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# Zlinx Xtreme - IP67 Wireless I/O

## PRODUCT MANUAL



ZXT9-IO-222R2

ZXT24-IO-222R2



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# Zlinx Xtreme I/O

Documentation Number: Zlinx Xtreme IO

*This product was designed and manufactured in Ottawa, Illinois USA*

*Using domestic and imported parts by*



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**1.****Overview**

**Thank you for purchasing a Zlinx Xtreme I/O product!** This product has been manufactured to the highest standards of quality and performance to ensure your complete satisfaction.

**1.1****Product Overview**

Zlinx Xtreme I/O is an, outdoor rated industrial grade wireless product. Its IP67 rating along with wide temperature ratings make it suitable for monitoring and controlling remote analog and discrete devices without the need for a separate enclosure resulting in costs and space savings.

**1.2****Prerequisites**

This manual assumes that the user has basic electronics knowledge and basic understanding of wireless communications. Users are strongly encouraged to read and understand the manual to its entirety. Setting up the wireless device without proper knowledge and understanding could result in equipment damage and bodily injury.

**1.3****Safety Information****WARNING**

Exposure to RF energy is an important safety consideration. The FCC has adopted a safety standard for human exposure to radio frequency electromagnetic energy emitted by FCC regulated equipment as a result of its actions in Docket 93-62 and OET Bulletin 65 Edition 97-01.

**DO NOT:**

- Operate unless all RF connectors are secure and any open connectors are properly terminated.
- Operate the equipment near electrical blasting caps or in an explosive atmosphere.

All equipment must be properly grounded for safe operations. All equipment should be serviced only by a qualified technician.

**1.4****Installation Information****Electrical Ratings****INPUT:**

ZXTx-IO-222R2, 10.0 - 30.0 VDC Class 2 input only

**AMBIENT TEMPERATURE:** 74°C maximum surrounding air ambient

**WIRING TERMINALS:**

Copper wire only

One conductor per terminal

Wire range: 10-28 AWG

Tightening Torque: 0.5 to 0.6 Nm.

Temperature rating of field wiring – 105 °C minimum (sized for 60°C ampacity).

**Please see the Quick Start Guide for UL Class 1 Division 2 installation instructions.**

This manual has been created to assist you in installing, configuring, and using your Zlinx Xtreme I/O modules. Please read it carefully and follow the instructions to achieve best results.

The manual is divided into the following major sections:

### **Table of Contents**

The table of contents is hypertext linked in the electronic documentation. This allows rapid navigation to each chapter.

### **Overview**

Overview section gives a general information on product standards compliance, prerequisites and safety information.

### **Product Introduction**

This section covers the Zlinx Xtreme I/O models, package contents, modes of operation, IO types and characteristics and User Interface components main features of the Zlinx Xtreme I/O products.

### **Hardware Installation**

This section provides necessary information for mechanical installation of the Zlinx Xtreme I/O modules. Panel/machine mount and conduit mount options are covered. Range estimates are shown for various terrains under different antenna options. Installation instructions are included for both standard antenna and high gain antenna and cable options.

### **Electrical Installation**

This section guides you through the wiring and termination for power supply as well as analog and digital I/Os.

### **Software Installation**

This section guides you through the software and USB driver installation process. The Software Configuration screens are explained in detail.

### **Startup & Configuration**

In this section, both easy setup (through push button) and advanced setup using software are explained. Information about setting the Zlinx Xtreme I/O module in Peer-to-Peer (Wire replacement) and Modbus mode are explained. Setting up I/Os, calibration, exception reporting and configuring alarms is detailed.

### **Use Cases**

This section provides setup & configuration instructions for setting up the product in Peer-to-Peer mode, and in Modbus mode when configured with a Radio Modem.

### **Testing & Troubleshooting**

Bench testing of the Zlinx Xtreme modules is explained in Peer-to-Peer and Modbus modes. The Built-in-Self-Diagnostics section explains self diagnosis report by the module using supplied software.

### **Appendices**

Appendixes include all essential reference information for Zlinx Xtreme I/O modules. Information found here includes a comprehensive references and useful tables of product properties.

### **Product Technical Specification**

This section contains detailed technical specifications about the Zlinx Xtreme I/O modules.

## **Default Configuration Settings**

All parameter default settings are listed.

## **Dimensional Drawings**

The hardware dimensional drawings are shown.

## **Modbus I/O Register Mapping**

This section explains the Modbus register mappings when I/O modules are communicating to a Modbus master (PLC/SCADA/etc.) through a radio modem.

## **Convert Voltage / Current to DAC**

Analog to Digital conversion for voltage and current I/Os are explained.

## **RF Basics**

This section offers a good description of Proprietary Radio Frequency communication.

## **Zlinx Xtreme to Zlinx Gen II Compatibility**

This section shows the compatibility of both indoor and outdoor versions of I/O modules and radio modems

## **Glossary**

Glossary covers main terms which are relevant to the understanding of the Zlinx Xtreme I/O concept.

## **Index**

Index includes major terms and page numbers where referenced in the manual.

### Product Specification Summary

Need to get an analog or a digital signal across a highway or river? Or just to the other end of your big warehouse? Zlinx Xtreme I/O can do the job faster, easier, and less expensively than stringing cable. Easy plug-and-play set-up saves installation and maintenance time.

Zlinx Xtreme I/Os are built to handle Xtreme hot and cold outdoor weather conditions.

- IP67, Outdoor rated
- Ranges to 40 miles.
- Frequency ranges: ISM band, 902 to 928 MHz; 2.4 to 2.5 GHz.
- Modulation: FSK – Frequency Shift Keying.
- DSSS (2.4 GHz) and FHSS (900 MHz) Technology.
- Signal strength indicator aids troubleshooting.
- 3 dBi for 900 MHz; 2.1 dBi for 2.4 GHz RPSMA male dipole.
- Wide temperature range -40C° to 74 C°.
- Versatile power: 10 to 30 VDC.
- Software for Windows XP (Home or Professional SP3); Windows 2000 SP4; Vista 32 bit; Windows 7.
- I/O Status Monitoring.
- CE, CSA approvals.
- Compatibility with Zlinx Gen II indoor models
- AES Encryption – 128 Bit on SR models, 256 Bit on LR models
- Software Selectable Transmitter Power
- Software Selectable Over-the-air Data Rate on LR models
- Exception Reporting option.
- Analog I/O Calibration option.
- Failsafe option for analog and digital outputs.
- Communication Failure Alarm option.
- Analog Inputs - True 16-Bit with 0-20mA, 4-20mA, 0-5V, 0-10V independent selections
- Digital Inputs – PNP or NPN independent selections
- Relay Driven Digital Outputs.

## 2.

## Product Introduction

### 2.1 Product Models

### Zlinx Xtreme I/O

**Zlinx Xtreme I/O modules** provide easy-to-use, cost-effective Peer-to-Peer (wire replacement) or Modbus connectivity solutions through license free wireless spectrum.



Figure 2-1 Zlinx Xtreme I/O Modules

Following I/O models are available:

- 1) ZXT24-IO-222R2      2.4 GHz, Short range, IP67 I/O module (2 Analog In, 2 Analog Out, 2 Digital In, 2 Relay Out)
- 2) ZXT9-IO-222R2      900 MHz, Long range, IP67 I/O module (2 Analog In, 2 Analog Out, 2 Digital In, 2 Relay Out)

### 2.2

### Package Contents

**Zlinx Xtreme IO Modules** are shipped with the following items included:

- Zlinx Xtreme I/O module.
- Standard antenna.
- Optional mounting ears
- Mounting screws
  - M4-0.7 25mm SS Phillips Pan Hd Machine Screws – qty. 4
  - M4-0.7 x 25mm SS Hex Head Cap screws – qty. 4
  - M4-0.7 DIN 985 A4 S/S Nylon Insert Lock Nuts – qty. 4
- A printed version of the Modbus Mode Zlinx I/O Quick Start Guide.
- A printed version of the Peer-to-Peer Mode Zlinx I/O Quick Start Guide.

- Product CD (consisting of Zlinx Xtreme I/O documentation and Zlinx Manager configuration software)
  - Zlinx I/O Manager Configuration Software.
  - Zlinx I/O Firmware Updater.
  - USB Driver for Xtreme Module
  - Zlinx Xtreme I/O manual in PDF format.
  - Zlinx Xtreme Radio Modem manual in PDF format.
  - The Modbus Mode Zlinx I/O Quick Start Guide in PDF format.
  - The Peer-to-Peer Mode Zlinx I/O Quick Start Guide in PDF format.

**Note:** A separate USB cable (not part of the contents) is necessary for programming the I/O module.

**NOTE: the Cable Glands cannot be used for Class 1 Division 2 applications. Please see the Quick Start Guide for additional information about UL Class 1 Division 2 installation instructions.**

## 2.3 of Operation

## Zlinx Xtreme I/O Modes

Zlinx Xtreme I/O systems can operate in Peer-to-Peer or Modbus Slave RTU modes. 900 MHz I/O Modules can be configured as repeaters to extend the radio coverage distance.

### 2.3.1 Peer-to-Peer I/O Mode

Peer-to-Peer configuration of IO modules is used in wire replacement applications for analog/digital IOs where cabling is not possible or it is very expensive. Typical examples include remote monitoring and control applications in clean rooms, buildings across parking lots or highways, remote water or fuel tank level monitoring, remote pump station control, etc.

In Peer-to-Peer mode, two Zlinx I/O modules of same type can be configured to provide wire replacement functionality. Input count of one module must match the output count of the other module for both digital and analog types. For example, a pair of 2 analog input, 2 analog output, 2 digital input and 2 digital output I/O modules or a pair of 4 digital input and 4 digital output modules can be configured in peer-to-peer mode. A pair of the following I/O modules is suitable for Peer-to-Peer configuration:

- ZXT9-IO-222R2
- ZXT24-IO-222R2

In this mode one Module is configured as a Master and the other as a Slave. It does not matter which end of the link is the Master and which is the Slave. Analog and Digital Input signals connected to one module are mapped to the corresponding analog and digital outputs on the other module and vice versa. Peer-to-Peer mode configuration can be established between outdoor rated Zlinx Xtreme IOs and indoor rated Zlinx Gem II IOs.

**Note:** However, -MR versions of indoor rated Zlinx Gen II I/O modules are not compatible with Zlinx Xtreme modules.

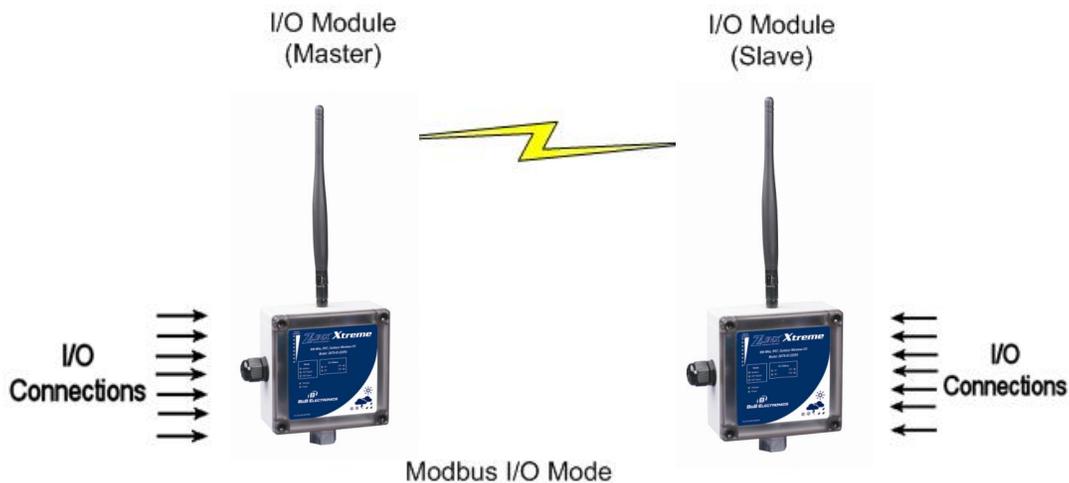


Figure 1-2 Peer-to-Peer Mode

### 2.3.2 Modbus I/O Mode

In Modbus mode, the Zlinx Xtreme I/O modules shall be configured as Modbus Slaves and can be controlled and monitored by a Modbus RTU Master (such as a PLC, SCADA, HMI, etc). A serial radio modem acts as a data pipe & has to be connected to the Modbus master through its serial port. Up to 247 wireless I/O modules can be remotely monitored and controlled by the Modbus master. The I/O signals appear in the Modbus register map resident in the I/O module memory that can be accessed by the master through the radio modem. Refer to Appendix – D for information about the Modbus register mapping.



Figure 2-2 Modbus I/O Mode

In Modbus I/O mode, up to 247 Zlinx I/O modules can be connected to a Modbus RTU master through a Radio Modem. Modules of both Zlinx Xtreme (outdoor) and Zlinx Gen II (indoor) types can be mixed and matched as long as their frequency rating is the same.

### 2.3.3 Repeater Mode

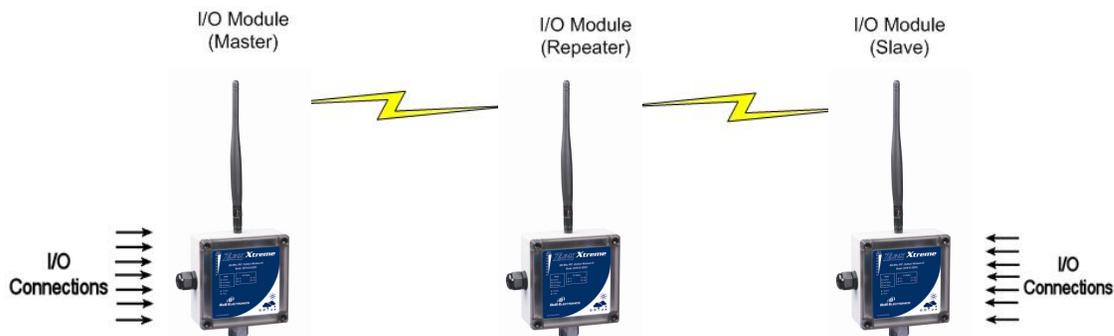


Figure 2-3 I/O Module as a Repeater

When a Zlinx Xtreme I/O Module is configured as a repeater, it relays data from a Modbus modem or an I/O Module and extends the range of communication. In a Peer-to-Peer System, a repeater unit can be placed between the Master and the Slave IO modules.

Only 900 MHz radios support the repeater functionality.

**NOTE:** Placing a repeater in a system will introduce an additional delay of 4ms. Each repeater introduced in a system will cut the data bandwidth to half.

## 2.4 I/O Types and Characteristics

The analog inputs, analog outputs and digital inputs are not isolated. They share the same common within the module. Digital outputs are isolated through relay contacts.

### 2.4.1 Digital / Pulse Inputs

Digital Inputs can detect the status of discrete control devices, contact closures, transistor switches or on/off DC voltage signals (low or high logic levels). Voltages below 1 VDC are interpreted as a low state. Voltages above 1 VDC up to 48 VDC are interpreted as a high state.

Each digital Input is selectable between NPN (sinking) and PNP (sourcing) types. The digital Input terminals can accept voltages in the range 0-48VDC.

The digital inputs can also be used as a pulse/frequency input in Modbus mode only. The maximum pulse frequency is 20 KHz.

### 2.4.2 Digital Outputs

Digital Outputs send on/off signals (low or high logic levels) to drive external devices such as indicators, relay coils or the inputs of other equipment such as PLC's, SCADA, etc. Digital Outputs in Zlinx Xtreme I/O modules have a Form C Relay (common, normally open and normally closed) rated at 4A and 250VAC.

### 2.4.3 Analog Inputs

Each analog input can be individually configured as voltage or current types. Following selections are available:

- a) 0-10 Vdc
- b) 0-5 Vdc
- c) 0-20 mA
- d) 4-20 mA

The data is automatically scaled as a 16 bit register (0-65,535) for full scale in the Modbus register. To see how to calculate corresponding values in Modbus, refer to section [Appendix F](#).

### 2.4.4 Analog Outputs

Each analog output can be individually configured as voltage or current types. Following selections are available:

- a) 0-10 Vdc
- b) 0-5 Vdc
- c) 0-20 mA
- d) 4-20 mA

The data is automatically scaled as a 12 bit register (0-4,096) for full scale in the Modbus register. To see how to calculate corresponding values in Modbus, refer to section [Appendix F](#).

# 2.5 User Interface Components



Figure 2-4 External View of Zlinx Xtreme I/O module

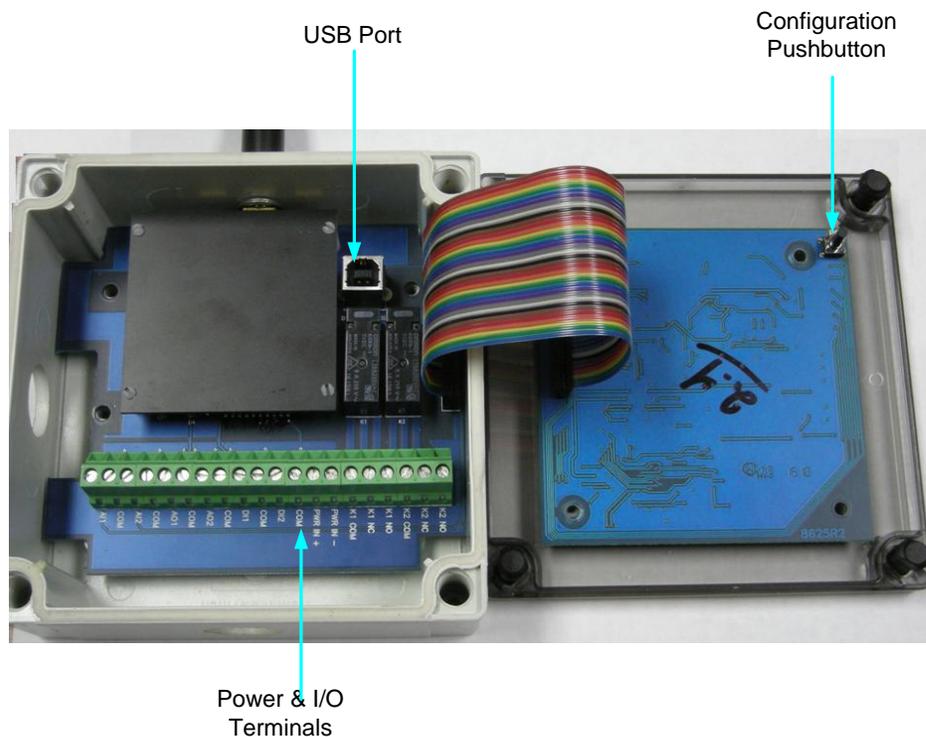


Figure 2-6 Internal View of Zlinx Xtreme I/O module

The external and internal view of the I/O modules is shown as above.

## 2.5.1 Radio Signal Strength Indicator (RSSI) LEDs

The **Signal Strength** LEDs provide an indication of the signal strength of the received radio signal. 8 Green LEDs in a bar graph format show the signal strength from Weak to Strong. The table below explains the RSSI LEDs:

LEDs Number turned ON	Signal Strength
0	No signal
1-3	Weak
4-6	OK
7-8	Strong

Figure 2-7 RSSI LED Status Table

## 2.5.2 Mode LEDs

The I/O module operates in one of the following 3 modes and its status is shown by the corresponding green LEDs:

- Modbus
- Peer-to-Peer Master
- Peer-to-Peer Slave

## 2.5.3 Wireless LED

This LED will flash whenever wireless data is transmitted or received.

## 2.5.4 Power LED

- 1) A green status LED indicates that an adequate dc power is available to the module.
- 2) This LED will flash on Comm. Fail.

## 2.5.5 I/O Status LEDs

Green status LEDs show the status of the digital inputs and relay outputs in the I/O module

## 2.5.6 Configuration Pushbutton

The Configuration Button allows the user to select one of the following I/O operation modes without the need for a PC:

- Modbus
- Peer-to-Peer Master
- Peer-to-Peer Slave.

Follow the steps below to change the I/O module configuration mode using the Configuration Push Button.

- 1) Press and HOLD the PB until all MODE LED's flash.
- 2) A single LED will begin to flash, which depends on the mode the device is currently in. An example would be the P2P Master LED will flash, if the device was in P2P Master mode.
- 3) Pressing the Config PB will increment through the other modes; P2P Slave, Modbus, etc.
- 4) If the Push Button is not pressed for 4 sec, the device will exit and select the mode that was indicated by the flashing LED.

The following default settings established when the mode is changed:

	ZXT24-IO-222R2	ZXT9-IO-222R2
<b>Peer-to-Peer master mode</b>		
Radio Network:	0x0c	0x00
Radio ID Number:	0x11	0x11
Radio Output Power:	(4) 63mw	(4) 1w
Number of Retries:	10	10
AES Security:	Disabled	Disabled
P2P Address:	1	1
OTA Baud:	Fixed*	115200
P2P Polling Rate:	0 sec	0 sec
<b>Peer-to-Peer slave mode</b>		
Radio Network:	0x0c	0x00
Radio ID Number:	0x11	0x11
Radio Output Power:	(4) 63mw	(4) 1w
Number of Retries:	10	10
AES Security:	Disabled	Disabled
P2P Address:	1	1
OTA Baud:	Fixed*	115200
P2P Slave Timeout:	30 sec	30 sec
<b>Modbus mode</b>		
Radio Network:	0x0c	0x00
Radio ID Number:	0x11	0x11
Radio Output Power:	(4) 63mw	(4) 1w
Number of Retries:	10	10
AES Security:	Disabled	Disabled
Modbus Address:	1	1
OTA Baud:	Fixed*	115200
Modbus Slave Timeout:	30 sec	30 sec

\* - "Fixed" for OTA Baud means that this parameter can't be changed and is equal to 250 Kbps.

Refer to section 6 for parameter descriptions.

## 2.5.7 Power & I/O Terminals

Screw terminals are provided for Power & I/O interface connections as shown. Refer to Chapter 4 for wiring information.

## 2.5.8 USB Port

The USB port is used to configure the I/O module and for firmware updates. The I/O module must be connected and powered for the Zlinx Manager Software to detect the IO module. Refer to section 4 for software installation and section 5 for programming the unit.

## 3.

## Hardware Installation

### 3.1 Before Installation

#### Recommended Practice

Before installing a new system, it is recommended to bench test the complete system and make sure the modules function satisfactorily. Refer to appropriate sections for your setup in Chapter 8 for reference.

In actual installations, poor communications can be caused by:

- Incorrectly installed antennas.
- Radio interference.
- Obstructions in the radio path.
- Bad weather
- Signal out of range.

If the radio path is a problem, higher gain antennas would help improve the range.

### 3.2

#### RF Site Considerations

When installing any radio equipment it is important to give careful consideration to the installation location and the surrounding area. Radio transmission and reception is affected by absorption, reflection and refraction of the radio signals. These factors are determined by the distance between the transmitting and receiving antennas, the type, position and amount of obstructions, antenna heights, frequency band and RF power used, and other factors.

There are several ways to optimize the RF environment to ensure satisfactory performance. A partial list of these follows:

- Select the Zlinx Xtreme I/O radio option that provides sufficient power for your application. Lower frequencies travel farther and are less affected by absorption in materials. Higher power levels generally provide greater penetration through objects.
- Select installation locations that come as close as possible to providing Line Of Sight access between the antennas.
- Avoid installation locations where metal objects may block, reflect, refract or cause multipathing of radio frequencies. In some cases reflections may enhance reception but in others it can cause problems.
- Select installation locations to increase antenna heights.
- Consider signal loss across antenna cables and connectors. User larger cables for low signal loss.
- Select equipment enclosures made of materials that minimize RF attenuation.
- Avoid locations with other radio equipment that may cause interference.
- In some cases alternate types of antennas (more directional) or remote antenna mounting (outside of enclosures or at a higher elevation) may be required.

As necessary, site survey should be carried out. Sometimes small changes in location can make a significant improvement to coverage. For RF information see Appendix G.

## 3.3

## Dimensional Information

The dimensional information with mounting holes is shown below.

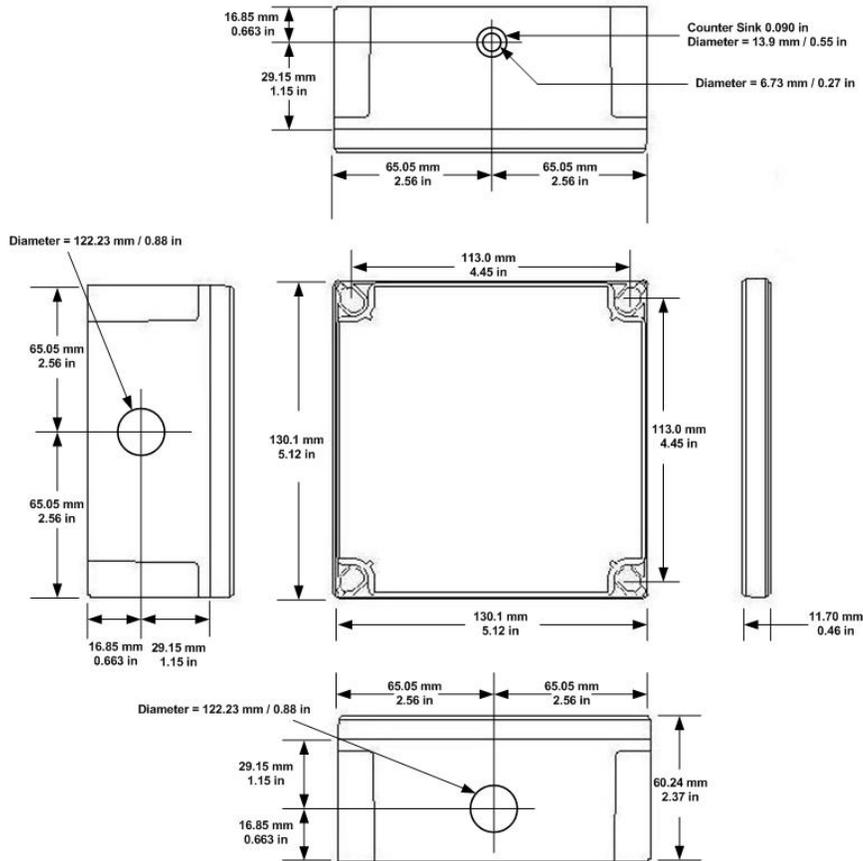


Figure 3-1 Dimensional Information

## 3.4

## Mounting Options

The Zlinx Xtreme I/O module can be panel or machine mounted. The module can be mounted with or without the optional mounting ears.

### 3.4.1 Without the mounting ears

The Zlinx Xtreme can be mounted on a back panel or a machine by removing the top lid. The top lid is removed by unscrewing the 4 corner screws. The module can be mounted using the supplied screws and nuts through the corner holes. Once secured, fasten the top cover.

### 3.4.2 With Mounting ears

4 optional mounting ears and screws are supplied as accessories. The ears can be attached to the Zlinx Xtreme by removing the top cover and securing through the corner holes. The module then can be mounted on the panel by marking the position of the holes on the back panel. Fig 3-2 shows the mounting scheme with ears.

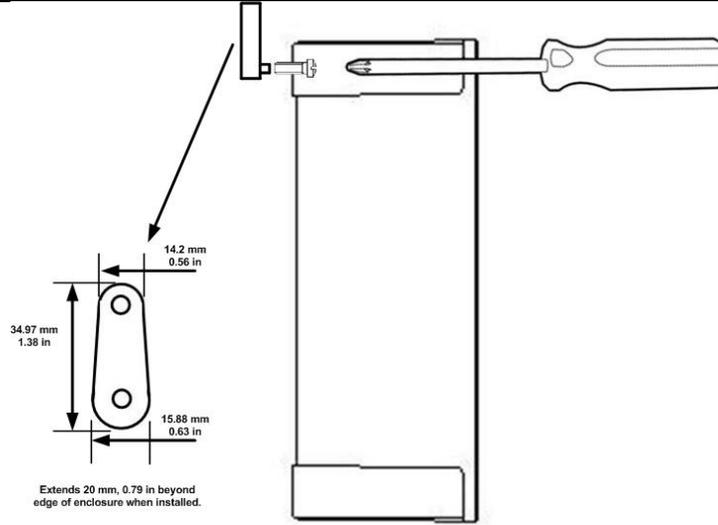


Figure 3-2 Mounting Ear dimensions

### 3.5

### Cabling Options

The Zlinx Xtreme module has two holes of 0.875" diameter for cable installation. Cable gland or conduit mounting is possible. A cable gland and conduit hub are included as accessories. Unused hole must be plugged by the supplied membrane gland in order to maintain IP67 rating.

#### 3.5.1 Cable Glands

**NOTE: the Cable Glands cannot be used for Class 1 Division 2 applications. Please see the Quick Start Guide for UL Class 1 Division 2 installation instructions.**

A Cable Gland is used to maintain the water tight rating while allowing a cable to enter the enclosure. The assembly consists of black molded nylon body, hex nut, cable nut and a rubber gasket and cable seal.

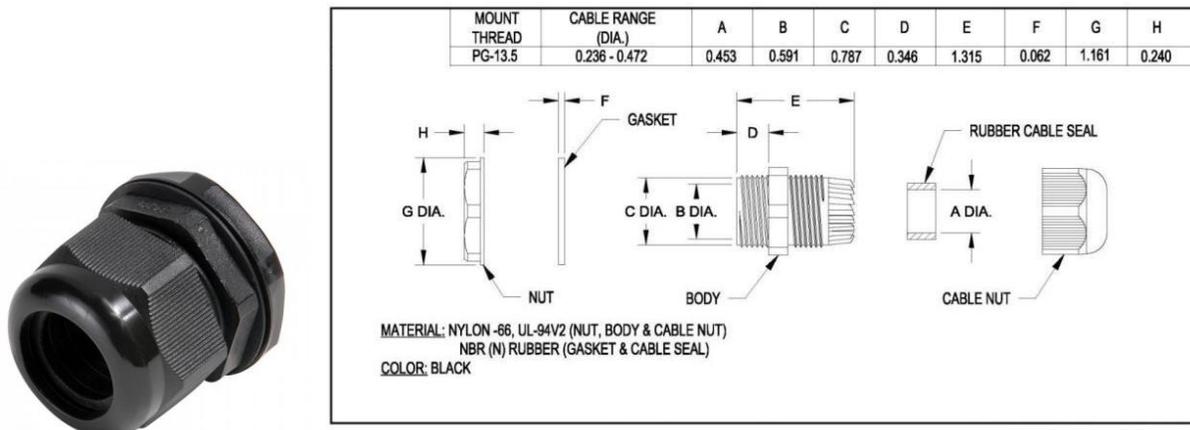


Figure 3-3 IP67 Cable Gland

Follow the steps below to install the cable gland:

1. Insert the Non-tapered end of the Body (D) through the conduit knock-out on the I/O module enclosure.
2. Place the Gasket around the body on the outside of the enclosure.
3. Thread the Hex Nut onto the Body from the inside of the enclosure.
4. Insert the cable through the Cable gland into the enclosure. Ensure you leave enough slack in the cable to reach the terminal blocks.
5. Place the Cable Nut onto the cable being careful to position the threaded side so that it can be attached to the Cable Body.
6. Tighten the Cable Nut. This will cause the tapered end of the Cable Body to compress, ensuring a water-tight seal.

### 3.5.2 Conduit Installation

**Unused conduit openings: Class 1 Division 2 installation requires a UL Recognized plug (UL Category Code QCRV2) be used when a conduit opening is not being used.**

A conduit hub is supplied with the Zlinx Xtreme I/O module where conduit installation is preferred to route the cables. It is suited to connect  $\frac{1}{2}$ " or  $\frac{3}{8}$ " conduit fittings and consists of a Body, Nut, and Gasket suitable for IP67 rating. It is used to secure threaded half inch rigid service entrance conduit.



Figure 3-4  $\frac{1}{2}$  inch Threaded Conduit Hub with dimensions

1. Insert the treaded end of the body into the conduit knock-out from the outside of the enclosure. The rubber gasket should be on the outside of the enclosure.
2. Thread the Nut onto the conduit body from inside the enclosure.
3.  $\frac{1}{2}$  Inch, rigid, threaded conduit can be attached to the threaded hub.

### 3.5.3 IP67 Membrane Cable Gland

**NOTE: the Cable Glands cannot be used for Class 1 Division 2 applications. Please see the Quick Start Guide for UL Class 1 Division 2 installation instructions.**

The membrane cable gland can be used to plug an unused hole in the enclosure or to route a cable.



Figure 3-5 IP67 Membrane Gland

Stuff the cable gland into the knock-out hole with the narrow end toward the inside of the I/ Module enclosure. The enclosure wall will fit into the indentation between the inside and outside portions of the gland.

### 3.5.4 Supplied Antenna

#### 900 MHz Supplied Antenna:

Your 900 MHz product comes supplied with a “rubber duck” style antenna which can be articulated up to 90 degrees. Then antenna is a  $\frac{1}{4}$  wave dipole with an Omni directional pattern and vertical polarization. It is recommended that your I/O product be mounted with the antenna on the top, perpendicular with the horizon

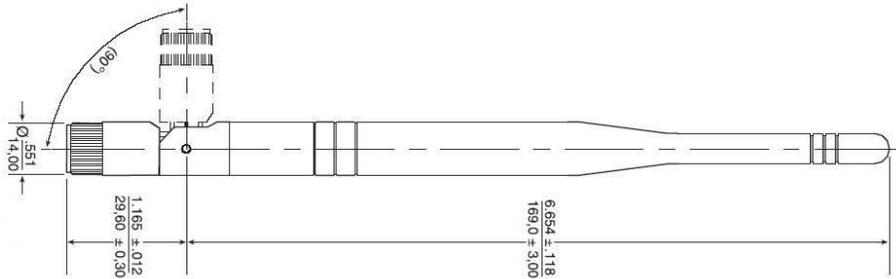


Figure 3-6 ZXT9-IO-222R2 Supplied Antenna

#### Antenna Specifications:

Impedance: 50 $\Omega$   
 Connector: RPSMA Female  
 VSWR: 2.0 Max (in band)  
 Gain : 3.0 dBi  
 Polarization: Vertical  
 Part Number: ZXT9-ANT1

#### 2.4 GHz Supplied Antenna:

Your Zlinx Xtreme 2.4 GHz product comes supplied with a “rubber duck” antenna which can be articulated up to 90 degrees. Then antenna is a  $\frac{1}{4}$  wave dipole with an Omni directional pattern and vertical polarization. It is recommended that your Zlinx Xtreme product be mounted with the antenna on the top, perpendicular with the horizon.

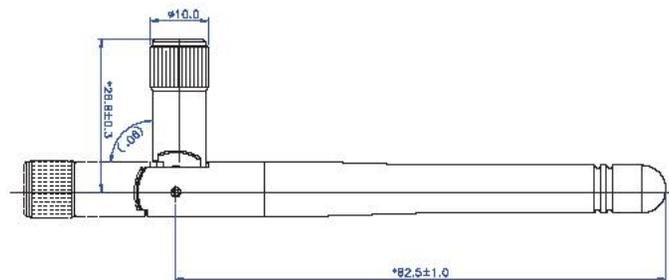


Figure 3-7 ZXT24-IO-222R2 Supplied Antenna

#### Antenna Specifications:

Impedance: 50 $\Omega$   
 Connector: RPSMA Female  
 VSWR – 2.0 Max (in band)  
 Gain – 2.1 dBi  
 Polarization – Vertical  
 Replacement Part Number – ZZ24D-ANT1

### 3.5.5 Optional hardware

Optional high gain antennas may be necessary to extend the range of the wireless radios. Omni antennas help propagate the radio frequency signals 360°. Yagi antennas are used for directional pointing. For point-to-point (aka peer-to-peer) applications, 2 Yagi antennas would offer the best performance. For point-to-multi point applications, an Omni antenna at the central location with Yagi antennas at the remote radios would offer the best performance. These high gain antennas must be mounted at elevated locations. Line of sight is necessary for better communication. The figures below show Point-to-Point and Point-to-Multi Point installations Using Omni and Yagi antennas.

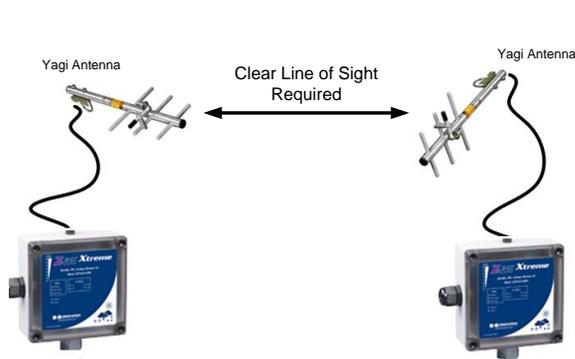


Figure 3-8 Point-to-Point System

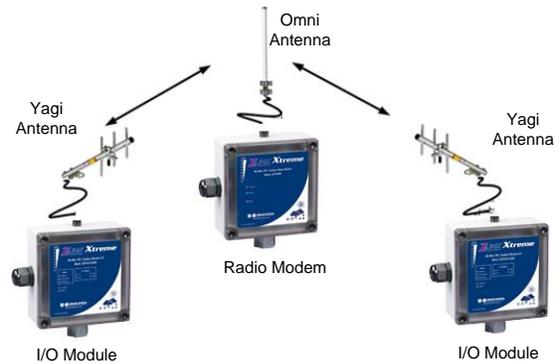


Figure 3-9 Point-to-Multi Point Modbus System

Extension cables are available to connect the radios to the antennas. Lightning arrestors are highly recommended in outdoor installations where thunderstorms and lightning are commonplace.

#### 3.5.5.1 High Gain Omni Antenna

An Omni-directional antenna is an antenna system which radiates power uniformly in one plane with a directive pattern shape in a perpendicular plane. This pattern is often described as "donut shaped". Omni-directional antenna can be used to link multiple directional antennas in outdoor point-to-multipoint communication.

These Omni Directional antennas are a good choice if you need to mount your antenna on a mast to increase its elevation. Please note that mounting brackets must also be purchased. Also note that these antennas have an N style connector. Refer to section 3.9 to select the correct cable.



Figure 3-10 Representative Omni Antenna

**FG9023 – High Gain Omni Directional (900 MHz)**

Use With: ZXT9 radios (900 MHz)  
Impedance: 50Ω  
Connector: N Female  
VSWR – 2:1 Max (in band)  
Gain – 3 dBi  
Polarization – Vertical  
Length – 25 inches  
Mounting Brackets (Sold Separately) – FM2

**FG9026 – High Gain Omni Directional (900 MHz)**

For Use With: ZXT9 radios (900 MHz)  
Impedance: 50Ω  
Connector: N Female  
VSWR – 2:1 Max (in band)  
Gain – 3 dBi  
Polarization – Vertical  
Length – 65 inches  
Mounting Brackets (Sold Separately) – FM2

**FG24008 – High Gain Omni Directional (2.4 GHz)**

For Use With: ZXT24 radios (2.4 GHz)  
Impedance: 50Ω  
Connector: N Female  
VSWR – 1.5:1 Max (in band)  
Gain – 8 dBi  
Polarization – Vertical  
Length – 24.5 inches  
Mounting Brackets (Sold Separately) – FM2

**3.5.5.2 High Gain Yagi Antenna**

A Yagi-Uda Antenna, commonly known simply as a Yagi antenna or Yagi, is a *directional antenna* system consisting of an array of a dipole and additional closely coupled parasitic elements (usually a reflector and one or more directors). The dipole in the array is driven, and another element, typically 5% longer, effectively operates as a reflector. Other parasitic elements shorter than the dipole may be added in front of the dipole and are referred to as directors. This arrangement increases antenna directionality and gain in the preferred direction over a single dipole.

Since Yagi Antennas are directional, they must point directly at the other antenna through a clear line of sight.

These Directional antennas are a good choice if you need to mount your antenna on a mast to increase its elevation. Note that these antennas have an N style connector. Refer to section 3.9 to select the correct cable.



Figure 3-11 Enclosed Yagi – Model YE240015 for 2.4 GHz Models



Figure 3-12 Representative Yagi Antenna

**YS8963 – High Gain Yagi (900 MHz) - For Use With: ZXT9-RM (900 MHz)**

Impedance: 50  $\Omega$   
 Connector: N Female  
 VSWR – 1.5:1(in band)  
 Gain – 6 dBi  
 Polarization – Vertical  
 Length – 16.8 in  
 Mounting Brackets – Included

**YS8966 – High Gain Yagi (900 MHz) - For Use With: ZXT9-RM (900 MHz)**

Impedance: 50  $\Omega$   
 Connector: N Female  
 VSWR – 1.5:1(in band)  
 Gain – 9 dBi  
 Polarization – Vertical  
 Length – 27.8 in  
 Mounting Brackets – Included

**YS89612 – High Gain Yagi (900 MHz) - For Use With: ZXT9-RM (900 MHz)**

Impedance: 50  $\Omega$   
 Connector: N Female  
 VSWR – 1.5:1(in band)  
 Gain – 11 dBi  
 Polarization – Vertical  
 Length – 49 in  
 Mounting Brackets – Included

**YS24008 – High Gain Yagi (2.4 GHz) - For Use With: ZXT24-RM (2.4 GHz)**

Impedance: 50  $\Omega$   
 Connector: N Female  
 VSWR – 1.5:1(in band)  
 Gain – 12.5 dBi  
 Polarization – Vertical  
 Length – 18 in  
 Mounting Brackets – Included

### 3.5.5.3 Antenna Cables & Connectors

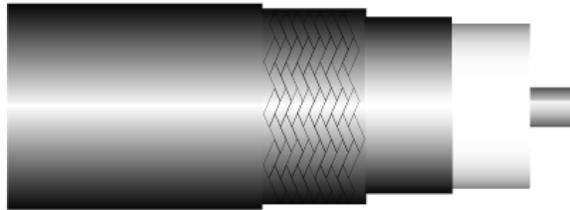
Antenna cables and connectors must be used when extending the standard or high gain antenna for outdoor antenna applications. Appropriate cable and connector must be chosen. It is important to know that RF signal is lost across the cables and connectors and hence for better performance, the cable length and connectors must be kept to a minimum. Also it is important to select a cable that matches the radio's impedance. An impedance mismatch will cause the radio link to become inefficient and could damage the radio. Selecting the incorrect cable could also cause significant signal loss. A rule of thumb is for every 3 dB of loss, your system will lose one half the output power emitted from the radio.

Three cable types are available, viz. LMR100, LMR195, and LMR400. LMR400 cable offers lower loss but is thicker and more difficult to work with. LMR100 is thin and easy to work with, but has a larger loss. It is recommended that you use the shortest possible cable run in your application.

Cable Type	900 MHz Loss Per 100 ft	2.4 GHz Loss Per 100 ft	Diameter
LMR-100	22.8 dB	38.9 dB	0.110 in
LMR-195	11.5 dB	19.0 dB	0.195 in
LMR-400	3.9 dB	6.8 dB	0.405 in

Figure 3-13 Antenna Cable Options and Signal Loss Information

400M



50 Ohm, FPE dielectric, AL Tape+95% braid, PE jacket, .405" OD

Figure 3-14 LMR400 Cable Cross Section

195M



50 Ohm, FPE dielectric, AL Tape+95% braid, PE jckt, .195" OD

Figure 3-15 LMR195 Cable Cross Section

100M



50 Ohm, FPE dielectric, AL Tape+95% braid, PE jckt, .105" OD

Figure 3-16 LMR100 Cable Cross Section

Along with the cable, a proper connector must be chosen. The I/O module uses an RPSMA Male (plug) connector. The optional high gain antenna has an N type Female connector. Therefore, an antenna cable that has a RPSMA Female jack at the module end and a N type Male connector at the antenna end the must be chosen.

If the supplied antenna needs to be extended, a cable with an RPSMA Female jack at the module end and an RPSMA Male (plug) at the antenna end must be selected since the supplied antenna has an RPSMA female (jack).

## Antenna Cable Part Numbers

Following standard cables available for purchase. The cable part numbering format is as follows:.

TTTT-AA BB-LLLL

Where,

TTTT = Cable Type (400M = LMR400, 195M = LMR195, 100M = LMR195)

AA = Connector A (NM = N-Male, SL = RPSMA Male (Plug))

BB = Connector B (NM = N-Male, SL = RPSMA Male (Plug))

LLLL = Length in inches (ex: 6 = six inches, leading zeros are not necessary)

For example, an 400M-NMSL-24 is an LMR400 cable with a N Male on one end and a RPSMA plug on the other, 24 inches in length.

### 3.5.5.4 Lightning Arrestors

A lightning arrestor can prevent damage to the radio due to high energy transients during lightning strikes. The arrestors limit surges to less than 45 volts in approximately 100 nanoseconds. A gas discharge tube changes from an open circuit to a short circuit in the presence of energy and voltage surges giving those surges a direct path to ground, thus protecting equipment.

They are designed with a rugged housing and high quality plated brass "N" connectors. It also features a user replaceable gas discharge tube (LA350GT) and are available in three models: the LABH350NN and the LABH2400N both allow bulkhead mounting and connector pass-through and the LAIL350NN allows inline placement only.

### 3.5.5.5 IP67 Power Supply



Figure 3-17 IP67 Power Supply

An optional IP67 power supply (p/n: CLG-60-24) is available suitable for outdoor applications. The

#### Power Supply Specifications:

Input Voltage: 90 ~ 295 Vac

Output Voltage: 24 Vdc

Rated Power: 60 W

Env. Rating: IP67, Indoor / Outdoor

Temp rating: -30°C ~ +70°C

# 4. Electrical Installation

Please see the Quick Start Guide for UL Class 1 Division 2 installation instructions.

Both power and I/O signals are connected to the terminal block provided in the I/O module. The terminal block can be accessed by removing the top cover and are provided at the bottom. Figure 4-1 shows the layout.

Consider the following requirements for cable connections and terminations.

- Wiring Terminals – Use Copper Wire Only, One Conductor per Terminal
- Wire range: 10-28 AWG
- Tightening Torque – 0.5 to 0.6 Nm
- Temperature Rating of field installed conductors - 105°C minimum, sized for 60°C ampacity

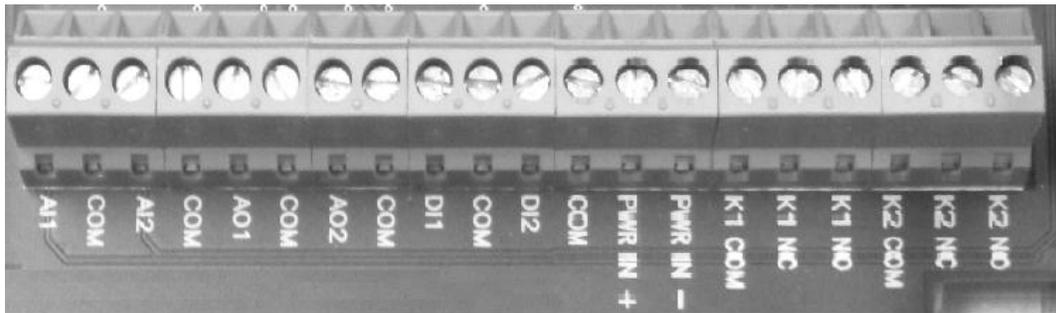


Figure 4-1 I/O Terminal Layout

## 4.1 Power Wiring

The radio modem requires a dc power supply from an external source. The permissible voltage range is 10 to 30 VDC. The typical power consumption is as follows:

ZXT24-IO-222R2:

Type: 1.7W  
Max: 4.5W

ZXT9-IO-222R2:

Type: 2.1W  
Max: 6.8W

An optional IP67 power supply shown in Section 3.5.5.5 may be used.

Connect the positive and negative power leads to the Power In(+) and Power In (-) terminals on the terminal block.

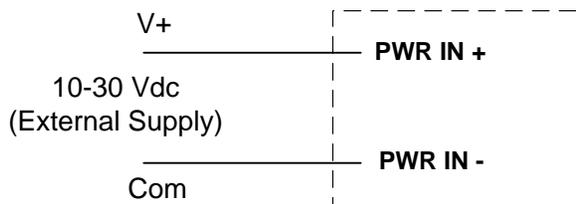


Figure 4-2 Power Wiring Connection

## 4.2

## I/O Wiring

The I/O module has the following options, PNP/NPN for digital I/Os and voltage/current for analog I/Os. The following wiring recommendations help the user to connect the devices to the I/O module.

### 4.2.1 DI Wiring

The digital inputs are software configurable for PNP (sourcing) and NPN (sinking) connections. Each Input selection can be independent of the other I/Os. PNP is chosen as the default setting. The configuration can be changed using the Manager Software as explained in Chapter 6. The following diagrams show typical connection wiring for both PNP and NPN connections with internal module power supply:



Figure 4-3 Typical Digital Input Wiring for PNP and NPN connection types (with internal PS)

If an external power source is used for the digital input connections, the external power supply common should be connected to the module power supply common. The diagrams below show the connection scheme:

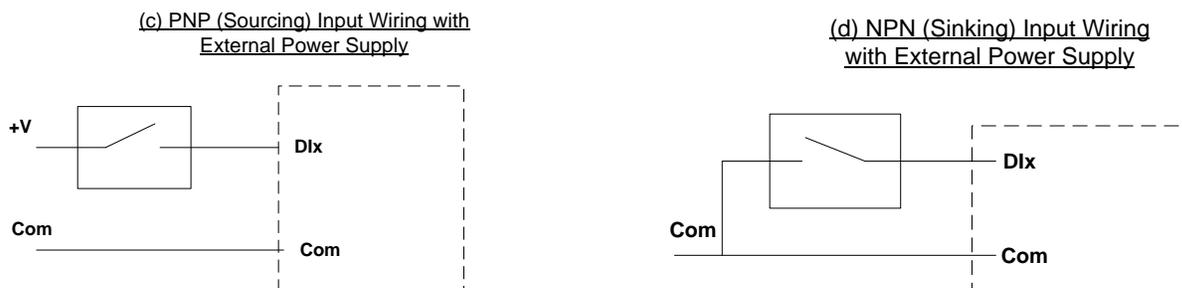


Figure 4-4 Typical Digital Input Wiring for PNP and NPN connection types (with external PS)

A pulse/frequency input can be connected to the digital input as follows:



Figure 4-5 Pulse Input Connection

### 4.2.2 DO (Relay) Wiring

Common, NO (normally open) and NC (normally closed) contacts of the relays are brought to terminals for wiring. The following diagram shows typical connection wiring for relay outputs:

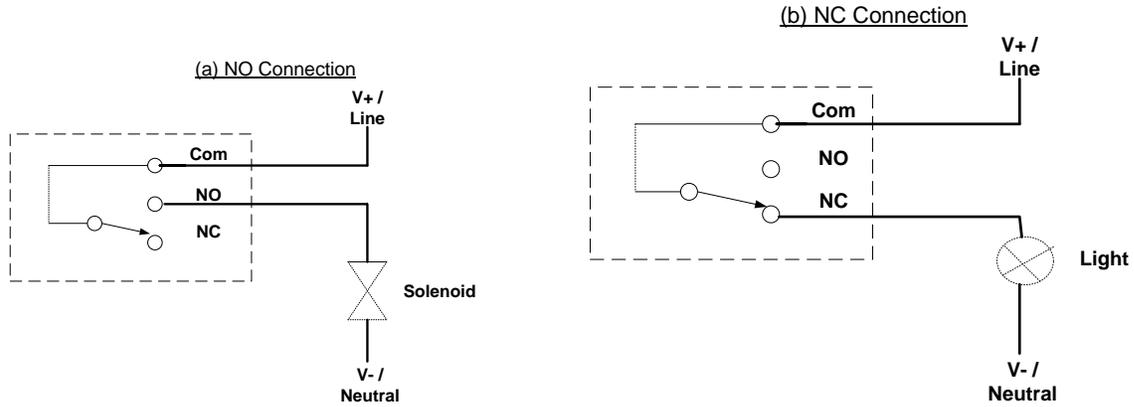


Figure 4-6 Typical Digital Output Wiring for Relay Outputs

### 4.2.3 AI Wiring

The following diagram shows typical connection wiring for Analog Inputs:

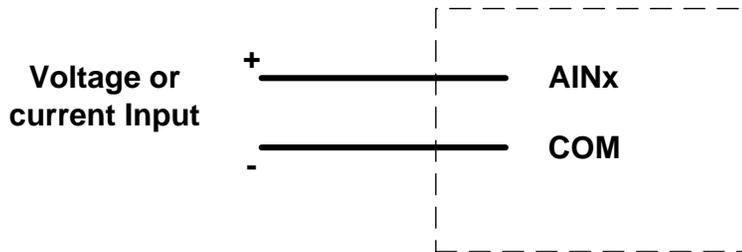


Figure 4-7 Typical Analog Input Wiring

### 4.2.4 AO Wiring

The following diagram shows typical Analog Output Wiring:

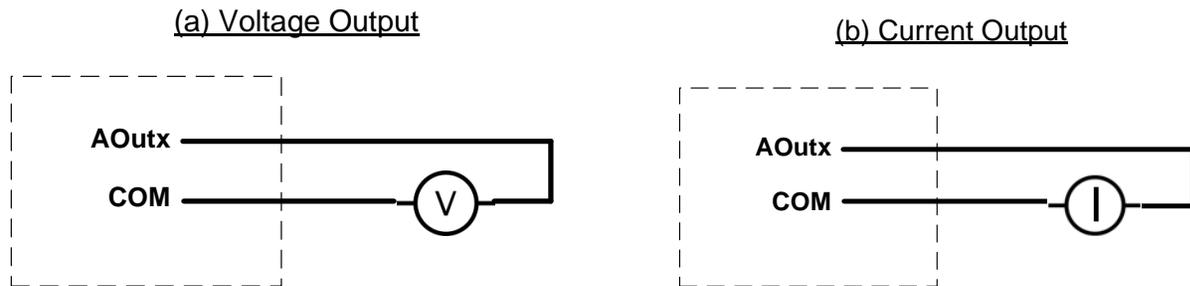


Figure 4-8 Typical Analog Output Wiring

## 5. Software Installation

### 5.1 Zlinx Manager Software Overview

Zlinx Manager Software is supplied along with the module in a CD. The software must be installed in a PC and launched to change the configuration of the wireless I/O module.

### 5.2 Computer System Requirements

The Zlinx Manager software requires the following computer hardware and operating systems:

- A PC with one USB port available..
- Operating System
  - Windows XP 32 & 64 bit (Home or Professional with SP1, SP2 or SP3)
  - Windows 2000 32 & 64 bit
  - Vista 32 & 64 bit
  - Windows 7 32 & 64 bit.

### 5.3 Installing Zlinx® Manager Software

The Zlinx manager software is available in the CD ROM which is included with the I/O module. Insert the CD into the CD drive. The installation process will start automatically. If it does not, then navigate to the CD ROM drive using Windows Explorer software and then double click the executable file on the CD.

**NOTE:** 1) Install the Zlinx Manager Software before connecting the I/O module to the PC.  
2): The software is also available for download from <http://www.bb-elec.com>.

1. The Welcome Screen will be displayed.



Figure 5-1 Installation Welcome Screen

2. Follow the prompts to install the software.
3. The Installation Complete Screen as shown below will be displayed. Click the "Finish" button.



Figure 5-2 Installation Completion Screen

## 5.4 Installing USB Drivers

The USB drivers will automatically be installed when the software is installed. If the "Add New Hardware" wizard appears when the hardware is attached, the USB drivers are available in the "USB Drivers" folder on the CD-ROM.

## 5.5 Connection to PC

To connect Zlinx Xtreme I/O to a PC:

1. Open the front cover of the Zlinx Xtreme I/O module
2. Apply power to the I/O unit
3. Connect the PC USB port to the USB port of the Zlinx Xtreme I/O Module using a USB cable.
4. Now the Zlinx Xtreme I/O module is ready to be configured from the PC.

## Establishing

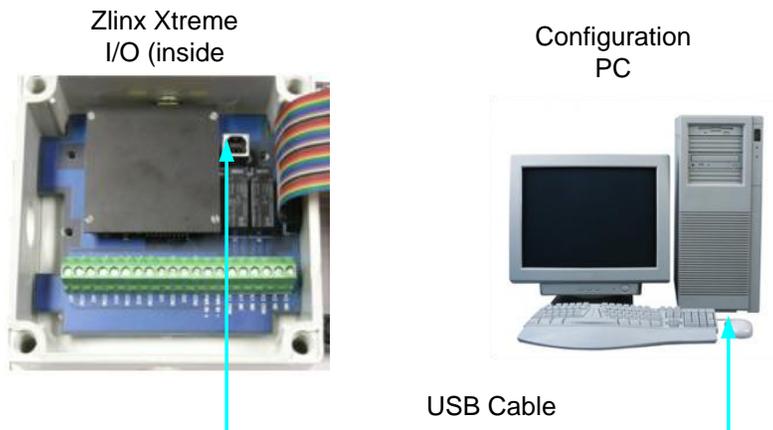


Figure 5-3 PC to I/O Module Connection

**Note:** In order for the PC to see the Xtreme module's COM port, the Xtreme module **must** be powered. If power is removed from the Xtreme module, the COM port will disappear from the PC even if you are configuring or monitoring the Xtreme module.

## 5.6 Starting Zlinx I/O Configuration Software

1. From the Windows Start menu, start the **Zlinx Manager** software. Zlinx Manager is common for both the I/O Module Configuration and the Radio Modem configuration. The default path is:

Programs/B&B Electronics/Zlinx/Zlinx Manager/Zlinx Manager

Zlinx Manager Screen opens offering navigation to Zlinx Manager or Radio Modem Manager.



Fig 5.4 Zlinx Manager Start Menu

2. Click on the **Zlinx I/O**. The following I/O menu screen opens. This screen allows access to I/O Configuration, Firmware Update and Monitor I/O Status



Fig 5.5 Zlinx Manager I/O Menu Screen

## 5.7 Unit Discovery

1. To go to the configuration window click on the **Zlinx I/O Configuration**.
2. The Zlinx Xtreme I/O splash window appears briefly, followed by the discovery window.
3. The Connection drop down list defaults to **Automatic** discovery. The software scans through COM-ports looking for Zlinx Xtreme I/O devices. The scan starts with the most recently used COM-port in which a device was found.

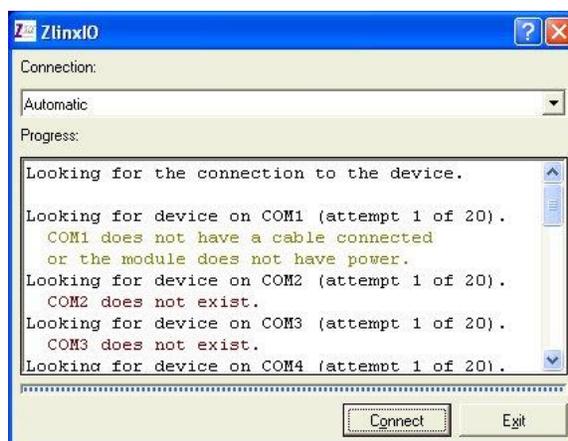


Fig 5.6 I/O Module Discovery Window

During the scan the Progress box displays information about the scanning process. The bar graph near the bottom of the window indicates progress.

4. If the device is not found, the Progress box displays:
  - "The device was not found on any serial port."*
  - a. Check the power supply and serial cable connections.
  - b. Click the **Connect** button. The connection process will be repeated and the device should be found.
5. If Automatic connection is not desired, a particular COM port (1 to 16) can be specified:
  - a. Select the COM port number from the Connection drop down list.
  - b. Click the **Connect** button to initiate the connection process.

**NOTE:** Clicking the **Stop** button stops the module discovery process.

6. If the device is found, the I/O Configuration Menu Screen opens.

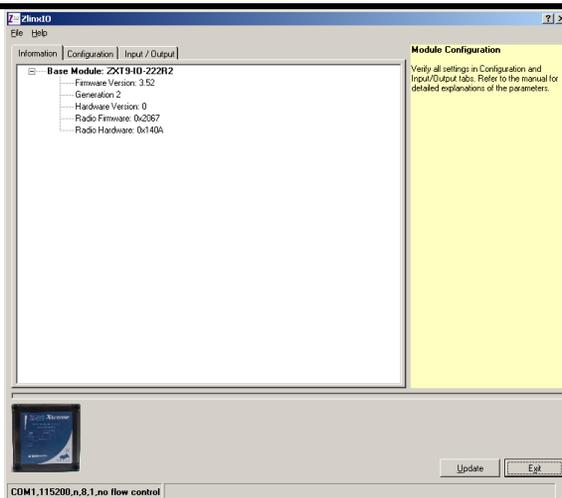


Fig 5.7 I/O Configuration Menu

The I/O Configuration Menu contains:

- Three tabbed panes: Information, Configuration, and Input/Output.
- A Help sidebar containing information and hints related to the current tab. If the sidebar is not visible enable it by going to **Help > Sidebar**.
- A graphic display of the I/O Modules discovered.
- A Status bar (at the bottom) showing the COM port and communications parameters: baud rate, parity, data bits, stop bits and flow control.
- An **Update** button used to save configuration parameters to the modules.
- An **Exit** button.

## 5.8 I/O Configuration Options

The following tabs are available in the I/O Configuration Manager. The configuration details are explained in Chapter 6.

### 5.8.1 Information Tab

The Information tab displays a tree structure listing:

- I/O Modules detected and their model numbers.
- Generation number.
- Firmware version number for each module.
- Hardware version number for each module.
- Radio firmware version number for the Xtreme Module.
- Radio hardware version number for the Xtreme Module.

---

## 5.8.2 Configuration Tab

The Configuration tab contains fields that allow configuration of:

- Wireless (Radio) parameters: Transmit Power, Channel Number, Network Identifier, Repeater Mode and AES Encryption settings.
- Communications Modes: Peer-to-Peer Master, Peer-to-Peer Slave, Modbus and related parameters.
- Parameters corresponding to the chosen communication mode.

## 5.8.3 Input/Output Tab

The Input/Output tab contains:

- A tree structure listing input and output types for each module.
- Input and output configuration options.

## 6.

# Configuration & Operation

The **I/O Configuration** software is used to configure the wireless I/O module. The I/O module can be configured to operate in Peer-to-Peer (wire-replacement) or Modbus modes receiving commands from a Modbus RTU Master. Digital Inputs can be configured to operate in Discrete (on/off) or Counter modes in PNP or NPN configuration, and Analog Inputs and Outputs are configurable for voltage or current loop operation with selectable ranges. Digital outputs are relay outputs. Section 2.4 provides more information on I/O Types and Characteristics.

## 6.1 Configuring the I/O

To enable the features described below (except Monitor):

1. Connect the I/O module to the Configuration PC
2. Start the Configuration Manager.
3. Choose **Zlinx I/O Configuration**
4. The Configuration Menu opens as shown in Fig 6-2. (See Section 5.6 for more details).

### 6.1.1 Wireless Settings

These settings are common for the I/O module irrespective of its operating mode, viz. Peer-to-Peer or Modbus I/O.

The I/O Modules can be configured for operation with different transmitter output power. They can also be configured to operate on several different radio channels. This allows multiple Zlinx Xtreme I/O systems to operate in the same area without interference. The number of different systems can be further increased by configuring a unique Network Identifier (which selects the frequency hopping sequence). 900 MHz Modules also can be used as repeaters, to extend the range of a system. Over-the-air (OTA) data rate can also be adjusted to increase range. A lower OTA data rate will increase the effective range of the radio, but will also increase the total throughput time.

Xtreme Module	Transmit Power Selectable	RF OTA Data Rate	AES Encryption
ZXT24-IO-222R2 (SR)	YES	NO	128 BIT
ZXT9-IO-222R2 (LR)	YES	YES	256 BIT

Fig 6-1 Transmit Power vs. OTA and AES Encryption for radios

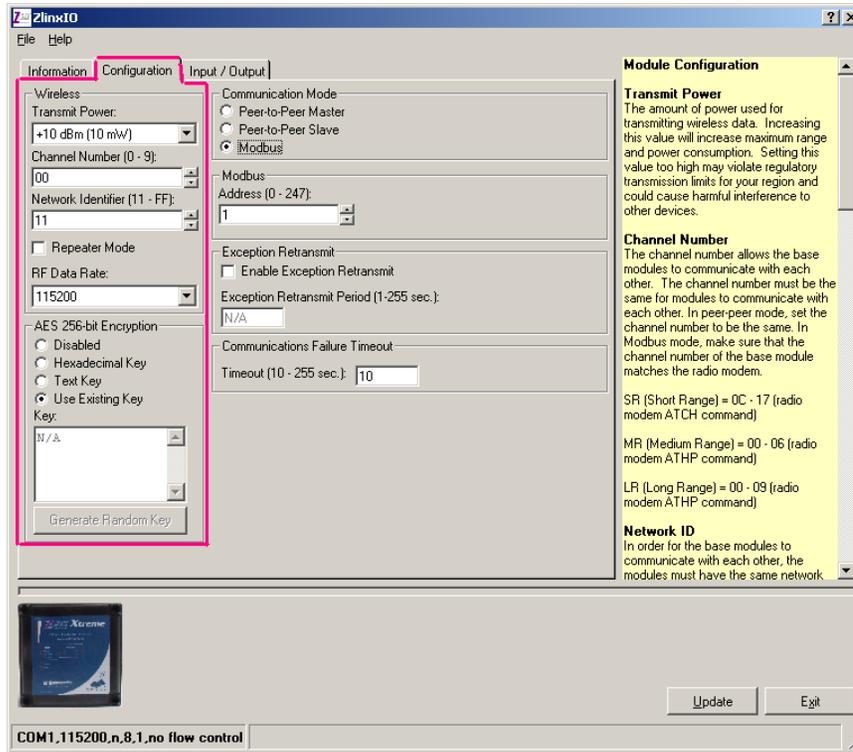


Fig 6-2 I/O Configuration Tab

**6.1.1.1 Transmit Power**

In the **Transmit Power** drop down list, select your desired output power in mW. The conversion between dBm and mW is shown in Appendix H . Increasing the power will increase maximum range and electrical power consumption. Setting this value too high may violate regulatory transmission limits for your region and could cause harmful interference to other devices. As a responsible user, make sure the transmitted power is within allowed limits for your region.

Xtreme Module	Power Selections	Factory Default
ZXT24-IO-222R2	10mW, 16mW, 25mW, 40mW, 63mW	63mW
ZXT9-IO-222R2	1mW, 10mW, 100mW, 500mW, 1000mW	1000mW

Fig 6-3 Transmit Power Ranges

**6.1.1.2 Channel Number**

Set the **Channel Number** field to match the channel used by the device with which it will communicate.

- a. If that device is another Zlinx Xtreme I/O Module, set the Channel Numbers the same when configuring each of them.
- b. If the device is a Modbus radio modem, the modem must be configured by using Zlinx Radio Modem Configuration Manager to match the Xtreme Module’s Channel Number.

- c. Channel Number range is different for 900 MHz and 2.4 GHz Zlinx Xtreme I/Os. The table below shows the ranges and commands in hexadecimal values:

Type/Range	Xtreme Module Channel Number Range	Factory Default
ZXT24-IO-222R2	0x0C to 0x17	0x0C
ZXT9-IO-222R2	0x00 to 0x09	0x00

Fig 6-4 Channel Number Range

#### 6.1.1.3 Network Identifier

- The **Network Identifier** field must match the Network Identifier used by the device with which it will communicate.
- If that device is another Zlinx Xtreme I/O Module, set its Network Identifier the same as the local I/O Module
- If that device is a Modbus Radio Modem, its Network Identifier must be configured by using the Radio Modem Configuration Manager to match that of the I/O module. Refer Radio Modem manual for configuration information.
- The Network Identifier range is different for both radio types (2.4 GHz and 900 MHz). The table below shows the channel number ranges in hexadecimal values.

Type/Range	Xtreme Module Network Identifier Range	Factory Default
ZXT24-IO-222R2	0x00 to 0xFF	0x00
ZXT9-IO-222R2	0x11 to 0xFF	0x11

Fig 6-5 Network Identifier Range

- If the Network Identifier is changed to outside the default value, it must be matched in the other device as well.

#### 6.1.1.4 Repeater Mode

- Select the Repeater checkbox if the Zlinx Xtreme I/O Module is to be used as a repeater, re-broadcasting I/O data received in Modbus or Peer-to-Peer modes.

The default value of the Repeater field is unchecked.

**NOTE:** Repeater Mode can only be implemented on the ZXT9-IO-222R2 Xtreme I/O Modules.

#### 6.1.1.5 RF Data Rate

900 MHz Xtreme Modules allow you to configure the over-the-air RF Data Rate. Using 9600 baud on these modules increases the effective range of the module.

This data rate may be configured for 9600 baud or 115200 baud.

### 6.1.1.6 AES Encryption

The following **AES Encryption** options are available

- a. **Disabled** – Select this option if you do not desire to encrypt your network.
  - i. Check the Disable option and press the Update button on the bottom of the screen.
- b. **Hexadecimal Key** - Select this option if you desire to use a hexadecimal stream to encrypt your network.
  - i. On the first Xtreme Module, check the Hexadecimal Key option. Press the Generate Random Key button. A random hexadecimal key will appear in the Key Box. (You can type your own hex key into the Key Box, but it is recommended that you use the random generator). This key will not be stored in the module until the Update Button on the bottom of the screen is pressed. Do not press the update button yet.
  - ii. Copy this key into a text file. You will need it to configure the key in the downstream Xtreme Module or radio modem.
    1. Highlight the characters displayed in the Key Box using your mouse and left mouse button.
    2. When all the characters are highlighted, press “CTRL” and “C” on your keyboard. This copies the characters to the Windows clip-board.
    3. Open Note Pad and press “CTRL” and “V” on your keyboard. The characters will appear. Save this file and use it to configure the key in the downstream module.
  - iii. Press the Update button on the bottom of the screen.
- c. **Text Key** – Select this if you desire to use a text sequence to encrypt your network.
  - i. On the first Xtreme Module, select the Text Key option. Type text into the key box. The text is limited to 128 or 256 bits (as applicable). If your text is not long enough, the remainder will be filled in with zeros when it is converted to ASCII by the software. The ASCII conversion happens automatically. If you desire, you can view the ASCII code by selecting the Hexadecimal Key option. The ASCII code will be displayed.
  - ii. Copy and save your text stream into a file in the same manner as step b.ii above.
  - iii. Press the Update button on the bottom of the screen.
- d. **Use Existing Key** – Select this option to use the key that is stored in the Xtreme Module.
- e. To update the key in a downstream Xtreme Module
  - i) Hexadecimal key:
    - (1) Select Hexadecimal Key
    - (2) If a key is displayed in the Key Box, delete it
    - (3) Open the file generated in step b. above.
    - (4) Copy the key by using your mouse and left click to highlight all of the characters. Press the “CTRL” and “C” key on your keyboard.
    - (5) With your mouse, left click in the Key Box. On your keyboard, press “CTRL” and “V”.
    - (6) Press the Update Button at the bottom of the screen.

- ii) If you are using a Text key, the key can be updated in two ways:
- (1) Copy Text Key
    - (a) Select Text Key
    - (b) If a key is displayed in the Key Box, delete it.
    - (c) Open the file generated in 6.c above
    - (d) Copy the key by using your mouse and left mouse button to highlight all of the characters. Press "CTRL" and "C" on your keyboard.
    - (e) With your mouse, left click in the Key Box. On your keyboard, press "CTRL" and "V".
    - (f) Press the Update Button at the bottom of the screen.
  - (2) Type Text Key
    - (a) Select Text Key
    - (b) If a key is displayed in the Key Box, delete it.
    - (c) Type in the key you generated in 6.c above.
    - (d) Press the Update Button at the bottom of the screen.
- f. Configuring AES Encryption on a Zlinx Radio Modem

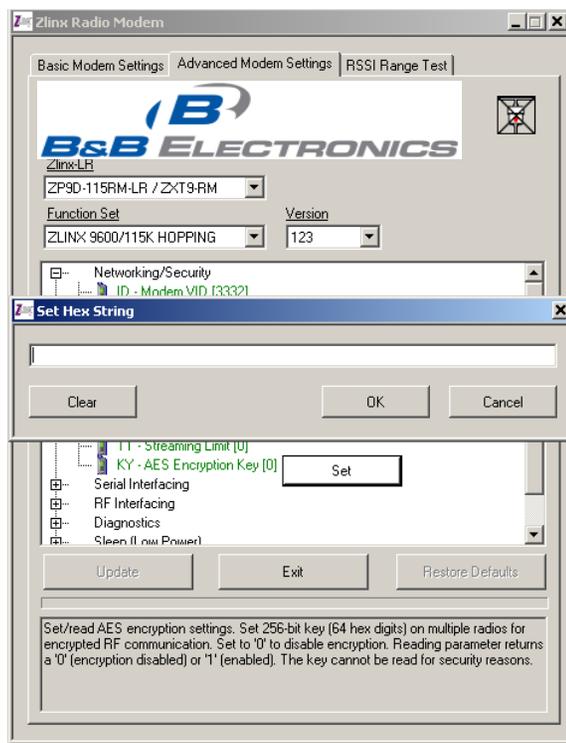


Fig 6-7 Zlinx Radio Modem Encryption

Figure 36 shows the Zlinx Radio Modem configuration screen.

Click the ATKY Set button (for SR models, the ATEE command also needs to be set to 1). The Set Hex String box will appear. Copy the key generated for the I/O module above into the box.

## 6.1.2 Modbus Mode Settings

When configured as a wireless Modbus node, Zlinx Xtreme I/O communicates with a Modbus RTU Master connected to a Zlinx Wireless Modbus Modem and provides remote I/O functionality. The configuration screen for Modbus Mode is shown below:

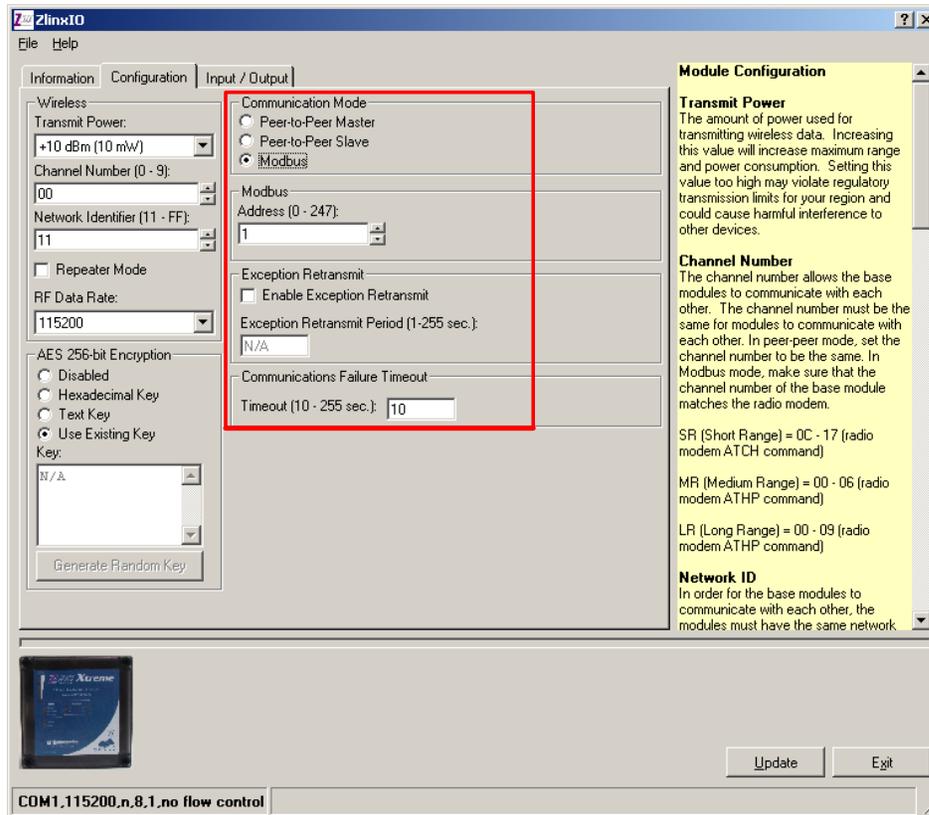


Fig 6-7 Modbus Mode Configuration

To configure the Zlinx Xtreme I/O for Modbus mode:

1. Select the **Configuration** tab.
2. Select the **Modbus** option button.
3. In the **Modbus Address** box, type the Modbus address to be used.

The allowable range of Modbus addresses is from 1 to 247. The default Modbus address is 1.

4. Set the value for the Communication failure timeout (in seconds). If within the predefined timeframe no data is coming from Modbus Master (Modbus Radio Modem), the Zlinx I/O device perceives it as a communication failure

### 6.1.3 Modbus I/O Addressing

In Modbus mode, Digital and Analog Input information from the Zlinx Xtreme I/O inputs is stored in the Zlinx Xtreme I/O memory in Modbus format and sent across the link to the Modbus modem. Digital and Analog Output information is sent from the Modbus modem to the Zlinx Xtreme I/O in Modbus format, which set the outputs to the desired states/levels.

To use Modbus mode successfully, an understanding of the Zlinx Xtreme I/O memory map assignments and Function Codes is necessary.

#### What is a Modbus Map?

A Modbus Map is simply a list for an individual slave device that defines:

- What the data is (ex. pressure or temperature readings).
- Where the data is stored (which tables and data addresses).
- How the data is stored (data types, byte and word ordering).

Some devices are built with a fixed map that is defined by the manufacturer, while other devices allow the operator to configure or program a custom map to fit their needs.

#### 6.1.3.1 Modbus Function Codes

The function code in the Master device query tells the addressed slave device what kind of action to perform. The data bytes contain any additional information that the slave will need to perform the function.

The following Modbus function codes are supported:

- Function 1: Read DO Status
- Function 2: Read DI's
- Function 3: Read AO Status
- Function 4: Read AI's
- Function 5: Write to Single DO (firmware v2.0 or higher)
- Function 6: Write to Single AO
- Function 15: Write to Multi DO's

For example, function code 03 will query the slave to read holding registers and respond with their contents. The data field must contain the information telling the slave which register to start at and how many registers to read.

#### 6.1.3.2 Modbus I/O Registers

Messages sent between Zlinx Xtreme I/O and a Modbus modem use Modbus memory addresses to specify the type of information being sent and where it is stored. In the Modbus addressing scheme, each type of I/O (DO, DI, AI, and AO) is stored in a different section of the memory. The following sections show the memory register maps for different I/O types.

##### 6.1.3.2.1 Digital (Relay) Outputs

There are 2 digital (Relay) outputs available in the I/O modules and their addressing is as follows:

Digital Outputs	Modbus Memory Address
Digital Output 1	00001
Digital Output 2	00002

Fig 6-8 Digital (Relay) Output Memory Table

When the Zlinx Xtreme I/O receives a Modbus message to write "1" to a discrete output register, the Zlinx Xtreme I/O module turns ON its corresponding Digital Output.

As an example, to turn on the second Digital Output (DO2) on the Xtreme Module, the Modbus Master must set a value of 1 in memory location 00002.

### 6.1.3.2.2 Digital Inputs

There are 2 digital inputs available in the I/O modules and their addressing is as follows:

Digital Outputs	Modbus Memory Address
Digital Input 1	10001
Digital Input 2	10002

Fig 6-9 Digital Input Memory Table

When a digital input is ON, the I/O module sets the corresponding Modbus register as a '1'. Otherwise, the register value is '0'. As an example, when the Digital Input (DO1) on the Xtreme Module goes ON, the Modbus register memory location 00002 will be set to a value of 1.

### 6.1.3.2.3 Analog Inputs

There are two 16-bit analog inputs available in the I/O modules and their addressing is as follows:

Analog Inputs	Modbus Memory Address
Analog Input 1	30001
Analog Input 2	30002

Fig 6-10 Analog Input Memory Table

The I/O module sets the register value based on the analog signal level.

As an example, for a 0-10V selection, when the analog input 1 is 5V, the memory location 30001 will read 32,768

Refer to Appendix F for analog data scaling.

### 6.1.3.2.4 Analog Outputs

There are two 16-bit analog inputs available in the I/O modules and their addressing is as follows:

Analog Outputs	Modbus Memory Address
Analog Output1	40001
Analog Output 2	40002

Fig 6-11 Analog Output Memory Table

To set a 5 mA output current at analog output terminal 2, when a selection of 0- 20mA is made, the Modbus Master must set a value of 16,384 in the memory location 40002.

Refer to Appendix F for analog data scaling.

### 6.1.3.2.5 Modbus Frequency / Counters Inputs

In Modbus mode, a Zlinx Xtreme I/O supports the two Digital Inputs in the following modes:

- Frequency
- Counters (Accumulators)

The table below show the Modbus register mapping for Frequency and Counter Inputs:

Frequency / Counter Data	Modbus Memory Address
DI1 - Frequency	40003
DI1 – Counter LS Register	40004
DI1 – Counter MS Register	40005
DI2 - Frequency	40006
DI2 – Counter LS Register	40007
DI2 – Counter MS Register	40008

Fig 6-12 Frequency/Counter Memory Table

### Frequency

Registers 40003 & 40006 hold the frequency values if Digital Inputs 1 and 2 are configured as Frequency Inputs. Maximum value of frequency is 20 KHz.

Flow meters typically generate a frequency based on the amount of fluid flowing through the sensor. The flow and respective frequency varies on the manufacture and sensor. The frequency measurement is located in a separate Modbus holding register and may not be written to. The frequency register is formatted in cycles/sec and requires the user to convert the frequency to respective flow units

### Counters

The most and least significant counter registers if Digital Inputs 1 and 2 are configured as Counter inputs are shown in Fig 6-12. Both the most and least significant counter registers have a range of 0 to 9999 and rollover.

Time to save totals register counts down the number of seconds (from 300-0 seconds) until the Accumulators are saved internally.

An example is a typical electric water meter that will generate a pulse per 1/10 gallon of water flowing through it. This type of application is best used with the Modbus accumulators. The accumulators are broken down into two registers, most significant count and least significant count. Both accumulators have a full count of 9999. When the least significant count exceeds 9999, it will increment the most significant count giving a total system count of 99,999,999.

The accumulators reside in the holding register map and maybe written to in order to reflect what a typical water meter may have displayed on its display. There is also a holding register associated with the accumulators that indicates the number of seconds before the accumulators are saved. The accumulator data is saved every ~5min.

**NOTE:** "Appendix D: Modbus I/O Assignments" of this manual contains a list of Modbus I/O assignments for the Zlinx Xtreme I/O.

### 6.1.3.3 Modbus I/O Addressing

The following examples show how the Modbus addressing works especially when viewed from a Modbus Master:

In general, Modbus protocol allows two types of I/O addressing: implied and extended. However, Zlinx Xtreme I/Os support implied I/O addressing only and uses HEX format. The addressing format ignores the I/O type digit (0 for DO, 1-for DI, 3 for AI and 4 for AO) and address number is the same irrespective of the I/O type.

DO	DI	AI	AO	Modbus Memory Address
00001	10001	30001	40001	Ox0001
00002	10002	30002	40002	Ox0002
00003	10003	30003	40003	Ox0003
00004	10004	30004	40004	Ox0004
00005	10005	30005	40005	Ox0005
00006	10006	30006	40006	Ox0006
00007	10007	30007	40007	Ox0007
00008	10008	30008	40008	Ox0008
00009	10009	30009	40009	Ox0009
00010	10010	30010	40010	Ox000A
00011	10011	30011	40011	Ox000B
00012	10012	30012	40012	Ox000C
00013	10013	30013	40013	Ox000D
00014	10014	30014	40014	Ox000E
00015	10015	30015	40015	Ox000F
00016	10016	30016	40016	Ox0010

Fig 6-13 I/O Addressing Table

The function code will specify the holding register operation

For example:

- Function code 2 associated with register Ox000B means read from digital input register 10011
- Function code 6 associated with register Ox000B means write to analog output register 40011

## 6.1.4 Peer-to-Peer Mode Settings

Peer-to-Peer mode is ideal for wire replacement applications involving analog and/or digital I/Os. A typical application is to control/monitor remote devices from a PLC or SCADA system where laying cables is too expensive or cannot be done for any reason.

In Peer-to-Peer mode, digital and analog signals can be wirelessly transmitted in both directions between two Zlinx I/O modules. The Zlinx I/O modules shall be indoor or outdoor (Zlinx Xtreme) type. For successful communication both Xtreme Modules must be of the same frequency type and have similar I/O count, i.e. analog and digital inputs of one module shall equal the analog and digital outputs of the other module and vice versa. One module is configured as Peer-to-Peer Master and other is configured as Peer-to-Peer Slave. It does not matter which one is configured as Master. Additionally, Peer-to-Peer Master address MUST match the Peer- to-Peer Slave address (1-255).

### 6.1.4.1 Peer-to-Peer Master

To configure the Zlinx Xtreme I/O Xtreme Module for Peer-to-Peer Master Mode:

1. Select the **Configuration** tab.
2. Select the **Peer-to-Peer Master** option button.
3. Set the Peer-to-Peer Master address from 1 to 255. Please note the Peer-to-Peer Slave address must also match.
4. The **Polling Rate** box contains the number of seconds between polls by the Master. The default value of 1 second is usually satisfactory. The range of values is 0 seconds to 20 seconds. If the I/O points are not updating properly, try increasing the value.

**NOTE:** "0" causes the firmware to transfer data as fast as possible with no delays..

- The **Retry Count** box contains the number of attempts that will be made to communicate with the Slave device before the module indicates communication has been lost. Lost communication is indicated by the Power LED's blinking. The default value of 10 is usually satisfactory. The range of values is 10 to 255.

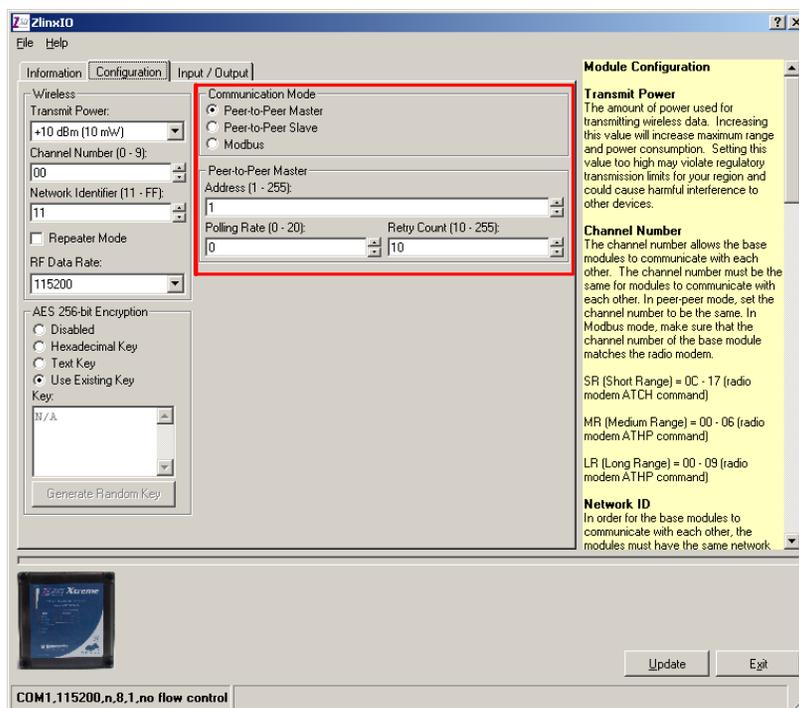


Fig 6-14 Peer-to-Peer Master Configuration

### 6.1.4.2 Peer-to-Peer Slave

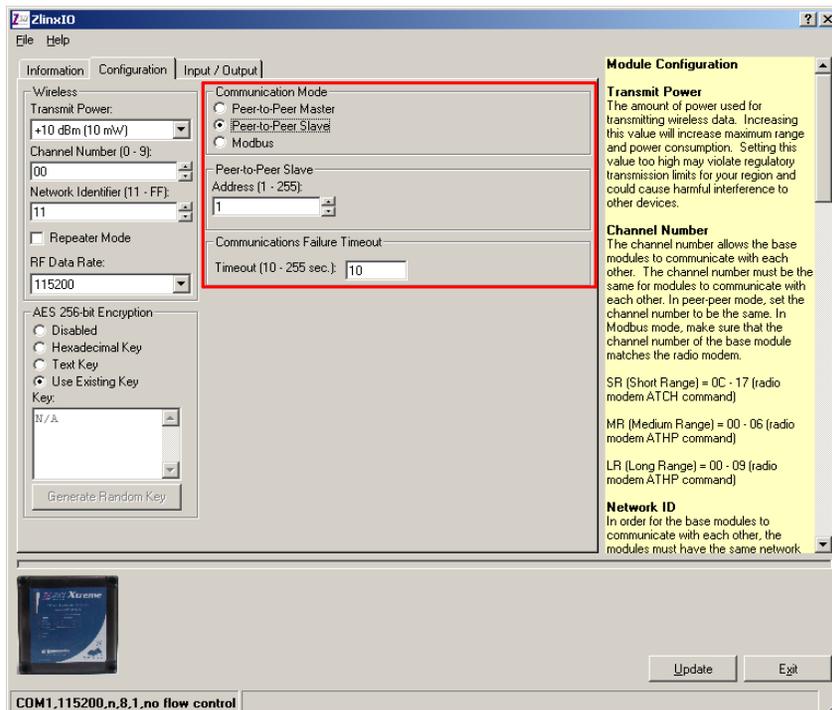


Fig 6-15 Peer-to-Peer Slave Configuration

To configure the Zlinx Xtreme I/O Xtreme Module for Peer-to-Peer Slave Mode:

1. Select the Configuration tab.
2. Select the Peer-to-Peer Slave option button.
3. Set the Peer-to-Peer Slave address from 1 to 255. Please note the Peer-to-Peer Master address must also match.
4. Communication Failure Timeout. If within the predefined timeframe no data is coming from Peer-to-Peer Master, Slave interprets it as a communication failure.

### 6.1.5 Input/Output Settings

Digital Inputs/Outputs and Analog Inputs/Outputs on Zlinx Xtreme I/O modules are configured from the Input/Output tab of the Zlinx Manager. The first two Digital Inputs on any module can be configured as Discrete inputs or Counter inputs. Any additional Digital Inputs operate as Discrete inputs only. Counter operation is only functional when the Zlinx Xtreme I/O is set up in Modbus mode. Analog Inputs and outputs can be configured for voltage or current loop operation.

To configure Digital and Analog I/O, select the Input/Output tab.

An input tree appears listing all Modules in the system and the inputs/outputs available on them.

#### 6.1.5.1 Digital Input Configuration

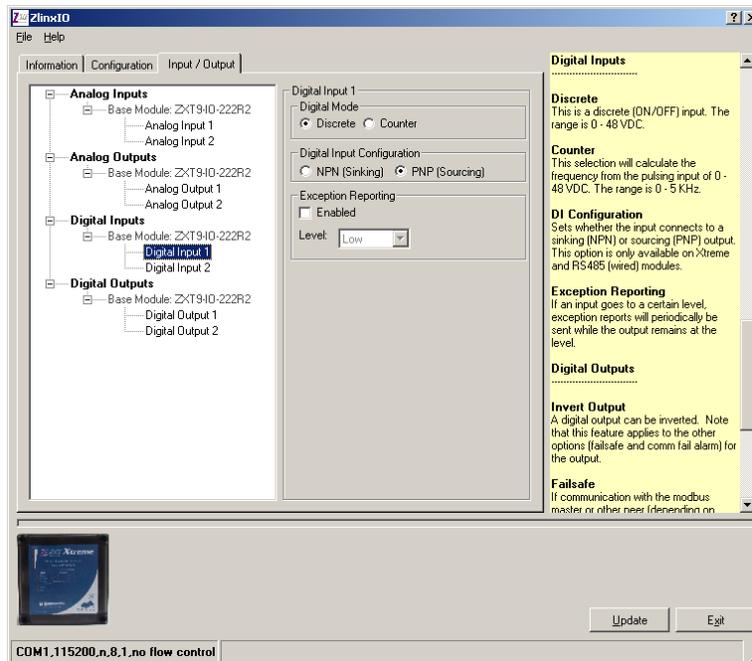


Fig 6-16 Digital Input Configuration

1. Select the Digital Input to be configured.
2. Select Discrete or Counter .

**NOTE:** See section - "Function code 2 associated with register Ox000B means read from digital input register 10011

Function code 6 associated with register Ox000B means write to analog output register 40011".

3. Select Digital Input type, PNP (Sourcing) or NPN (Sinking) based on the input connection
4. For Exception Reporting, refer to Section 6.1.6.

### 6.1.5.2 Digital (Relay) Output Configuration

1. Select the Digital (Relay) Output to be configured.
2. Select communication 'Fail Safe' condition if necessary.
3. Digital (Relay) Output 1 can be selected to indicate communication failure by selecting the check box. The high or low level selection is user configurable for the communication failure condition.

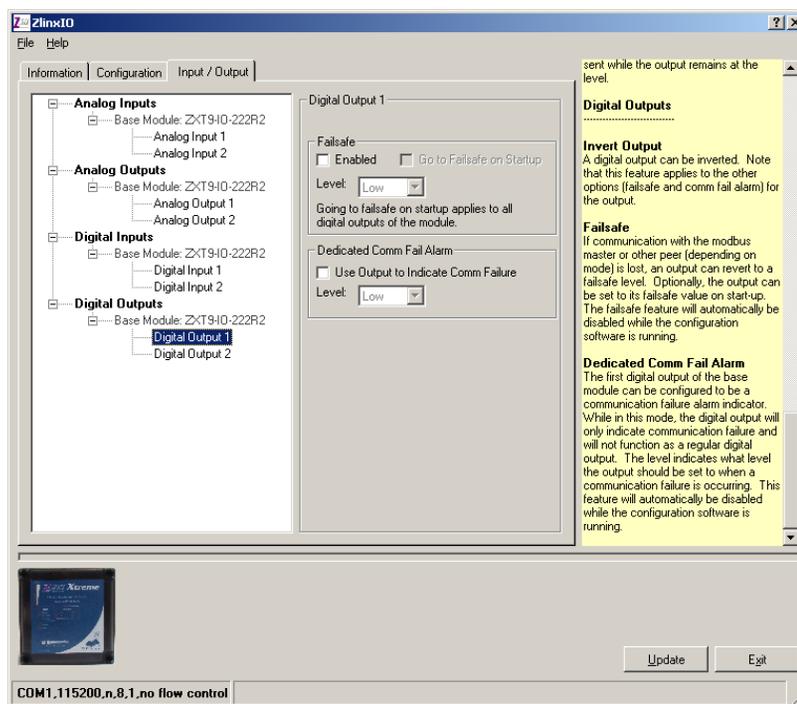


Fig 6-17 Digital (Relay) Output Configuration

### 6.1.5.3 Analog Input Configuration

1. Select the Analog Input to be configured
2. Select the required Analog Mode (0-5 Vdc; 0-10 Vdc; 0-20 mA; 4-20 mA)
3. For calibration, refer to section 6.1.7.
4. For exception reporting, refer to sections 6.1.6.

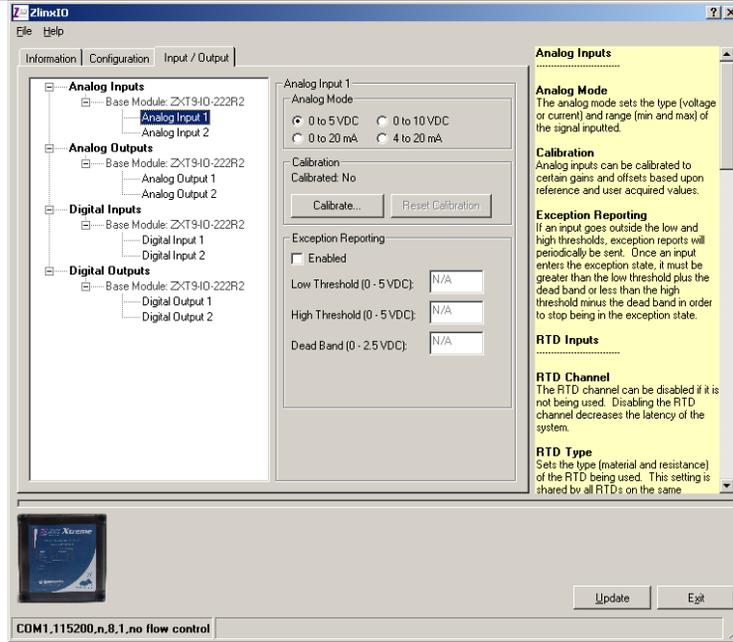


Fig 6-18 Analog Input Configuration

#### 6.1.5.4 Analog Output Configuration

1. Select the Analog Output to be configured.
2. Select the required Analog Mode (0 to 10 or 0 to 5 VDC, or 0 to 20 or 4 to 20 mA).
3. Set the value of the analog output on a communications fail safe condition
4. For Calibration of the analog output, refer to the section 6.1.7.

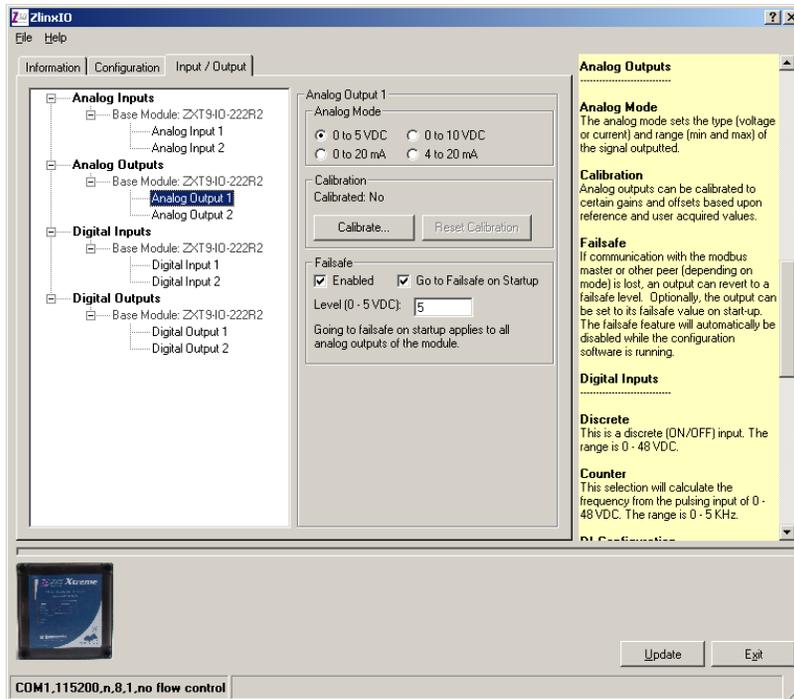


Fig 6-19 Analog Output Configuration

## 6.1.6 Exception Reporting

This feature provides the ability of reporting possible problems on input devices (AIs and DIs). It is applicable to Modbus mode only.

For Analog Inputs exception reports will be periodically sent if an input goes outside the low and high thresholds. Once an input enters the exception state, it must become greater than the low threshold plus the dead band value or less than the high threshold minus the dead band value in order to come out of the exception state.

In general, the Modbus protocol does not support exception reporting. In a typical Modbus system the Modbus Master sends a request to a respective Slave device and the slave device will respond with an ACK. Typical Slave data does not contain I/O addressing data. Any data sent from the Slave to the Master, without the Master first requesting it, will be ignored by the Master. Therefore, the end user is required to use a custom driver to capture the exception data.

Analog Exception errors are generated when user-defined High or Low limits are exceeded. If an Analog Input value rises above the High limit, an exception is generated and immediately sent out. Data is updated and retransmitted based on the Exception Retransmit timer. Exception is transmitted in the timeframe predefined by the user within the allowable range. If the Exception reporting timeout is set to zero, the exception is sent only once to the Modbus Master.

- ❑ Analog Value > HIGH LIMIT = Exception Error.

The High exception error is cleared when the Analog Input value falls below the high limit – the dead band value.

- ❑ Analog Value < (HIGH LIMIT – DEAD BAND) = Exception Error Cleared.

If an Analog Input value falls below the LOW limit, an exception is generated and immediately sent out. Data is updated and retransmitted based on the Exception Retransmit timer.

- ❑ Analog Value < LOW = Exception Error.

The Low exception error is cleared when the Analog Input value rises above the low limit + the dead band value.

- ❑ Analog Value > (Low + DEAD BAND) = Exception Error Cleared.

### 6.1.6.1 Sample Modbus Exception Packet

Exception Modbus packets do not follow the typical Modbus protocol. The Xtreme Module is a Slave device and in a typical system, slave devices do not generate outgoing requests. When the Xtreme Module generates an exception, the Xtreme Module will generate a Modbus packet that emulates a "Master Poll". The exception packet is sent to the Master and does not require an ACK.

### 6.1.6.2 Digital Exception Format

#### Xtreme Module DI exception

01 02 00 01 0E 98 2C

01	Slave Address
02	Function (Read DI's)
00	I/O Address High (0-15 = Base)
01	Byte Count
0E	Digital Inputs (8-DI's) 1110
98	Checksum High
2C	Checksum Low

### 6.1.6.3 Analog Exception Format

#### Xtreme Module AI exception

01 04 00 08 00 00 00 00 00 00 98 2C

01	Slave Address
04	Function (Read AI's)
00	I/O Address High (0-15 = Base, 16-31=EXP module 1)
08	Byte Count 08
00	Analog Input-1 High Byte
00	Analog Input-1 Low Byte

00	Analog Input-2 High Byte
00	Analog Input-2 Low Byte
00	Analog Input-3 High Byte
00	Analog Input-3 Low Byte
00	Analog Input-4 High Byte
00	Analog Input-4 Low Byte
98	Checksum High
2C	Checksum Low

To set the option of Exception Reporting, go to the Digital Input Configuration Screen or Analog Input Configuration Screen as appropriate.

### 6.1.7 Calibration

It is possible to Calibrate Analog Inputs or Outputs from the Zlinx Manager.

There are two methods of Calibration:

- Single Point

Only one data point is used. The gain is 1 and the offset is the difference between the reference and acquired values.

- Two Point

The two data points are used to create a line. The gain is the slope of the line and the offset is the intercept.

**NOTE:** Power cycle does not reset Calibration settings.

To set Calibration for Analog Inputs:

1. Connect an analog source to the Analog Input and set it to a known value . (ex. 5V)
2. Enter this value in the Reference text box.
3. Click the Read Current Value button.
4. The Acquired text box will be filled in with the acquired value

If using the Two Point method, repeat these steps for the second calibration point.

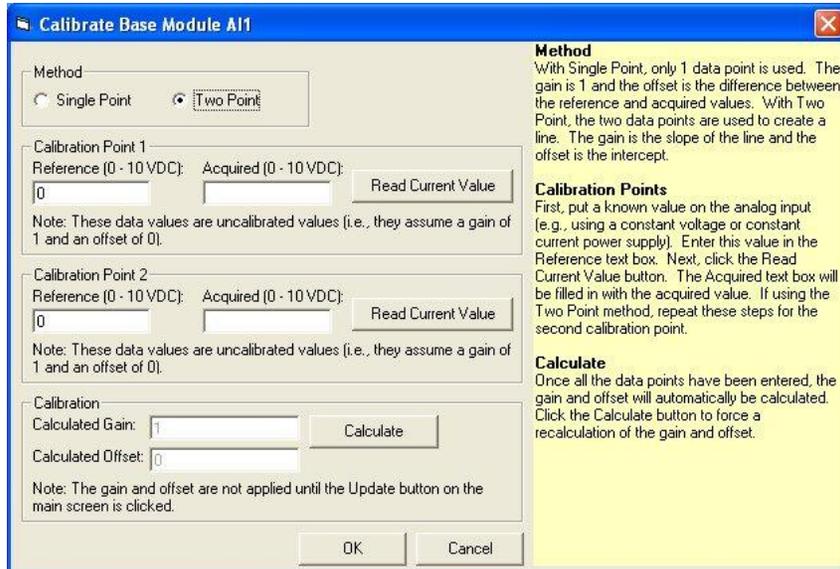


Fig 6-20 Analog Input Calibration

To set Calibration for Analog Outputs:

1. Enter a value in the Reference text box.
2. Click the Set Current value button.
3. Supply power to the device.
4. Measure the output value and enter the measured value in the Acquired text box.
5. Values will be filled in automatically in the calibration field.

If using the Two Point method, repeat these steps for the second calibration point.

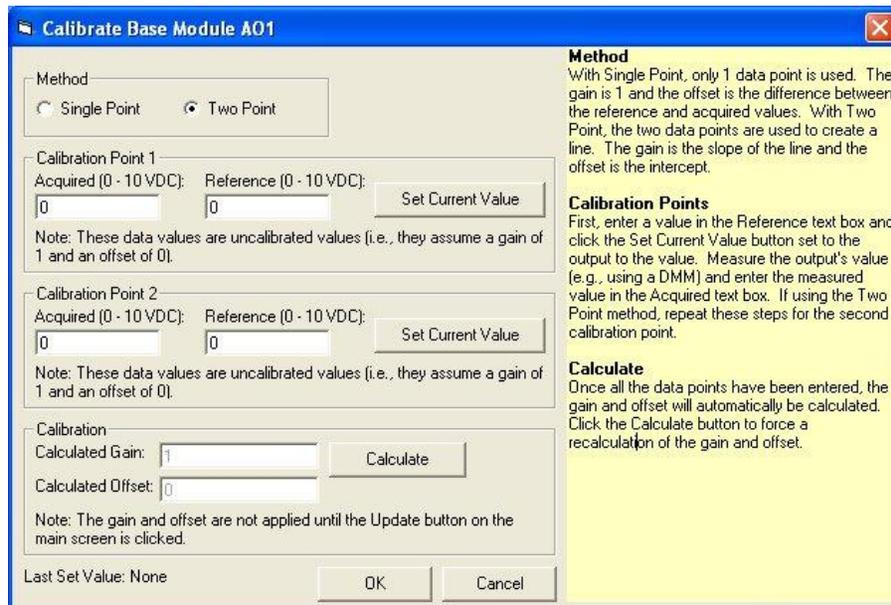


Fig 6-21 Analog Output Calibration

### 6.1.8 Zlinx I/O Monitor

From Zlinx Manager the user can choose the option Zlinx I/O Monitor. This option allows the monitoring of all Analog and Digital I/O values (in V, mA, on/off; degrees Celsius for RTD) real time.

To start the Monitor feature:

1. Start Zlinx Manager.
2. Choose Zlinx I/O Monitor from the list.
3. Zlinx I/O Monitor window will open.
4. Choose the COM port the system is connected to.
5. Click on the **Start Monitoring** button.

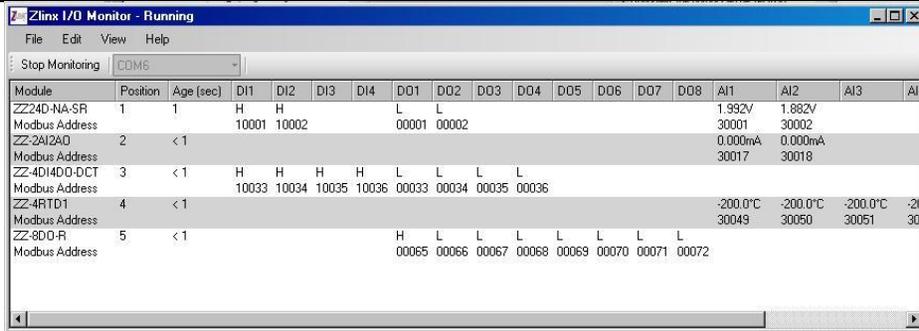


Fig 6-22 Zlinx Xtreme I/O Monitor

**NOTE:** Monitor doesn't show the inverted values for the DO's if such option is enabled.

### 6.1.9 Saving the Configuration

When all configuration settings are complete, click the **Update** button to save them in the Zlinx Xtreme I/O Module.

1. After pressing the **Update** button the Configuration Manager switches to the Information tab.
2. The Progress bar at the bottom of the windows shows the progress of the update.
3. The Status bar displays the following text:
4. Sending radio parameters to the Xtreme Module.

When the updating process is complete, it is possible to switch to any other tab to see or edit any parameters.

**NOTE:** When configuration is complete and saved, power can be removed from the Xtreme Module and it should be disconnected from the PC.

## 6.2 Updating Zlinx I/O Firmware

B&B Electronics continually add new features to the Zlinx Xtreme I/O modules and the updated firmware would be available for download at [www.bb-elec.com](http://www.bb-elec.com). Whenever the latest version of Zlinx Manager software is installed on your computer, the latest version of Zlinx Xtreme I/O Firmware Updater software is also installed. This can be used to update the firmware in your Zlinx Xtreme I/O modules. The following procedure describes the firmware updating process:

1. Disconnect power from the Xtreme Module.
2. Disconnect Xtreme Module from external equipment. The easiest way to disconnect is to unplug all I/O terminal blocks.
3. Connect the PC USB port to the Zlinx Xtreme I/O USB port using a USB cable.
4. From the Windows **Start** menu, start the Zlinx Manager and choose Zlinx I/O Firmware Updater software.

The Zlinx I/O Firmware Updater Caution dialog box appears.

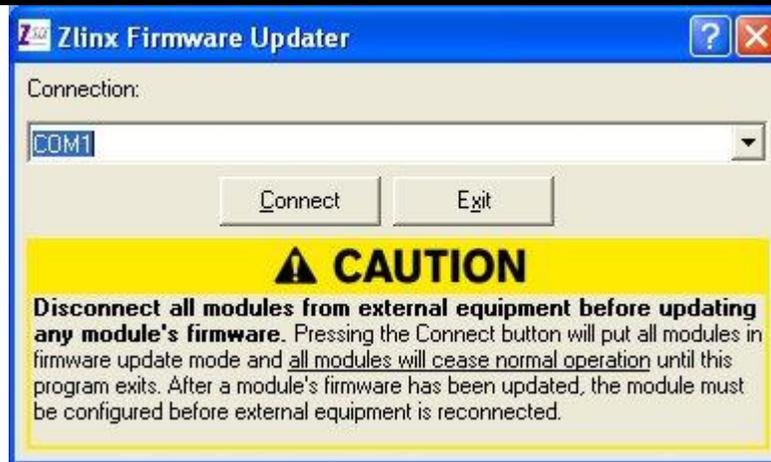


Fig 6-23 Firmware Updater Caution Dialog Box

5. Select the USB COM port from the Connection drop down list.
6. Click **Connect**.
7. Re-apply power to the Zlinx Xtreme I/O Module. The Power LED should go on and stay on.
8. The Zlinx Xtreme I/O Firmware Updater window opens and displays a list of the Xtreme Modules.
9. On the module list, select the Xtreme Module to be updated.
10. In the Firmware Image drop down box, select the image file (.hex).
11. Click the **Program** button to load the firmware into the module.
12. Repeat steps 9 to 11 for the other modules in the system.
13. When all updates are complete, click **Exit**.
14. Before reconnecting the I/O run the Zlinx Manager software and check to ensure all modules are configured properly.
15. When the configuration check is complete:
  - a. Exit the Zlinx Manager program.
  - b. Disconnect power from the Xtreme Module.
  - c. Disconnect the Xtreme Module from the PC
  - d. Reconnect the I/O.
  - e. Re-connect power to the Xtreme Module.

**NOTE:** It is necessary to perform Power Cycle on all modules after Firmware Update.

## 6.3 Diagnostics and Testing

Most problems are related to incorrect configuration, or radio path problems. Before performing final installation of the Zlinx Xtreme I/O modules, bench test the functionality first. If it does not work properly in this test, it will not work properly installed. If problems are found, check wiring and software configurations.

If the bench-test is successful, and problems are experienced after installation, check the radio path.

### 6.3.1 Testing Modbus Mode Operation

Using a Modbus radio modem, a PC and Modbus simulation software (e.g. Modscan) you can test the link and hardware, and investigate the operation of the Zlinx Xtreme I/O. Modscan is a Windows application that simulates a Modbus Master node. You can read from and write to memory locations on the Zlinx Xtreme I/O. Modscan is available as a fully functional time-limited demo from [www.win-tech.com](http://www.win-tech.com)

### 6.3.2 Testing Peer-to-Peer Mode Operation

To diagnose possible problems in Peer-to-Peer mode perform the following checks:

1. Configure one of the two Peer-to-Peer base devices as a MASTER and the other as a SLAVE.
2. Select a "Polling" rate on the Master device. Typically a setting of "0" or "1" seconds works best.

**NOTE:** "0" causes the firmware to transfer data as fast as possible.

3. Configure a Slave "Communications Failure Timeout". Recommended setting is "20" seconds.
4. Ensure the same Peer-to-Peer Address for both units.
5. Ensure same Wireless setting for: "Channel", "Network Identifier" and "AES Encryption" for both units.

Test communications between the units by performing the following tests.

1. Confirm the **RF Data** LED's on the Master and Slave devices are flashing, indicating communications between the Master and Slave devices.
2. If the **RF Data** and **Bus** LED's are flashing in a "Rail-Road" manner, the system is NOT communicating.
3. On the Master system connect an LED to DO-1 of the Xtreme Module. The LED should immediately come ON.
4. On the Slave system connect a wire from VIN+ to DI-1 of the Xtreme Module (for NPN Configuration connect VIN- to DI-1). The LED of the Master device should shut OFF.

# 7.

# Troubleshooting

This section is designed to help you answer some of the more common questions asked regarding installation and configuration of Zlinx Xtreme I/O.

Problem	Causes and Resolutions
Power LED is not on	<input type="checkbox"/> Insure that power connections to the Xtreme Module are properly connected and correct power voltage and current is applied.
Power LED is blinking	<input type="checkbox"/> No wireless connection established
RSSI – No Signal (No LEDs ON) Or Weak Signal (3 or less LEDs ON)  and  Wireless LED intermittently blink:	<input type="checkbox"/> Firmware does not match The firmware for all Xtreme Modules must match. The firmware revision number may be viewed on the information tab of the configuration software. See section 6.2 “Updating Zlinx I/O Firmware”. If the firmware does not match, then update the firmware with the Zlinx I/O Firmware Updater software.  <input type="checkbox"/> No Peer-to-Peer communication link The communication link is not established. Verify that all parameters in the configuration tab in the programming software are correct.  Make sure that there are no obstacles in the path of the wireless transmission.

Figure 7-1 Problem-Cause-Resolution Table

## 7.1 Testing Digital and Analog I/O

There are simple tests that can be performed to confirm the functionality of the hardware and wiring configurations. The following diagrams can be used to aid in diagnosing problems with device connections.

To properly connect a Digital Output to the Digital Input of your data acquisition equipment, you need to know whether the output is “sinking” or “sourcing”. A “sinking” output acts simply as a switch to ground and may be referred to as a dry contact. A “sinking” output requires an additional power source for connected devices or an internal pull up resistor. A “sourcing” output supplies the voltage itself and requires a pull down resistor between the digital input or output and ground to provide the low voltage condition when the output is turned off.

To test devices you need to create a working system. For the purpose of the test create a system in Peer-to-Peer mode. Create two systems: System-1 consisting of a Xtreme Module, System-2 consisting of a Xtreme Module. Both Xtreme Modules must be the same model. Analog and Digital Input signals connected to AI’s and DI’s on one system appear on the corresponding AO’s and DO’s on the other system and vice versa.

### 7.1.1 Testing DI

On System-1 connect one side of the switch to the DI on the Zlinx Xtreme I/O device and the other side of the switch to high or ground depending on PNP or NPN configuration (see Figure 7-2). The LED corresponding to the DI should be ON

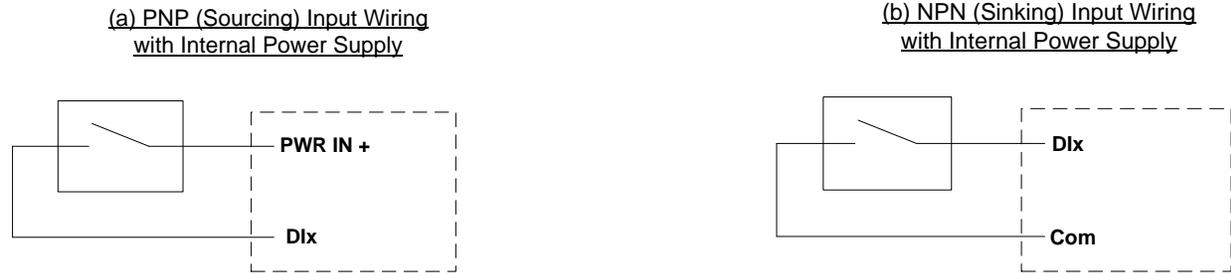


Figure 7-2 Digital Input (Sourcing driver) wiring

### 7.1.2 Testing DO (Relay O/P)

To test a “relay” output the following can be performed. See “Appendix E: Zlinx Xtreme I/O Models and Features” to find out which modules are relay. On System-1 on the corresponding Zlinx Xtreme I/O device connect a Light through COM and NO contact of the relay output (see **Error! Reference source not found.3**). Make sure to check the polarity of the LED while connecting it. On System-2 perform contact closure on the corresponding DI. The relay output should turn ON and the Light should turn ON

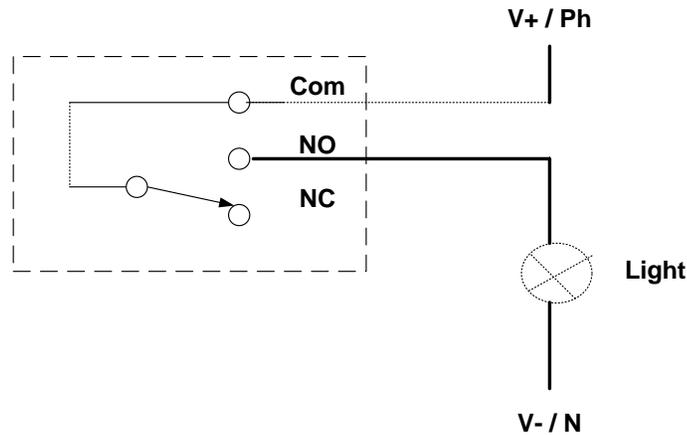


Figure 7-3 Relay Output Testing

### 7.1.3 Testing AI in “Voltage” Mode

Connect an AA battery (1.5 VDC) on the AI-1 on System-1 (see Fig 7-4) and a voltmeter on the corresponding AO-1 on System-2. Make sure the polarity is correct while connecting the battery. Measure the voltage on the Analog Output on System-2. It has to indicate 1.5 VDC.

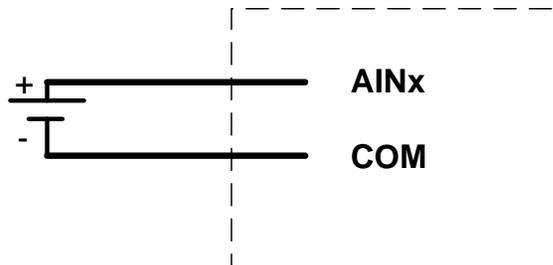


Figure 7-4 Analog Input wiring

### 7.1.4 Testing AO in “Voltage” Mode

To test an Analog Output in “voltage” mode the following can be performed. Refer to “Appendix E: Zlinx Xtreme I/O Models and Features” for the list of Analog Output modules. On the corresponding Zlinx Xtreme I/O device on System-1 connect an AO to a voltmeter as shown in the figure below (Fig 7-5). Supply a voltage signal on the AI side of System-2. Confirm on System-1 with a voltmeter that the voltage on the corresponding output matches the voltage input.

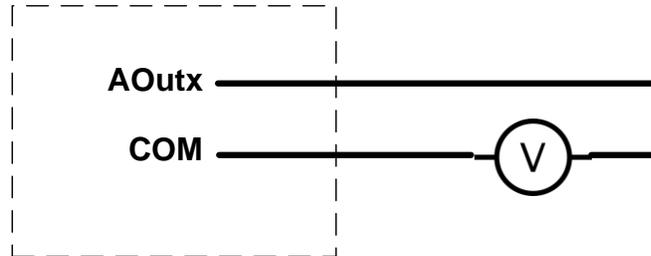


Figure 7-5 Analog Output (Sourcing driver) wiring

## Appendix A: Default Configuration Settings

<b>Power Setting:</b>	ZXT24-IO-222R2 Xtreme Modules, 63mW, ZXT9-IO-222R2 Xtreme Modules, 1000mW
<b>Wireless Channel Number:</b>	0x0C for ZXT24-IO-222R2 Xtreme Modules 0x00 for ZXT9-IO-222R2 Xtreme Modules
<b>Wireless Network ID:</b>	0x00 for ZXT24-IO-222R2 Xtreme Modules 0x11 for ZXT9-IO-222R2 Xtreme Modules
<b>Repeater Mode:</b>	Not selected
<b>Communication Mode:</b>	Modbus
<b>Modbus Address:</b>	1
<b>Digital Inputs:</b>	Discrete & PNP
<b>Analog Inputs:</b>	4 to 20 mA
<b>Analog Outputs:</b>	4 to 20 mA

## Appendix B: Product Specifications

<b>Xtreme I/O Module Models:</b>	ZXT24-IO-222R2 ZXT9-IO-222R2										
<b>Manual:</b>	Electronic version of this manual, PDF available										
<b>CD-ROM disc:</b>	Zlinx Manager PDF of Zlinx Xtreme I/O User Manual PDF of Quick Start guide										
<b>Operating Systems supported:</b>	Windows 2000/XP/Vista/7 (32 & 64 bit)										
<b>Dimensions:</b>	3.23 x 3.15 x 3.35 in (82L x 80W x 85H mm)										
<b>Radio Properties</b>											
<b>ZXT24-IO-222R2 (SR) Option:</b>	Up to 300 ft indoors / 1 mile outdoors (Line Of Sight)										
<b>ZXT9-IO-222R2 (LR) Option:</b>	Up to 3000 ft indoors / 14 miles outdoors (Line Of Sight)										
<b>Antennas:</b>	For 2.4 GHz models: 4.25 inch Omni-directional rubber duck antenna. PN: ZZ24D-ANT1 For 900 MHz models: 7.7 inch Omni-directional rubber duck antenna. PN: ZXT9-ANT1										
<b>Receiver Sensitivity</b>											
ZXT24-IO-222R2; ZXT24-RM	-102 dBm										
ZXT9-IO-222R2 ZXT9-RM	-100dbm @ 115.2K -110dbm @ 9600										
<b>LED Indicators</b>											
<b>Receive Signal Strength Indicator:</b>	The RSSI indicator is 8 Green LEDs in a bar graph format from Weak to Strong										
	<table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>LEDs Number turned ON</th> <th>Signal Strength</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>No signal</td> </tr> <tr> <td>1-3</td> <td>Weak</td> </tr> <tr> <td>4-6</td> <td>OK</td> </tr> <tr> <td>7-8</td> <td>Strong</td> </tr> </tbody> </table>	LEDs Number turned ON	Signal Strength	0	No signal	1-3	Weak	4-6	OK	7-8	Strong
LEDs Number turned ON	Signal Strength										
0	No signal										
1-3	Weak										
4-6	OK										
7-8	Strong										
<b>RF Data Indicator:</b>	Green LED (blinks with TD or RD data traffic, Off = no data traffic)										
<b>Power Indicator:</b>	Green LED, Blinks with Communication Failure										
<b>I/O Connectors:</b>	Screw terminal										
<b>Digital Inputs</b>											
<b>Voltage Range:</b>	0 to 48 VDC										
<b>Low Voltage (0):</b>	1.0 VDC maximum										
<b>High Voltage (1):</b>	Greater than 1.0 VDC										
<b>Pull up/down current:</b>	38uA										

<b>Frequency Input:</b> Two DI inputs per module software selectable as Counters, 0 to 20 kHz range (do NOT exceed more than 20 kHz)
--

<b>Analog Inputs/Outputs</b>	
<b>Ranges:</b>	0-5VDC; 0 to 10 VDC; 0 to 20mA; 4-20mA
<b>Resolution:</b>	16 bit (analog inputs); 12 bit (analog outputs)
<b>Input Accuracy:</b>	0.2 % full scale reading typical, 0.5 % max
<b>Output Accuracy:</b>	0.27 % full scale reading typical, 0.63 % max
<b>AI Load Resistance:</b>	100 Mega ohms when configured for voltage input 250 ohms when configured for current input
<b>AO Max Output Current:</b>	1mA when configured for voltage output
<b>AO Max Source Load:</b>	450 ohms when configured for current output
<b>Input Protection:</b>	Over-voltage to 2x max input voltage
<b>Power Supply Voltage Requirements:</b>	10 – 30 VDC
<b>Power Supply:</b>	Not included
<b>Xtreme Module Power Connector:</b>	Fixed screw terminal connector
<b>Digital Outputs (Relay)</b>	
<b>Number of Relays:</b>	2
<b>Type:</b>	C (normally open and normally closed)
<b>Output Connection:</b>	3 terminals per relay (Common, NO, NC)
<b>Common Connection:</b>	3.5mm removable terminal block (1 per bank of 4 output)
<b>Ratings:</b>	250 VAC @ 4A, 30 VDC @ 4A
<b>Power Consumption:</b>	ZXT24-IO-222R2 (SR) = 4.5W Max ZXT9-IO-222R2 (LR) = 6.8W
<b>Operating Temperature:</b>	-40 to 74°C (-40 to 165 ° F)
<b>Storage Temperature:</b>	-40 to 85 °C (-40 to 185 °F)
<b>Humidity:</b>	0 to 90% R.H. non-condensing
<b>Enclosure Rating:</b>	IP67
<b>Mounting:</b>	Wall mount
<b>Certifications:</b>	FCC: Part 15 Class A CISPR (EN55022) Class A EN61000-6-2 Generic Standards for Industrial Environments EN61000-4-2 ESD EN61000-4-3 RFI EN61000-4-4 EFT EN61000-4-5 Surge EN61000-4-6 CI
<b>Accessories and Replacement Parts:</b>	ZZ24D-ANT1 2.4 GHz band antenna. ZXT9-ANT1 900 MHz band antenna. 195M-SLSW-24 Antenna cable.

## Appendix C: Expected Latency

Before you lift a finger towards the perfect wireless installation, think about the impact of wireless communications on your application. Acceptable bit error rates are many orders of magnitude higher than wired communications. Most radios quietly handle error detection and retries for you - at the expense of throughput and variable latencies.

Software must be well designed and communication protocols must be tolerant of variable latencies. Not every protocol can tolerate simply replacing wires with radios. Protocols sensitive to inter-byte delays may require special attention or specific protocol support from the radio. Do your homework up front to confirm that your software won't choke, that the intended radio is friendly towards your protocol, and that your application software can handle it as well.

Assumptions:

- No RF retries.
- Units were less than 3 feet apart during the testing in a clean RF environment.

### Modbus Mode

Reading Inputs		Setting Outputs	
ZXT24-IO-222R2	ZXT9-IO-222R2	ZXT24-IO-222R2	ZXT9-IO-222R2
126 mS	164 mS	68 mS	69 mS

### Peer-to-Peer Mode

Latency in Peer-to-Peer Mode		
Xtreme Modules	Digital	Analog
ZXT24-IO-222R2	80 mS	126 mS
ZXT9-IO-222R2	115 mS	126 mS

## Appendix D: Modbus I/O Assignments

### 00001-00112 Discrete Digital Outputs

Modbus function codes supported are:

- Function 1: Read DO Status
- Function 2: Read DI's
- Function 3: Read AO Status
- Function 4: Read AI's
- Function 5: Write to Single DO (firmware v2.0 or higher)
- Function 6: Write to Single AO
- Function 15: Write to Multi DO's

### 00001-00002 Discrete Digital Outputs /Relays

Modbus Address	Description	#Bytes	Count	V Range
00001	Digital Output-1	-	0-1	Refer to Appendix B
00002	Digital Output-2	-	0-1	Refer to Appendix B

### 10001-10002 Discrete Digital Inputs

Modbus Address	Description	#Bytes	Count	V Range
10001	Digital Input-1	-	0-1	Refer to Appendix B
10002	Digital Input-2	-	0-1	Refer to Appendix B

### 30001-30004 Analog Inputs/ Special Registers

Modbus Address	Description	#Bytes	A/D Count	(V)/(I)Range
30001	Analog Input-1	2	0-65535	0-10vdc/0-20ma
30002	Analog Input-2	2	0-65535	0-10vdc/0-20ma
30003	Input Power Supply (0-30 Vdc)	2	0-65535	0-10vdc/0-20ma
30004	Reserved	2	0-65535	0-10vdc/0-20ma

### 40001-40008 Analog Output /Counter Registers

Modbus Address	Description	#Bytes	D/A Count	(V)/(I)Range
40001	Analog Output-1	2	0-4095	0-10vdc/0-20ma
40002	Analog Output-2	2	0-4095	0-10vdc/0-20ma
40003	DI1 – Frequency Input	2	0-4095	0-10vdc/0-20ma
40004	DI1 – Counter Low	2	0-4095	0-10vdc/0-20ma
40005	DI1 – Counter High	2	0-4095	0-10vdc/0-20ma
40006	DI2 – Frequency Input	2	0-4095	0-10vdc/0-20ma
40007	DI2 – Counter Low	2	0-4095	0-10vdc/0-20ma
40008	DI2 – Counter High	2	0-4095	0-10vdc/0-20ma

## Appendix E: Zlinx Xtreme I/O Models and Features

Xtreme Modules			
Model Number	Module Type	Frequency/Range	I/O
ZXT24-IO-222R2	Base	2.4 GHz, short range	2AI, 2AO, 2DI, 2DO (relay DO's)
ZXT9-IO-222R2	Base/Repeater	900 MHz, long range	2AI, 2AO, 2DI, 2DO (relay DO's)

Compatible Radio Modems		
Radio Modem Model	Description	Zlinx Xtreme I/O Xtreme Module Model
ZXT24-RM	2.4 GHz RS-232/422/485 radio modem 250kbps	ZXT24-IO-222R2
ZXT9-RM	900 MHz RS-232/422/485 radio modem 115.2 kbps	ZXT9-IO-222R2
Accessories		
Model Number	Description	
ZZ9D-ANT2	900 MHz band antenna	
ZZ24D-ANT1	2.4 GHz band antenna	
CLG-60-24	IP67 Power Supply, 24V, 60W	

## Appendix F: Convert Voltage/Current to DAC

In Zlinx Xtreme I/O modules, analog inputs are 16 bit and analog outputs are 12 bit. The Modbus register scaling for the analog inputs and outputs for different selections are shown below:

### 1. Analog Output (0-10 VDC Selection):

Voltage Full Range = 0-10VDC

DAC full range is 4096 counts as AO's are 12Bit (0-4095 range), 4096

Holding Register Value to Send = Voltage Desired \* 4096 / 10

(ex) For sending out 2.5V, Holding Register Value =  $2.5 * 4096 / 10 = 1024$

### 2. Analog Output (0-5 VDC Selection):

Voltage Full Range = 0-5VDC

DAC full range is 4096 counts as AO's are 12Bit (0-4095 range), 4096

Holding Register Value to Send = Voltage Desired \* 4096 / 5

(ex) For sending out 2.5V, Holding Register Value =  $2.5 * 4096 / 5 = 2048$

### 3. Analog Output (0-20 mA Selection):

Current Full Range = 0-20mA

DAC full range is 4096 counts as AO's are 12Bit (0-4095 range), 4096

Holding Register Value to Send = Current Desired \* 4096 / 20

(ex) For sending out 10 mA, Holding Register Value =  $10 * 4096 / 20 = 2048$

### 4. Analog Output (4-20 mA Selection):

Current Full Range = 4-20mA

DAC full range is 4096 counts as AO's are 12Bit (0-4095 range), 4096

Holding Register Value to Send = (Current Desired-4) \* 4096 / 16

(ex) For sending out 10 mA, Holding Register Value =  $(10-4) * 4096 / 16 = 1536$

### 5. Analog Input (0-10 VDC Selection):

Voltage Full Range = 0-10VDC

DAC full range is 65536 counts as AI's are 16 Bit (0-65,535 range), 65,536

Input Register Value = Actual Voltage \* 65536 / 10

(ex) Input register value for 2.5V =  $2.5 * 65536 / 10 = 16384$

### 6. Analog Input (0-5 VDC Selection):

Voltage Full Range = 0-5 VDC

DAC full range is 65536 counts as AI's are 16 Bit (0-65,535 range), 65,536

---

Input Register Value = Actual Voltage \* 65536 / 5

(ex) Input register value for 2.5V =  $2.5 * 65536 / 5 = 32768$

**7. Analog Input (0-20 mA Selection):**

Voltage Full Range = 0-20 mA

DAC full range is 65536 counts as AI's are 16 Bit (0-65,535 range), 65,536

Input Register Value = Actual Current \* 65536 / 20

(ex) Input register value for 10 mA =  $10 * 65536 / 20 = 32768$

**8. Analog Input (4-20 mA Selection):**

Voltage Full Range = 4-20 mA

DAC full range is 65536 counts as AI's are 16 Bit (0-65,535 range), 65,536

Input Register Value = (Actual Current – 4) \* 65536 / 16

(ex) Input register value for 10 mA =  $(10-4) * 65536 / 16 = 24576$

## Appendix G: Radio Frequency Basics

This section summarizes changes made in current product version.

### What is dBm?

Radio Frequency (RF) power is measured in milli-Watts (mW) or, more usually in a logarithmic scale of decibels (dB), or decibels referenced to 1 mW of power (dBm). Since RF power attenuates as a logarithmic function, the dBm scale is most useful. Here are some examples of how these scales relate:

1mW = 0dBm	A 2-fold increase in power yields 3dBm of signal.
2mW = 3dBm	A 10-fold increase in power yields 10dBm of signal.
4mW = 6dBm	A 100-fold increase in power yields 20dBm of signal.
10mW = 10dBm	
100mW = 20dBm	
1W = 30dBm	

Figure G-1 The dBm scale

### Lower Frequencies - Better Propagation

Industrial applications typically operate in “license free” frequency bands, also referred to as ISM (Industrial, Scientific, and Medical). The frequencies and power of these bands varies from country to country. The most common frequencies encountered are:

- ❑ 2.4 GHz band (Short Range) – nearly worldwide.
- ❑ 915 MHz band (Long Range) – North America, South America, and some other countries.

As frequency rises, available bandwidth typically rises, but distance and ability to overcome obstacles is reduced. For any given distance, a 2.4 GHz installation will have roughly 8.5 dB of additional path loss when compared to 900 MHz. However, lower frequencies require larger antennas to achieve the same gain.

### Range Performance

The more sensitive the radio is, the lower the power signal it can successfully receive, stretching right down to the noise floor. There is so much variety in specifications for radio sensitivity, that it is difficult to make a meaningful comparison between products. The most meaningful specification is expressed at a particular bit error rate and will be given for an ideal environment shielded from external noise. Unless you are in a high RF noise environment, typically resulting from numerous similar-frequency radio transmitters located nearby, the odds are good that the noise floor will be well below the receive sensitivity, so the manufacturer’s rated receive sensitivity will be a key factor in your wireless system and range estimates.

You can often improve your receive sensitivity, and therefore your range, by reducing data rates over the air. Receive sensitivity is a function of the transmission baud rate so, as baud rate goes down, the receive sensitivity goes up. Many radios give the user the ability to reduce the baud rate to maximize range.

The receive sensitivity of a radio also improves at lower frequencies, providing another significant range advantage of 900 MHz (vs. 2.4 GHz) - as much as six to twelve dB!

### RF Noise

RF background noise comes from many sources, ranging from solar activity to high frequency digital products to all forms of other radio communications. That background noise establishes a noise floor which is the point where the desired signals are lost in the background ruckus. The noise floor will vary by frequency.

Typically the noise floor will be lower than the receive sensitivity of your radio, so it will not be a factor in your system design. If, however, you're in an environment where high degrees of RF noise may exist in your frequency band, then use the noise floor figures instead of radio receive sensitivity in your calculations. If you suspect this is the case, a simple site survey to determine the noise floor value can be a high payoff investment.

When in doubt, look around. Antennas are everywhere nowadays - on the sides of buildings, water towers, billboards, chimneys, even disguised as trees. Many sources of interference may not be obvious.

## Fade Margin

Fade margin is a term critical to wireless success. Fade margin describes how many dB a received signal may be reduced by without causing system performance to fall below an acceptable value. Walking away from a newly commissioned wireless installation without understanding how much fade margin exists is the number one cause of wireless woes.

Establishing a fade margin of no less than 10dB in good weather conditions will provide a high degree of assurance that the system will continue to operate effectively in a variety of weather, solar, and RF interference conditions.

There are a number of creative ways to estimate fade margin of a system without investing in specialty gear. Pick one or more of the following and use it to ensure you've got a robust installation:

- Some radios have programmable output power. Reduce the power until performance degrades, then dial the power back up a minimum of 10dB. Remember again, doubling output power yields 3 dB, and an increase of 10dB requires a ten-fold increase in transmit power.
- Invest in a small 10dB attenuator - pick the correct one for your radio frequency! If you lose communications when you install the attenuator installed in-line with one of your antennas, you don't have enough fade margin.
- Antenna cable has greater attenuation at higher frequencies. Specifications vary by type and manufacturer so check them yourself but, at 900 MHz, a coil of RG58 in the range of 50 to 100 feet (15 to 30 m) will be 10dB. At 2.4GHz, a cable length of 20-40 feet (6 to 12 m) will yield 10dB. If your system still operates reliably with the test length of cable installed, you've got at least 10dB of fade margin.

## Remember Your Math

Contrary to popular opinion, no black art is required to make a reasonable prediction of the range of a given radio signal. Several simple concepts must be understood first, and then we can apply some simple rules of thumb.

The equation for successful radio reception is:

***TX power + TX antenna gain – Path loss – Cabling loss + RX antenna gain – 10dB fade margin > RX Radio sensitivity or (less commonly) RF noise floor***

Note that most of the equation's parameters are easily gleaned from the manufacturer's data. That leaves only path loss and, in cases of heavy RF interference, RF noise floor as the two parameters that you must establish for your particular installation.

In a perfect world, you will measure your path loss and your RF noise conditions. For the majority of us that don't, there are rules of thumb to follow to help ensure a reliable radio connection.

## RF Attenuation and Line of Sight

In a clear path through the air, radio signals attenuate with the square of distance. Doubling range requires a four-fold increase in power, therefore:

- Halving the distance decreases path loss by 6dB.
- Doubling the distance increases path loss by 6dB.

When indoors, paths tend to be more complex, so use a more aggressive rule of thumb, as follows:

- Halving the distance decreases path loss by 9dB.
- Doubling the distance increases path loss by 9dB.

Radio manufacturers advertise “line of sight” range figures. Line of sight means that, from antenna A, you can see antenna B. Being able to see the building that antenna B is in does not count as line of sight. For every obstacle in the path, de-rate the “line of sight” figure specified for each obstacle in the path. The type of obstacle, the location of the obstacle, and the number of obstacles will all play a role in path loss.

Visualize the connection between antennas, picturing lines radiating in an elliptical path between the antennas in the shape of a football. Directly in the center of the two antennas the RF path is wide with many pathways. A single obstacle here will have minimal impact on path loss. As you approach each antenna, the meaningful RF field is concentrated on the antenna itself. Obstructions located close to the antennas cause dramatic path loss.

Be sure you know the distance between antennas. This is often underestimated. If it’s a short-range application, pace it off. If it’s a long-range application, establish the actual distance with a GPS or Google Maps.

The most effective way to reduce path loss is to elevate the antennas. At approximately 6 feet high (2 m), line of sight due to the Earth’s curvature is about 3 miles (5 km), so anything taller than a well-manicured lawn becomes an obstacle.

Weather conditions also play a large role. Increased moisture in the air increases path loss. The higher the frequency, the higher the path loss.

Beware of leafy greens. While a few saplings mid-path are tolerable, it’s very difficult for RF to penetrate significant woodlands. If you’re crossing a wooded area you must elevate your antennas over the treetops.

Industrial installations often include many reflective obstacles leading to numerous paths between the antennas. The received signal is the vector sum of each of these paths. Depending on the phase of each signal, they can be added or subtracted. In multiple path environments, simply moving the antenna slightly can significantly change the signal strength.

Some obstacles are mobile. More than one wireless application has been stymied by temporary obstacles such as a stack of containers, a parked truck or material handling equipment. Remember, metal is not your friend. An antenna will not transmit out from inside a metal box or through a storage tank.

### **Path Loss Rules of Thumb**

To ensure basic fade margin in a perfect line of sight application, never exceed 50% of the manufacturer’s rated line of sight distance. This in itself yields a theoretical 6dB fade margin – still short of the required 10dB.

De-rate more aggressively if you have obstacles between the two antennas, but not near the antennas.

De-rate to 10% of the manufacture’s line of sight ratings if you have multiple obstacles, obstacles located near the antennas, or the antennas are located indoors.

### **Antennas**

Antennas increase the effective power by focusing the radiated energy in the desired direction. Using the correct antenna not only focuses power into the desired area but it also reduces the amount of power broadcast into areas where it is *not* needed.

Wireless applications have exploded in popularity with everyone seeking out the highest convenient point to mount their antenna. It’s not uncommon to arrive at a job site to find other antennas sprouting from your installation point. Assuming these systems are spread spectrum and potentially in other ISM or licensed frequency bands, you still want to maximize the distance from the antennas as much as possible. Most antennas broadcast in a horizontal pattern, so vertical separation is more meaningful than horizontal separation. Try to separate antennas with like-polarization by a minimum of two wavelengths, which is about 26 inches (0.66 m) at 900 MHz, or 10 inches (0.25 m) at 2.4 GHz.

### **Cable Loss**

Those high frequencies you are piping to your antennas don’t propagate particularly well through cable and connectors. Use high quality RF cable between the antenna connector and your antenna and ensure that all connectors are high quality and carefully installed. Factor in a 0.2 dB loss per coaxial connector in addition to the cable attenuation itself. Typical attenuation figures per 10 feet (3 meters) for two popular cable types are listed below.

Frequency	Cable Types	
	RG-58U*	LMR-400*
900 MHz	1.6 dB	0.4 dB
2.4 GHz	2.8 dB	0.7 dB

\*Loss per 10 feet (3 meters) of cable length

Figure G-2 Attenuation figures

While long cable runs to an antenna create signal loss, the benefit of elevating the antenna another 25 feet (7.6 m) can more than compensate for those lost dB.

## Appendix H: Transmit Power - dBm to mW Conversion

dBm	Watts
0	1.0 mW
1	1.3 mW
2	1.6 mW
3	2.0 mW
4	2.5 mW
5	3.2 mW
6	4 mW
7	5 mW
8	6 mW
9	8 mW
10	10 mW
11	13 mW
12	16 mW
13	20 mW
14	25 mW
15	32 mW

dBm	Watts
16	40 mW
17	50 mW
18	63 mW
19	79 mW
20	100 mW
21	126 mW
22	158 mW
23	200 mW
24	250 mW
25	316 mW
26	398 mW
27	500 mW
28	630 mW
29	800 mW
30	1.0 W
31	1.3 W

dBm	Watts
32	1.6 W
33	2.0 W
34	2.5 W
35	3.2 W
36	4.0 W
37	5.0 W
38	6.3 W
39	8.0 W
40	10 W
41	13 W
42	16 W
43	20 W
44	25 W
45	32 W
46	40 W
47	50 W

# Glossary

## ADC

Analog to digital converter.

## Analog Input (AI)

An analog input is a measurable electrical signal with a defined range that is generated by a sensor and received by a controller. The analog input changes continuously in a definable manner in relation to the measured property.

## Analog Output (AO)

An analog output is a measurable electrical signal with a defined range that is generated by a controller and sent to a controlled device, such as a variable speed drive or actuator. Changes in the analog output cause changes in the controlled device that result in changes in the controlled process.

## Cu10

Copper 10 Resistance thermometers, also called resistance temperature detectors (RTDs), are temperature sensors that exploit the predictable change in electrical resistance of some materials with changing temperature. They are slowly replacing the use of thermocouples in many industrial applications below 600 °C, due to higher accuracy and repeatability.

## DCE

Data Communications Equipment. This indicates how a serial cable, DB9 or DB25 is pinned out as far as inputs and outputs are concerned. A straight through serial cable can be used when connecting a DTE device to a DCE device, but a null modem cable is required to connect a DCE to DCE or DTE to DTE device.

## DIN

A standardized 35 mm wide metal rail used for mounting industrial equipment inside racks and enclosures.

## Digital Input (DI)

A digital input typically consists of a power supply (voltage source), a switch and a voltage-sensing device (analog-to-digital converter). Depending on the switch's open/closed status, the sensing device detects a voltage or no voltage condition, which in turn generates a logical 0 or 1, ON or OFF, alarm or normal or similarly defined state.

## Digital Output (DO)

A digital output typically consists of a switch (either mechanical as in a relay, or electronic as in a transistor or triac) that either opens or closes the circuit between two terminals depending on the binary state of the output.

## FCC

The Federal Communications Commission (FCC) is an independent United States government agency. The FCC was established by the Communications Act of 1934 and is charged with regulating interstate and international communications by radio, television, wire, satellite and cable. The FCC's jurisdiction covers the 50 states, the District of Columbia, and U.S. possessions.

## LOS

Line-of-sight propagation refers to electro-magnetic radiation including light emissions traveling in a straight line. The rays or waves are diffracted, refracted, reflected, or absorbed by atmosphere and obstructions with material and generally cannot travel over the horizon or behind obstacles.

## PLC

Programmable controllers operate by producing signals that are sent to devices connected to PLC outputs.

### **Pt100**

Platinum 100 Resistance thermometers, also called resistance temperature detectors (RTDs), are temperature sensors that exploit the predictable change in electrical resistance of some materials with changing temperature. As they are almost invariably made of platinum, they are often called platinum resistance thermometers (PRTs). They are slowly replacing the use of thermocouples in many industrial applications below 600 °C, due to higher accuracy and repeatability.

### **Pt1000**

Platinum 1000 Resistance thermometers, also called resistance temperature detectors (RTDs), are temperature sensors that exploit the predictable change in electrical resistance of some materials with changing temperature. As they are almost invariably made of platinum, they are often called platinum resistance thermometers (PRTs). They are slowly replacing the use of thermocouples in many industrial applications below 600 °C, due to higher accuracy and repeatability. Suitable for air, water, oil and fuel temperature measurement.

### **RTD**

Resistance thermometers, also called resistance temperature detectors (RTDs), are temperature sensors that exploit the predictable change in electrical resistance of some materials with changing temperature. As they are almost invariably made of platinum, they are often called platinum resistance thermometers (PRTs). They are slowly replacing the use of thermocouples in many industrial applications below 600 °C, due to higher accuracy and repeatability.

### **RSSI**

In wireless communications, received signal strength indication (RSSI) is a measurement of the power present in a received radio signal.

### **Sinking**

Refers to a device or component that accepts (absorbs) current. Conventional current flows into this sinking device.

### **Sourcing**

Refers to a device or component that provides current. Conventional current flows out of a sourcing device.

### **SCADA**

Supervisory Control And Data Acquisition. It generally refers to an industrial control system: a computer system monitoring and controlling a process. The process can be industrial, infrastructure or facility based as described below.

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