ZigBee to Serial (RS-232/422/485)

EX-9212-ZigBee-S
User Manual

First Edition, May 2011

Disclaimer

Information in this document is subject to change without notice and does not represent a commitment of ours.

We reserve the right to make improvements and/or changes to this manual, or to the products and/or the programs described in this manual, at any time.

We assume no responsibility for its use, or for any infringements on the rights of third parties that may result from its use.

This product might include unintentional technical or typographical errors. Changes are periodically made to the information herein to correct such errors, and these changes are incorporated into new editions of the publication.

Reproduction of the contents of this copyrighted publication, in whole or part, without written permission of ours, is prohibited. Throughout this manual we use notes to make you aware of safety consideration.

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, we do not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

 **Attention：**

Risk of injury or equipment damage exists. Only personnel familiar with drive and power products and the associated equipments should plan or implement the installation, star-up, configuration, and subsequent maintenance of the product using a serial converter. Failure to comply may result in injury and/or equipment damage.

Preface

Related Documentation

Specification (Reference CD in the pack)

Quick Installation Guide (Reference CD in the pack)

User Manual (Reference CD in the pack)

CE/FCC

Related documents

Item：	Refer to：	Publication：
1	User Manual	
2	Quick Installation Guide	
3	Specification Sheet	
4	CE/FCC Approval Letter	

Notice：

Supporting documentation can be obtained from your local dealer or distributor. It can also be viewed on website.

Related Software and Firmware

Item：	Refer to：	Version：
1	Device Management Utility	
2	Firmware	

Notice：

Any version change or upgrade without notifies.

Table of Contents

Chapter1. Introduction

The ZigBee protocol was developed to provide low-power, wireless connectivity for a wide range of network applications concerned with monitoring and control. ZigBee is a worldwide open standard controlled by the ZigBee Alliance. The ZigBee standard builds on the established IEEE 802.15.4 standard for packet-based wireless transport. ZigBee enhances the functionality of IEEE 802.15.4 by providing flexible, extendable network topologies with integrated set-up and routing intelligence to facilitate easy installation and high resilience to failure.

ZigBee wireless connectivity means that it can be installed easily and cheaply, and its built-in intelligence and flexibility allow networks to be easily adapted to changing needs by adding, removing or moving network nodes. The protocol is designed such that nodes can appear in and disappear from the network, allowing some devices to be put into a power-saving mode when not active.

1.1 Overview

We provide new ways of wireless connecting legacy ZigBee devices to Serial as RS-232/422/485 port with D I/O of EX-9000/ EX9000-M series. The converters are designed to operate in serial signal over ZigBee wireless network. The ZigBee to Serial device is usually used as an end- device at the ZigBee network. The data can transmit via ZigBee 801.15.4 protocol. The device is packaged in a PVC or steel material (Depend on model) case well suited for industrial environments. This device provides one serial port of RS-232 or 422 or 485 (Auto Detection)

The ZigBee wireless converter is a low-cost, high performance design. By careful selecting high quality with competitive prices components in the world, the products made network connectivity possible with affordable cost for virtually all kinds of devices.

The converters are designed to connect the device operating in serial signal over ZigBee wireless network.

This ZigBee wireless converter Series consists of three models:

EX-9212-ZigBee-S, EX-9212-ZigBee-E, EX-9212-ZigBee-Z.

EX-9212-ZigBee-S is a serial to ZigBee converter device within one serial port of RS-232/422/485 (Auto-Detection) which can connect the DI/O of EX-9000/ EX9000-M series .

EX-9212-ZigBee-E is a TCP/IP Ethernet port to ZigBee converter device within one Ethernet 10/100Mbps of RJ-45 port.

EX-9212-ZigBee-Z is a bridge router device of wireless ZigBee which it is a multi-access device with routing function.

All of models can be provided with high transmission power (18dBm) function of RF and temperature / humidity sensors by optional.

This user manual will guide you step by step for the various functions of this converter.

1.2 Package Checklist

Converter is shipped with the following items:

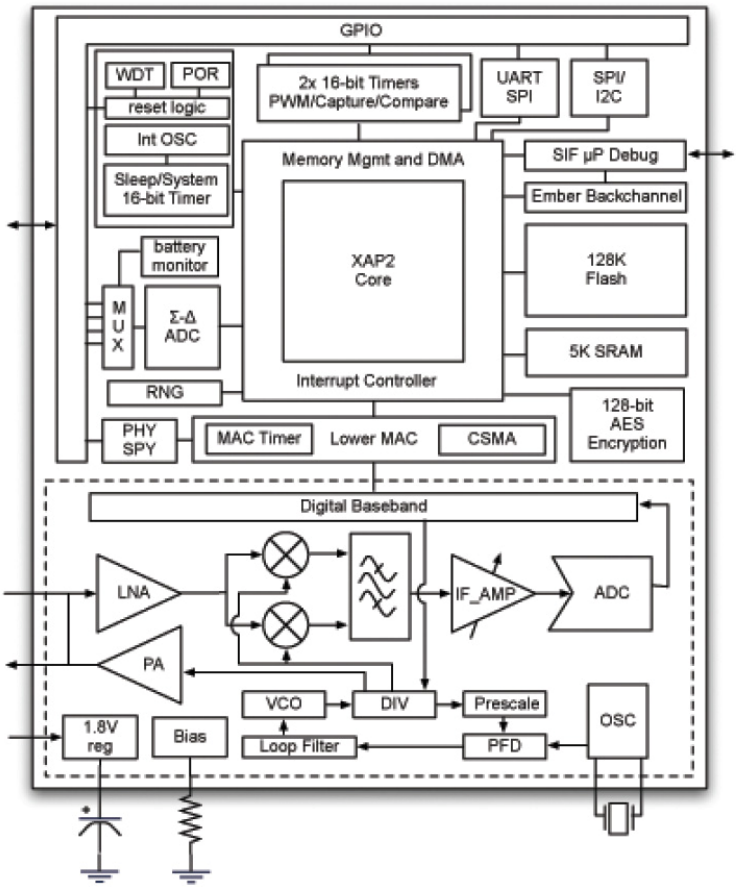
- □ ZigBee Device x 1
- □ User Manual CD x

Notice：

Notify your sales representative if any of the above items is missing or damaged.

1.3 Block Diagram

1.3.1 CPU Diagram



ZigBee module provides a cost-effective RF transceiver solution for 2.4GHz IEEE 802.15.4 data links and ZigBee wireless networks and is based on the Ember™ EM250 platform. The single-chip solution consists of an IEEE 802.15.4-compliant 2.4GHz RF transceiver with a 16-bit XAP2b microprocessor. It's designed to support point to point, point to multi-point, and mesh network applications.

The EM250 from Ember provides a ZigBee System-on-Chip that combines a 2.4GHz IEEE 802.15.4 compliant radio transceiver with a 16-bit microprocessor. The radio provides best-in-class RF performance with excellent sensitivity and transmits power for long range, and 802.11immunity. A flexible RF interface minimizes external components in configurations with or without external LNA/PAs. Designed specifically for use with EmberZNet, Ember's ZigBee compliant embedded mesh networking software, the EM250 is optimized for designs requiring long battery life, low external component count, and a reliable,

proven, industry-standard networking solution. Innovative on-chip debugging (Insight Port) provides developers with the most advanced views into their application and network available in the industry.

1.3.2 General Features

- Ember™ EM250 platform
- 128KB Flash memory
- 5KB SRAM
- 16-bit XAP2b microprocessor
- 17 general purpose I/O ports
- DMA-SPI, I2C and UART interfaces
- Integrated 12-bit resolution ADC
- Designed for EmberZNet ZigBee Pro compliant networks
- Miniature footprint: 2cm x 3cm
- Integrated PCB trace antenna and U.FL external antenna connector
- 16 RF channels
- Over indoor 30m and outdoor visual contact 100m of range
- Non-intrusive debug interface (SIF)
- AES 128-bit encryption
- Low power consumption
- Constant RF out power over 2.1~3.6 V voltage range
- FCC certification in process
- RoHS compliant

1.4 Product Features

1.4.1 ZigBee Network Nodes

A wireless network comprises a set of nodes that can communicate with each other by means of radio transmissions, according to a set of routing rules (for passing messages between nodes). A ZigBee wireless network includes three types of node:

- **Coordinator Node:**

This is the first node to be started and is responsible for forming the network by allowing other nodes to join the network through it. Once the network is established, the Co-coordinator has a routing role (is able to relay messages from one node to another) and is also able to send/receive data. Every network must have one and only one Coordinator. EX-9212-ZigBee-S and EX-9212-ZigBee-E can be used the role of coordinator to connect with host device.

- **Router Node:**

This is a node with a routing capability, and is also able to send/receive data. It also allows other nodes to join the network through it, so plays a role in extending the network. A network may have many Routers. There is only the EX-9212-ZigBee-Z to play a route node of ZigBee networks in EX-9212-ZigBee series.

- **End Device Node:**

EX-9212-ZigBee-S and EX-9212-ZigBee-E are usually played the role of the end-device for collecting data from the serial device. This is a node which is only capable of sending and receiving data (It has no routing capability). A network may have many End Devices.

1.4.2 ZigBee Network Topology

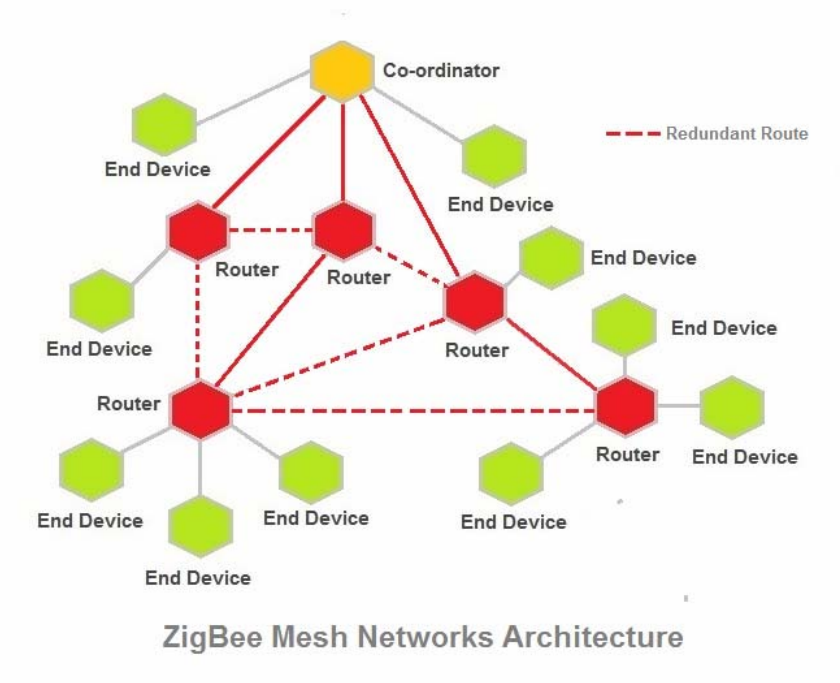
ZigBee facilitates a range of network topologies from the simplest Star topology, through the highly structured Tree topology to the flexible Mesh topology. ZigBee is designed primarily for Mesh networks. A Mesh network has little implicit structure. It is a collection of nodes comprising a “Coordinator Device” and a number of “Router Devices” and/or “End Devices”.

-Each node, except the “Coordinator Device”, is associated with a “Router Device” or the “End Device” - this is the node through which it joined the network and is known as its ‘parent’. Each parent may have a number of ‘children’.

-“End Device” can only communicate directly with its own parent.

-Each “Router Devices”, “End Devices” and the “Coordinator Device” can communicate directly within radio range. The “Coordinator Device plays as a role of routing table manager for monitoring and managing the routing status of the ZigBee network.

It is the last property above that gives a mesh network its flexibility and efficiency in terms of inter-node communication. A mesh network is illustrated in the figure below.



1.4.3 Ideal Applications for ZigBee

ZigBee is suitable for a wide range of applications, covering both commercial and domestic use, which includes:

- Point-to-point cable replacement (e.g. wireless mouse, remote controls, toys)
- Security systems (e.g. fire and intruder)
- Environmental control (e.g. heating and air-conditioning)
- Hospital patient monitoring
- Lighting control
- Home automation (e.g. home entertainment, doors, gates, curtains and blinds)
- Automated meter reading (AMR)
- Industrial automation (e.g. plant monitoring and control)

ZigBee wireless communications also enable some applications to be developed that currently cannot be implemented with cabled systems. Examples are applications that involve mobility, which must be free of cabling (e.g. long-term health monitoring, asset tracking in warehouses). Existing applications (such as lighting control and industrial plant monitoring) that currently rely on cable-based systems can be implemented more cheaply as ZigBee reduces or removes cable installation costs. ZigBee can also be beneficial in environments where cable-based solutions can be difficult and expensive to install - for example, in home security systems, sensors need to be easy to install.

1.5 Product Specifications

Hardware
CPU：Ember™ EM250 16-bits CPU, 24 MHz
RAM：5K Bytes SRAM
ROM：128K Bytes Flash ROM

ZigBee
IEEE 802.15.4 compliant
Frequency: ISM band 2400 ~ 2480MHz
Receiver Sensitivity: -95dBm
RF Output Power: 3 dBm, (18 dBm for High Power)
Sleep Current: 1uA (with active sleep timer)
TX current < 24 mA , RX current < 28 mA
Security processor (128 bits AES)
Operation Voltage: 2.1 V~ 3.6V
Antenna: SMA Type, 2 dBi, changeable
Distance: Up To 150~200 Meters in free space
(600~800 Meters for High Power)
Data Rate: 250K bps
Application Mode: Mesh, Star

Serial Port * 2 ports
Port：RS-232 / 422 / 485 * 1 Ports (Auto Detection)
RS-232 Port：Rx, Tx, GND, RTS, CTS (DB9 Female)
RS-422：Rx+, Rx- , Tx+, Tx- (Surge & Over current protection)
RS-485：Data+, Data- (Surge & Over current protection)
RS-422/485 Port：Built-In Terminal Block
Speed：1200 bps ~ 115.2 Kbps
Parity：None, Odd, Even
Data Bits：7, 8
Stop Bits：1, 2
Flow Control: RTS / CTS
15KV ESD for all Serial signals

Firmware
Updated Via COM Port

Power
DC9 ~ 24V/150mA@9V, 60mA@24V
Over Current & Reverse Protection

LED Indicators
SYS (red), Pairing (green), Rx (red), Tx (green)

Environment
Operating Temperature：0 ℃ ~ +75℃
Storage Temperature：-20℃ ~ +85℃

Dimensions
100 * 90 * 25 mm (W * D * H)

Weight
150 gm. (Not include power adapter)

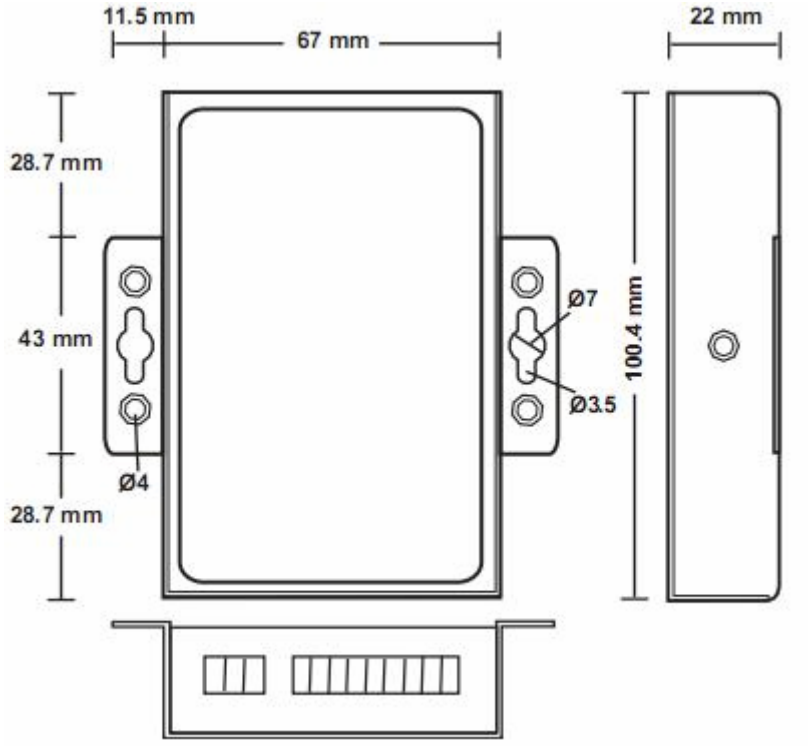
Wall Mountable

Din-Rail (Optional)

Regulatory Approvals
RoHS

Warranty
1 year

1.6 Dimension



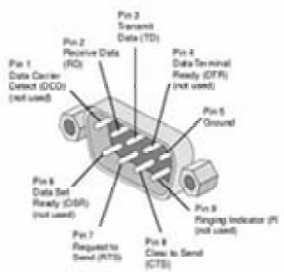
Chapter2. Hardware Introduction

2.1 Product Panel Overview

2.2 Port Description

2.2.1 RS-232 Serial Port

RS-232 D-Sub 9 Pin Connector-Male Assignment



Pin No.	Signel	Direction	Description
Pin1	DCD	⇦	Data Carrier Detect (Not Used)
Pin2	RxD	⇦	Receive Data
Pin3	TxD	⇨	Trasmit Data
Pin4	DTR	⇨	Data Terminal Ready
Pin5	GND	----	Ground
Pin6	DSR	⇦	Date Set Ready (Not Used)
Pin7	RTS	⇨	Request to Send
Pin8	CTS	⇦	Clear to Send
Pin9	RI	⇦	Ring Indicator (Not Used)

⇦: Receive by DTE Device
⇨: Transmitted from DTE Device

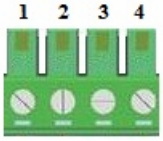
In telecommunications, RS-232 (Recommended Standard 232) is the traditional name for a series of standards for serial binary single-ended data and control signals connecting between a DTE (Data Terminal Equipment) and a DCE (Data Circuit-terminating Equipment). It is commonly used in computer serial port. RS-232 is the most popular interface port in early computer devices, industrial controller, sensor and instruments etc. There are several connector types of RS-232 port. This ZigBee device is provided a RS-232 D-Sub 9 pin male connector and a terminal block with 4 pins of RS-422/485 port. They are only one port can be in active status by auto-detection during connected. Simply connect RS-232 cable with female type connector (option) between the ZigBee device and RS-232 serial port interface device as sensor, detector, and instruments etc. When RS-422/485 port is used and you may prepare a twisted pair wire for connecting between. When the power is connected and is properly supplied, the “PWR” indicator will be light and “Pair” indicator will be blink once per three seconds. After the device pairing and network data layer linking, data traffic occurs on the network, “Tx” and “Rx” indicators will blink during data transferring and receiving.

2.2.2 RS-422/485 Serial Port

RS-422 Port

Pin Assignment

Serial Port	RS-422			
Pin No.	1	2	3	4
Pin Signal	T+	T-	R+	R-



The RS-422 protocol greatly expands the practical possibilities of the serial bus. It provides a mechanism by which serial data can be transmitted over great distances (to 4,000 ft.) and at very high speeds (to 10 Mbps). This is accomplished by splitting each signal across two separate wires in opposite states -- one inverted; the other not inverted.

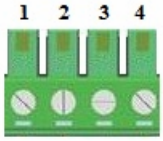
The difference in voltage between the two lines is compared by the receiver to determine the logical state of the signal. This wire configuration, called differential data transmission, this potential difference will affect both wires equally, and thus not affect their inverse relationship. Twisted pairs of wire, which ensure that neither line is permanently closer to a noise source than the other, are often used to best equalize influences on the two lines. Errors can be caused by high noise levels affecting one side of the receiver to a different extent than the other. To combat this, each receiver is generally grounded.

Errors in balanced transmission systems such as RS-422 can be also caused by signal reflections. As data transfer speeds increase and travel over longer distances, the signal can be reflected back from the far end of the wire. To combat this, termination resistors are placed at the far end of the cable which make the cable appear electrically as if it is indefinitely long -- indefinitely long lines don't have ends, thus can't reflect from one end to the other. These termination resistors will differ depending on the protocol used. For RS-422 a 100 ohm resistor is placed at the receiving device.

RS-485 Port

Pin Assignment

Serial Port	RS-485			
Pin No.	1	2	3	4
Pin Signal	D+	D-	X	X



RS-485 is an upgraded version of the RS-422 protocol that was specifically designed to address the problem of communication between multiple devices on a single data line. It is a balanced transmission system that is virtually identical to RS-422 with the important addition of the ability to allow up to 32 devices to communicate using the same data line. Thus any Point A through Point FF can directly communicate with each other, taking on the role of master and slave as needed. This is achieved with translatable drivers which are usually controlled by a programmable handshake line to ensure that only one device acts as a driver at one time.

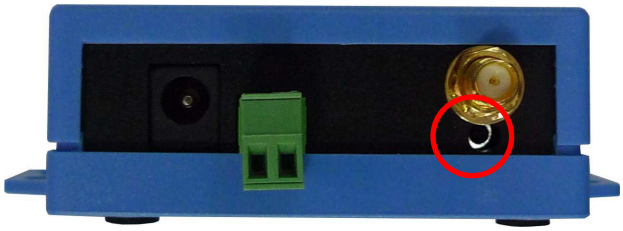
In such a system, the RS-485 line cannot be thought to have a beginning and an end, because communication can be initiated from any point on the line. Thus, terminating resistors must

be placed at both ends of the RS-485 wire to achieve the infinite line illusion. For RS-485, 120 ohm resistors are placed at the two furthest points of the communication link.

2.2.3 Antenna port

The connector of antenna is a standard reverse SMA jack. Simply connect it to a 2.0dBi (Standard) or 5.0dBi dipole antenna (Standard Rubber Duck) and it is 50 Ohms impedance and can support 2.4GHz frequency

2.2.4 Pair / Set Button



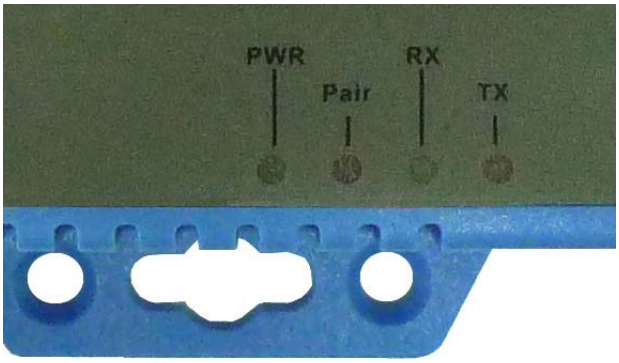
The “Pair/Set” button is for pairing the devices and use a pin to push the Pair/Set button for active it. For more detail information please see chapter 3.3. The device’s pairing procedures.

2.2.5 Power DC IN Outlet

The ZigBee device has two DC power input for choice. One is powered by a single 9Vdc (inner positive/outer negative) power adapter and 500mA of current. A suitable power supply adapter is part of the packaging. DC-In power outlet is at the left side of ZigBee device and put the adapter into the socket. Other one is usually supplied DC +24 V in the computer center directly and you may use “DC power terminal block” for inputting the power. If the power is properly supplied, the “PWR” red color LED will be on.

2.3 LED Indicators

The LEDs indicate of the device status.



PWR Indicator:

It is a power indicator (When the power is on, the LED will be on.)

Pair Indicator:

It shows the device indicator of pairing status and when ZigBee End Device is operated in pair status then the LED will be blink every three seconds.

The pair LED indicator of ZigBee Coordinator is normally blinking once per 3 seconds and when active the pairing function within 60 seconds period that the pair LED indicator will be blinked once second.

Rx Indicator:

Data received indicator (When packet are receiving from the network, the LED will blink.)

Tx Indicator:

Data sent indicator (When packets are sending to the network, the LED will blink.)

Chapter3. Getting Start

Before Getting Started

Administrators should read this part of the manual carefully, especially during installation. Please verify that all the items in the Package Checklist are presented. Before initial installation and configuration the device, you will also need a PC or notebook PC within Ethernet port.

Step 1: Connect the power source

Please find a suitable AC-DC power adapter which it is a part of the packaging. The converter device is powered by a single 9VDC (inner positive/outer negative) power source with 500mA of current. The adapter of AC input power is autosensing design from 110 240 voltage. The DC power jack at the left side of the ZigBee device and put the adapter into the socket. If the power is properly supplied, the “PWR” LED will be on.

Step 2: Check the power status of the device

When power is connected and users can verify the LED indicator of “PWR” on the top panel. If the power is properly supplied, the “PWR” LED indicator will be on that if the power input fails, LED indicators will not be light up.

Step 3: Check the status of the device after connecting the power

When power is properly worked and the next step is to pairing both devices as Coordinator and End Device. To verify the LED indicator of “Pair”, if the pair is successful that the “Pair” LED indicator will be blinking every three seconds.

3.1 Hardware Installation

3.1.1 DIN-Rail Mounting

The aluminum DIN-Rail attachment plate is included in the package. If you need to reattach the DIN-Rail attachment plate to the converter, make sure the stiff metal spring is situated towards the top, as shown in the figures below.

The DIN-Rail attachment plate should already be attached to the back panel of the converter device. If you need to reattach the plate, make sure the metal spring is situated towards the top, as shown in the figures below.

STEP 1: Insert the top of the DIN-Rail into the slot just below the metal spring.

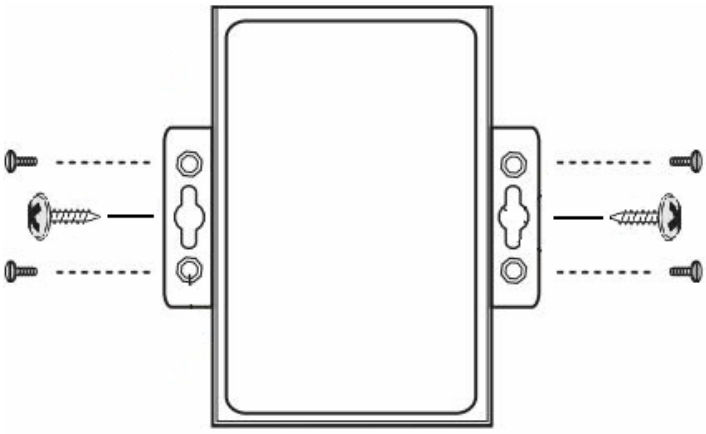
Metal spring

STEP 2: The unit will snap into place as shown below.

3.1.2 Wall Mounting

Step 1：

There are two brackets on both sites of the converter device and it come standard with the converter. They are used to attach the converter to a wall, or the inside of a cabinet. Use two screws per bracket to attach the converter to a wall (Figure 3.8).



Step 2：

The heads of the screws should be less than 6.0 mm in diameter, and the shafts should be less than 3.5 mm in diameter, as shown in the figure 3.8 at the up .Do not screw the screws in all the way—leave a space of about 2 mm to allow room for sliding the wall mount panel between the wall and the screw heads.

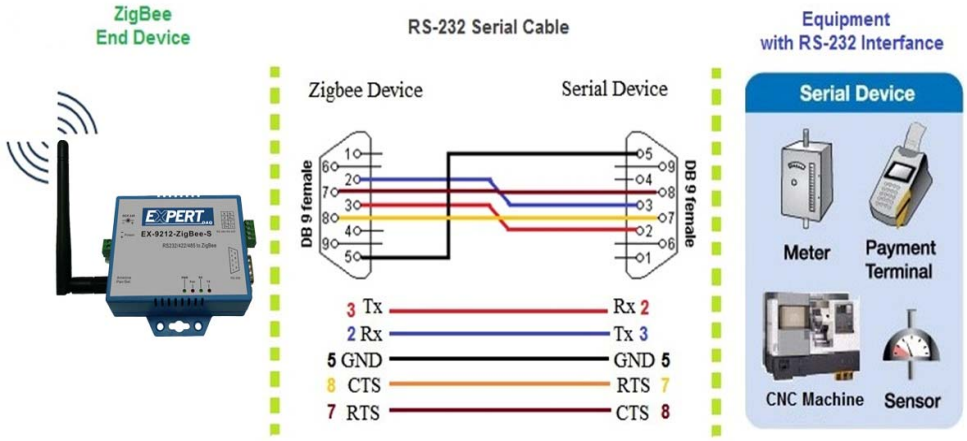
3.2 Serial Port Wiring Architecture

3.2.1 RS-232 Wire Architecture

The RS232 specification defines both the Mechanical, Electrical, and Functional characteristics. RS232 is an Unbalanced (Single Ended), unidirectional (point-to-point) interface - signal is referenced to ground. RS232 drivers feature a controlled slew rate. Normal output levels are +5 volts. The RS-232 interface uses Asynchronous Framing [Known data width, 8bits] with Non-return to zero encoding. The RS232 interface is synchronous when the clocks are used (DA / DB), otherwise it is asynchronous. The RS232 interface is rated to operate up to 20kbps. Use TIA/EIA-562 (low voltage version of RS232) or TIA/EIA 423 for higher data rates.

The maximum cable length is not defined, but this produces a maximum cable length of something less than 20 meters.

If the connected equipment or device is RS-232 interface that you may reference the wiring architecture as below:

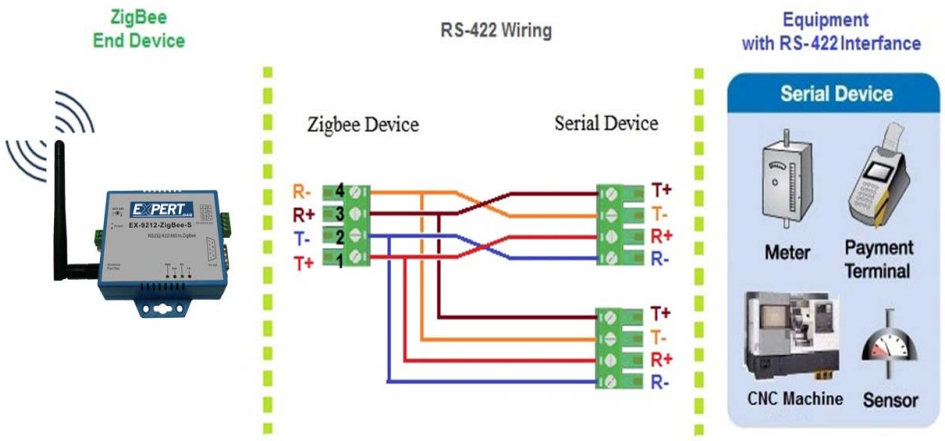


3.2.2 RS-422 Wire Architecture

RS-422 is a telecommunication standard for binary serial communications between devices. It is the protocol or specifications that must be followed to allow two devices that implement this standard to speak to each other. RS-422 is an updated version of the original serial protocol known as RS-232. One device will be known as the “Data Terminal Equipment” (DTE) and the other device is known as “Data Communications Equipment” (DCE). For instance, in a typical example of a serial link between the ZigBee end-device and detector sensor、device、equipment, ZigBee end-device is the DTE device and detector sensor、machine、terminal device are the DCE devices.

RS-422 is a balanced four wire system. The signal sent from the DTE device is transmitted to the DCE device through two wires and the signal sent from the DEC device to the DTE device is transmitted through the other two wires. The signals on each pair of wires are the mirror opposite of each other, a "1" datum is transmitted as a plus 2 volt reference on one wire and a minus 2 volt reference on the other wire. To send a "0" datum, a minus 2 volt reference is transmitted through one wire and a plus 2 volt reference on the other wire. That is the opposite of what was done to transmit a '1' datum. This balanced differential approach allows for much longer distances between the DCE device and the DTE device than was possible with the earlier 3 wire RS-232 communication standard.

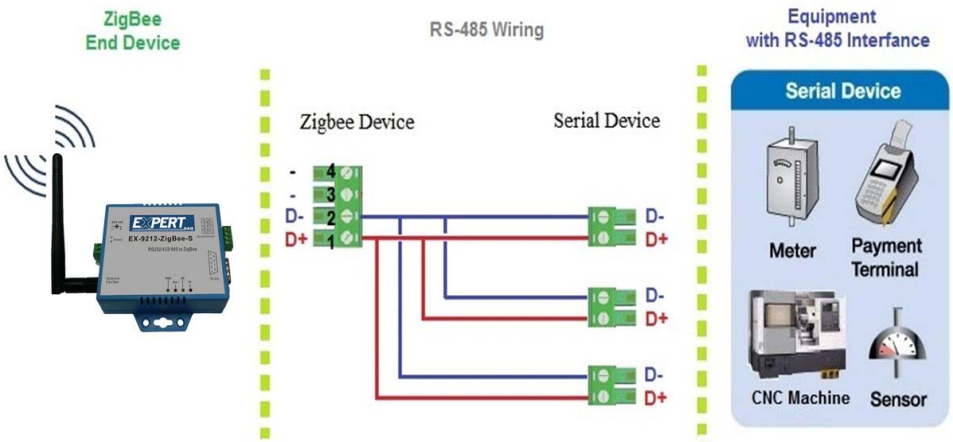
If the connected equipment or device is RS-422 interface that you may reference the wiring architecture as below:



Standards are also always changing as limitations are encountered and new solutions are proposed. If the changes become too drastic then a new standard evolves. In this way the RS-422 standard has evolved from, and in many cases replaced, the original RS-232 standard. In fact the RS-422 standard has now been superseded by the RS-485 standard which adds additional features to the RS-422 standard.

3.2.3 RS-485 Wire Architecture

If the connected equipment or device is RS-485 interface that you may reference the wiring architecture as below:



RS-485 is a telecommunications standard for binary serial communications between the devices. It is the protocol or specifications that need to be followed to allow devices that implement this standard to speak to each other. This protocol is an updated version of the original serial protocol known as RS-232. While the original RS-232 standard allowed for the connection of two devices through a serial link, RS-485 allows for serial connections between more than 2 devices on a networked system.

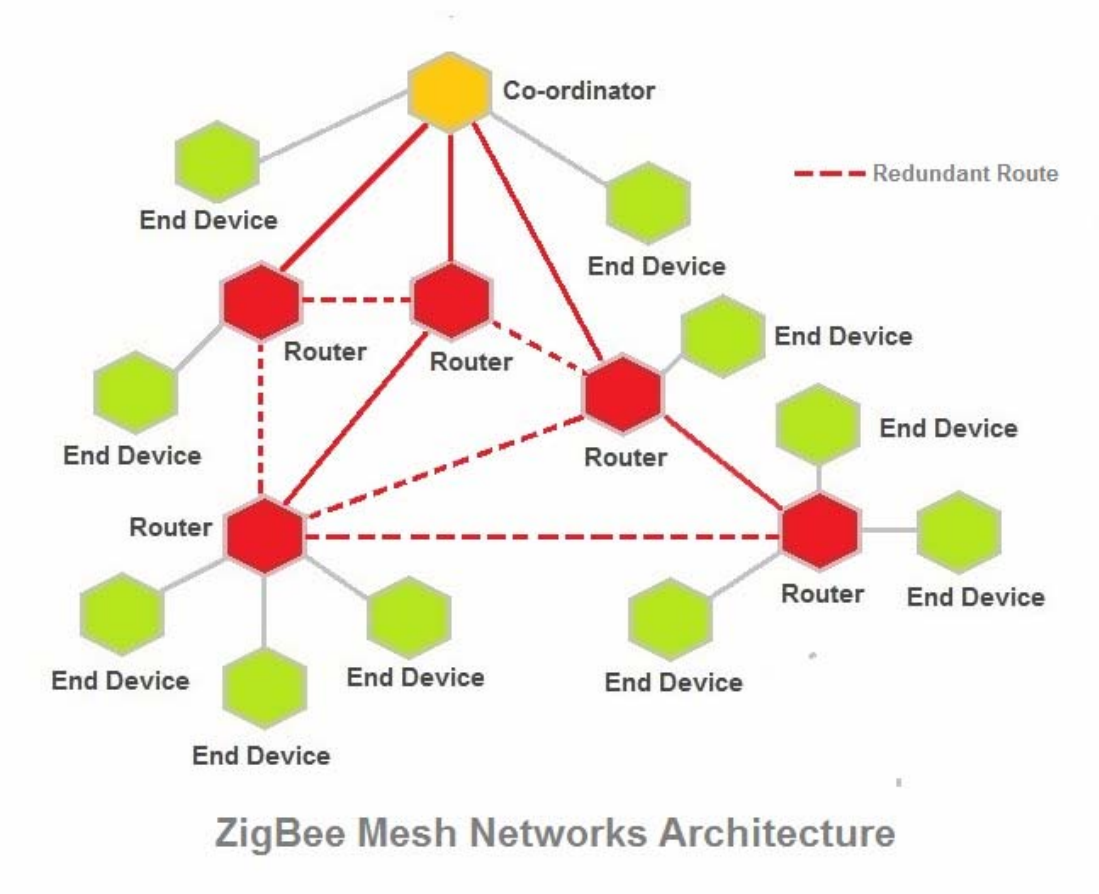
A RS-485 compliant network is a multi-point communications network. The RS-485 standard specifies up to 32 drivers and 32 receivers on a single (2-wire) bus. New technology has since introduced "automatic" repeaters and high-impedance drivers and receivers such that the number of drivers and receivers can be extended to hundreds of nodes on a network. RS-485 drivers are now even able to withstand bus contention problems and bus fault conditions.

A RS-485 network can be constructed as either a balanced 2 wire system or a 4 wire system. If a RS-485 network is constructed as a 2 wire system, then all of the nodes will have equal

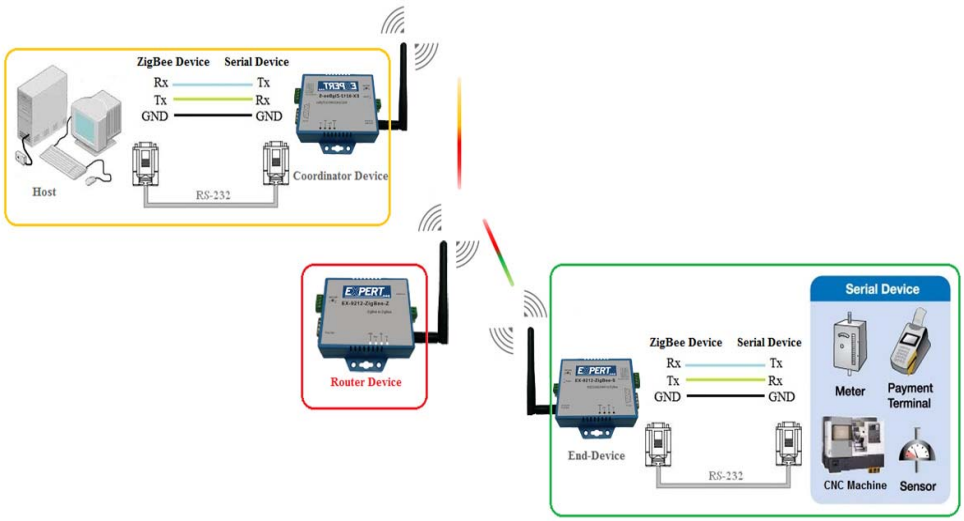
ranking. A RS-485 network constructed as a 4 wire system has one node designated as the master and the remaining nodes are designated as slaves. Communication in such a system is only between master and slaves and never between slaves. This approach simplifies the software protocol that needs to be used at the cost of increasing the complexity of the wiring system slightly.

3.2.4 ZigBee to Serial Device Architecture

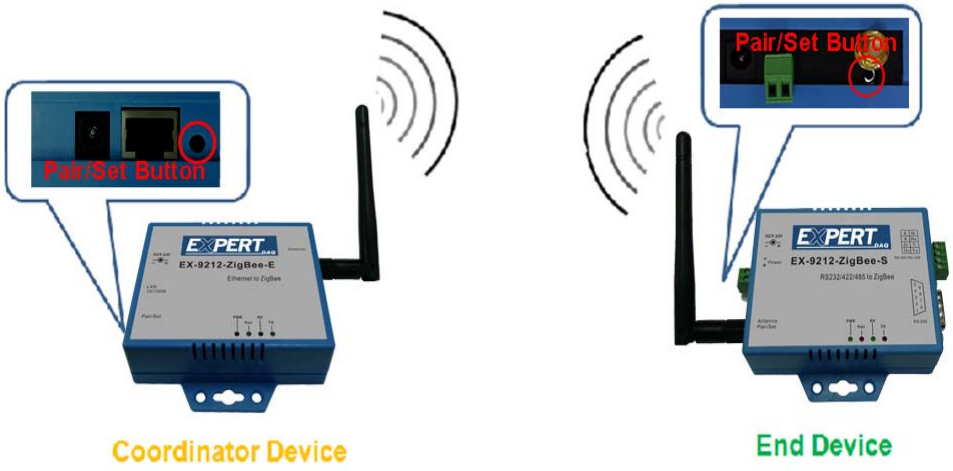
- **General ZigBee Application Architecture**



● **EX-9212-ZigBee-S Device - ZigBee Architecture**



3.3 The device's pairing procedures



a. After power on ZigBee Coordinator device and check if the Pair LED blinks once per 3 seconds.

b. Check if Pair LED of ZigBee End Device is eternally on. If it is on eternally, it means ZigBee End Device is not paired yet.

c. Use a pin to push the Pair/Set button of Coordinator device on left site.

- Pair LED starts to flash about 60 seconds (waiting ZigBee End Device to join).
- If no ZigBee End Device joins, ZigBee Coordinator changes to blinks per 3 seconds.

d. Use a pin to push the Pair/Set button until ZigBee End Device starts to flash (This action must be completed during the 60 seconds that ZigBee coordinator flashes for). When ZigBee End Device starts to flash, it means ZigBee End Device has been joined the ZigBee Coordinator network.

e. PS. Above steps is the default setting before shipment, inapplicable to end user.

f. ZigBee has been paired during the test process before shipment, so above steps is required only when ZigBee needs to joins other network.

g. Above steps is for ZigBee hardware set up.

h. And then you will need to use AT Command Mode Paring Procedure to paring Data Link Layer between ZigBee Coordinator and ZigBee End Device.

i. Please refer to AT Command instruction guide for more details.