Unistep Technologies

ZCI

ZigBee Industrial Control Interface Board

CONTROL PANEL PROGRAM

USER MANUAL

REVISION HISTORY

Rev	Date	
1.02	Apr 6, 2015	Modifications to capture changes to the CP program in v0.51.2
1.00	Mar 19, 2015	First Draft

1. Introduction

Thank you for purchasing the ZCI Board. This user manual is intended both as an introduction to the rich set of functions designed into the board, and also as a detailed reference on how to make the best use of those functions.

1.1 Intended Use and Functionality

The ZCI Control Panel program was conceived with the following possible applications in mind:

1. Functional testing of the ZCI board
2. Learning about the ZCI board and the features
3. ZigBee network view and management
4. Configuration of the board and the on-board devices
5. Learning how to use the UCP commands and the syntax
6. Demonstration of board features and functions

1.2 What Has Been Included

Much of the functionality and many of the features of the ZCI Board and the UCP (Unistep Command Processor) has been included within the ZCI Control Panel program. In addition, since the ZCI board was designed to be part of a networked group of boards, a certain amount of network functionality has been built into the ZCI CP.

- Configure I/O facilities and on-board hardware and firmware devices
- Test and exercise all I/O functions and devices
- Board power configuration
- ZigBee module and ZigBee network configuration
- Save, load, and transfer board configuration
- Direct access to ZigBee module and UCP commands
- Remote reset of ZigBee modules and ZCI boards

1.3 What Has Been Left Out

Some of the ZCI firmware/UCP features would require a specific network application to be properly demonstrated or tested. The Control Panel program excludes such features and functions:

- All auto-monitor and related reporting functions
- Application development support functions
- ZigBee port mirroring
- UCP command response options
- Any accuracy or performance testing or validation
- Simultaneous communication with more than one remote board
- ZigBee firmware update function
- ZCI board firmware update function
- Sleep mode
- Enable/disable command processing
- 8-Bit port write and read operations
- UCP or ZigBee serial port configuration options

2. Main Components

2.1 ZCI Board Components

ZCI board is a complete system made up of the following hardware and software components

- MCU (Micro Control Unit)
- UCP and the board firmware running on the MCU
- USB Port circuitry
- ZigBee network module
- ZigBee protocol stack and the AT command processor running on the ZigBee Module
- Power supply and power management circuitry
- Indicators , input switches and connectors
- Configuration Table and non-volatile memory on the MCU

2.2 ZigBee Network

A ZigBee network is formed with two or more network nodes. A network cannot be formed without a Coordinator node. There can be only one coordinator in a given network. Other nodes can be routers, end points, or sleepy end points.

ZCI board can function as any one of these node types with proper configuration of the network module on the board. The coordinator, more traditionally, can also be a ZigBee USB 'Stick' plugged to a USB port on the computer.

2.3 ZCI Boards as Network Nodes

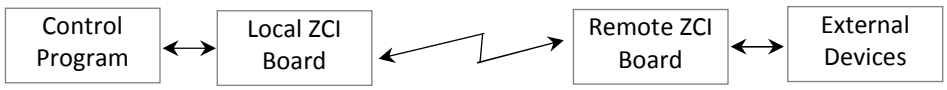
The natural long-term function of a ZCI board is most likely to be a network node that controls external devices such as lights, motors, locks, fans, etc. and accepts (reads) inputs from external sensors, switches, etc. In this setup, the board is likely to be powered by an external power source such as a battery pack or a power adapter. In this mode, ZCI board is likely to be accepting and executing commands from a central control program.

During development and configuration, however, the ZCI board can also be connected to a nearby computer through the USB port. Besides being a requirement during development and configuration, this mode of operation is also convenient because the board can be powered through the USB port. When the board is connected to a computer through the USB port, all of the ZigBee network functionality and the features are still available on the network. In fact, a 'Mirror' function has been built into the UCP specifically for this mode of operation. By turning the Mirror Mode on, all of the commands directed to the node through the ZigBee network, and the responses provided by the UCP can be mirrored to the USB port as a very effective observation and debugging tool.

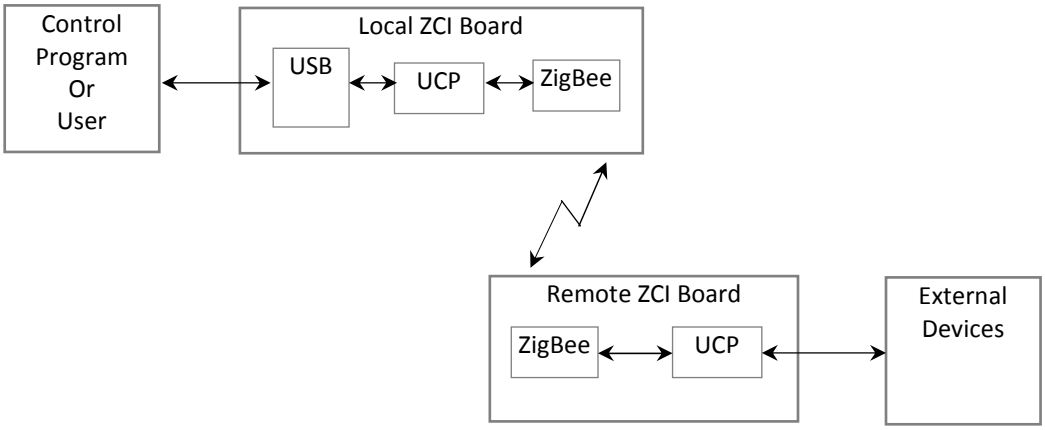
When the ZCI board is connected to the ZigBee network and the USB port at the same time, the UCP will execute commands received from either port, simultaneously.

2.4 Command Layers

Please consider the following, possibly a very common setup:



Now, from a command processing point of view, the picture is actually as follows:



So, the user or the central application may need to communicate with any of the following entities specifically:

- Local UCP - LU
- Local ZigBee - LZ
- Remote ZigBee - RZ
- Remote UCP - RU
- External Devices - ED

The ZCI Control Panel program is aware of these layers and proper tunneling mechanisms are employed to pass through a given entity to reach other entities 'downstream':

- LU - Local USB connection, as a default, reaches LU
- LU → LZ - 'Pass through' mode is used to reach LZ
- LU → LZ → RZ - Pass through mode plus ZigBee Remote Commands are used to reach RZ
- LU → LZ → RZ → RU - Pass through mode plus ZigBee remote commands plus ZigBee Unicast commands are used to reach RU
- LU → LZ → RZ → RU → ED - Pass through mode plus ZigBee remote commands plus ZigBee Unicast commands plus UCP command execution are used to reach ED

If a ZigBee USB stick is used as the node attached to the Control Program, then the LU stage is by-passed, but the rest of the chain remains the same.

ZCI Control Panel can accommodate either a ZCI board or a ZigBee USB stick as both the local and remote ZigBee nodes. If a target is a ZigBee USB stick, then ZCI hardware functions are disabled and only the ZigBee-related functions are available.

2.5 User Applications

ZCI Board and the UCP are designed for a large and robust wireless network application managed and controlled by a central control program, as mentioned above. The method of communication on the ZigBee network to control devices attached to the remote nodes, however, is always the same; whether it is a central control program or a user using a terminal emulation program, all communication takes place through the use of commands issued to the UCP or the ZigBee command processors.

This is also exactly how the ZCI Control Program goes about carrying out its operations; it issues commands and evaluates the responses.

3. Channel Control

The ZCI Control Panel program user interface is made up of two main components:

1. Channel Control Panel on the left
2. Device Control and Configuration Tabs on the right

As different tabs are selected, the Channel Control Panel remains active and is always visible.

3.1 Target Board Selection

When ZCI boards are connected both as a local and remote nodes, either one can be selected as the target for ZCI Control Panel program operations. In this area the current target is shown, along with the ***Board Name*** and the ***Serial Number*** of the target board. If no ZCI board is selected, the word 'None' appears in between the 'Local and 'Remote' signs.

3.2 Port & Channel Control

26 available I/O Channels are numbered from Ch 1 to Ch 26, grouped as four ports A, B, C, and D. One control button is assigned to each channel to enable / disable that channel. When the channel is enabled, the label to the left of the button lights up, and the small window to the right of the button indicates the assigned function as follows:

DIN	Digital Input
DOL	Digital Output, initialized to logic LOW or '0'
DOH	Digital Output, initialized to logic HIGH or '1'
AIN	Analog Input
PW1 - PW5	Pulse-Width Modulator
PG1 - PG4	Pulse Generator
SP1 - SP2	SPI Channel

Function indicator window is color-coded as a visual aid. Since the DAC (Digital-To-Analog Converter) device outputs have their own dedicated output channels, they are not shown in this Port & Channel Control Group.

Note: All ZCI I/O and UCP related functions will be disabled if the currently selected target node is not a ZCI board with UCP in command mode.

3.3 Target ZigBee Node Info

Operational Network ID and the Short Network Address of the target ZigBee node device is shown in this area.

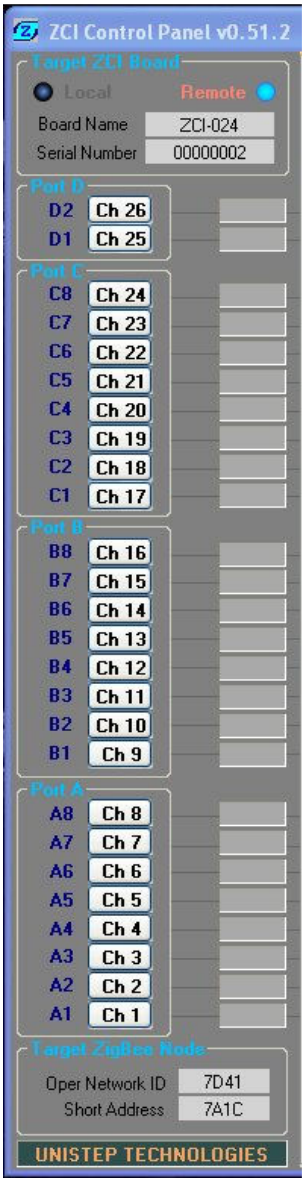


Fig 3.1 - Channel Control Panel

4. Connection Management

4.1 USB Port Selection

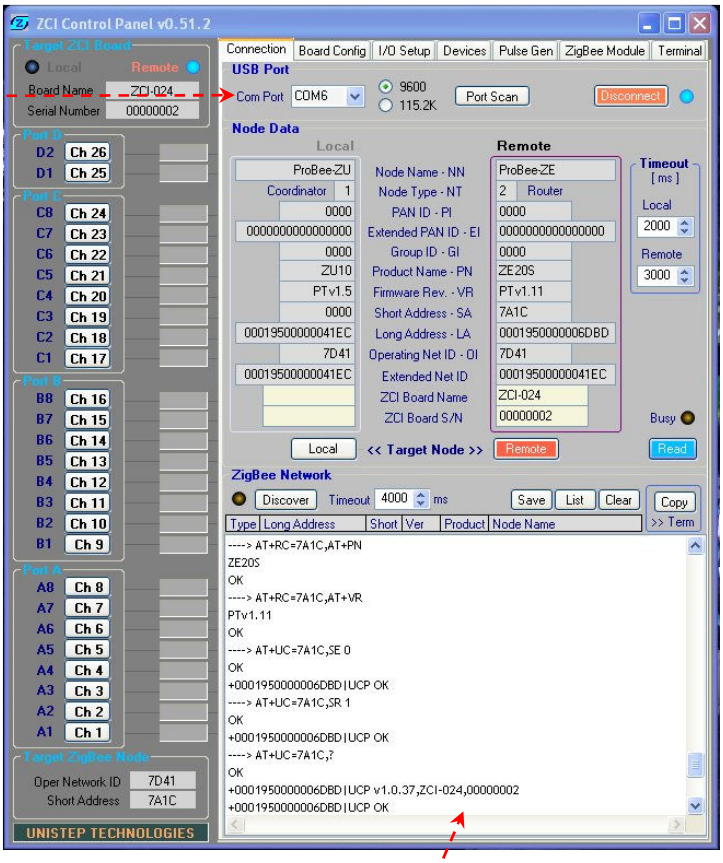


Fig. 4.1 - Connection Tab

Drop-down list box shows the ***Com Ports*** assigned to the currently active USB devices. Select the Com Port that has been assigned to the local ZigBee device (USB Stick or the ZCI Board) connected to the computer. Since the program scans available Com Ports at the time of start-up, if a USB device is connected after the program has started, a new scan needs to be initiated with the ***Port Scan*** button.

When the desired Com Port is selected, the ***Connect*** button can be pressed to connect to the USB device. When the connection is successful, the button text changes to 'Disconnect' and the power light to the right of the button lights up.

To disconnect from the USB device, just press the ***Disconnect*** button. When the ZCI Control Panel program is shut down, it attempts to disconnect from the USB device and close the Com Port. If this process is somehow interrupted, there's the danger of the Com Port being left open. It is, therefore, good practice to disconnect before the program is terminated.

4.2 ZigBee Network Discovery and Communication Display Window

Communication Display Window -- Commands sent out by the program and the responses received are all shown on this window. This window is scrollable and has a buffer size of about 64K characters. Window and buffer contents can be cleared with the ***Clear*** button. ***Save*** button saves the contents of the window and the buffer as a text file. Out-going commands are preceded with the '- - - ->' characters.

Discover Button - This command button is used to initiate a network discovery to get a list of nodes presently on the ZigBee network. As network nodes respond, their data will be shown in the command display window. Discovery is not complete as long as the busy lamp to the left of the ***Discover*** button is blinking.

Responses to network discovery request will look like the following line:

ZED |0001950000006DBD|1AFF|PTv1.7|ZE20S|ProBee-ZE

If any of these response lines is highlighted (with a single mouse click, for example), data contained in the response will be parsed, extracted, and shown in the ***Remote*** section of the ***Node Data*** panel. Pressing the ***Read*** button will read additional data from the node, including the UCP/ZCI information. Reading the UCP/ZCI information is critical, because without these, UCP functions will not be available.

Timeout is the length of time, in milliseconds, that the program waits for the nodes to respond following the last response activity. On a busy network, it may be necessary to increase the timeout value to give all nodes a chance to respond.

List button displays a list of all the discovered nodes in a compact and 'clean' format that is suitable for analysis and browsing. When the node list is displayed, individual fields in the node entry more-or-less align with the column headings at the top of the window. This is useful for quick review of the ZigBee nodes.

Copy button copies the highlighted line text to the command buffer at the bottom of the ***Terminal*** tab, as a convenient short-cut to entering command lines.

4.3 Node Data

This section of the Control Panel shows detailed network and configuration data for the local and remote nodes.

Target Node can be selected by the ***Local*** and ***Remote*** buttons at the bottom of this section. Selected (target) node is indicated by the heading at the top of the panel and the purple box enclosing the node data.

Proper data field names are shown in the center area, along with the short-hand abbreviations that are recognized by the ZigBee command processor when sending commands to the ZigBee module.

Busy Light indicates that there are on-going command-response transactions, and it should be paid attention to. ZCI Control Panel program can manage active transactions only with a single node and one transaction at-a-time. If commands are issued (by pressing command buttons, for example) while the ***Busy*** light is on, the program may not be able to interpret out-of-sequence responses accurately.

Local and Remote Timeouts - These two settings determine how long, in milliseconds, the program waits when it has not received a valid response from local or remote nodes, respectively.

By pressing the ***Local*** and ***Remote*** target selection buttons, commands issued by the program can be directed to either node. The 'tunneling' process (reaching a remote UCP by going through two ZigBee modules, for example) is handled by the program, without the need for user intervention. The resulting commands, however, can be observed in the communication window, as a way of learning this method.

5. Board Configuration

5.1 Target ZCI Board

Visual Identification - Pressing the ***Identify*** button will make the MS indicator on the target ZCI board blink once, briefly. This is helpful for a visual confirmation of the target board.

Board Name can be changed with the Write button. ***Serial No*** and the ***UCP Version*** are read-only fields.

5.2 Security Configuration

Security restrictions only apply to board operations on the ZigBee network. There are no restrictions on the USB connections.

Security Level

0 - No restrictions
1 - Board will communicate only with the nodes designated as ***Primary*** or ***Secondary***.

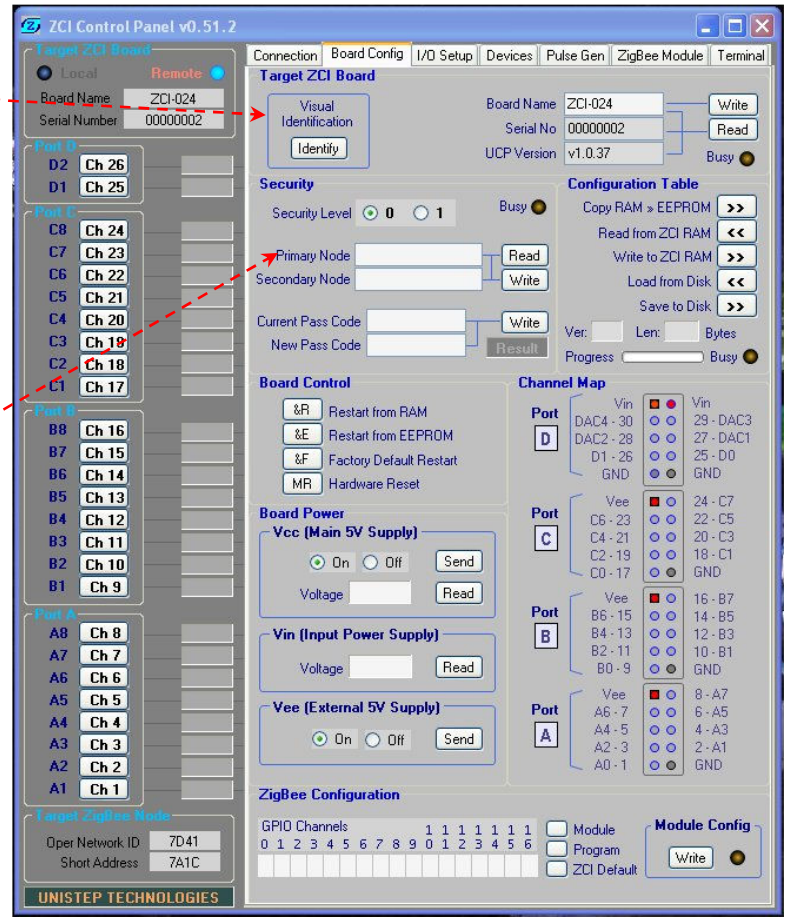


Fig. 5.1 - Board Configuration Tab

Primary and Secondary Nodes
These fields are for the Long Addresses of the Primary and Secondary Nodes.
When the security level is '1', the board in question will only communicate with the Primary and Secondary nodes. Commands from all other nodes will be ignored.

Pass Code - As explained in the ***ZCI User Manual,*** Commands that affect security settings are Privileged Commands and will require the ***System Pass Code*** for execution.

If the System Pass Code is being set for the first time, just enter the pass code in the ***New Pass Code*** field and push ***Write***. To change the pass code, however, current pass code is required.

CAUTION: Extreme care is recommended when working with security settings, since a simple error in these settings can easily make the board non-responsive and non-reachable through the ZigBee network. If this happens, a physical USB connection to the board will be necessary to be able to make changes to the board configuration.

5.3 Configuration Table Management

The command buttons in this section are used for Configuration Table management. The ZCI Control Panel program does not have the capability to modify the entries in the Config Table directly. These changes are made by the UCP as required, following execution of commands.

Configuration Table is where all the board configuration and setup information is kept. On the ZCI Board there exist three separate copies:

1. ***Default Config Table in EEPROM*** - This is the factory default configuration table that was loaded on the MCU during manufacture. It cannot be modified without reloading the MCU firmware.
2. ***Current Config Table in EEPROM*** - This is the copy of the Config Table that gets loaded at power up or after a hardware reset.
3. ***Active Config Table in RAM*** - This copy of the Config Table is what determines the configuration settings of the board, therefore the operation of all of the devices. Any changes to the configuration or device settings are captured in the Config Table. If a particular configuration needs to be saved, then it needs to be copied from RAM to EEPROM with the TC (**T**able **C**opy) command. Otherwise, next hard reset will overwrite the copy in RAM with the copy from the EEPROM.

Copy from RAM to EEPROM - This operation is be used when changes are made to the active configuration table and the changes need to be saved and made permanent.

Read from RAM - Active Configuration table is copied from RAM into program memory.

Write to RAM - Configuration table in the program memory is copied to the ZCI board and a soft-reset is executed to configure the board accordingly.

Load from Disk - Configuration table is read from a disk file into program memory.

Save to Disk - Copy of the configuration table in program memory is written to disk.

In a production environment, if a number of ZCI boards need to be configured with identical or similar settings, the commands above can be used to save a successful configuration and upload it to other boards very quickly.

Ver - Version of the Config Table (Read-only field)
Len - Length of the Config Table (Read-only field)
Progress & Busy - Progress and Busy indicator during copy and transfer operations

5.4 Board Reset

In addition to POR (Power-On-Reset) and the hardware ***Master Reset*** button (MR) on the board, the following methods are available to restart the board:

- ***Restart from RAM*** - MCU is reset but the Config Table in RAM is retained and used for configuration.
- ***Restart From EEPROM*** - This is identical to a POR reset. MCU is restarted and the Configuration Table is loaded from EEPROM.
- ***Factory Default Restart*** - MCU is restarted and the original configuration table provided at the factory during manufacture is loaded. Note that this operation does not destroy the copy of the configuration table in EEPROM, which could still be used if necessary.
- ***Hardware Reset*** - Using the I/O facilities of the ZigBee module, a hardware Master Reset is initiated which is electrically equivalent to the MR Button being physically pressed.

5.5 Board Power Control

Controls in this group help manage and monitor the power supply rails on the ZCI board.

Vcc (Main 5V Supply) - 5V supply rail is what feeds the MCU and the rest of the circuitry on the board. If the board functions are not needed for a while, power consumption of the board can be reduced to an absolute minimum by turning off the 5V supply. Since this also kills the UCP, option to turn off the 5V supply is not available when the ZCI board is the ***Local Target***.

Similarly, since the 3.3V rail is what powers the ZigBee module, it cannot be turned off either.

Read Buttons - Read and display the actual 5V Rail and the unregulated power input voltages.

Vee (External 5V Supply) - Vee is the supply voltage that appears on the A, B, and C port connectors to provide power to external circuits or devices. This power supply can be turned on or off by selecting the option buttons and pressing the ***Send*** button.

5.6 Channel Map

This section is intended as a visual aid in working with the I/O ports and channels on the ZCI Board. Please notice the dual method of referencing a given channel, like B0 - Ch 9. The port references (A6, B0, etc.) are used in documentation and while working with the board I/O signals, but the channel referencing (Ch 1, Ch 25, etc.) is the only method recognized by the UCP.

5.7 ZigBee Module I/O Configuration View

ZigBee module I/O channel configuration is determined by a string of numbers where each digit controls the basic configuration of its assigned channel. The three read buttons (Module, Program, and the Default) read the configuration from three different sources, and the ***Write*** button writes the configuration to the ZigBee module and resets the module to put the settings into effect.

Module - Read the configuration string from the target ZigBee module.
Program - Read the configuration string as composed by the controls in the C/P Program ZigBee Module tab.
ZCI Default - Default configuration string programmed into the Control Panel application.

ZCI Control Panel program provides the functionality to modify only the I/O channels GPIO1 to GPIO8. Remaining nine channels (GPIO0, GPIO9 - GPIO16) are used internally by the ZCI board circuitry and needed for proper functionality. Modifying any of the configuration settings for these channels, or unintentionally changing the output signal states of any of these channels will disrupt some function on the ZCI board.

Please consult the ZigBee module User Manual for details ZigBee module configuration settings.

6. I/O Setup

6.1 I/O Channel Configuration

Each I/O channel can be setup to have one of five possible configurations:

Digital Input
Digital Output - L, initialized to logic ‘Zero’ or ‘Low’ state
Digital Output - H, Initialized to logic ‘One’ or ‘High’ state
Analog Input
Special Function, such as a PWM output, or an SPI bus signal.

Of these five configurations, one of the first four can be selected directly by clicking on the radio button for the desired channel. When the Channel is enabled by clicking on the Channel Control button, the selected configuration will be sent to the ZCI board with the appropriate command(s). These commands can be observed in the ZigBee Network discovery window in the ***Connection*** tab.

The special function configuration is selected by a device control section within the ***Devices*** and ***Pulse Gen*** tabs.

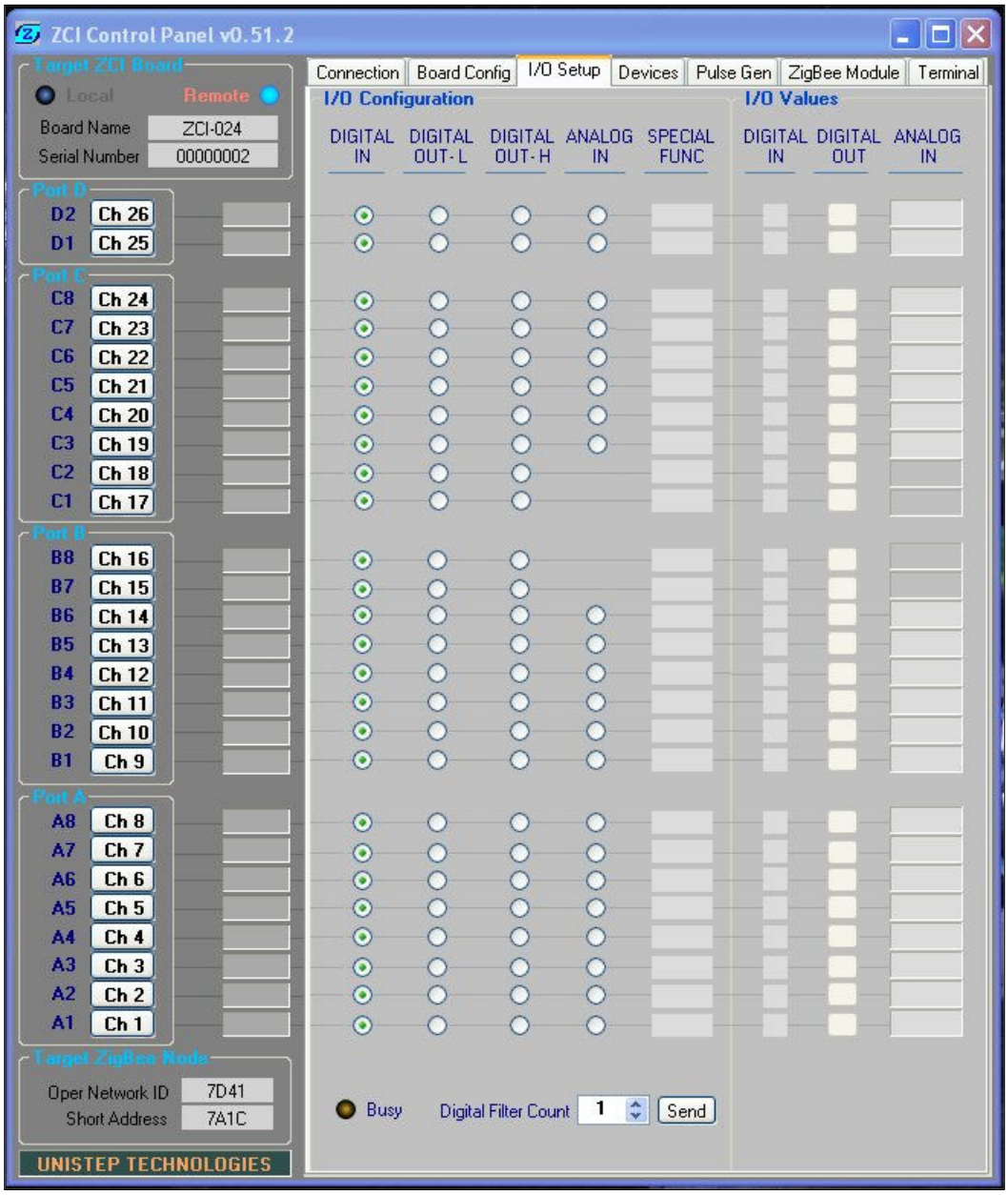


Fig. 6.1 - I/O Configuration Tab

6.2 I/O Channel Values

Controls in this section show the input value, if the channel is an input channel, or they show and control the output value, if the channel is an output channel.

Digital In - Digital input state when the channel is a digital input channel. The input value is not read or monitored continuously; it is only read when the channel is enabled. If the input is likely to change, this can be observed only by turning the channel on and off.

Digital Out - The text on this button shows the output value of the digital output section. Output value can be toggled by pressing the button.

Analog In - When the channel is configured as a Digital-In channel, the value displayed in the window shows the 10-bit conversion result of the ADC (Analog-to-Digital Converter) as a voltage reading expressed in mV.

To update the reading, the channel needs to be turned off and on again.

6.3 Digital Filter Count

To reduce or eliminate the effects of noise in the system, each digital input can be read more than once. For digital inputs, the ***Digital Filter Count*** setting determines how many consecutive identical readings are required before the result is reported.

The ***Send*** button sends the value in the window to the ZCI board as the ***Digital Filter Count.***.

7. On-Board Devices

7.1 DAC (Digital-To-Analog-Converter) Control

Control gadgets in this group control the operation and configuration of the Digital-to-Analog Converter (DAC) channels as follows:

Power Light - Turns on when the DAC is enabled; turns off when the DAC is disabled.

Enable/Disable Button - This button turns the DAC on or off. When the DAC is off, the output is brought down to zero. When the DAC is turned on, the ***DAC Count*** value is immediately sent to the device and appears at the assigned channel. The assigned channel can be seen on the face of the Enable button.

Output Slider and Count - Either of these input gadgets can be used to set the output level of the DAC, and they are active at the same time. When the slider position is changed, the count value is updated and when a count value is entered, the slider position is adjusted accordingly for a visual indication of the output magnitude. These controls can be adjusted even when the DAC is turned off. The value is sent to the device as soon as the DAC is turned on (enabled).

If a DAC output needs to be adjusted without turning the DAC off and on, then the ***Send*** button can be used to (re)send the desired output value.

Reference Voltage Selector - The internal reference voltage of each DAC can be selected individually as 2.048 V or 4.096 V. Since the DACs on the ZCI board are 10-bit devices, each count represents 2 mV or 4 mV, respectively.

Output Value - The voltage equivalent of the selected count, taking the selected reference into account, is shown in the Output Value window. Beware, though, that this is a calculated value and not a measured one. The actual output value is affected by the offsets and accuracy limits of the DAC circuit, and may be slightly different.

Send Button - This button can be used to send the currently selected output value to the DAC at any time, as long as the DAC is powered (enabled).

7.2 ADC (Analog -To-Digital-Converter) Setup

Control gadgets in this group control the operation and configuration of the Analog-to-Digital Converter (ADC) channels as follows:

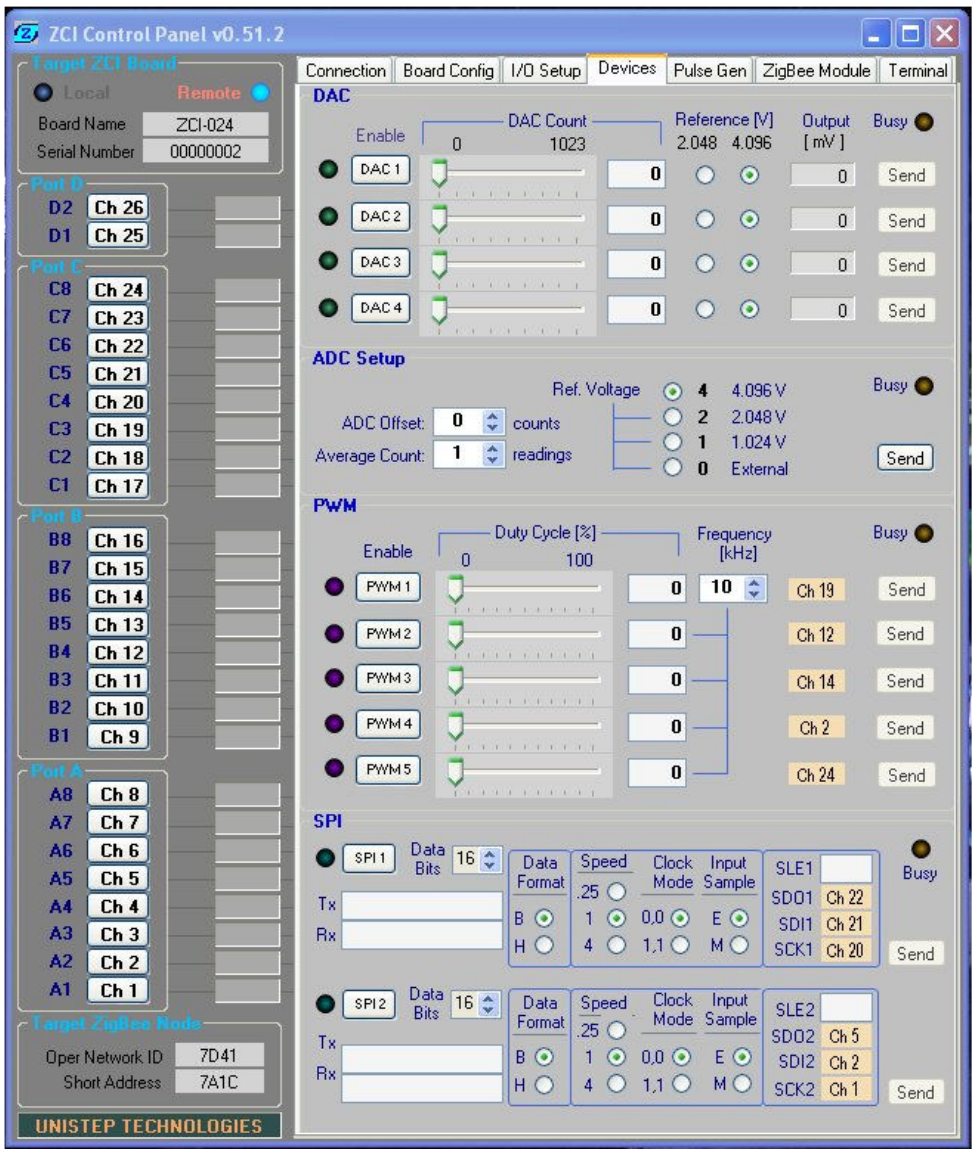


Fig. 7.1 - Device Control Tab

ADC Offset - If a constant error is observed with all the ADC channels, this might be balanced out with an offset adjustment. The value in the window will be added to all analog measurements.

Average Count - To reduce or eliminate the effects of noise in the system, each analog input can be read more than once, reporting the average value as the result. For analog measurements, the ***ADC Average Count*** setting determines how many consecutive readings will be taken and averaged. Please note that the measurement will take proportionally longer with higher averaging counts.

Ref Voltage - The ADC circuit on the ZCI board offers three choices for the internal voltage reference, and a choice of using an external reference. Selection is made by the ***Ref Voltage*** control.

Busy Light - The busy indicator light stays lit while the conversion is taking place.

Send Button - ADC Configuration settings are sent to the board with the ***Send*** button.

7.3 PWM (Pulse Width Modulator) Control

Control gadgets in this group are used to turn the Pulse Width Generators on and off, and also control the duty cycle and the frequency of the output signal.

Power Light - This light turns on when the PWM generator is enabled.

Enable/Disable Button - This control button turns the PWM generator on or off. When the generator is turned off, the Duty Cycle and frequency settings are immediately effective.

Duty Cycle Slider - Duty cycle can be selected quickly with this slider control.

Duty Cycle Value - Desired duty cycle value can also be entered in this text entry box. The slider control will follow the value entered.

PWM Frequency - This up/down numeric control is common to all five PWM generators and controls the frequency of the signal for all PWM generators. Frequency is shown in kHz and can be changed between 1 kHz and 250 kHz. Duty cycle is value is maintained when the frequency is varied.

Assigned Channel - Each PWM generator is assigned an I/O Channel which is shown in this window.

Send Button - If the PWM parameters are changed while the PWM is running, new parameters can be put into effect with the ***Send*** button.

7.4 SPI Channel Controls

ZCI Board provides two independent SPI ports that can be used to communicate with external devices. All aspects of the SPI communications can be controlled with the widgets in this group. Controls are identical for the two SPI ports.

The SPI controller on the ZCI board is configured to function as an SPI Host only; it cannot function as an SPI Slave.

Power Light - Lights up when the SPI port is enabled.

Enable/Disable Button - Turns the port on or off. When the power is turned on, the assigned channels are reserved for SPI usage and cannot be used for any other function. When the power is turned off, assigned channels are released.

Data Bits (Frame Length) - Length of the data frame to be sent, in number of bits.

Tx Data - Data to be sent on the SPI bus. Together with the ***Data Display Format*** control, data can be entered either in Binary or Hexadecimal format. The window is wide enough to show all of the binary digits up to 16. If the data is longer than 16 bits, the window scrolls with the keyboard arrow keys.

Rx Data - Data received on the SPI bus. Together with the ***Data Display Format*** control, data can be shown either in Binary or Hexadecimal format. The window is wide enough to show all of the binary digits up to 16. If the data is longer than 16 bits, the window scrolls with the keyboard arrow keys.

Rx Data window is a read-only text window.

Data Display Format - This tool selects the data display format (binary or hexadecimal) and converts valid numbers between the two bases. This version of the program does not do validation on the data entered, so care should be taken to enter valid binary or hexadecimal numbers.

Transmission Speed - This control selects the clock rate for the SPI bus. The values shown are in MHz; so the available choices are 250 kHz, 1 MHz, and 4 MHz.

Clock Mode - Of the possible modes of clocking, modes 0,0 and 1,1 is supported by the program and can be chosen with this control.

Input Data Sample Point - Input digital data can be sampled either at the mid-point of the clock pulse ('M') or at the end ('E').

SLE (Slave Latch Enable) Channel - There are no pre-assigned channels for the SLE signal, and it can be assigned to any available channel with this text box control. The SLE is an active low signal that can be used to select a device on the SPI bus.

Serial Data Output Channel - This window shows the channel that is pre-assigned to the SDO signal.

Serial Data Input Channel - This window shows the channel that is pre-assigned to the SDI signal.

Clock Channel - This window shows the channel that is pre-assigned to the SCK signal.

Send Button - Initiates a send-receive cycle. Data in the TxData window is sent and the received data is shown in the RxData window.

Busy Light - Lights up while the SPI transaction is taking place.

Pulse Generators

ZCI board has four (4) independently adjustable pulse generators that can be assigned to any I/O Channel. The ***Pulse Gen*** tab houses the controls to start and stop the pulse generators, assign I/O channels, and adjust the pulse durations and pulse periods.

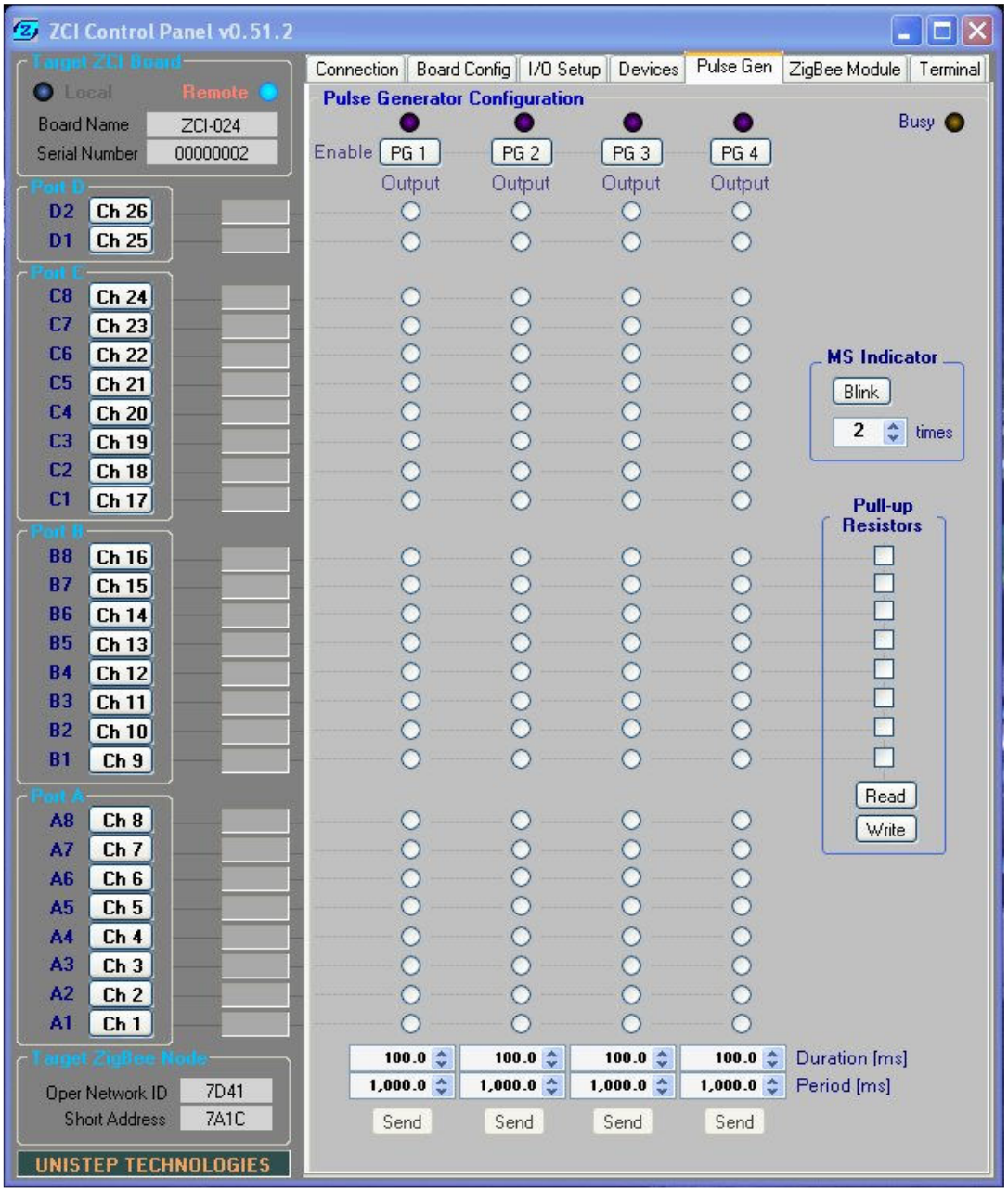


Fig 8.1 - Pulse Generator Tab

8.1 Pulse Generator Configuration

Power Light - Lights up when the pulse generator is enabled

Enable/Disable Button - Turns the pulse generator on and off. When the pulse generator is turned on, duration and period settings are sent immediately and the pulse generator starts running.

Output Channel Indicator - When the pulse generator is running, selected Channel is also visible just below the enable button.

Output Channel Selector - The vertical column of radio buttons are used to select the desired output channel for the pulse generator. For each pulse generator device, only one un-assigned channel can be selected.

When the generator is no longer running, selection is still retained but the channel is no longer reserved for the pulse generator.

8.2 Pulse Generator Control

Pulse Duration Entry - This numeric up/down control selects the pulse duration in milliseconds. The range is from 0.0 ms to 32,767.5 ms. A duration of 0.0 ms effectively turns off the pulse generator without releasing the channel.

Pulse Period Entry - This numeric up/down control selects the pulse period in milliseconds. The range is from 1.0 ms to 65,535.0 ms.

Send Button - Pulse generator parameters can be updated while the generator is running with the Send button. Change takes place immediately.

Busy Light - Shows the pulse generator read or write activity.

8.3 MS (MCU Status) Indicator

MS indicator on the ZCI board can be made to blink with this control, usually as a method of visually identifying the board or as a way of indicating a condition.

Blink Count - Number of blinks required.
Blink Button - Sends the blink request to the ZCI board.

8.4 Pull-Up Resistor Configuration

Port B circuits have the mechanism to connect an internal pull-up resistor to each channel on this port. Controls in this group can be used to configure the pull-up resistors.

Pull-Up Resistor Select - Each selection box can be ticked on or off to indicate if a pull-up resistor is desired on that channel.

Configuration Read - This button reads and displays the current pull-up resistor configuration.

Configuration Send - This button sends (writes) the pull-up resistor configuration to the board.

9. ZigBee Module

In its own right, the ZigBee module offers a powerful command set, a rich set of features, and a good selection of configuration options. The ZCI board and the Control Panel Program use only some of these features and commands for their own operation. The rest of the functionality is available to the user. Some of this functionality is included in the ZCI Control Program features to provide an easy way to learn about this functionality and how to employ it.

ZigBee module features are mentioned here as they relate to the use and function of the ZCI Control Panel program. For an in-depth treatment of all the features, please consult the ZigBee Module data sheet and user manual.

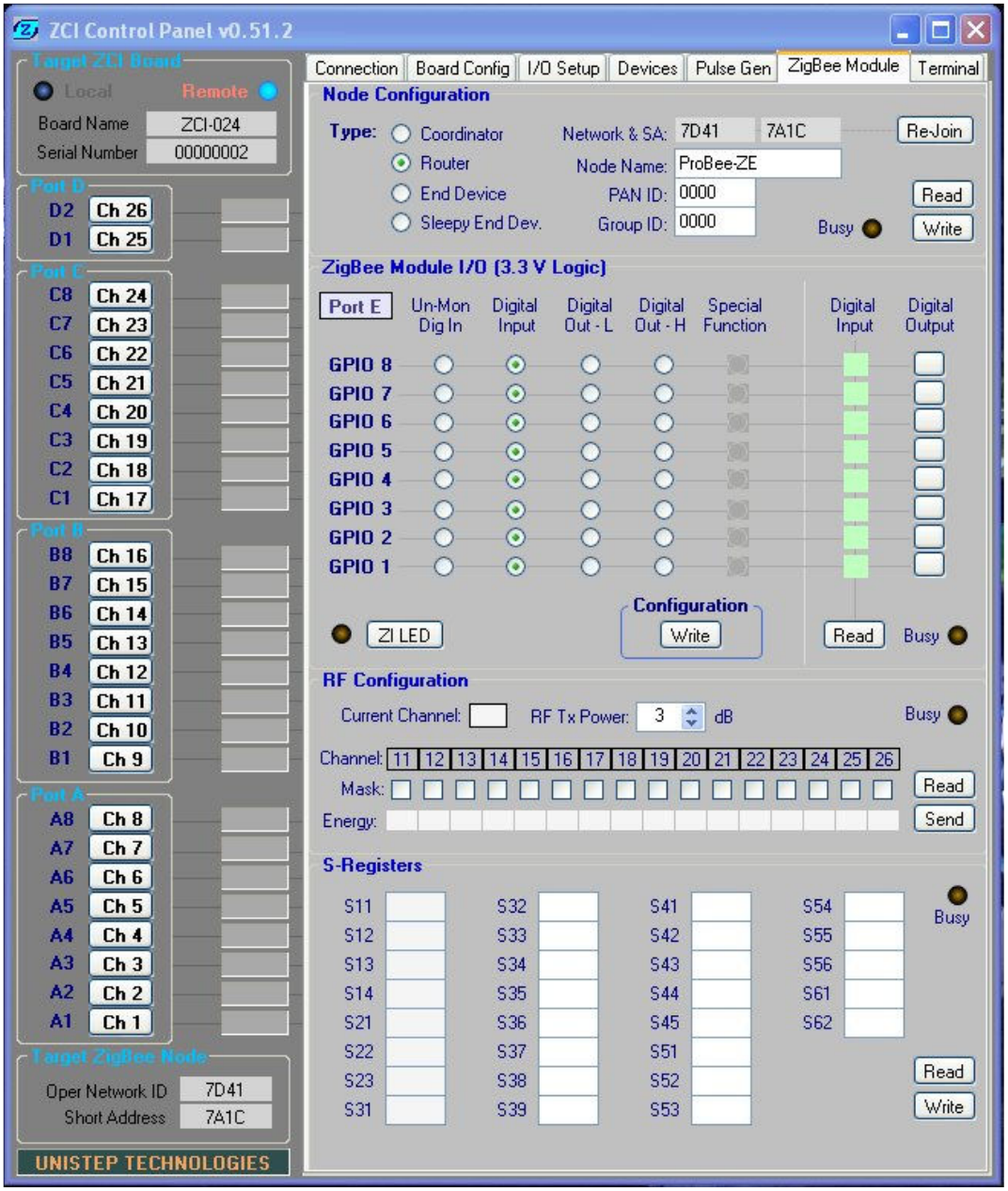


Fig. 9.1 - ZigBee Module Tab

9.1 ZigBee Node Configuration

Node Type - This section is both a display and also a selection mechanism for the ZigBee Module Node Type. Each node can be one of the four types indicated. Node type can be re-read with the ***Read*** button and changed with the ***Send*** button.

Please note that when the node type is changed, the module is forced by the ZigBee protocol to re-join the network and assigned a new Short Address (SA). Program accommodates this behaviour by giving the module time to reboot and re-join the network. The Short Address (SA) is also updated.

Network Info - Network Operational ID and the current SA (Short Address) of the node is shown here.

Node Name - ZigBee node also supports a node name, which is separate than the ZCI Board Name. Node Name is shown here and can be changed if desired.

PAN ID - PAN ID of the node.

Group ID - Group ID of the node.

Re-Join Button - A ZigBee module that has just powered up will search for available ZigBee networks, send a request to join a network and will join the first network that permits joining. If there are multiple ZigBee networks, the Re-Join button can be used to force the ZigBee module (and therefore, the ZCI board) to leave the current network and join the next network on the list.

Read Button - Reads the five pieces of node information in this section.

Write Button - Writes the Node Name, PAN ID and Group ID to the ZigBee module.

9.2 ZigBee Module I/O Configuration

ZigBee module I/O configuration is similar to the I/O configuration of the ZCI Board; Each channel can have digital and analog input or output functions assigned. On the ZCI Board, however, the I/O channels available to the user can only support digital I/O. There are two input configurations, two output configurations, and a special function configuration, as seen below:

Un-Monitored Digital In - The 'neutral' safe state of the ZigBee I/O channels is Un-Monitored Digital Input. In this state, the channel cannot have an output contention with any external circuits and the input value cannot be read.

Digital Input - Digital value at the channel input can be read.

Digital Output Initialized to Logic 'Low' or '0' - An output configuration where the channel is initialized to a logic low state as soon as it's enabled.

Digital Output Initialized to Logic 'High' or '1'0' - An output configuration where the channel is initialized to a logic high state as soon as it's enabled.

Special Function - Changing the configuration to 'Special Function' for the ZigBee Module I/O channels that are available to the user is not permitted. Therefore, this option is 'grayed out'.

Configuration Write Button - Used to send the configuration to the ZigBee module and activate the changes.

Busy Indicator - Indicates that there's on-going exchange between the program and the board.

9.3 ZigBee Module I/O Values

Digital Input - Digital input values returned by the ZigBee module upon receiving the request for read operation on all channels. If the channel is an input channel, shown value represents the input signal state. If the channel is an Un-Monitored input channel, returned value may be arbitrary. If the channel happens to be an output channel, the value of the output buffer will be returned.

Digital Input Read Button - A read operation is initiated with the ***Read*** button in this group.

Digital Output - If the channel is configured as a digital output, the logic level of the output is shown in this column. Output state can be toggled by pressing the button.

ZI LED Button - This button turns on and off the ZI LED indicator on the board.
ZI LED Indicator - This light mimics the behaviour of the ZI LED light on the board.

9.4 ZigBee Module RF Radio Configuration

Controls in this section are used to monitor and configure the RF Radio circuitry on the ZigBee module. A read operation is needed to retrieve the current settings.

The node in question can be a ZCI board, A USB Stick, or any other device that complies with the ProBee stack protocol from Sena Technologies.

Current Channel - The ZigBee channel that is currently being used by the network.

RF Tx Power - RF transmitter output power of the RF circuit on the node. This figure can be changed to pump out more or less power from the RF transmitter circuit.

Channel Mask - List of RF channels that the network is permitted to use. This feature is used to keep the network away from noisy channels or to divide the available channels in use by two adjacent very active circuits.

The mask can be modified to limit the network operation to a subset of the available channels.

RF Configuration Read Button - Pressing the ***Read*** button reads the current configuration and populates the displays in this group of controls.

Channel Energy Display - If the target node is Local, it can measure and report the signal energy observed in each of the 16 ZigBee RF channels. Pressing this button starts the measurement process. These readings can be used to troubleshoot and optimize network operation in an area where there seems to be a large degree of RF activity in the ISM band.

Send Button - Pressing the Send button sends the Tx Power and Channel Mask settings to the ZigBee node and immediately activates them.

Busy Light - As usual, this light indicates on-going command/response activity.

9.5 ZigBee Module S-Register View and Setup

S-Registers, a proven architecture of the dial-up modem days, hold many of the configurable parameters of the ZigBee device. For fine-tuning the network or for programming specialized network functions such as security, the designer will need to read and modify the contents of these registers. As usual, the ***Read*** button

reads the contents of these registers and the ***Write*** button writes the contents back to the registers. All register values can be modified, except for S11 which is used by the UCP.

S-Register Values - Contents of the S-Registers are shown as decimal numeric values.

Read Button - Reads the S-Register contents.

Write Button - Writes the values back to the registers.

Busy Light - Indicates on-going command/response activity.

10. Terminal Tab

A simple serial command terminal is included in the ZCI Control Panel program to facilitate interaction with the ZCI board or ZigBee device connected to the USB port.

10.1 Command Terminal Window

Window Area - shows the outgoing and incoming messages (commands and responses). It is a long scrollable buffer that will hold up to 64 KB of characters. Clicking on a line will copy the line to the ***Command Window***.

Timeout - Duration in ms that the terminal program waits for incoming characters to decide when the line should be fetched and given to the user.

Clear - Clears the contents of the Terminal Window.

10.2 Command Line Window

Command Line - Commands to be sent are typed here. 'Enter' key or pressing the ***Send*** button will send the command.

Busy Light - As usual, shows that there are active command/response transactions taking place.

