ZN-241G
802.15.4 Radio

Technical Reference

CIRRONET

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Important Regulatory Information

Cirronet Product FCC ID: HSW-ZN241
IC 4492A-ZN241

Note: This unit has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their expense.

FCC s MPE Requirements

Information to user/installer regarding FCC s Maximum Permissible Exposure (MPE) limits.

Notice to users/installers using the following mobile antennas, with Cirronet RF products:

ZN241 5 dBi and 2 dBi Omni Antennas

The field strength radiated by any one of these antennas, when connected to Cirronet RF products, may exceed FCC mandated RF exposure limits. FCC rules require professional installation of these antennas in such a way that the general public will not be closer than 20 cm from the radiating aperture of any of these antennas. End users of these systems must also be informed that RF exposure limits may be exceeded if personnel come closer than 20 cm to the apertures of any of these antennas.

Approved Antennas

5 dBi Collinear – Nearson Antennas

	Nearson Server <<<<< S-151AH-2450S Client >>>>> S-151FL-36-AH-2450	
Colinear		Colinear
5 dBi		5 dBi
7"		7"
SMA		SMA
R/A Swivel		Right Angle Straight Swivel

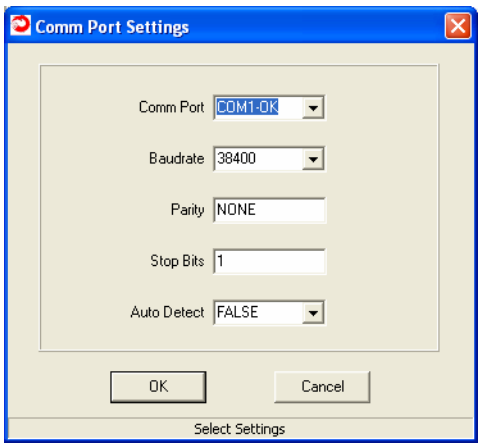
Table of Contents

1. Getting Started

The ZN-241G is designed to connect to another 802.15.4 radio. In almost all cases, if you turn two ZN-241Gs on in range of each other, they will link to each other. The simplest method for using two ZN-241Gs is to attach the antennas, power them both up and then check the link lights (center red LED) on both radios. If they are both lit, and the default baud rate of 38,400 is acceptable, no further configuration is needed. The radios can be used as is.

1.1 Changing the Baud Rate

The ZNWizard software simplifies the configuration of several radio parameters, the most basic being setting a baud rate other than the default. To change the baud rate, connect the ZN-241G to a PC by plugging in the serial cable to the 9 pin connector on the radio then connecting the other end to the serial port on the PC. Plug the transformer end of the power supply into a wall outlet and the other end into the ZN-241G and launch the ZNWizard software; the following screen will appear.



Select a different baud rate using the drop down menu labeled Baudrate then Click OK; the following screen will display. Close down ZN Wizard and connect the other ZN-241G up in the manner described above and repeat the procedure for the second radio, then click OK. The radios are now ready for use.

1.2 Other Select Comm Port Settings

In addition to changing the baud rate, you may also change the Comm Port, Parity, Stop Bits and whether or not Auto Detect is needed. Default values for these parameters are displayed in the window above. Available Comm Ports will be marked with an “OK”; others will be marked with ‘N/A”. The Auto Detect function works this way. If set to FALSE, once OK is selected, the program uses the default settings to search for the radio. If set to TRUE, the program will begin a systematic process beginning with the first valid port (COM 1 in most cases) then will cycle through each baud rate, then each parity setting, then each stop bit setting finally changing to the next available COM port and repeating the process until a radio is found.

2. Firmware Requirements

The radio supports protocol-based messaging with one-hop mesh routing capability for transmissions between the base and a remote (in either direction). Peer-to-peer messaging is not officially supported, but should work for limited applications. The ZN-241G will support transparent messaging in addition to protocol-based service.

2.1 Addressing

The ZN-241G uses 8-bit network addresses, which are assigned by the base. Each radio also carries a factory-set 64-bit MAC address. When a remote connects to the base for the first time, the base assigns a network address (NWK) between 01 and 60 (decimal) for that MAC address and records it in an EEPROM table so that the same address is assigned if the devices are power-cycled. Under normal operation, it is required that no more than 60 remotes connect to a base. If this limit is exceeded, the table will be automatically cleared and all network addresses reassigned on a first-come, first-serve basis.

There are two special reserved network addresses. The base has NWK address of **`0x00`**, and **`0xFF`** is used to indicate a broadcast packet.

2.2 Protocol Modes

The ZN-241G can be used in either transparent or protocol-based applications. By default, the radio is configured at startup to operate in transparent multipoint mode. To change settings, the user must enable protocol mode. This is accomplished by sending the `EnterProtocolMode` command as the first string delivered to the radio after power-up. In order to be accepted, the command must be entered contiguously with no space between characters of more than `TransparentModeTimeout` (default = 5 ms); otherwise, the packet will be treated as transparent data instead of a command and sent over-the-air.

The ZN-241G configuration is stored in a set of variable length registers. Most can be both read from and written to, but some are read-only. Changes made by the user to the register settings are temporary until a `SaveSettings` command is executed. Resetting the radio or power-cycling will clear any changes that have not been saved to permanent memory using the `SaveSettings` command.

The ZN-241G may be configured to start in protocol mode at power-up, in which case the `EnterProtocolMode` command is not required.

3. Serial Protocol

All of the packets in the ZN-241G serial protocol have a common header format:

1 byte	1 byte	1 byte	1 byte	Varies
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

The start-of-packet (SOP) character, `0xFB`, is used to distinguish the beginning of a packet and to assure synchronization in the event of a startup glitch on the serial port at startup.

The Length byte is defined as the length of the remainder of the packet following the length byte itself (or the length of the entire packet - 2).

The message type (MSGType) identifier specifies the type of command or reply packet. Based on this value, as well as various packet options which allow the rest of the packet to be decoded. It is a bitfield-oriented specifier, decoded as follows:

Bit 7-5 -- Reserved for future use.

Bits 4 -- Reply. Indicates this packet is a reply.

Bits 3:0 – Type. Indicates the packet type/command.

As indicated, the lower 4 bits (3:0) specify a packet type or command specifier. Bit 4 is a modifier indicating that the packet is a reply to a previously received packet. The reply packet always has the original command type as bits 3:0, with bit 4 set to one.

The Transaction ID (TransID) is provided as an identifier to help a host device distinguish replies from multiple commands that may be in process. It is currently expected that the module will always reply to commands in the order they are received, but this may not always be the rule in future extensions to the protocol.

Transaction IDs for commands and replies are paired -- the reply will match the command. Since event packets are not generated in response to a command, a separate transaction ID counter is maintained by the radio for events, and is initialized to **`0x00`** at startup.

Arguments are packet-specific fields. These vary in size and number depending on the type of packet and whether it is a packet sent from the user or reply from the radio; see the tables in Section 4 for more information.

Packets that are generated on the serial interface by the user are referred to as "host" packets. Packets that are generated by the radio are referred to as "reply" packets. For many packet types, there is a reply packet that corresponds to a host packet; e.g., when the host sends a `TxData` packet, the radio will reply to indicate the status of the transmission, whether it succeeded or failed. Some packet types are host-only or reply-only.

4. ZN-241G Commands

Each ZN-241G command generally has two forms, a command from the host and a reply from the radio. Depending on the direction, they have different arguments as shown in the table below. Unsolicited events from the radio such as receive data packets or status announcements make up a third category of packets.

To assist in interpreting the data flow, the direction is indicated by the high nybble of the packet type -- e.g., an `EnterProtocolMode` command from the host is packet type **`0x00`**, and the `EnterProtocolMode` reply from the radio is packet type **`0x10`**. Events, such as `Announce` packets or `RxData` packets are indicated by **`0x20`** in the high nybble. If multiple arguments are to be provided, they are to be concatenated in the order shown. Little-endian byte format is used for all multi-byte arguments.

Packet Type					
CMD	Reply	Event	Description	Direction	Arguments
0x00			EnterProtocolMode	from Host	"ZN-241G"
	0x10		EnterProtocolModeReply	from Radio	none
0x01			ExitProtocolMode	from Host	none
	0x11		ExitProtocolModeReply	from Radio	none
0x02			SoftwareReset	from Host	none
	0x12		SoftwareResetReply	from Radio	none
0x03			GetRegister	from Host	Reg
	0x13		GetRegisterReply	from Radio	Reg,Val
0x04			SetRegister	from Host	Reg,Val
	0x14		SetRegisterReply	from Radio	none
0x05			TxData	from Host	Addr,Data
	0x15		TxDataReply	from Radio	TxStatus,LQI
		0x26	RxData	from Radio	Addr,LQI,Data
		0x27	Announce	from Radio	AnnStatus,add'l fields

Arguments:

Reg	Register location (see table) (2 bytes)	
Val	Value to read/write to/from register (see table for size and acceptable range)	
Data	User data (variable size, 0..100 bytes permitted)	
Addr	Network address of sender or recipient (1 byte)	
TxStatus	Result of last `TXData` operation (1 byte) 0 = Acknowledgement received 1 = No acknowledgement received 2 = (Remote) Not linked	
LQI	Link quality index, `0x01` to `0x7F`. Values of `0x00` and `0xFF` have special meanings (1 byte) **00** = No LQI measured because no ACK was received **FF** = No LQI measured because packet was relayed	
PanID	802.15.4 PAN identifier of network joined (2 bytes)	
SerNum	Serial number of radio joining (also used as 802.15.4 MAC address) (8 bytes)	
AnnStatus	Status announcement (1 byte) Additional fields are also reported depending on the status code:	
	Status Code	Add'l fields
	A0 = Radio has completed startup initialization	none
	A1 = Base: PAN has been formed, ready for data	`PanID`
	A2 = Base: A remote has joined our PAN	`SerNum,Addr`
	A3 = Remote: Joined a PAN, ready for data	`PanID,Addr`
	A4 = Remote: Exited PAN (base is out of range)	none
	A5 = Remote: Base has restarted	none
	Status codes for error conditions	Add'l fields
	E0 = Protocol error – invalid packet type	none
	E1 = Protocol error – invalid argument	none
	E2 = Protocol error – parser error	none
	E3 = Protocol error – parser timeout	none
	E4 = Protocol error – register is read-only	none
	E8 = UART receive buffer overflow	none

4.1. ZN-241G Registers

Location	Name	R/W	Size	Range	Default
0x0000	DeviceMode	R/W	1	0..1	0 = Remote, 1 = Base
0x0001	SerialRate	R/W	1	0..255	38400 bps (**0x19**)
0x0002	SerialParams	R/W	1	0..7	n,8,1 (**0x00**)
0x0003	ProtocolMode	R/W	1	0..3	0 = trans/pt-pt with auto-match 1 = trans/pt-pt 2 = trans/multi 3 = protocol
0x0004	PanID	R/W	2		**0x0001**
0x0005	ChannelMask	R/W	4		All but 2480MHz
0x0006	CurrPanID	R	2	00-FFFF	
0x0007	CurrChannel	R	1	0..15	
0x0008	CurrNwkAddress	R	1	0..62	
0x0009	MacAddress	R	8		
0x000A	TxAttemptLimit	R/W	1	0..16	5 attempts
0x000B	TxTimeout	R/W	1	0..255	5 ms
0x000C	AutoRelayEnable	R/W	1	0..1	1 (enabled)
0x000D	HardwareVersion	R	1	0-F	Upper nybble is first digit; lower nybble is second digit. Ex: **1100 0110** F(12) 6= ver. 12.6
0x000E	FirmwareVersion	R	1	0-F	
0x000F	LinkStatus	R	1	0..1	1 = linked
0x0010	TransLinkAnnEn	R	1	0..1	0 = default, 1 = “LINK” announce
0xFFFF	MemorySave	W	1	Write **0x00** to load factory defaults (“MO”) Write **0x01** to save settings to EEPROM (M>”)	

DeviceMode

Sets the mode of the radio. 0=Remote (default), 1=Base. There can be only one base radio for the network.

Baudrate

Sets the rate divisor of the serial port. The baud rate is given by

```
BAUD = 1e6 / (SerialRate+1)
```

The following are recommended `Baudrate` settings for common baud rates:

Setting	Nominal	Actual	Error
0x67	"9600"	9615	+0.2%
0x33	"19200"	19231	+0.2%
0x19	"38400"	38460	+0.2%
0x10	"57600"	58824	+2.1%
0x08	"115200"	111111	-3.7%

Note that these rates are approximate, not exact. Note that because the ZN-241G is -3.7% slow at the 115200 bps rate, the host device *must* be configured for 2 stop bits to use this rate! Likewise, at 57600, it may be necessary in some applications to configure the ZN-241G for 2 stop bits to avoid overrunning the host.

SerialParams

Sets the operating parameters of the serial port. The following modes are supported:

Setting	Mode
0x00	No parity, 8 data bits, 1 stop bit
0x01	No parity, 8 data bits, 2 stop bit
0x02-03	reserved
0x04	Even parity, 8 data bits, 1 stop bit
0x05	Even parity, 8 data bits, 2 stop bit
0x06	Odd parity, 8 data bits, 1 stop bit
0x07	Odd parity, 8 data bits, 2 stop bit

ProtocolMode

Enables or disables use of the radio's host protocol.

- 0 = transparent / point-to-point / ACK / with Auto-Match (default)
- 1 = transparent / point-to-point / ACK
- 2 = transparent / multipoint / no-ACK
- 3 = protocol / multipoint / ACK

In transparent modes, the radio will accumulate bytes until either it reaches a maximum size of 109 bytes, or there is a gap in the data longer than the `TxTimeout`. The difference between the ACK and no-ACK modes is that if ACKs are enabled, the radio will send the message and wait for a response from the intended recipient. If none is received, it will resend the message up to `TxAttemptLimit` times. When finished, the radio will output a TX_DATA_REPLY packet to indicate the result to the host. In no-ACK mode, each datagram is sent over the air only once, there is no acknowledgement, and there is no TX_DATA_REPLY notification.

Auto-Config mode, which is the default, is intended to allow a pair of units to communicate with each other right out of the box without any configuration by the user. When configured for Auto-Config, a radio will alternate between base and remote modes approximately every 4 seconds attempting to link with another radio. If the link is broken, either due to one radio powering off or going out of range, the Auto-Config process will resume toggling the device mode until a link is recovered.

In protocol mode, the maximum allowable packet size is 109 bytes (payload bytes), or a length value of 112.

`PanID`

Sets the radio's PAN identifier. Radios must have the same PAN identifier in order for them to link or exchange data. A remote may be given a `PanID` of `0xFFFF`, which instructs it to take the PAN ID of the first base it finds. In this case, the `CurrPanID` register may be used to read back the ID of the PAN selected.

`ChannelMask`

Sets the list of channels that the radio is allowed to choose from. (See Section 7 - Frequency Selection.) For a base radio, it is generally recommended that one channel be selected in the mask. This gives it a known channel for frequency planning purposes. If more than one channel is enabled, the base will pick one of them at random at startup, and not switch from it unless the radio is reset or power-cycled.

For a remote radio, the channel mask specifies which channels it will look for a base on. For greatest flexibility, it is useful to set a remote for all channels, so that the remotes need not all be reconfigured if it is necessary to reassign the base to a new frequency. For a slightly faster link time, set the remote's mask to a single channel. If a remote loses link, is reset, or is power-cycled, it will rescan all of the channels in its mask continually until its base is found.

`CurrPanID`

Used to read back the radio's current PAN identifier. For use with remotes that have been set with `PanID` = **`0xFFFF`**.

CurrNwkAddress

Used to read back the radio's current network address. This is a number between **0x00** and **0x3D** (61decimal). The base is always address 0. Remotes will report **0xFF** if they have not yet linked with a base. Base radios store network addresses they have assigned to remotes in EEPROM, so a remote should get the same address each time it connects. There is a limit of 61 remote addresses that the base can store, however, and if this limit is reached, the base clears its table and reboots to ensure that all remotes are forced to disconnect and reattach.

CurrMacAddress

Used to read back the radio's unique factory-set MAC address.

TxAttemptLimit

The maximum number of times a radio will attempt to send a data packet if no ACK is received. See `ProtocolMode` for more details. Default is 5 attempts

TxTimeout

In transparent mode, the maximum gap between data bytes before a message will be gathered from the buffer and sent over the air. Units are milliseconds. Default is 5 milliseconds. See `ProtocolMode` for more details.

AutoRelayEnable

Enables the auto-relay messaging feature of the ZN-241G. This allows a transmitting radio which has not been acknowledged by its recipient to relay its message to another radio to retransmit on its behalf.

HardwareVersion

This returns a 2-digit BCD identifier indicating the hardware version the radio is running on.

FirmwareVersion

This returns a 2-digit BCD identifier indicating the firmware version the radio is running.

LinkStatus

Indicates whether radio is ready to send data. '0' = unlinked, '1' = linked.

TransLinkAnnEn

In transparent mode, other than the LED, there is no direct means of determining whether or not a radio is linked. Setting this field to a one will cause the radio to send the string "LINK" to the host, either in the case of a remote whenever it successfully associates with a base, and in the case of a base whenever a remote successfully associates with it. Disabled by default.

MemorySave

Writing a zero to this location clears all registers back to factory defaults. Writing a one to this location commits the current register settings to EEPROM. When programming registers, all changes are considered temporary until this command is executed

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4.2 ZN-241G Configuration Examples

Some example commands and replies are listed below.

Example 1: Configure a remote to switch from transparent mode to protocol mode, set the PAN ID and channel mask, save the new settings, and restart so that they take effect. After connection with the base, send a message to the base and receive a response.

Enter Protocol Mode

Host Packet

FB	08	00	00	ZN-241G
SOP (0XFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Reply Packet

FB	02	00	10	
SOP (0XFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Set Register - PAN ID = `0xE701`

Host Packet

FB	06	01	04	04 00 01 E7
SOP (0XFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Reply Packet

FB	02	01	14	
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Set Register - Channel Mask = 2440 MHz only

Host Packet

FB	08	02	04	05 00 00 00 04 00
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Reply Packet

FB	02	02	14	
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Set Register - Protocol Mode = mode 3 (protocol enabled)

Host Packet

FB	05	03	04	03 00 03
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Reply Packet

FB	02	03	14	
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Set Register - Save changes to EEPROM

Host Packet

FB	08	04	04	FF FF
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Reply Packet

FB	02	04	14	
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Reset Radio

Host Packet

FB	02	00	00	
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Reply Packet

FB	02	00	10	
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Status Announce - Initialization complete

Reply Packet

FB	03	01	17	00
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Status Announce - Joined PAN

Reply Packet

FB	03	02	17	04
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Transmit Data (to base, address `0x0000`)

Host Packet

FB	0B	03	05	00 00 54 65 73 74 69 6E 67
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

Reply Packet

FB	02	03	15	00 C4
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

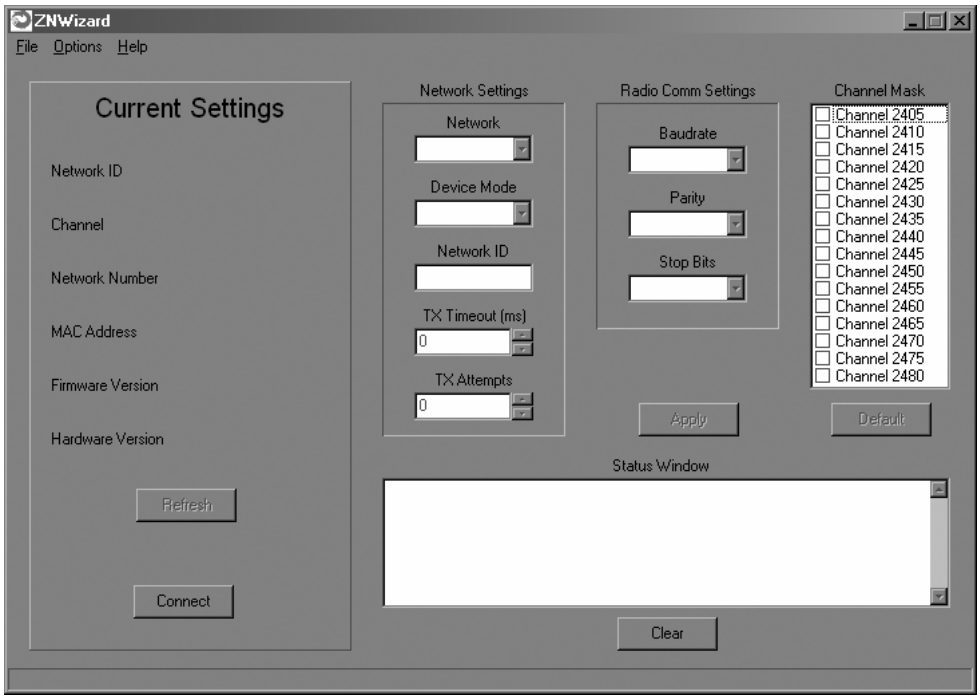
Receive Data (from base, address `0x0000`)

Reply Packet

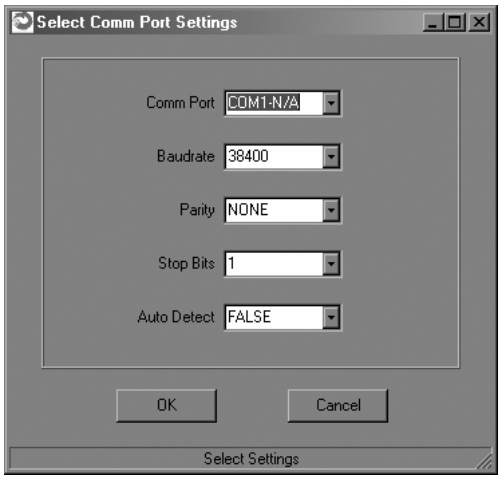
FB	13	04	15	00 00 C2 4D 65 73 73 61 67 65 20 72 65 63 65 69 76 65 6D
SOP (0xFB)	**Length (in bytes)**	**TransID**	**MSG Type**	**Arguments**

5. ZN Wizard

ZNWizard can be found on the Software and Documentation CD. Double click on znwizard.exe and the following screen will appear.

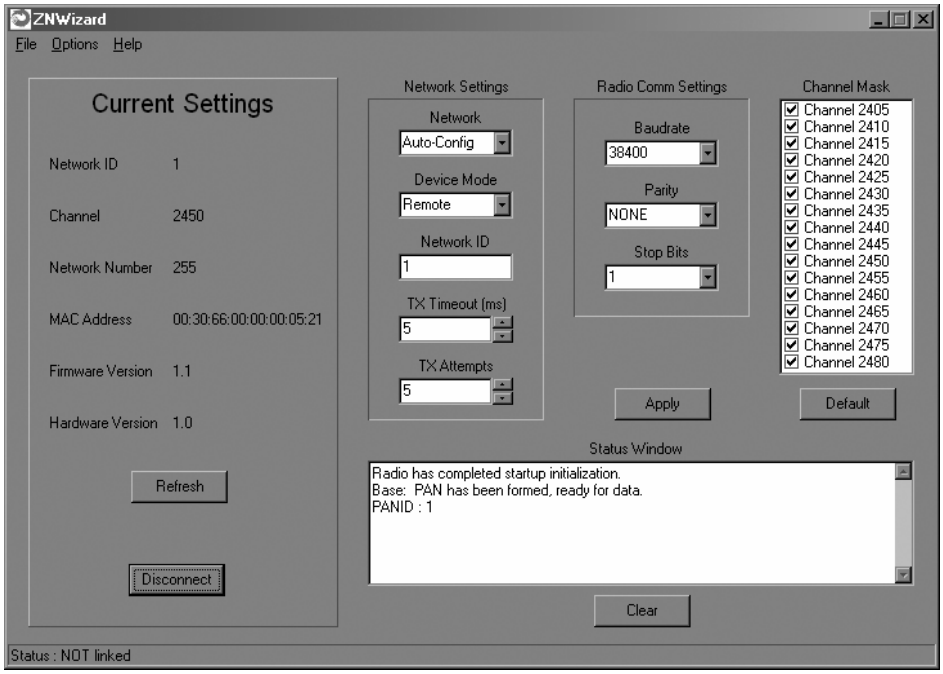


Click on Connect and the Select Comm Port Settings dialog will display as shown below. This dialog allows for changing configuration parameters for the Comm Port, Baudrate, Parity, Stop Bits and Auto-Detect.



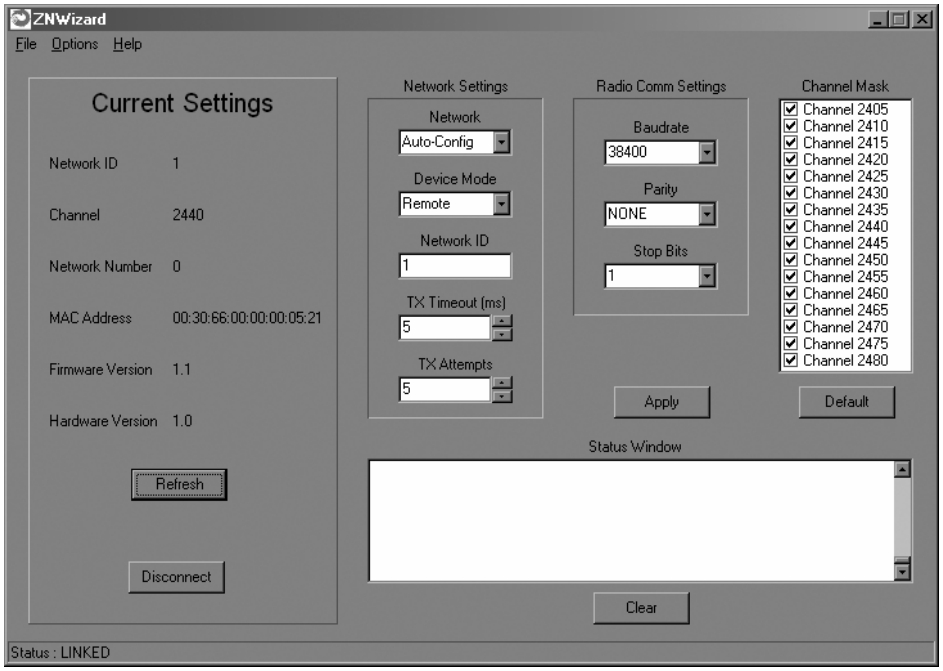
If all the default settings are suitable, click OK and the software will go out and find the ZN-241G. If there is a problem with the default settings, use the drop-down menus to make changes. For a more detailed description of these parameters, refer to the individual descriptions at the end of this section.

Once a ZN-241G is found, the following screen will display.

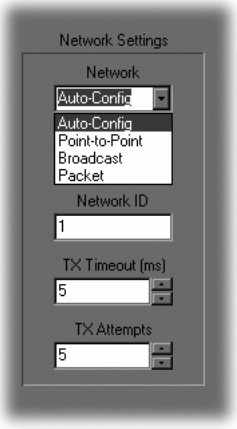
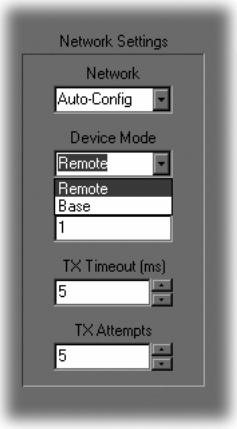
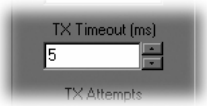
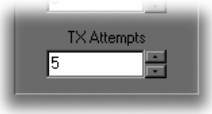


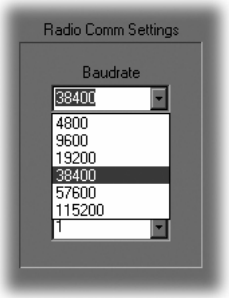
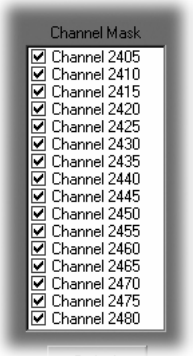
Notice that the "Status" in the lower left hand corner of the screen says "NOT linked". If another ZN-241G cannot be found, the program will continue to periodically attempt to find and link with another ZN-241G. During that time, the Status Window will continue to display information regarding the search.

Once another radio has been found and linked to, the "Status" in the lower left hand corner will change to LINKED and the Current Settings window will update as shown below.



In addition to changing the baud rate, ZN Wizard allows you to modify many other parameters in the ZN-241G radio. In the center of the dialog window is a box labeled, "Network Settings". The first drop down menu is labeled "Network" as shown below.

	The four choices are, Auto-Config, Point-to-Point, Broadcast and Packet. For a more detailed description of these parameters, refer to Section 4.1
	Device Mode sets the mode of the radio to either Remote (default) or Base. There can be only one base radio for the network.
	This sets the Network identifier. Radios must have the same network identifier in order for them to link and exchange data.
	In transparent mode, the maximum gap between data bytes before a message will be gathered from the buffer and sent over the air. Units are milliseconds and the default is 5 ms.
	The maximum number of times a radio will attempt to send a data packet if no ACK is received. Default is 5 attempts.

	Sets the rate divisor of the serial port. Default is 38,400.
	This sets the parity operating parameters for the serial port. Default is NONE.
	This control sets the stop bits operating parameter for the serial port. Default is 1.
	This sets the list of channels the radio is allowed to choose from. For a more detailed description of these parameters, refer to Section 4.1. See also Section 7 – Frequency Selection.

After changing any parameters on the ZN Wizard, click on the Apply button to save the settings.

6. Frequency Selection

The ZN-241G uses a set of channels as defined by the IEEE 802.15.4 / ZigBee standards which span a range from 2405 to 2480 MHz with 5 MHz spacing between channels:

Center Frequency (MHz)	Nominal Occupied BW	ZigBeee Channel Designator
2405	2402.5-2407.5	11
2410	2407.5-2412.5	12
2415	2412.5-2417.5	13
2420	2417.5-2422.5	14
2425	2422.5-2427.5	15
2430	2427.5-2432.5	16
2435	2432.5-2437.5	17
2440	2437.5-2442.5	18
2445	2442.5-2447.5	19
2450	2447.5-2452.5	20
2455	2452.5-2457.5	21
2460	2457.5-2462.5	22
2465	2462.5-2467.5	23
2470	2467.5-2472.5	24
2475 (default)	2472.5-2477.5	25
2480	2477.5-2482.5	26

The *channel mask* is the name used to describe the list of frequency channels that a ZN-241G can use. The default channel mask for remote radios allows them to operate on any frequency from 2405 to 2475 (channel 2480 is reserved for manufacturing test purposes and therefore not included). The default channel mask setting for base radios is to use 2425 MHz only.

Because the default channel mask for remote radios allows them to link to a base on any channel (except for 2480), the installer can easily change the frequency of the entire network simply by changing the channel mask of the base radio. It is not recommended that the channel mask of the base radio be set to include more than one channel. If more than one channel is provided, at power-up the base will select one of the enabled channels at random, which will make the network difficult to troubleshoot if there are any interfering signals in the area.

When changing the base's channel, the base must be reset or power-cycled for it to take effect. The remote radios will not be immediately aware that the base has changed frequency, and may take up to 35 seconds to find the base at the new frequency and reconnect. Alternatively, the remotes may all be powered off and back on, in which case they will locate the base at the new frequency in the usual amount of time it takes them to link (3-6 seconds).

The most likely source of interference for ZN-241G networks is from nearby 802.11b/g access points. A laptop computer with a wireless card or a portable WiFi detector such as the one offered by Canary Wireless (http://www.canarywireless.com) may be used to identify potential threats. 802.11b/g defines 11 channels in the 2.4 GHz band:

802.11 Channel	Nominal Occupied BW	Center Frequency (MHz)
1	**2401-2423**	**2412**
2	2406-2428	2417
3	2411-2433	2422
4	2416-2438	2427
5	2426-2448	2432
6	**2431-2453**	**2437**
7	2436-2458	2442
8	2451-2473	2447
9	2452-2463	2452
10	2446-2468	2457
11	**2451-2473**	**2462**

WiFi access points typically default out of the box to one of three channels: 1, 6, or 11. The ZN-241Gs default channel setting is 2475 MHz, which places it beyond the highest legal 802.11gb channel in the U.S. If this frequency is not available, another good choice is 2425 MHz, which places it at the notch between 802.11b/g channels 1 and 6. This way, even if there are 802.11b/g networks running at both 1 and 6, there is a pretty good chance that the ZN-241G will be able to penetrate their interference. Since the ZN-241G's signal spans a smaller portion of the band, its signal is more concentrated.

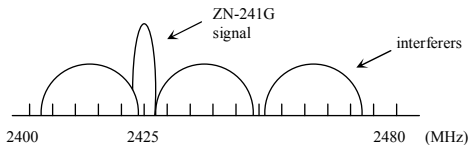


Figure 1. WiFi signals versus ZN-241G signal

In most cases, even though the presence of nearby WiFi access points may be detected, it is unlikely that anything but a very strong signal would be able to actively interfere with a ZN-241G network. To interfere with another transmitter, a competing RF signal must in general be of the same order of magnitude in strength.

Another point to consider is that WiFi access points only transmit when they have data to send. If interference from WiFi signal is suspected, consider whether more problems occur during particular times of day when the WiFi network would most likely be heaviest.

If an interfering signal cannot be positively identified, a good approach is to try moving the base to the opposite end of the band (e.g. from 2425 to 2475 MHz) and see if the operation of the system improves. If this doesn't work, the middle of the band may then be tried (2450 MHz).

Troubleshooting example:

An installation has been experiencing high packet error rates and slow response times ever since a new business opened across the street. The problems occur most frequently during the lunch rush. A WiFi detector indicates that there is a strong signal on 802.11b/g channel 4 (2427 MHz). The installer changes the channel of the the ZN-241G base to 2475 MHz. After monitoring the system for 48 hours, it was determined that the problems had ceased and that the new channel was free from interference.

Channel Mask Field Format

The binary representation* for the default remote Channel Mask is:

00	F8	FF	03
0000 9999	0001 1111	1111 1111	1100 0000
0 7	8 15	16 23	24 31

*(in little-endian order as required for GET_REGISTER).

7. Specifications:

- Star topology with limited peer-to-peer capability, one base and up to 60 remotes.
- Single-hop mesh store-and-forward to enable routing around dead spots.
- Operating Band 2400-2483.5 MHz
- Radio Type Direct Sequence (DTS), IEEE 802.15.4 PHY layer
- Channel Bit Rate 250 Kbps
- Channel Chipping Rate 2 Mcps
- Modulation MSK with Raised Cosine Filtering
- Certification Type DTS device per FCC 15.247 and ETS 300-328
- RF power +17 dBm typical, +15 dBm minimum
- Receiver Sensitivity -98 dBm typical, -95 dBm minimum
- Link Margin 110 dB (approximately 3 Km LOS propagation)
- Adjacent Ch. Rejection >39 dB with jammer @ 5 MHz offset
- Spurious Output Per FCC 15.247 and ETS 300-328
- Input Voltage 5.5 volts minimum, 6 volts nominal, 15 volts max
- Current Consumption 70 mA typical operating, 180 mA peak (transmit)
- Operating Temp Range -40 C to + 70 C
- Humidity 95% Non-condensing
- RF Connector Reverse SMA
- Host Connector Male DB-9 (Amp 747840-3)
- Power Connector CUI Stack PJ-002A

A ZN-241G network consists of a Base and one or more Remotes. The radio type will be selectable by the user.

8. Hardware Requirements

The hardware for the ZN-241G includes the following:

- 6v DC supply.
- Reverse-polarity SMA connector.
- Male DB-9 DCE interface (4-wire interface: TXD, RXD, and CTS only). Note that DCE interfaces are usually female.

9. Warranty

Seller warrants solely to Buyer that the goods delivered hereunder shall be free from defects in materials and workmanship, when given normal, proper and intended usage, for twelve (12) months from the date of delivery to Buyer. Seller agrees to repair or replace at its option and without cost to Buyer all defective goods sold hereunder, provided that Buyer has given Seller written notice of such warranty claim within such warranty period. All goods returned to Seller for repair or replacement must be sent freight prepaid to Seller's plant, provided that Buyer first obtain from Seller a Return Goods Authorization before any such return. Seller shall have no obligation to make repairs or replacements which are required by normal wear and tear, or which result, in whole or in part, from catastrophe, fault or negligence of Buyer, or from improper or unauthorized use of the goods, or use of the goods in a manner for which they are not designed, or by causes external to the goods such as, but not limited to, power failure. No suit or action shall be brought against Seller more than twelve (12) months after the related cause of action has occurred. Buyer has not relied and shall not rely on any oral representation regarding the goods sold hereunder, and any oral representation shall not bind Seller and shall not be a part of any warranty.

THE PROVISIONS OF THE FOREGOING WARRANTY ARE IN LIEU OF ANY OTHER WARRANTY, WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL (INCLUDING ANY WARRANTY OR MERCHANT ABILITY OR FITNESS FOR A PARTICULAR PURPOSE). SELLER'S LIABILITY ARISING OUT OF THE MANUFACTURE, SALE OR SUPPLYING OF THE GOODS OR THEIR USE OR DISPOSITION, WHETHER BASED UPON WARRANTY, CONTRACT, TORT OR OTHERWISE, SHALL NOT EXCEED THE ACTUAL PURCHASE PRICE PAID BY BUYER FOR THE GOODS. IN NO EVENT SHALL SELLER BE LIABLE TO BUYER OR ANY OTHER PERSON OR ENTITY FOR SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFITS, LOSS OF DATA OR LOSS OF USE DAMAGES ARISING OUT OF THE MANUFACTURE, SALE OR SUPPLYING OF THE GOODS. THE FOREGOING WARRANTY EXTENDS TO BUYER ONLY AND SHALL NOT BE APPLICABLE TO ANY OTHER PERSON OR ENTITY INCLUDING, WITHOUT LIMITATION, CUSTOMERS OF BUYERS