay output receiver. The transmitter has two optically isolated inputs for 0V dry-contacts. The receiver has three relays (one relay output for each sensor input and one relay output for a transmitter fault), and four visible LED indicators for power, transmitter fault, and the two outputs.

Typically, the *WSN-100* is delivered as a uniquely keyed transmitter and receiver pair. There can be an unlimited number of keyed pairs in the same area - one pair will not interfere with operation of another. Alternatively, the *WSN-100* can be special ordered for a single transmitter unit keyed to multiple receiver units.

The transmitter can be powered by three standard "D" type batteries or by an external power-supply. The optically isolated inputs are activated by any dry contact (such as a float switch) that require no power external power.

A red LED on the receiver shows that the power is on. Two yellow LEDs display the state of the output relays. If the receiver loses contact with the transmitter a red "FAULT" LED turns on and the fault-relay's contacts close. The fault relay also closes if the receiver loses power.

The system requires no configuration and can be installed in minutes. Units can be mounted – indoors or outdoors – with screws, or ordered with a powerful magnet for easy slap-on installation to a steel tank or frame.

This manual describes the installation and operation of the WSN-100 Wireless Relay Set.

Site Considerations

Before permanently installing the *WSN-100*, the equipment should be tested for operation in the desired environment. The *WSN-100* may not be the appropriate solution for all installations. Landscape and terrain obstructions may affect the radio's performance. The *WSN-100* range is primarily dependent on the radio wave propagation characteristics of the site, but may be improved with alternative antenna selection. For help in determining that your site is appropriate call 925-683-6258 for Technical Support.

The following material has been extracted from Digi Application Note XST-AN010a June 2012. Read the entire application note go at http://ftp1.digi.com/support/images/XST-AN010a-MaximizingRange.pdf

Visual vs. RF Line-of-Sight

Attaining RF Line-of-Sight (LOS) between the sending and receiving antennas is essential in achieving long range in wireless communication systems. There are two types of LOS that are generally used to describe an environment:

- *Visual LOS* is the ability to see from one site to the other. It requires only a straight linear path between two points.
- *RF LOS* requires not only visual LOS, but also a football-shaped path free of obstacles for data to optimally travel from one point to another.

Fresnel Zone

The Fresnel Zone can be thought of as a football-shaped tunnel between two sites that provides a path for RF signals. In order to achieve the greatest range, the football-shaped path in which radio waves travel must be free of obstructions. Buildings, trees or any other obstacles in the path will decrease the communication range.

If the antennas are mounted just barely off the ground, over half of the Fresnel Zone ends up being obstructed by the earth resulting in significant reduction in range. To avoid this problem, the antennas should be mounted high enough off of the ground so that the earth does not interfere with the central diameter of the Fresnel zone. It is also important to understand that the environment may change over time due to growing vegetation, building construction, etc. If obstacles exist between two points, the antennas can be raised on one end or on both ends to clear the Fresnel Zone of obstructions.

How far above the ground and other obstacles the antennas need to be is determined by the diameter of the Fresnel Zone. The diameter of the Fresnel Zone depends upon the frequency and distances between the two radios. [The *WSN-100* uses 2.4 GHz radios. At 1000' the Fresnel Zone is 11 feet, at 1 mile the zone is 21 feet.]

Mounting Considerations

When mounting an antenna, care should be taken to make sure it is as far away from metal objects as possible. If nearby metal gets too close to an antenna, it has the potential to interfere with the way the antenna radiates and may cause some undesirable results.

In some cases, a cable must be used to connect an antenna to a transmitter or receiver. All RF cables add some loss to the system. For any given cable, the longer the cable the more signal will be lost over that cable. Because of this the length of the cable should be kept as short as possible.

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Standard Installation

Check the transmitter and receiver installation locations for radio connectivity before permanent installation.

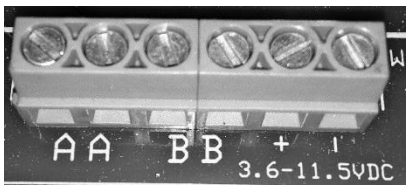
WSN-100T Transmitter

(**CAUTION:** *The connection terminals for the WSN-100T are on the electronic circuit board. Incorrect connections will cause the unit to fail and may damage the unit. If you are not familiar with basic hand tools and making electrical terminal connections you should have a qualified professional perform the installation.*)

Loosen the front cover's four retention screws. The front cover is also the battery-holder. Do not allow the cover/battery-holder to hang by the battery wires and be careful not to pull too hard or you may pull the battery leads out of the power terminal. It may help mounting to disconnect the battery leads so you can fully remove the front cover. (**WARNING:** *When re-connecting battery be sure to connect the red wire to '+' and the black wire to '-'. Incorrect power connection will cause a failure and may damage the unit.*)

Under the retention screws there are fastening holes. Use four #8 screws or bolts to fasten the unit to your mounting location (#8 x ¾" when mounting to wood). It is recommended that the transmitter be mounted at least 5' above the ground with the antenna pointing straight up.

On the circuit board there are terminals labeled "A A" and "B B" for inputs A and B, respectively. Connect your float-switches (or other types of dry-contacts) to these terminals. Be sure your connections are snug – the wire is tight – but do not over-tighten. (**WARNING:** *The WSN-100T is designed for use with 0-volt dry-contact inputs. Applying a voltage signal to the inputs could damage the unit.*)



Install three standard D-type alkaline batteries into the battery holder. Close the Velcro retaining straps. Do not allow the batteries to hang loose by the battery leads. Batteries should be replaced every six months. Use quality batteries – we recommend Energizer or Duracel batteries. If battery voltage drops too low the transmitter will not work and will activate a fault on the receiver. Do not leave dead batteries in an unused device as they may leak and damage the equipment. Do not store with batteries installed.

Reconnect the battery leads. (**WARNING:** *When re-connecting battery be sure to connect the red wire to '+' and the black wire to '-'. Incorrect power connection will cause a failure and may damage the unit.*) If you are using an external power supply, be sure the voltage is between 4VDC -9VDC with a supply current of at least 300 mA. Be sure to connect the positive ('+') and negative ('-') wires to the correct terminals to avoid damage to the unit.

Replace the front cover. Do not force the cover in place. If the battery back is correctly aligned – perpendicular to the antenna – the lid will press snugly against the enclosure. Do not over-tighten the front cover's retention screws.

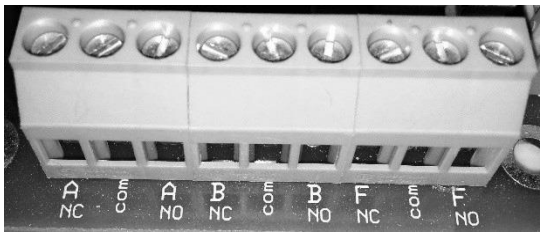
WSN-100R Receiver

(**CAUTION:** *The connection terminals for the WSN-100R are on the electronic circuit board. Incorrect connections will cause the unit to fail and may damage the unit. If you are not familiar with basic hand tools and making electrical terminal connections you should have a qualified professional perform the installation.*)

Loosen the front cover's four retention screws. Under the retention screws there are fastening holes. Use four #8 screws or bolts to fasten the unit to your mounting location (#8 x ¾" when mounting to wood). It is recommended that the receiver be mounted at least 5' above the ground with the antenna pointing straight up.

There are two terminal strips on the WSN-100R circuit board, one for power and the other for the three relay outputs. There are three terminals for each of the three output relays – normally-closed (NC), common (com), and normally-open (NO). The outputs are labeled A, B, and F.

Outputs A and B are controlled by the WSN-100T inputs A and B. (**NOTE:** *The terminal labeled "com" is the common connection for the NC and NO output it is positioned between.*) The output relays can switch up to 2A at 250VAC/220VDC but should not be used to directly power a motor.



For the most common application – when input A is closed, close output A – connect to the "com" terminal between the A terminals and connect to the A/NO terminal.

Output F is the FAULT relay. The FAULT relay is energized when the system is functioning properly (no fault) and de-energizes when there is no communication from the transmitter (FAULT LED ON) or when the receiver has a power loss. When using the FAULT relay to signal a fault it is recommended you connect to the "com" terminal between the F terminals and connect to the F/NC terminal.

Make the desired connections to the output terminals. Be sure your connections are snug – the wire is tight – but do not over-tighten.

Power has a separate terminal strip. The power supply should have a voltage between 5VDC-24VDC with a supply current of at least 300 mA. Be sure to connect the positive ('+') and negative ('-') wires to the correct terminals to avoid damage to the unit. (**WARNING:** *Incorrect power connection will cause a failure and may damage the equipment*.)

Replace the front cover. Align the cover so that the LEDs are visible through the display window. Do not over-tighten the front cover's retention screws.

Typical Wiring Schematic

Figure 1 shows a typical two float arrangement. The low float is acting as a low-water alarm.

The WSN-100 will support any control configuration. Floats should be connected as they would be for a standard wired control.

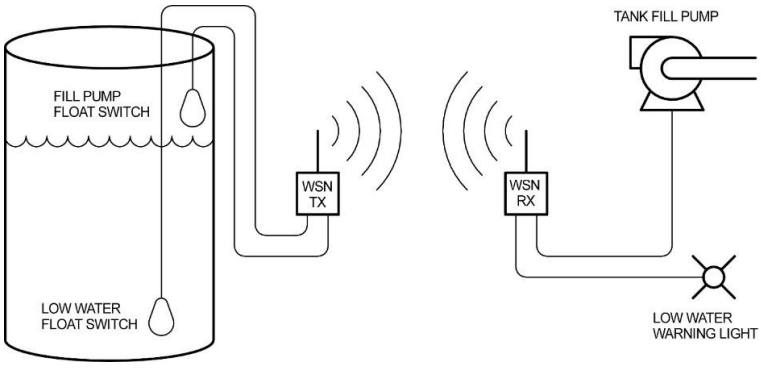


Figure 1: Typical Tank Fill Configuration

Figure 2 shows typical float connections to the WSN-100-T for a possible pump-up control scenario. In this example both floats are wired as normally-closed (closed down). The internal battery pack is being used to power the unit. Alternatively an external power supply could be used (4VDC – 9VDC, 300mA).

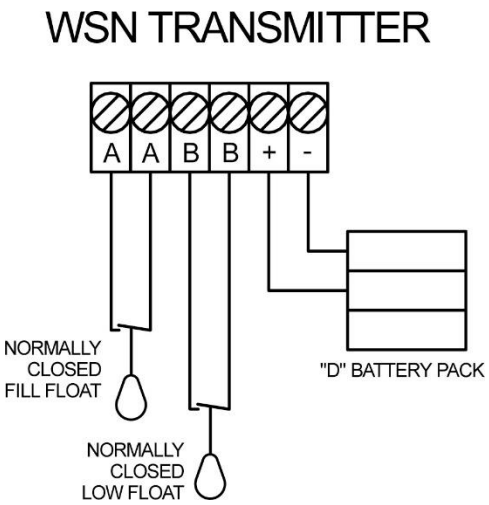


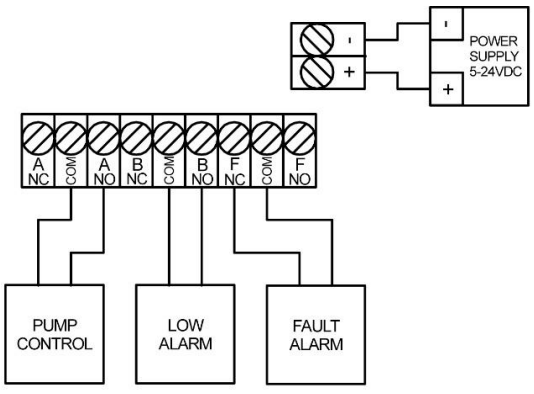
Figure 2: Typical Float Connections

When the high float drops the switch closes to send a run signal to the fill pump run relay. When the float is up the switch is open (the run relay is off).

When the low float drops the switch closes to send a low water alarm to an alarm indicator and/or the pressure system controller.

Figure 3 shows a possible arrangement for controller connections to the WSN-100-R. The example demonstrates one way to interface with the receiver's outputs.

When the fill float drops, the receiver's output A is energized, closing the A/NO (normally-open) contact and energizing the pump control. When the fill float flips back up the A/NO contact opens, turning off the pump. If the low float drops the receiver's output B is energized closing the B/NO contact, activating the low alarm. If the transmitter fails (or the receiver loses power) the fault relay will de-energize, closing the F/NC (normally-closed) contact to signal a fault alarm.



POWER THROUGH THE WSN RECEIVER RELAYS MUST NOT EXCEED 2AMPS AT 250VAC

Figure 3: WSN-100-R Typical Connections

The WSN-100-R fault relay is energized during normal operation. It de-energizes if there is a loss of signal from the WSN-100-T or a loss of power to the WSN-100-R circuit board. Typical connection for the fault alarm is to the F/NC terminal.

Using Normally-Closed Contacts

The A/NC and B/NC contacts can be used as indicator signals. It is usually not advisable to use the NC contacts directly for pump or motor control. If there is a loss of power to the WSN-100-R, or if radio connection fails, all of the relays de-energize, closing the NC contacts – this could cause an undesired run signal. It is generally preferable wire the inputs for the desired control logic and to use the NO contact outputs.

Figure 4 provides a possible configuration for safely using a NC contact for pump or motor control. This configuration uses the F/NO contact as a safety interlock. When the WSN is operating properly the fault relay is energized and the F/NO contact is closed. If the system fails the fault relay de-energizes and the F/NO contact opens.

Wiring the control signal through the F/NO contact as shown will prevent an inadvertent run signal being generated by the A/NC contact when there is loss of power or radio signal.

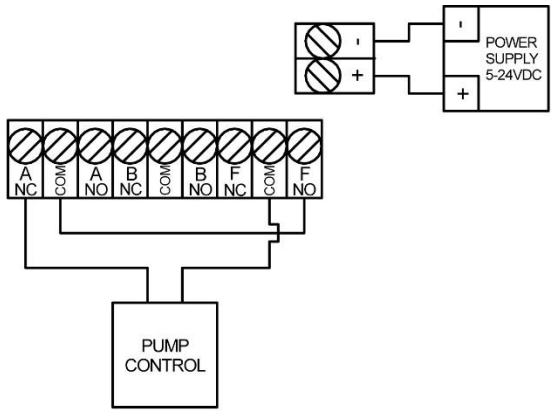


Figure 4: Safely Using NC Contact for Pump Control

WSN-100 Specifications

	WSN-100T (Transmitter)
Supply Power	4VDC – 9VDC, 300 mA
Operational Current	215 mA (transmitting) (45 - 260 µA sleep-mode)
Battery Type	3 standard "D" type cells (nominally 4.5 VDC)
Battery Life	Recommended change every 6 months (up to 12 months possible)
Inputs	2ea – Dry-Contacts (no applied voltage on inputs) optically-isolated, non-polarized
Connections	Terminal Screws

	WSN-100R (Receiver)
Supply Power	5VDC – 24VDC, 300 mA
Operational Current	70 – 260 mA
Indicators	Power – Red LED Fault – Red LED Outputs (2) – Yellow LEDs
Connections	Terminal Screws
Output Relays	2 Control Relays (N/O) 1 Alarm Relay (closes on loss of power or loss of transmitter signal) (2A max current; 250VAC/220VDC max voltage)
Contact Resistance	100 mΩ (max)

	Enclosure
Industrial Temperature Rating	-40° C to 85° C (-40° F to 185° F)
Humidity	5% to 95% Relative-Humidity, non-condensing
Enclosure Material	Polycarbonate
Enclosure Type	NEMA 4X IP66 (Transmitter) NEMA 12K IP66 (Receiver) (Receiver is available in NEMA 4X without visible LED indicators)
Enclosure Size	5.12 x 5.12 x 2.95 In

Radio Specifications

	Standard Radio
Radio Type	WPAN 802.15.4
Operating Frequency	ISM 2.4 GHz
Range	up to 300 feet – urban / industrial up to 1000 feet – residential up to 1 mile – RF unobstructed line-of-site (with 2.1 dBi Dipole Antenna)
Interference Immunity	DSSS (Direct Sequence Spread Spectrum)
Transmit Power	60 mW (+18 dBm)
Receiver Sensitivity	-100 dBm
Antenna Type	2.4 GHz 3 dBi Rubber Duck Antenna (RP-SMA jack for direct mount or remote antenna options)
Network Security	128-bit AES Encryption
Transmit Current	215 mA
Receive Current	55 mA
Sleep Mode	< 10uA
Regulatory Approvals	FCC 15.247 (USA): OUR-XBEEPRO IC RSS 210 (Canada): 4214A-XBEEPRO

Warranty Terms and Conditions

LIMITED WARRANTY

Aruna Advanced Automation, LLC (hereafter, "*Aruna*") warrants that from the date of shipment by Aruna to Customer, and continuing for a period of one (1) year, the Equipment will be free from defects in manufacturing and workmanship, under normal use. This limited warranty extends only to the original user of the Equipment. Customer's sole and exclusive remedy and the entire liability of Aruna and its suppliers under this limited warranty will be, at Aruna's or its service center's option, shipment of a replacement, or on-site repair under the applicable service contract offering chosen by Customer, or a refund of the purchase price. Aruna replacement parts, used in Equipment repair, may be new or equivalent to new. Aruna's obligations hereunder are conditioned upon the returned of affected Products, if applicable, in accordance with Aruna's then-current Return Equipment Authorization (RMA) procedures.

RESTRICTIONS

This warranty does not apply if the Equipment (a) has been altered, except by Aruna, (b) has not been installed, operated, repaired, or maintained in accordance with instructions supplied by Aruna, or (c) has been subjected to abnormal physical or electrical stress, misuse, negligence, or accident.

DISCLAIMERS

Aruna intends for the Equipment to be reliable. The Documentation may, however, contain technical inaccuracies, typographical errors or other mistakes. Aruna may make corrections or other changes to the Documentation at any time. Aruna and its suppliers reserve the right to make corrections, modifications, enhancements, improvements and other changes to its products, programs and services at any time or to discontinue any products, programs, or services without notice.

You acknowledge and agree that the application notes, reference designs, user guides, and errata included herein are provided as an example only and that you will exercise your own independent analysis and judgment. Aruna assumes no liability for your product designs or any applications assistance provided by Aruna.

LIMITATION OF LIABILITY

In no event shall Aruna or its suppliers be liable for any indirect, special, incidental or consequential damages or any damages whatsoever, including but not limited to, damages resulting from loss of use, data, profits, whether in an action of contract, negligence or other tortious action resulting from or arising out of the use or performance of the Equipment, regardless of whether Aruna or an authorized Aruna representative has been advised of the possibility of such damages.

Regulatory Approvals

FCC 15.247 (USA): OUR-XBEEPRO
IC RSS 210 (Canada): 4214-A-XBEEPRO

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

WARNING: *To satisfy FCC RF exposure requirements for mobile transmitting devices, a separate distance of 20cm or more should be maintained between the antenna of this device and persons during device operation. To ensure compliance, operations at closer than this distance is not recommended. The antenna used for this transmitter must not be co-located in conjunction with any other antenna or transmitter.*

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures: Re-orient or relocate the receiving antenna, Increase the separation between the equipment and receiver, Connect equipment and receiver to outlets on different circuits, or consult the dealer or an experienced radio/TV technician for help.

Technical Support

For technical support contact:

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Oakland, CA 94611

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