ZB2430 SDK

USER MANUAL

Laird TECHNOLOGIES

Innovative **Technology**
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REVISION HISTORY

REVISION HISTORY

Revision	Description

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OVERVIEW

OVERVIEW

This document contains information about the hardware included as part of the Laird Technologies OEM ZB2430 family Developer Kit.

The ZB2430 Development Kit is designed to allow flexibility at the hardware interface level so that the development board can easily be interfaced to the OEM product, to a PC for performance testing, or to any other device that will support RS232 or USB serial interfaces.

The ZB2430 Development Kit is a complete, integrated package that contains all of the hardware, software, and documentation needed to integrate an OEM transceiver quickly and effortlessly.

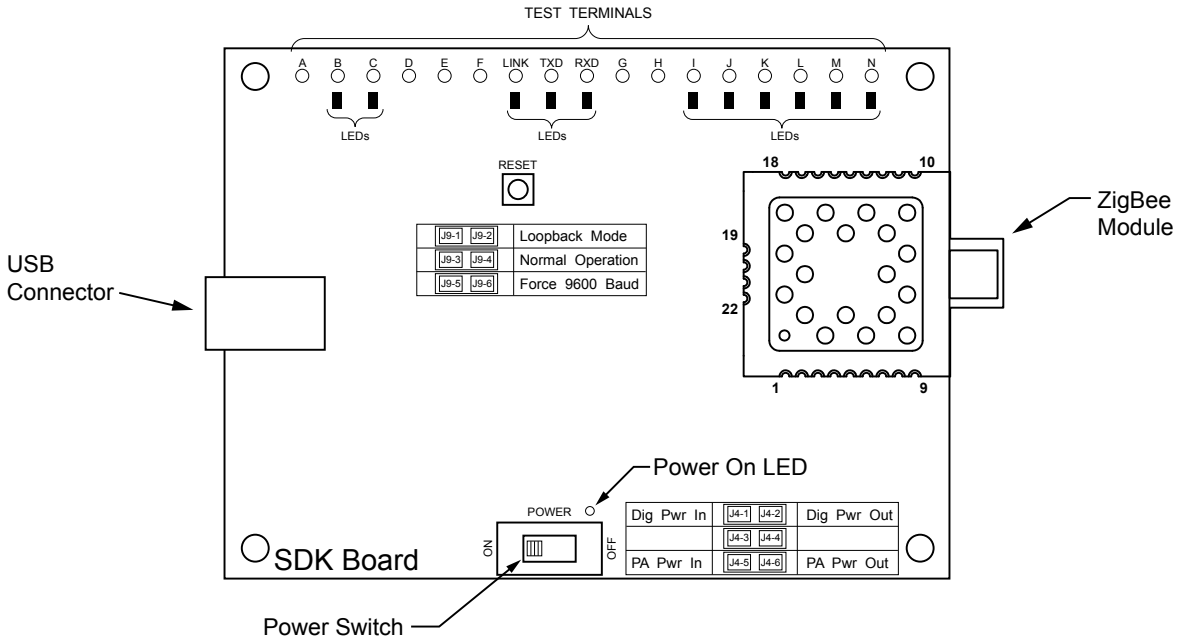
There are a number of Development Kits to choose from depending on the OEM needs. The complete list is in the table below.

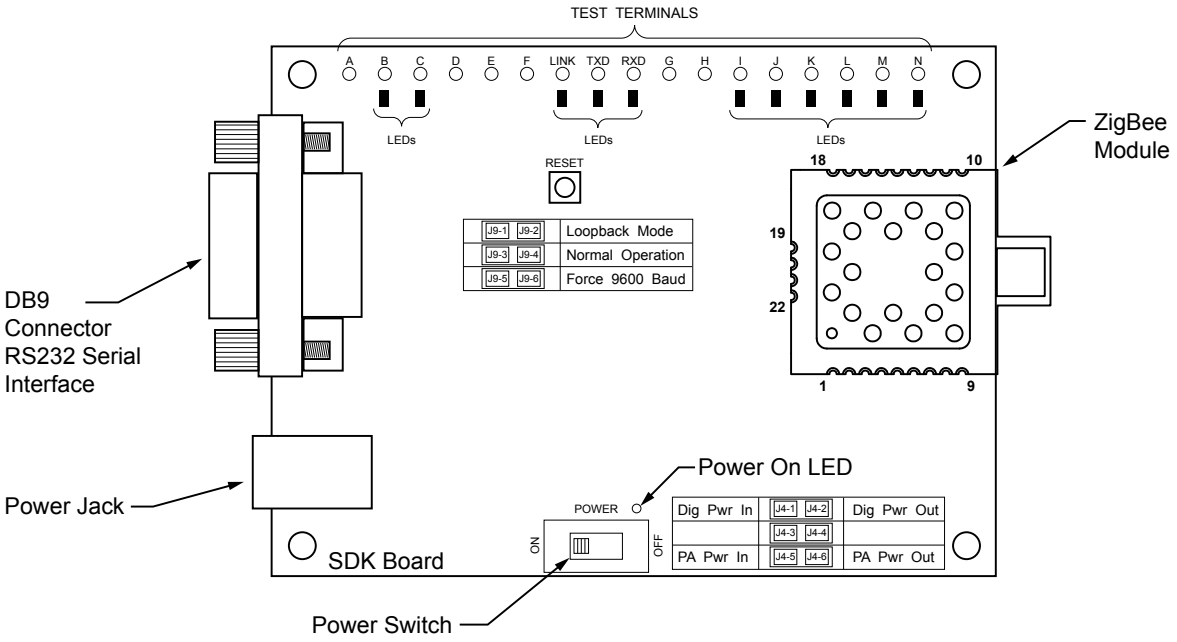
ZB2430 DEVELOPMENT KITS*	
Part Number	Description
SDK-Z100S1UF	100mW External Antenna
SDK-Z100S1AF	100mW Internal Antenna
SDK-Z040S1UF	40mW External Antenna, CE version
SDK-Z040S1AF	40mW Internal Antenna, CE version
SDK-Z100S1UF-M	100mW External Antenna with OAD Functionality
SDK-Z100S1AF-M	100mW Internal Antenna with OAD Functionality
SDK-Z040S1UF-M	40mW External Antenna with OAD Functionality, CE version
SDK-Z040S1AF-M	40mW Internal Antenna with OAD Functionality, CE version

*All Development Kits come with one Coordinator with a USB Interface, two Routers with RS-232 Interfaces, and two End Devices with RS-232 interfaces. -M units also come with an RS-232 Commissioner for OAD functionality

HARDWARE

The ZB2430 DEVELOPMENT KIT board is provided so that the developer can use a standard PC interface to operate the transceivers and to aid in system integration. It uses either a RS232 (Router or End Device) or USB (Coordinator) data format to interface to the transceiver.





HARDWARE

The configuration and operation of the ZB2430 DEVELOPMENT KIT board is continuously shown by the LEDs located on the front edge of the board. Refer to the following tables for definitions of the LEDs and DB9 connector pin assignments.

LED	LED COLOR	PURPOSE
B	Green	This LED will illuminate when GIO_6 is low.
C	Red	This LED will illuminate when GIO_4 is low.
I	Green	This LED will illuminate when 9600_BAUD is high.
J	Red	This LED will illuminate when GIO_7 is low.
K	Red	This LED will illuminate when GIO_3 is low.
L	Green	This LED will illuminate when GIO_2 is low.
M	Red	This LED will illuminate when GIO_1 is low.
N	Green	This LED will illuminate when GIO_0 is low.
LINK	Red	This LED will illuminate when In_Range is high.
TXD	Green	This LED will illuminate when TXD is low.
RXD	Red	This LED will illuminate when RXD is low.
Power	Green	This LED will illuminate when the POWER switch is turned on and the module is receiving power.

DB9 PIN	SIGNAL NAME	DESCRIPTION	DIRECTION1
1	DCD	Data Carrier Detect	I
2	RXD	Received Data	I
3	TXD	Transmitted Data	O
4	DTR	Data Terminal Ready	O
5	GND	Signal Ground	
6	DSR	Data Set Ready	I
7	RTS	Request to Send	O
8	CTS	Clear to Send	I
9	RI	Ring Indicator	I

1. Note: I/O direction is relative to the PC.

POWER SWITCH

The ZB2430 DEVELOPMENT KIT board is equipped with a power switch. This switch is used to turn the power to the board on and off. This power switch should be turned OFF when the USB or power supply cable is connected or disconnected to prevent possible damage to the board.

SWITCH	DESCRIPTION
Power	When set to the OFF position, power will be removed from the ZB2430 Development Kit board and the ZB2430 transceiver.

JUMPER USAGE

The ZB2430 DEVELOPMENT KIT board utilizes a set of jumpers to accomplish certain tasks. There are two sets of jumpers, the J4 set and the J9 set.

JUMPER SET J4

The J4 set of jumpers is used to complete the circuits that supply power to the radio. There are two jumpers, and BOTH JUMPERS MUST BE PROPERLY INSTALLED for the module to operate. A jumper MUST be installed on J4-1 and J4-2 to supply power to the radio itself. Another jumper MUST also be installed on J4-5 and J4-6 to supply power to the power amplifier.

HARDWARE

JUMPER SET J9

The J9 set of jumpers is used to control how the development kit board will operate. Only one jumper is used with this jumper set. There are three operational modes:

- Loopback – When the jumper is installed on pins J9-1 and J9-2 the unit will operate in loopback mode. This means that the radio will receive data and then turn around and transmit the same data. The loop is on the serial interface of the module and points back to the radio. This jumper is useful for range testing.
- Normal Operation – When the jumper is installed on pins J9-3 and J9-4, the unit will operate in its normal mode. This means that the radio will operate however it is configured using the SDK software application.
- Force 9600 Baud – When the jumper is in stalled on pins J9-5 and J9-6, the unit will only operate at 9600 Baud. This is a recovery mode that is used when the user is unable to communicate with the radio. This mode places the unit in a known operating state so the user can go in and access the programmed data via the development software.

JUMPER ID	LABEL	USAGE
J4-1	Dig Pwr In	A jumper MUST be connected to these two pins for operation. This is the power supply circuit for the radio.
J4-2	Dig Pwr Out	
J4-3	Not Used	Not Used
J4-4	Not Used	Not Used
J4-5	PA Pwr In	A jumper MUST be connected to these two pins for operation. This is the power supply circuit for the power amplifier.
J4-6	PA Pwr Out	
J9-1	Loopback	To configure the radio for loopback operation, a jumper will be connected to these two pins. A jumper MAY NOT be connected to the Normal Operation or Force 9600 Baud pins at the same time.
J9-2	Loopback	
J9-3	Normal Operation	During normal operation, a jumper will be connected to these two pins. A jumper MAY NOT be connected to the Loopback or Force 9600 Baud pins at the same time.
J9-4	Normal Operation	
J9-5	Force 9600 Baud	To force the radio to operate at 9600 Baud, a jumper is connected to these two pins. A jumper MAY NOT be connected to the Loopback or Normal Operation pins at the same time.
J9-6	Force 9600 Baud	

INTERFACING THE ZB2430 DEVELOPMENT KIT TO OTHER RS232 HARDWARE

The development kit serial board is defined as a DCE (Data Communications Equipment) device. A DCE device is wired to the interface directly with the DTE (Data Terminal Equipment) device. Typically, a DTE device is defined as a PC, while a DCE device is defined as a peripheral. To interface a DCE device to another DCE device, or a DTE device to another DTE device, a null modem is required. The null modem simply swaps pins to convert a DCE device to a DTE device, and vice-versa. Normally, a null modem consists of a female and a male DB9 connector. A typical null modem configuration is shown in the following graphic.

DB9 PIN	SIGNAL NAME	DCE DIRECTION	DTE PIN	SIGNAL NAME	DTE DIRECTION	NULL MODEM FEMALE DB9	NULL MODEM MALE DB9
1	DCD	O	1	DCD	I	1	4 or NC
2	RXD	O	2	TXD	I	2	3
3	TXD	I	3	RXD	O	3	2
4	DTR	I	4	DTR	O	4	6 & 1 or NC
5	GND		5	GND		5	5
6	DSR	O	6	DSR	I	6	4 or NC
7	RTS	I	7	RTS	O	7	8
8	CTS	O	8	CTS	I	8	7
9	RI	O	9	RI	I	9	NC

SOFTWARE

SDK SOFTWARE INSTALLATION

The OEM software is provided in the included CD under Design Kits and Software -> Resources. Click on the OEM Configuration Utility to install the software. During the installation, the software will prompt the user to install the Laird Technologies USB Driver. It is recommended that the user installs the driver at the same time as the software. The first time the software is run, the following message will be displayed:

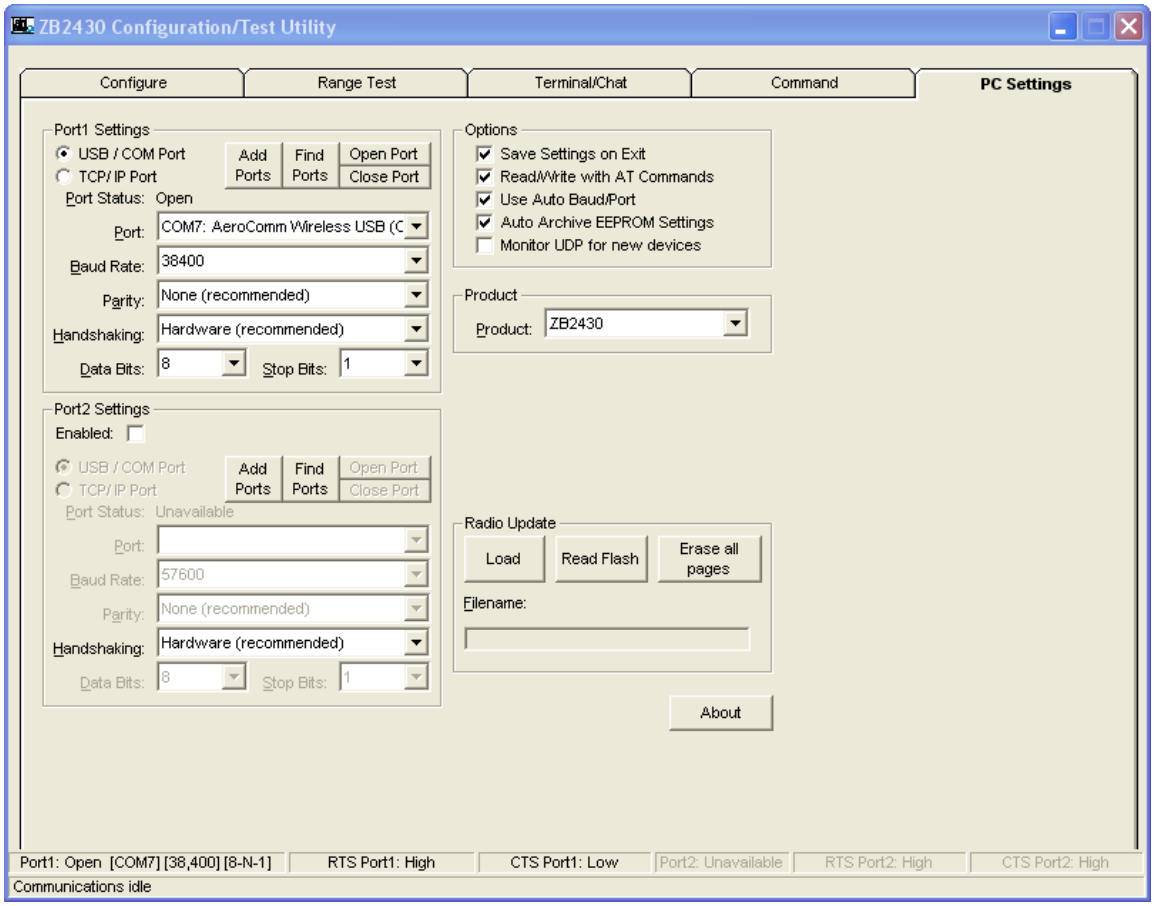
Click "OK." The software will attempt to open COM1 of the PC. If there is a conflict or the port does not exist, the software will show the port as unavailable. This error will be displayed when one of the following conditions exists:

- There is other software running that has control over the COM1 port. Locate this software and shut it down while running "Laird OEM.exe" software.
- The PC either does not have a COM1 port or the port has been disabled.

PC SETTINGS TAB

The PC Settings tab is shown in the following graphics, as it will appear the first time the program is run.

Select the ZB2430 in the Product pull-down menu. Doing this will automatically select the default baud rate of 38400. Use the Find Ports button to search Windows for existing Com Ports. The ports will then be available in the drop-down for the Port1 Settings. If the desired Com Port is not found, you can manually add it with the Add Ports button. If the COM port is listed as unavailable, a different COM port can be selected in the Port pull-down menu. The application can use two serial ports if the Enabled: box is checked under Port 2 settings.



SOFTWARE

Port 1/Port 2 Options

The application can control up to (2) COM ports, including virtual COM ports. The Port pull-down menu allows selection of any COM port which was discovered with the Find Ports button or added manually with the Add Ports button. When a port selection is made, the application will attempt to open the port and list its status as:

- Unavailable
- Open
- Closed

The Port Status is shown just above the Port pull-down menu and also in the status bar at the bottom of the screen. The software will only be able to communicate with a radio if the Port Status is Open.

Although menus are shown for Baud Rate, Parity, Handshaking, Data Bits, and Stop Bits, only the Baud Rate, Parity, and Handshaking menu selections can be changed.

Options

The application also provides the following options:

Save Settings On Exit

When this option is enabled, all changes made to the Settings tab will be automatically loaded the next time the application is run. Otherwise, any changes made will be discarded.

Read/Write With AT Commands

When this option is enabled, the application will use AT Commands for its read/write EEPROM functions instead of the standard configuration commands. This box should be checked at all times unless Pin 15 (CMD/DATA) is pulled Logic Low.

Auto Baud

When this option is enabled, the application will provide the option to scan all available COM Ports using the most common baud rates, until a radio is found. If no radio is found or the application cannot open the port, an error message will be reported. The application will only use Auto Baud when prompted by the user after an unsuccessful write process.

Auto Archive

When this option is enabled, the application will archive the EEPROM settings for each radio after a successful write process.

Although not required, the application will prompt the user to type a description of the changes made. Auto Archive can be used to restore the radio to a previously known working configuration.

Monitor UDP For New Devices

This option is used for legacy ConnexNet products and does not apply to the ZB2430.

Status Bar

Located at the bottom of the application window, the status bar gives the state of Port 1, RTS Port 1, CTS Port 1, Port 2, RTS Port 2, and CTS Port 2 lines. When the text appears black, the current state will be shown. When the text appears gray, the current state will not be shown. The text shown in the bottom status bar gives a simplified status of the current, pending software process. The software has no pending process when “Communications Idle” is shown. On the right side of the status bar a progress bar is maintained to indicate the progress of longer commands such as a Find Ports or Write Radio.

About Button

The About button can be pressed to determine the revision number of the application and the contact information for Laird Technologies.

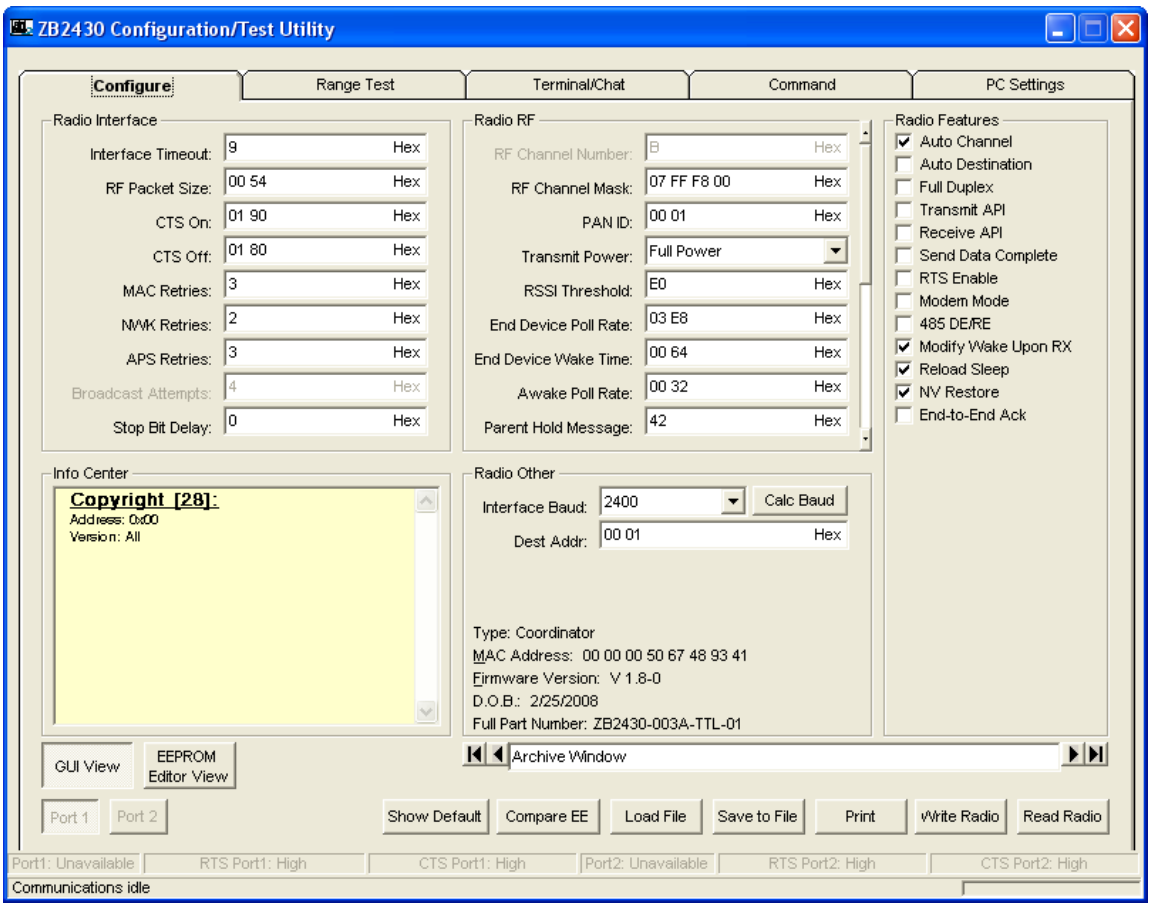
SOFTWARE

CONFIGURE TAB

The configure tab is used to display the 256 byte EEPROM contents. The screen is able to do this in two formats:

- GUI
- Hexadecimal

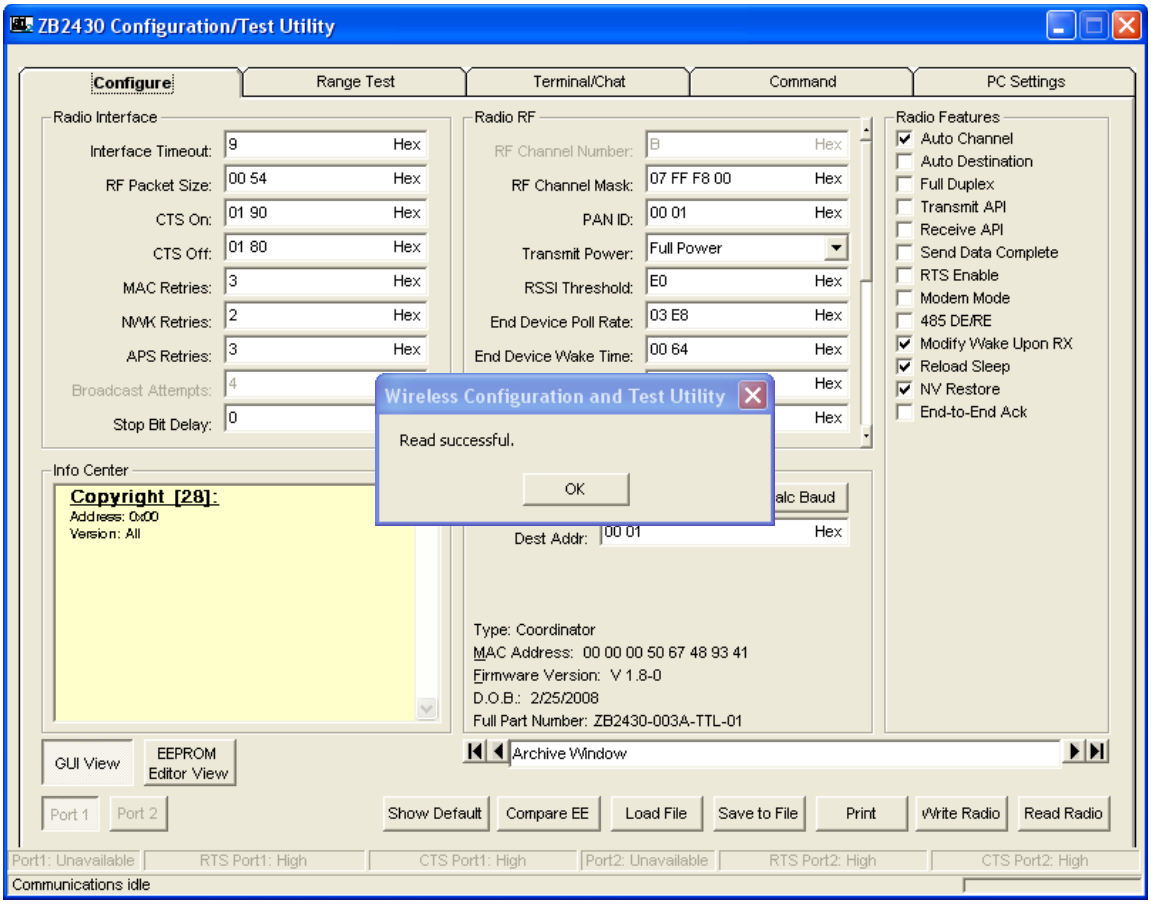
The GUI format is the default method of display. The user may change the display by using buttons located in the lower left corner of the application window. Clicking on the GUI View button will display the data in GUI format, while clicking on the EEPROM Editor View button will display the data in hexadecimal.



SOFTWARE

Read Radio Button

To update the Configure and EEPROM Editor View pages with the EEPROM contents of a radio currently connected to the proper port on the PC, click the Read Radio button. A successfully read radio will result in the following message being displayed:



Write Radio Button

After making changes to the controls on the Configure tab, the Write Radio button can be pressed to save those changes to the radio EEPROM.

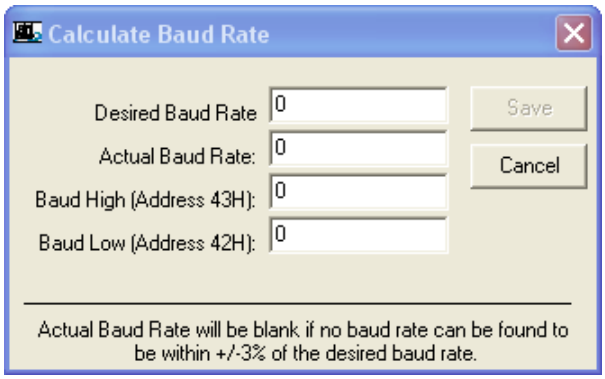
Port 1/Port 2 Buttons

When the Port 1 button is depressed, the Write Radio and Read Radio buttons communicate through Port 1. When the Port 2 button is depressed, the Write Radio and Read Radio buttons communicate through Port 2.

SOFTWARE

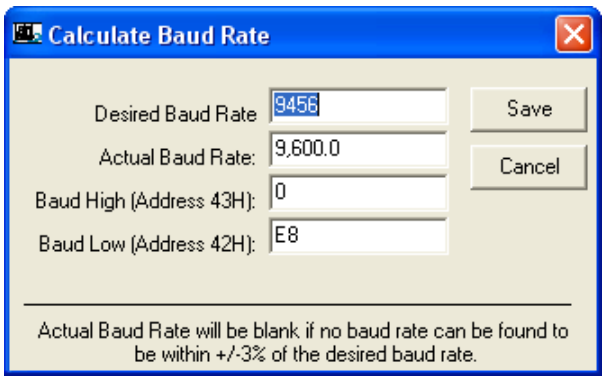
Calc Baud Button

The Baud pull-down menu includes all standard PC baud rates. In some rare cases, a user may want to use a non-standard baud rate. To do this, the user will need to click on the Calc Baud button. The Calculate Baud Rate dialog box will appear.

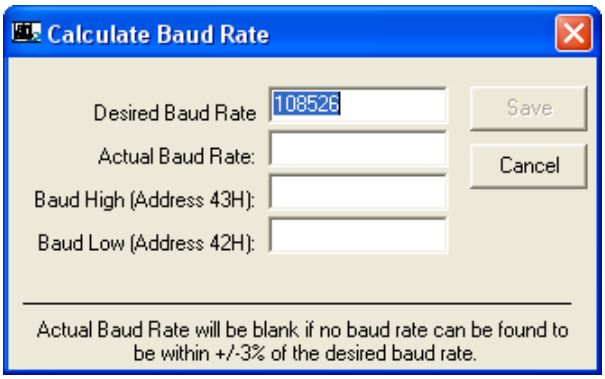


To calculate the settings for a particular baud rate, type that baud rate into the Desired Baud Rate text field. If the number in the Desired Baud Rate text field is ±3% of an acceptable baud rate, the rest of the fields in the Calculate Baud Rate will automatically populate. If the baud rate is not supported by the radio, the remaining text fields will continue to display the number 0.

An example of an acceptable non-standard baud rate being accepted is shown in the following graphic:



Acceptable Baud Rate Found



No Acceptable Baud Rate Found

Clicking the Save button will cause the baud rate shown in the Actual Baud Rate window to be displayed in the Baud window on the Configure tab of the application. Clicking Cancel will ignore these changes. The Actual Baud Rate will not always match the Desired Baud Rate. However, the program verifies that the Desired Baud Rate is within 3% of the Actual Baud Rate (as required by the radio).

SOFTWARE

Hex/Decimal Button

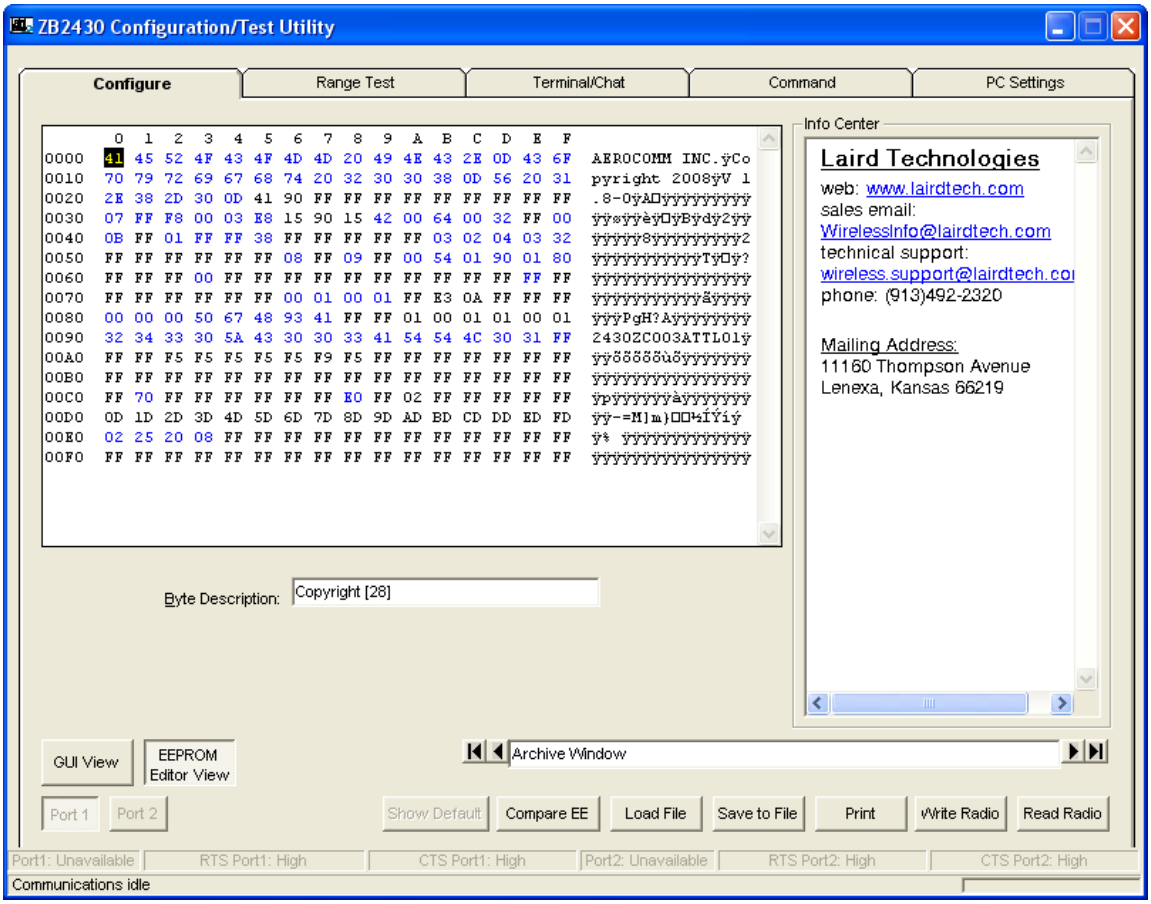
All of the text entry type boxes found on the Configure tab have an indication of whether the value is presented in Hexadecimal (Hex) or Decimal (Dec). The indication (Hex or Dec) can be pressed to toggle between Hexadecimal and Decimal notation.

GUI View Button

Clicking the GUI View Button enables a GUI representation of the 256 byte EEPROM contents of the radio.

EEPROM Editor View Button

Clicking the EEPROM Editor View enables a hexadecimal dump of the full 256 byte EEPROM resident on the radio. The EEPROM Editor View is shown in the following graphic, as it will appear after a radio has been successfully read:



Save to File Button

This button is used to save an EEPROM program to a file. This allows for the current state of the EEPROM to be restored at a later time.

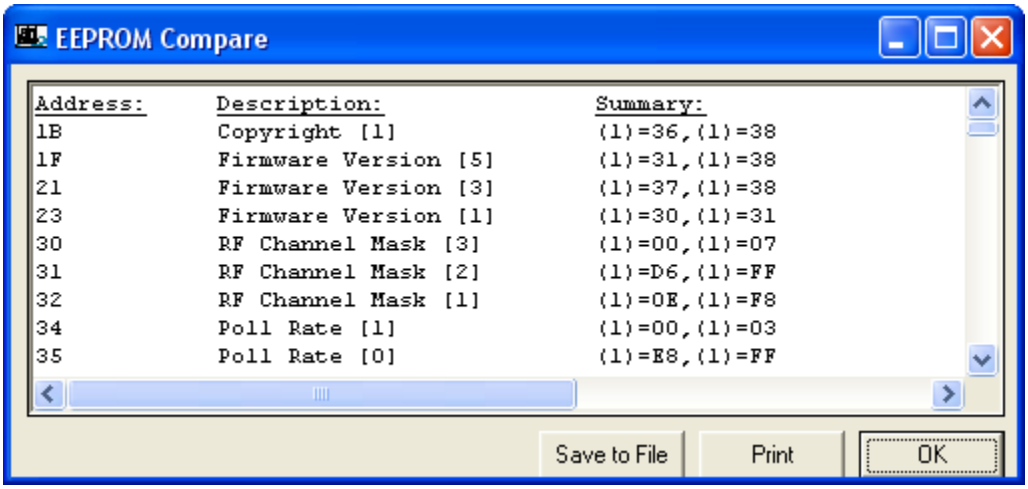
Load File Button

This button is used to load a file previously created by this application can be loaded to restore an EEPROM to a former state.

SOFTWARE

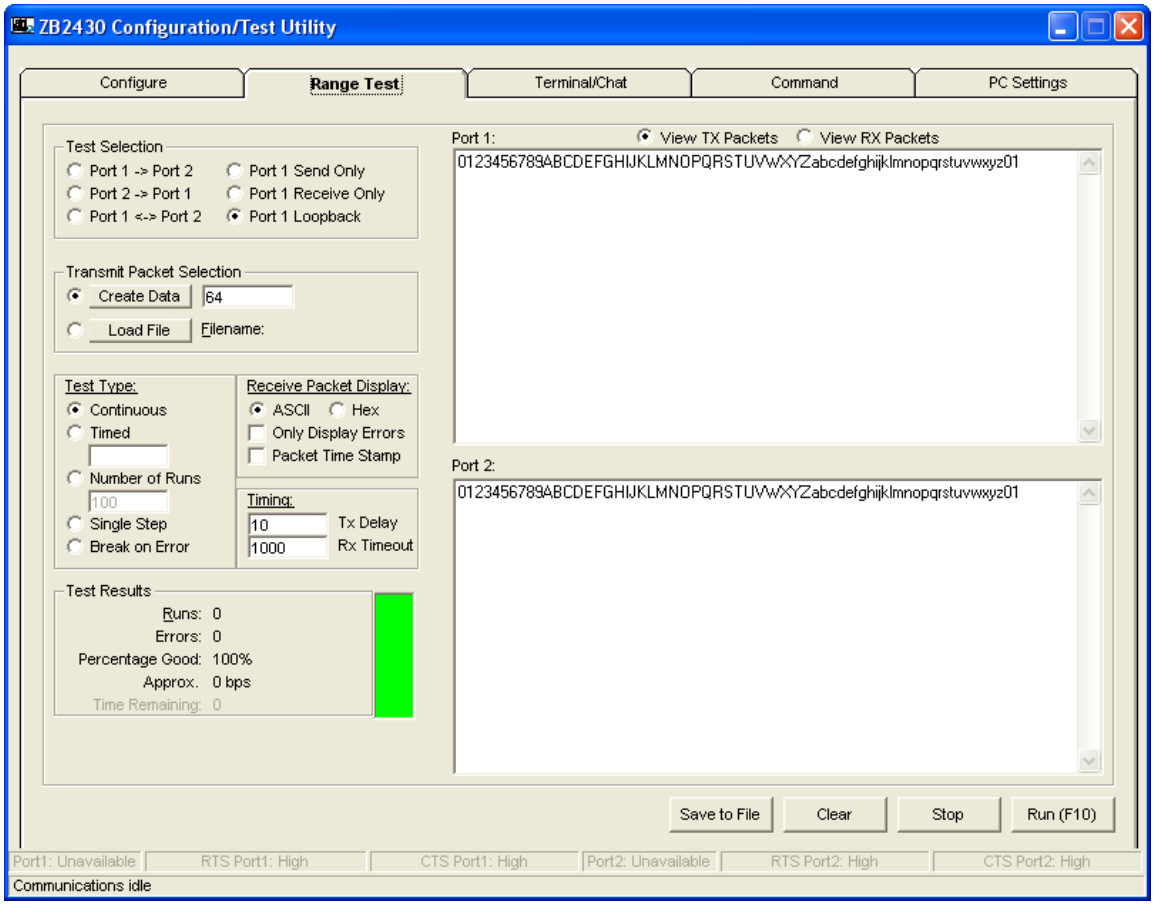
Compare EE Button

The Compare EE button allows you to compare two or more saved EEPROM files. This can be a very useful tool when analyzing performance of two or more transceivers. An example is shown in the following graphic:



RANGE TEST TAB

The Range Test tab allows packets of data to be sent between two radios and reports the numbers of successes and errors. An example is shown in the following graphic:



SOFTWARE

Test Selection

There are six test options that can be selected. For each of these options, excluding Port 1 Send Only, the SDK application will perform data verification as part of the test. This means that the application will send specific data out and the application expects a specific response to that transmission. If it does not get that specific response, it will report an error.

Important: The ports referred to are Ports for the application, NOT the Windows communication ports.

The available selections are:

- Port 1 -> Port 2 – This test selection is used when two development kits are connected to one PC. This selection is used to send data from the radio connected to Port 1 to the radio connected to Port 2.
- Port 2 -> Port 1 – This test selection is used when two development kits are connected to one PC. This selection is used to send data from the radio connected to Port 2 to the radio connected to Port 1.
- Port 1 <-> Port 2 – This test selection is used when two development kits are connected to one PC. This selection is used to send bi-directional data from both radios connected to the PC.
- Port 1 Send Only – This test selection is used when one development kit is connected to a PC. This selection is used only to send data from the radio connected to Port 1. This would most often be used when the remote radio is connected to a second PC and is running the Port 1 Receive Only test. There is no data verification with this option.
- Port 1 Receive Only – This test selection is used when two PCs are being used with two development kits. One development kit is connected to each PC. When this selection is made, the radio attached to the port of PC 1 will be receiving data sent from the radio attached to PC 2, which is set to Port 1 Send Only. Both PCs should be set up with the same number of bytes in the Create Data field.

  Important: The test on both computers should be initiated at the same time. If this is not done, there may be some errors reported until the two radios synchronize with each other.
- Port 1 Loopback – This test selection is used with two development kits and one PC. The PC will be connected to one development kit and will be running the development software. The second development kit will be powered on. The radio attached to the second development kit is set up in loopback mode, using a jumper to connect jumper pins J9-1 and J9-2. The radio attached to PC 1 will transmit data to the remote radio. The remote radio will receive the data and retransmit it back to the radio attached to PC 1.

There are three typical hardware setups.

1. One radio is plugged into a serial or USB port on a PC. The second radio is plugged into a separate power supply with a loopback adapter connected.
2. One radio is plugged into a serial or USB port on a PC. The other radio is plugged into a different serial or USB port on the same computer.
3. One radio is plugged into a serial or USB port on a PC. The other radio is connected to a serial or USB port on another PC.

If using two PCs for the test, the application run on both sides should have the second COM port disabled on the PC Settings tab.

TEST SELECTION	PORT 1 ACTION	PORT 2 ACTION	HARDWARE SETUP
Port 1 -> Port 2	TX	RX	2
Port 2 -> Port 1	RX	TX	2
Port 1 <-> Port 2	TX/RX	TX/RX	2
Port 1 Send Only	TX	N/A	3
Port 1 Receive Only	RX	N/A	3
Port 1 Loopback	TX/RX	N/A	1

SOFTWARE

Transmit Packet Selection

This section allows you to select the data packet used to perform the Range Test. You may either create data of a specified byte length or load your own text or configuration file.

Note: Laird Technologies recommends that the maximum packet length does not exceed 0x54 (84) bytes.

Test Type

The test type allows you to select how long the test will be performed. The choices are shown in the following graphic:

TEST TYPE	DESCRIPTION
Continuous	Test will run until stopped.
Timed	Test will run for a specified time period.
Number of Runs	Test will run for a specified number of runs.
Single Step	Test will run for a single step.
Break on Error	Test will run until an error occurs.

Receive Packet Display

This section allows you to select how the received packets will be displayed. The user is provided the following options:

- ASCII or Hexadecimal format
- Packet Time Stamp
- Only Display Errors

Timing

This section allows you to modify the TX and RX timing of the test.

TX Delay

This field allows the operator to change the amount of delay between transmissions (in milliseconds {ms}).

RX Timeout

This field allows the operator to change the amount of time to allow for a packet to be displayed.

Test Results

The Test Results area is used to displays the results of the test.

Runs

The run number is incremented every time a test is completed, whether errors occurred or not.

Errors

This is the number of errors that occurred while the test was being performed.

Percentage Good

This is the percentage of test results that were successful.

$$\frac{\text{Runs - Errors}}{\text{Runs}} \text{ X } 100 = \text{Percent Good}$$

Approx.

This is a display of the approximate throughput of the radio. The application uses a rough calculation to display the amount of data transferred in bits per second (bps).

Time Remaining

This field is used to indicate how much longer the test will run. Depending on how the test was initially setup, this field may display time, or if the test was set to run a specific number of runs, it will display the number of runs that remain.

SOFTWARE

Port 1/Port 2

Displays the Tx or Rx activity for Port 1 and Port 2.

View Tx Packets/View Rx Packets

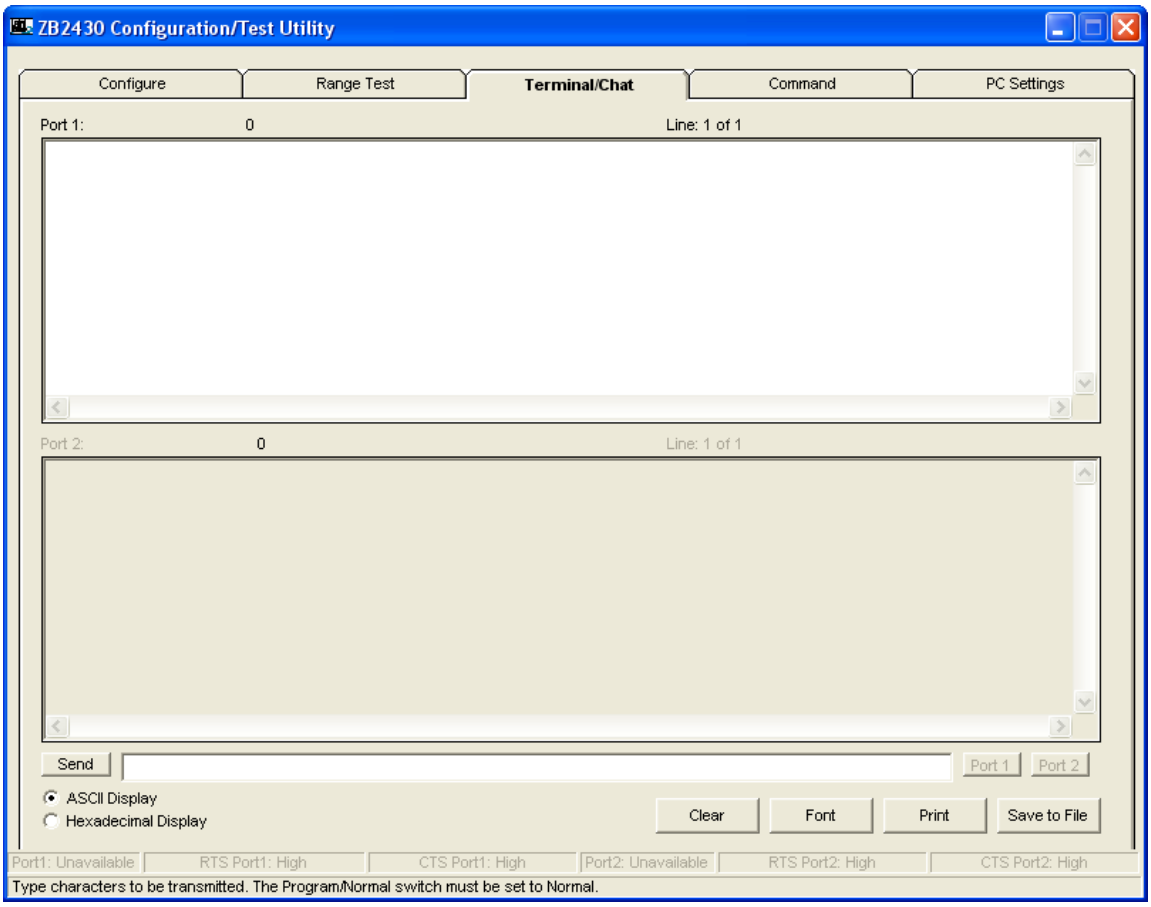
Allows you to switch between Tx or Rx packets in the Port 1/Port 2 display.

Clear Button

This button sets all of the statistics and errors back to zero. This can be used while a test is running.

TERMINAL/CHAT TAB

The Terminal/Chat tab is used to send small data packets between two COM ports. As data is received it is appended to the appropriate Port window. An example of the Terminal/Chat tab is shown below.



Send Button

This button is used to send the data in the textbox out the selected port(s). The current user's Windows username is also sent with the data.

ASCII Display

When selected, newly received data will be displayed in ASCII format.

Hexadecimal Display

When selected, newly received data will be displayed in Hexadecimal format.

Clear Button

Pressing the Clear Button will erase all of the text that has been displayed in both text windows.

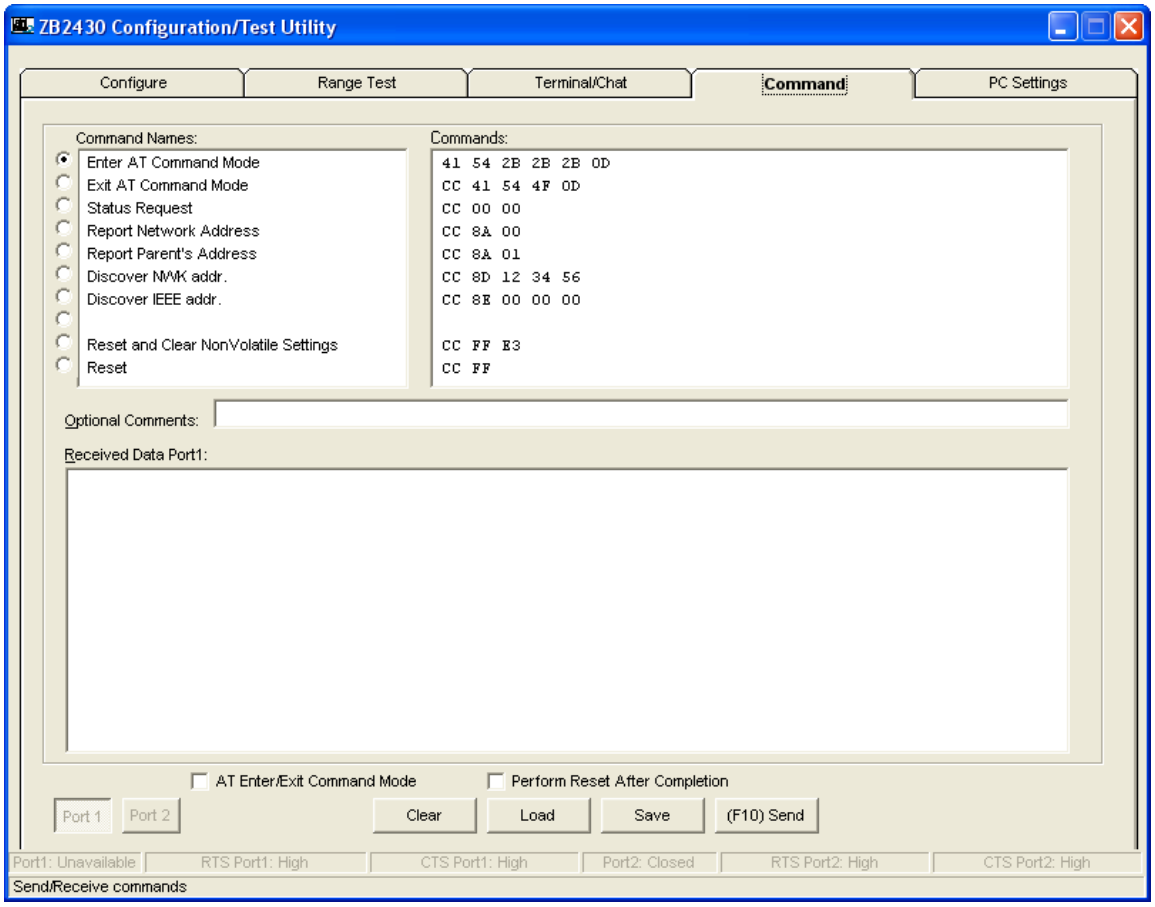
Font Button

Pressing the Font button will bring up a font selection window allowing the font used in the text boxes for both terminals to be changed. Both terminals will use the same font.

SOFTWARE

COMMAND TAB

The Command tab is used to send configuration commands (product family dependent) to the radio on the selected port. Below is an example of the Command tab for the ZB2430 product family:



Radio Buttons

The application sends one command at a time. The command can be selected by clicking the radio button next to that command.

Command Name Field

The Command Name field consists of a list of the most commonly used commands for the module. Additional commands may be added to the list. The length of the Command Name is not restricted and is not required by the application.

Command Field

The Command field contains a list of the commands for each of the command names in the Command Name field. When a command name is selected in the Command Name field, the command that is in the same position in the adjacent Command field is the command that will be sent to the radio.

Optional Comments Field

The Optional Comments field is where the user may enter any comments that they would like to accompany the command information. This field is not restricted in length and is not required by the application. The description for a particular command will be displayed when that commands radio button is selected.

SOFTWARE

Received Data Port 1/Port 2 Window

Data received over the serial port while on the Command tab (whether in response to a command or not) will be displayed in the Received Data window in hexadecimal format.

AT Enter/Exit Command Mode

When selected, the radio will enter/exit AT Command mode as required to complete the selected command by creating a virtual version of the Command/Data Line. The Enter AT Command mode asserts this virtual line Low (to enter Command Mode) and the Exit AT Command Mode asserts this virtual line High (to enter Data Mode).

Perform Reset After Completion

When enabled, the radio will be reset after the selected command has completed. This is useful when issuing EEPROM Byte Write commands, since changes to the EEPROM will not be affective until after the module has been reset.

Port 1/Port 2 Buttons

When Port 1 is depressed, received data will be shown for Port 1. When Port 2 is depressed, received data will be shown for Port 2.

Send Comm

This button sends the selected command out of the selected serial port.

Troubleshooting

PROBLEM	SOLUTION
No lights on SDK Board.	1. Check the power connection. The VCC LED should be lit when power is applied to the serial board. 2. Make sure there is nothing shorting VCC to GND and that the radio is seated into it's interconnect board properly. 3. Make sure that the Power switch is in the On Position.
Radio EEPROM cannot be read by Laird Technologies OEM.exe.	1. Verify that power is applied and that the serial/USB cable is connected to the serial board and the PC. 2. Verify that the correct serial/USB port is selected in the software (Port 1 or Port 2). 3. Verify baud rate and port address on the PC Settings page. 4. Verify the Port Status is Open in the Status bar or in the Port 1 Settings on the PC Settings tab.
EEPROM can be read/viewed with the OEM software, but data cannot be sent between the two transceivers using OEM.exe.	1. Reset both radios. 2. Make sure both transceivers have the same Channel Number and PAN ID (if applicable). 3. Check all cables and connections. 4. Check radio addressing (if applicable). 5. Make sure that radios are separated by at least ten feet. 6. Make sure the In Range LED is lit on both transceivers. 7. Reset each radio's NVRAM with the CC FF E3 command
Packets can be sent between both radios using OEM.exe but cannot be sent from software or hardware not supplied by Laird Technologies	1. Use the Hardware section of this manual to determine if a null-modem adapter is required for interfacing to the hardware. 2. Make sure the baud rate of the radios matches that of the OEM Host hardware.
A Framing or Data Timeout error occurs while running a Range Test.	1. Verify that the baud rate on the PC Settings page matches that of the radio's EEPROM. 2. Verify that both radios are powered on and that the Port settings are correct. 3. Verify that the In Range LED is lit on both radios.

TECHNICAL SUPPORT

Please refer to the contact information included in the SDK for further details. For all other inquiries, please refer to the ZB2430 Quick Start Guide and ZB2430 User's Manuals.

ZigBee™ Basics and Tips

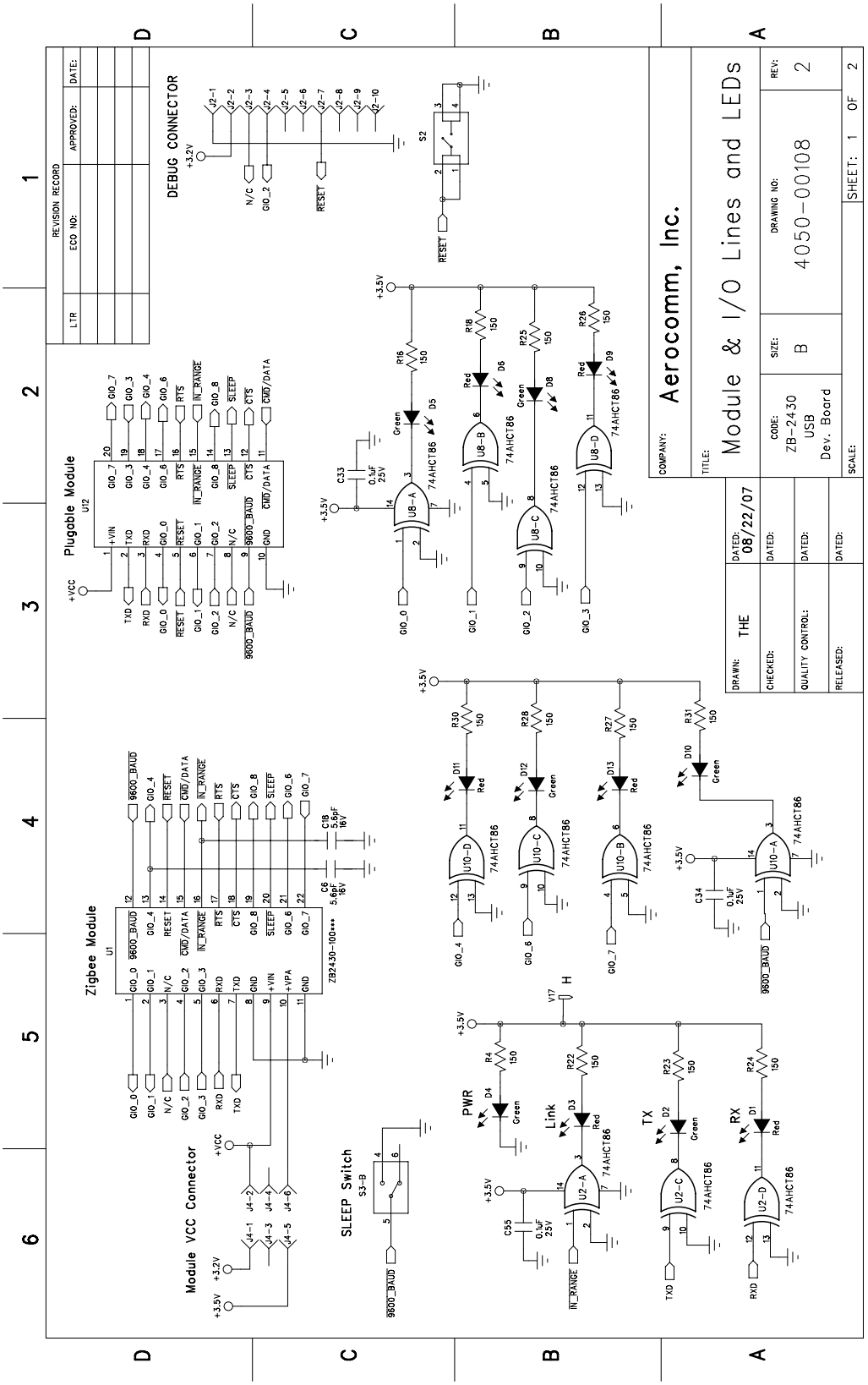
1. For best results, power up the Coordinator first, and then the Router(s).

2. The ZB2430 is shipped in 16-bit addressing mode in which the Coordinator assigns each device a 2 byte Network address. The Coordinator will always have a Network address = 0x0000 but since the Network addresses are assigned based on when a device joins the Network, it is possible that the Routers will have a different address on every power-up.

3. In order to send data to a specific device on the network, the OEM must compile a table which lists the 64-bit MAC and the corresponding 16-bit Network address. The Discover commands (CC 8D & CC 8E) can aid in this process.

4. The ZB230 utilizes the ZigBee mesh architecture. When a device is powered up, it will attempt to associate with the Coordinator. If it is unable to associate with the Coordinator, it will associate and become a child of an available parent Router. Once associated with the parent Router, data can be sent through the network using the 16-bit Network address of the desired device.

ZIGBEE DEVELOPMENT KIT SCHEMATIC



Enclosed is the schematic for the Zigbee Development Kit. This schematic is to be used as a hardware reference for designing the ZB2430 module onto a PCB. Please note this schematic comes with a number of options for various interfaces and modules which are not populated on every development kit and which are not necessarily designed to operate together.

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LWT-MAN-ZB2430-SDK 0309

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Limited Warranty, Disclaimer, Limitation of Liability
For a period of one (1) year from the date of purchase by the OEM customer, Laird Technologies warrants the OEM transceiver against defects in materials and workmanship. Laird Technologies will not honor this warranty (and this warranty will be automatically void) if there has been any (1) tampering, signs of tampering; 2) repair or attempt to repair by anyone other than an Laird Technologies authorized technician. This warranty does not cover and Laird Technologies will not be liable for, any damage or failure caused by misuse, abuse, acts of God, accidents, electrical irregularity, or other causes beyond Laird Technologies' control, or claim by other than the original purchaser. In no event shall Laird Technologies be responsible or liable for any damages arising: From the use of product; From the loss of use, revenue or profit of the product; or As a result of any event, circumstance, action, or abuse beyond the control of Laird Technologies, whether such damages be direct, indirect, consequential, special or otherwise and whether such damages are incurred by the person to whom this warranty extends or third party. If, after inspection, Laird Technologies' determines that there is a defect, Laird Technologies will repair or replace the OEM transceiver at their discretion. If the product is replaced, it may be a new or refurbished product.