



# Quick Start Guide

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### 1 Overview

The WiSI™ system provides the most cost effective solution available for wirelessly transmitting sensor data from remote locations to a Modbus® enabled device such as RTU, PLC, HMI, or SCADA systems. WiSI is an all-in-one radio, data acquisition and control, optionally self-powered device; all enclosed in an IP-67 rated outdoor package.

WiSI operates standalone in applications where previously remote monitoring was too expensive or difficult to install and maintain. WiSI provides four low-power models. Two have an integrated solar panel and maintenance free energy storage and can communicate for up to a week without sunlight. With no batteries, regular maintenance is not required. Two other low-power models run from an external 6-28 VDC power, and are ideal for applications where energy harvesting is a must.

WiSI comes standard with a 2.4GHz radio, antenna or RP-SMA connector, 4 analog inputs, 4 digital inputs, 4 digital outputs, and 5V and 18V DC instrument supplies capable of sourcing up to 25 mA for powering several sensors or a 4-20 mA loop.

Standard features also include a quarter milliamp current supply for powering RTDs and an RS232 port for communicating with other equipment and unit setup.

Data is securely passed with 128-bit AES encryption with user-defined key. Star networks with up to 16 nodes have a range of up to 2 miles. For greater distances or dense data collection, tree networks can have up to 250 nodes per network. WiSI's unique physical design allows it to be deployed by slipping it into a 2" inside diameter pipe or mounting it to an enclosure backpan. WiSI is easy to integrate into existing systems via Modbus RTU communication protocol. Onboard diagnostics make field setup simple. A WiSI system is easily configured through free setup software that allows users to individually control the measurement frequency, alarming conditions and other settings for each node.

## 1.1 System Components

A WiSI system consists of a collection of the three WiSI components:

- Coordinator
- Router
- End-node (Solar Powered)

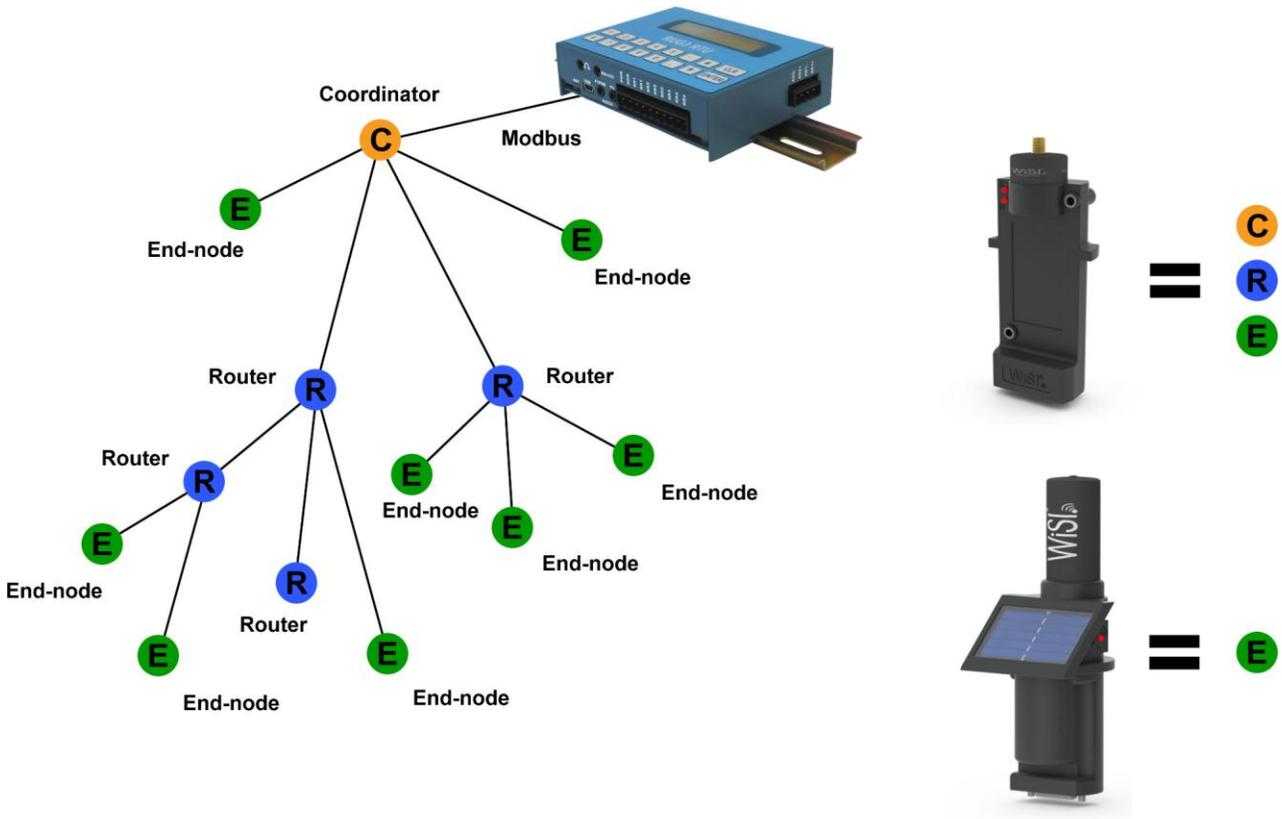
The node types and their roles are summarized in the table below. Note that a WiSI network must have one and only one Coordinator which provides the access point for the wireless network from upstream control and data acquisition systems.

WiSI Component	Role
Coordinator 	<p>The Coordinator is an essential node and plays a fundamental role at system initialization, during which its tasks are:</p> <ul style="list-style-type: none"> <li>• Selects the radio channel to be used by the WiSI network</li> <li>• Starts the network</li> <li>• Allows other nodes to connect to it (that is, to join the network)</li> </ul> <p>The Coordinator provides message routing, security management and acts as a Modbus slave to an upstream RTU passing data to and from the WiSI network. In addition, the Coordinator may also gather local data and respond to digital I/O requests just like all WiSI nodes. A Coordinator must remain active and therefore cannot sleep.</p>
Router 	<p>In addition to gathering local data and responding to digital I/O requests, the Router also:</p> <ul style="list-style-type: none"> <li>• Relays messages from one node to another (routing)</li> <li>• Allows other nodes to connect to it (that is, to join the network)</li> </ul> <p>A Router must remain active and therefore cannot sleep.</p>
End-Node 	<p>The main tasks of an End-node at the network level are sending and receiving messages. An End Device cannot have children. The WiSI End-node can be externally powered, or self powered with its own integrated solar power source and long life super capacitor storage. The WiSI End-node will sleep when not gathering, transmitting or receiving data.</p>

WiSI nodes come in two flavors; Externally Powered, and Solar Powered. WiSI Externally Powered nodes are available to perform any of the roles defined for network elements; Coordinator, Router or End-node. WiSI Solar Powered nodes are only available for End-node applications.

## 1.2 Dynamically Self Configuring Network

A WiSI wireless network self configures upon startup, and will automatically reconfigure as required to maintain network integrity. Every WiSI network consists of a single Coordinator which maintains network integrity and conveys network data to and from the Modbus connected RTU. Reliable network communications is maintained by automatic network reconfiguration using redundant communication paths.



The WiSI Configuration Console is used to configure and load each of the WiSI network components.

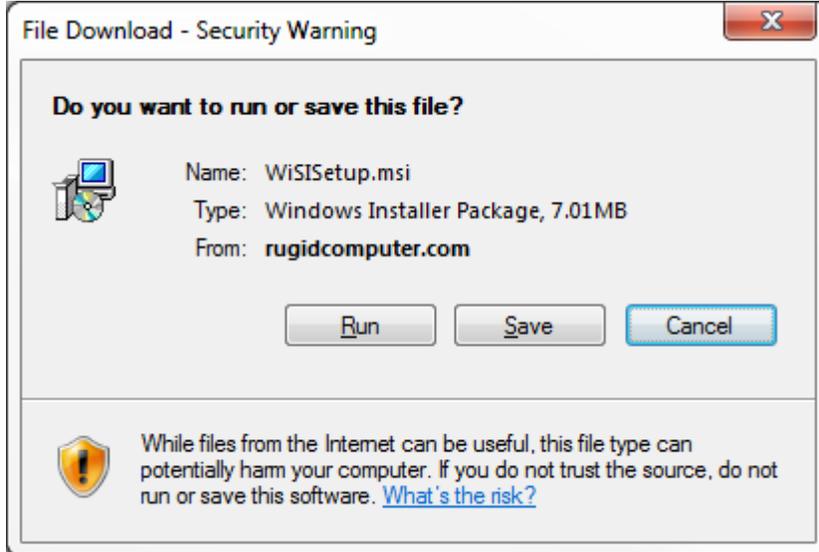
## 2 Unpacking and Setup

A minimum WiSI system consists of at least one End-node, Coordinator module, desktop docking station for programming, and a Windows based PC running the WiSI Configuration Console.

Insert picture of package contents.

## 2.1 Installing WiSI Configuration Console

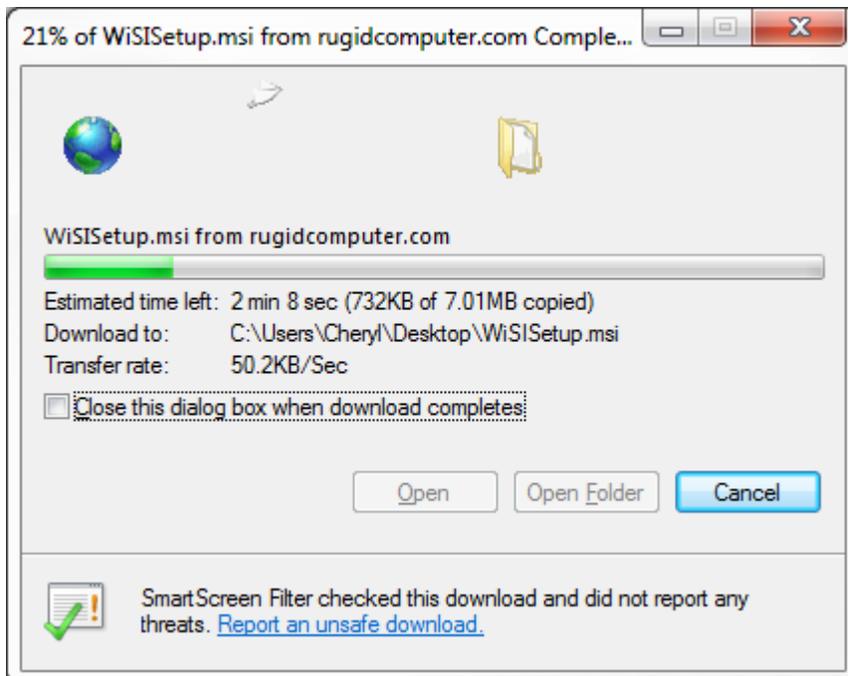
Download the WiSI Configuration Console installer package from <http://www.rugidcomputer.com/WiSI/WiSISetup.msi>. Upon downloading from the website, the following message will appear.



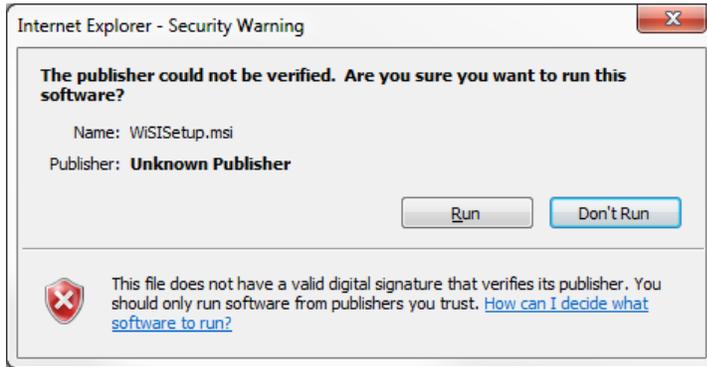
Click 'Run' to begin the download and automatically start installation of the WiSI Configuration Console.

Selecting 'Save' will allow you to save a copy of the installer package on your development PC. The file may be saved to any desired location. When the download is complete you will be given the option of running the saved file, or opening an explorer window to view the downloaded file. When ready, double-clicking "WiSISetup.msi" will start the installation.

The following screen shows a download of the WiSISetup.msi application.



At the conclusion of the download, the following screen may appear:



Select 'Run' to proceed with installation of the WiSI Configuration Console.

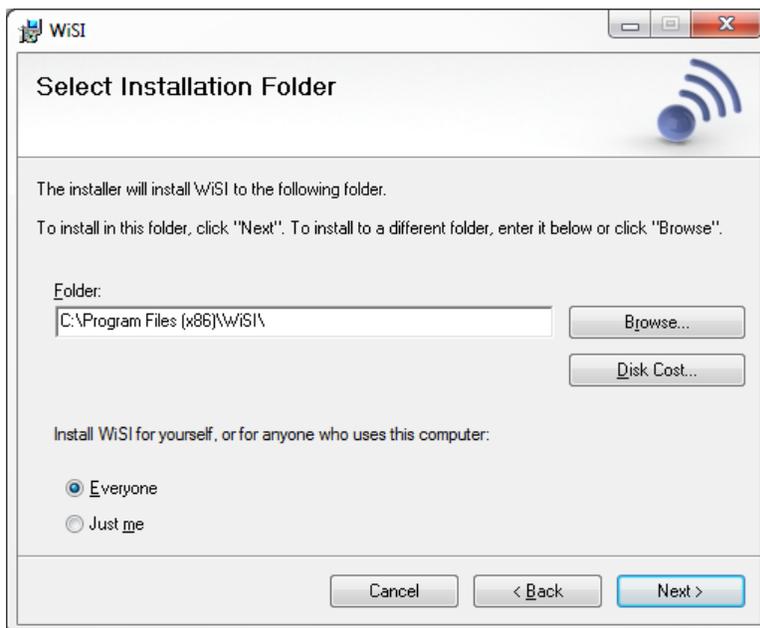


If you already downloaded and installed a version of the WiSI Configuration Console, and the newly downloaded version matches the installed version, then you will see the following screen:

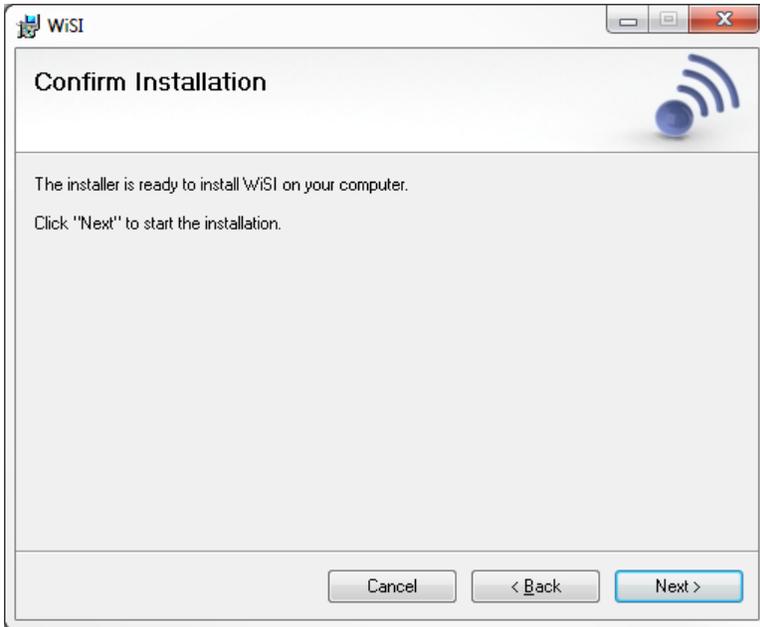


For the case of re-installing the same version, simply select 'Finish' to re-install the WiSI Configuration Console.

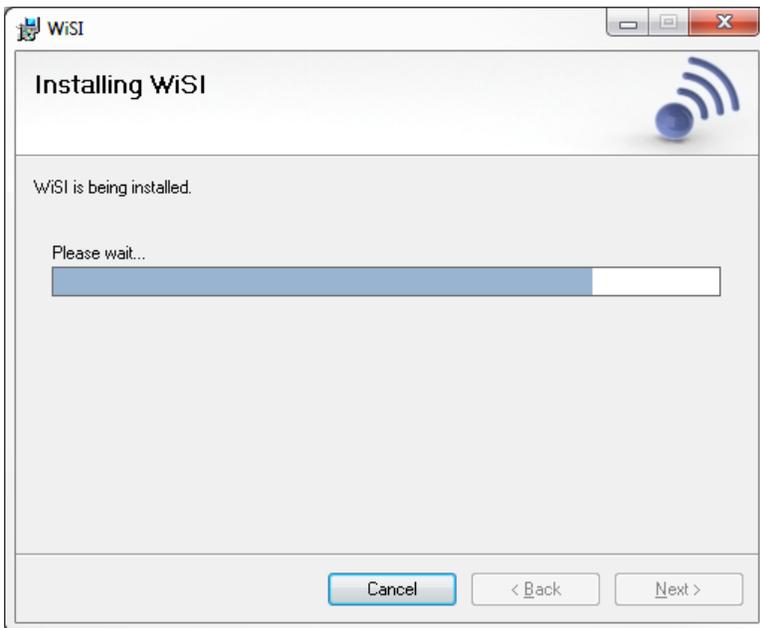
For the installation of a newer version, or first time installation, selecting 'Next' from the 'Welcome to WiSI Setup Wizard' screen will prompt for the install location as shown below. Accept the default location, or enter an alternative path.



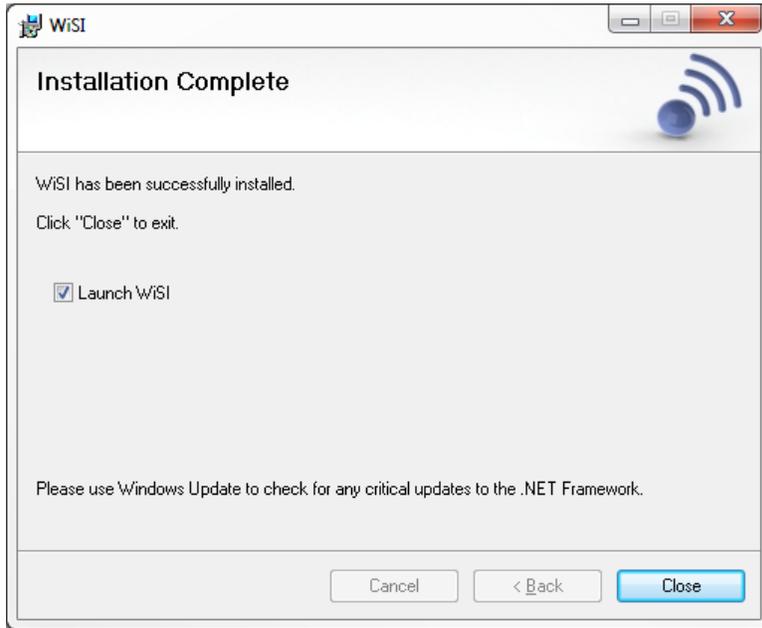
Selecting 'Next' will prompt for confirmation of the install selections:



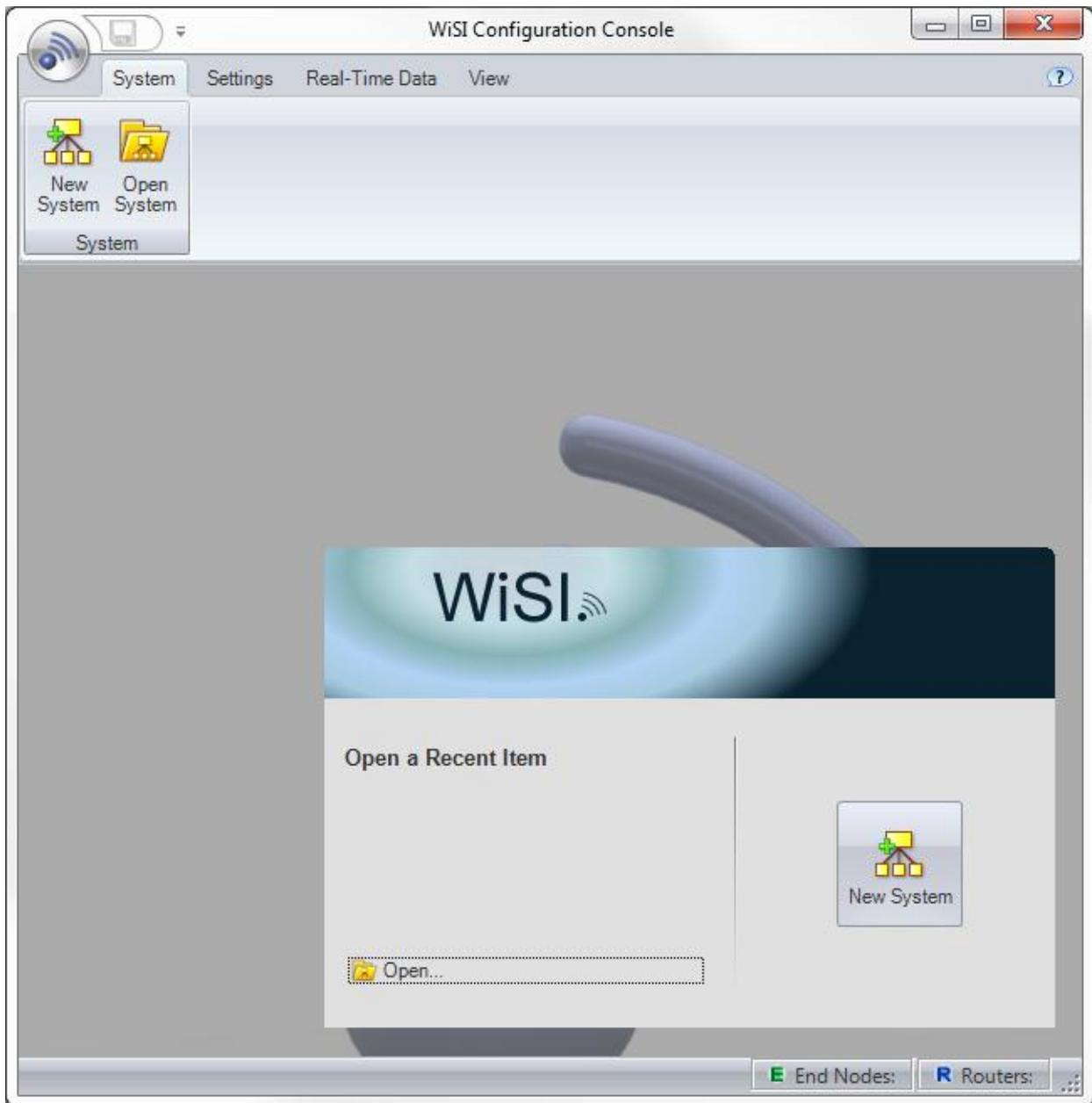
Selecting 'Next' will install the WiSI Configuration Console:



Upon completion, the following screen will be displayed:



If the 'Launch WiSI' box is checked, selecting 'Close' on the installation complete screen will automatically launch the WiSI Configuration Console. The WiSI Configuration Console will start with the opening screen shown below.



After successfully installing the WiSI Configuration Console, proceed to install the WiSI Programming Kit detailed in the following section. See the WiSI Configuration Console Users Guide for additional installation information.

## 2.2 Setup WiSI Programming Kit

The WiSI Programming Kit consists of a docking station, wall charger, USB cable, and magnetic wand.



The WiSI Docking Station provides a means of powering a WiSI module. In addition, the WiSI Docking Station and associated USB connection provide a means for the WiSI Configuration Console to configure a WiSI module prior to deployment.

The WiSI Magnetic Wand provides a means to “wake up” a sleeping WiSI End-node. Additional details on Magnetic Wand usage will be provided in the Deployment section of this Quick Start Guide.





### 2.2.1 Installing USB Driver

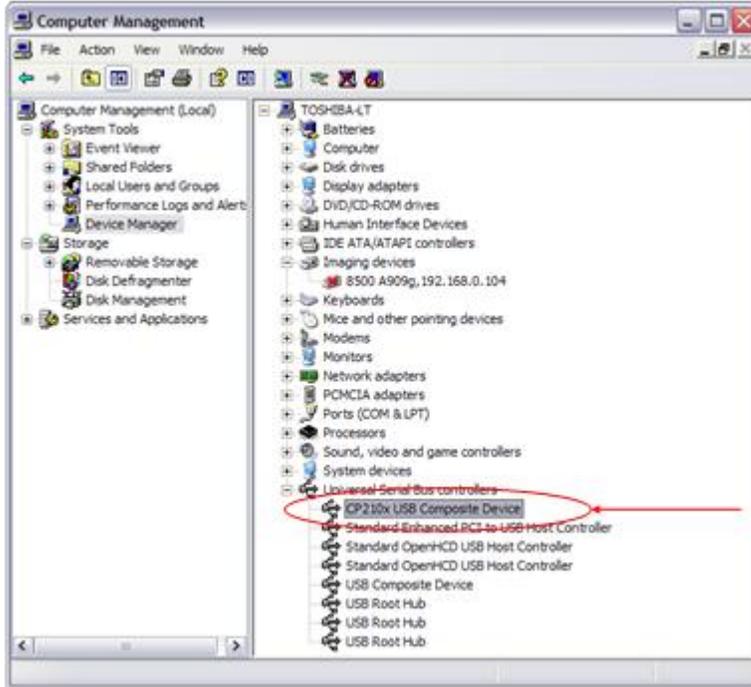
The WiSI Docking Station requires support on the development PC for the USB CPX-210x Composite Device. The Rug3 Driver Installation document available on the Rugid Computer website provides detailed instructions for verifying/installing the required USB driver.

<http://www.rugidcomputer.com/Downloads/HT0801%20-%20RUG3%20USB%20Driver%20Installation.pdf>

If needed, the CPX-210x Composite Device driver may be downloaded from the Rugid Computer website:

[http://www.rugidcomputer.com/Downloads/CP210x\\_VCP\\_Win2K\\_XP\\_S2K3.exe](http://www.rugidcomputer.com/Downloads/CP210x_VCP_Win2K_XP_S2K3.exe)

Verify successful driver installation by connecting the WiSI docking station to the PC via the included USB cable, and verifying the existence of the 'CP210x USB Composite Device' driver in the 'Control Panel/ Administrative Tools/Computer Management/Device Manager/Universal Serial Bus controllers' as in the example below:

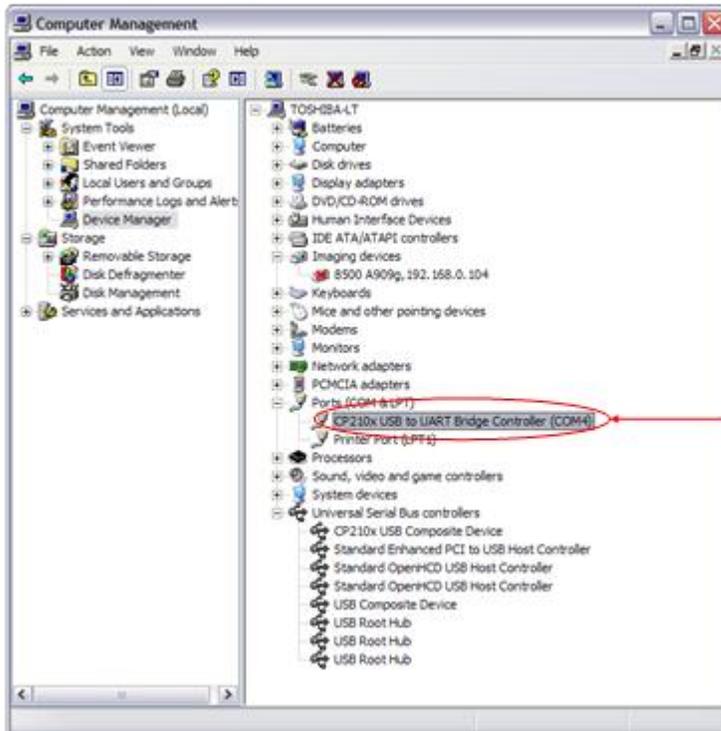


*Note: The WiSI docking station must be connected to the PC via the USB cable for the CP210x USB Composite Device to appear in the Universal Serial Bus Controllers list.*

### 2.3 Connecting WiSI Docking Station to Configuration Console

The WiSI Docking Station communicates with the WiSI Configuration Console through the supplied USB cable. The WiSI Configuration Console must be configured to attach to the virtual serial port using the following steps:

1. Attach the WiSI Docking Station to the WiSI development PC via the supplied USB cable
2. Bring up the '*Control Panel/Administrative Tools/Computer Management/Device Manager/Ports (COM&LPT)*' as shown below. Note the Com port assigned to the '*CP210x USB to UART Bridge Controller*', which in the example below has been assigned to COM4.



*Note: The WiSI docking station must be connected to the PC via the USB cable for the 'CP210x to UART Bridge Controller' to appear in the Ports list.*

The WiSI Configuration Console will be configured to use this port in the following section.

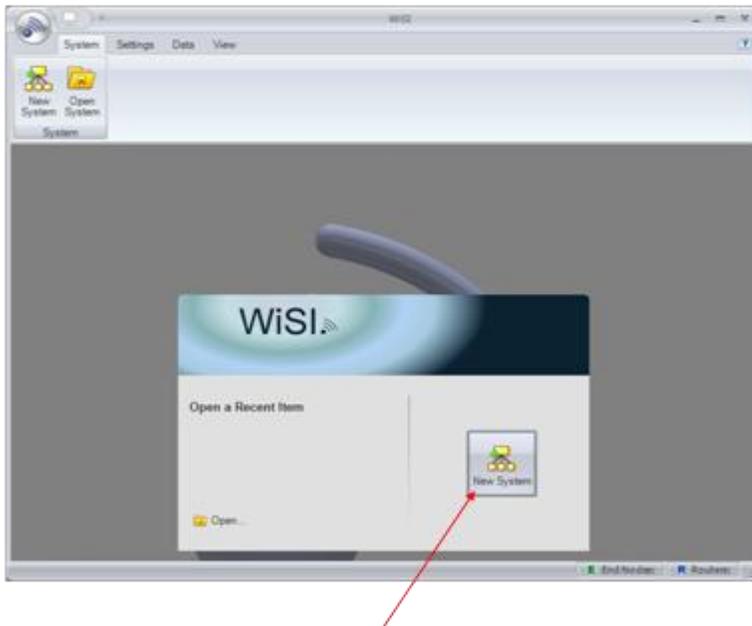
### 3 Configuring Your First WiSI System

The WiSI Configuration Console makes it easy to configure your WiSI system. The following section will describe how to create your first WiSI wireless network. Before you proceed, make sure that you have successfully installed the latest WiSI Configuration Console and USB driver on your development PC. Also make sure that you follow the one-time instructions to connect the WiSI Docking Station to your development PC as described below.

You will need at least one Coordinator, an End-node, and the WiSI Programming Kit to proceed with your first WiSI wireless network configuration.

#### 3.1 Configuration Console Startup

Bring up the WiSI Configuration Console on your development PC.

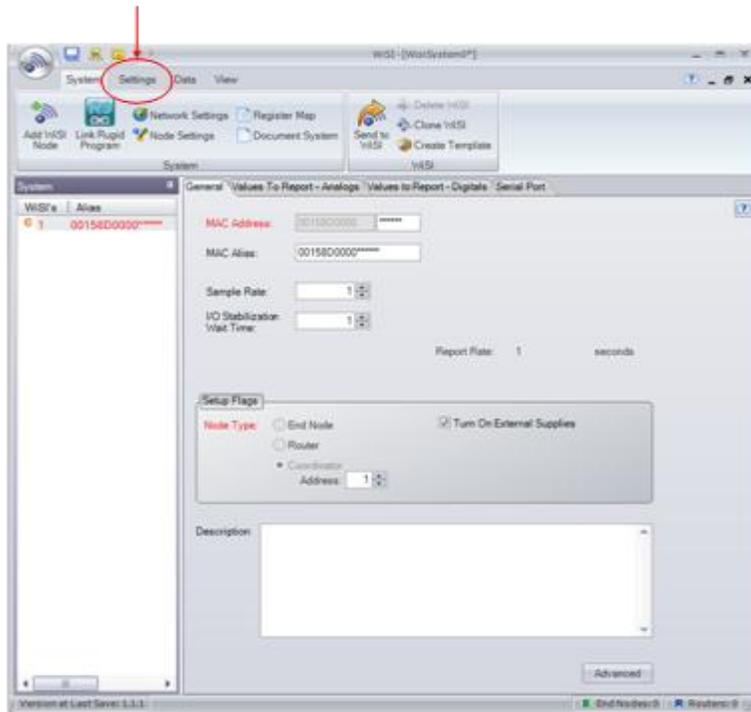


Select the 'New System' button which will bring up the Network Settings screen. Select 'OK' in the Network Settings screen, which will bring up the main WiSI Configuration Console screen.

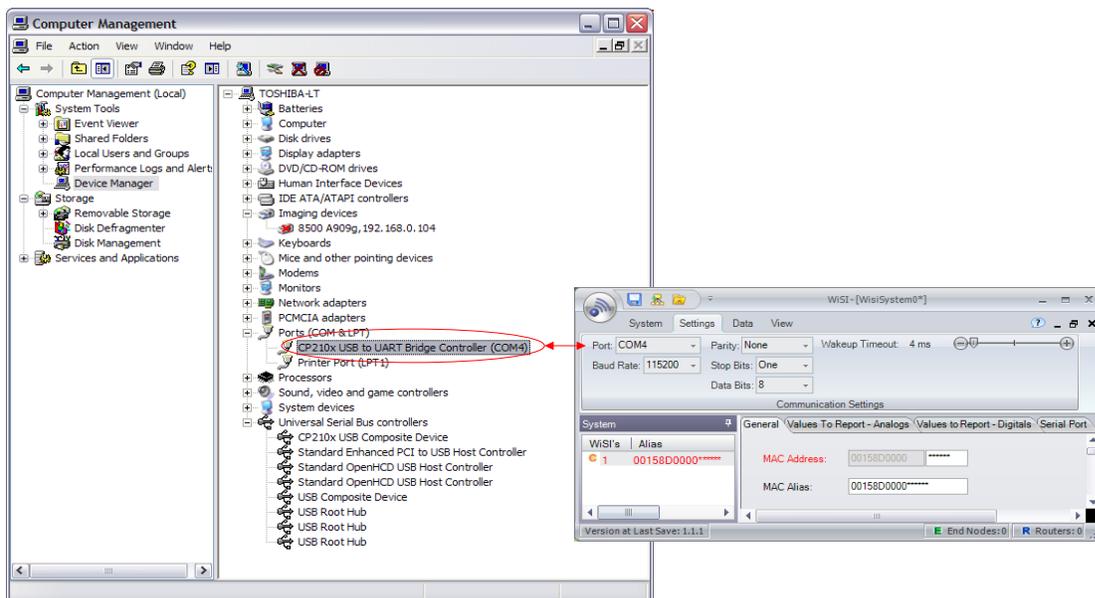
##### 3.1.1 Connecting WiSI Docking Station to Development PC

The WiSI Docking station connects to the Development PC through USB. Verify that the WiSI Configuration Console is using the correct COM port for connection to the WiSI Docking Station as shown below:

Select the 'Settings' Tab as shown below:



The Port number must match the port assigned to the CPX210x USB to Bridge controller. For this example, the Port will be set to COM 4. Also, verify that the Baud Rate is set to 115200, Parity to None, Stop Bits to One, and Data Bits to 8 (the default settings for new WiSIs from the factory).



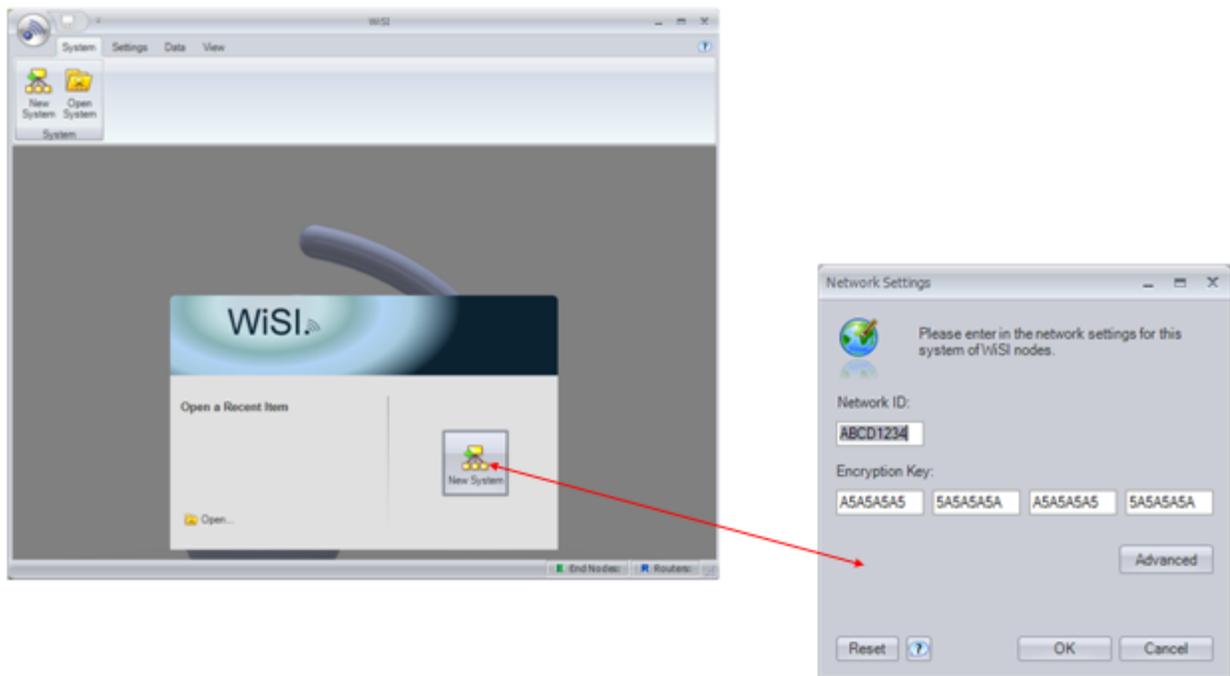
The WiSI Configuration Console is now ready to communicate with a WiSI node attached to the Docking Station.

### 3.1.2 Charging WiSI Solar Powered Nodes

Normally, all WiSI Solar Powered End-nodes are shipped fully charged, and in a state of deep sleep. However, depending upon the length of storage, it is possible the Solar Powered End-node may be fully discharged when placed into service. Solar Powered End-nodes must be charged to a minimal state before attempting communication with the WiSI Configuration Console. This can be accomplished by setting the End-node in direct sunlight for a least an hour, or charging through the docking station USB connection for at least 10 minutes. Charging through USB requires a “powered” USB connection to the WiSI Configuration Console PC, or by plugging the USB cable directly into the included 115V wall charger.

## 3.2 Configuring System

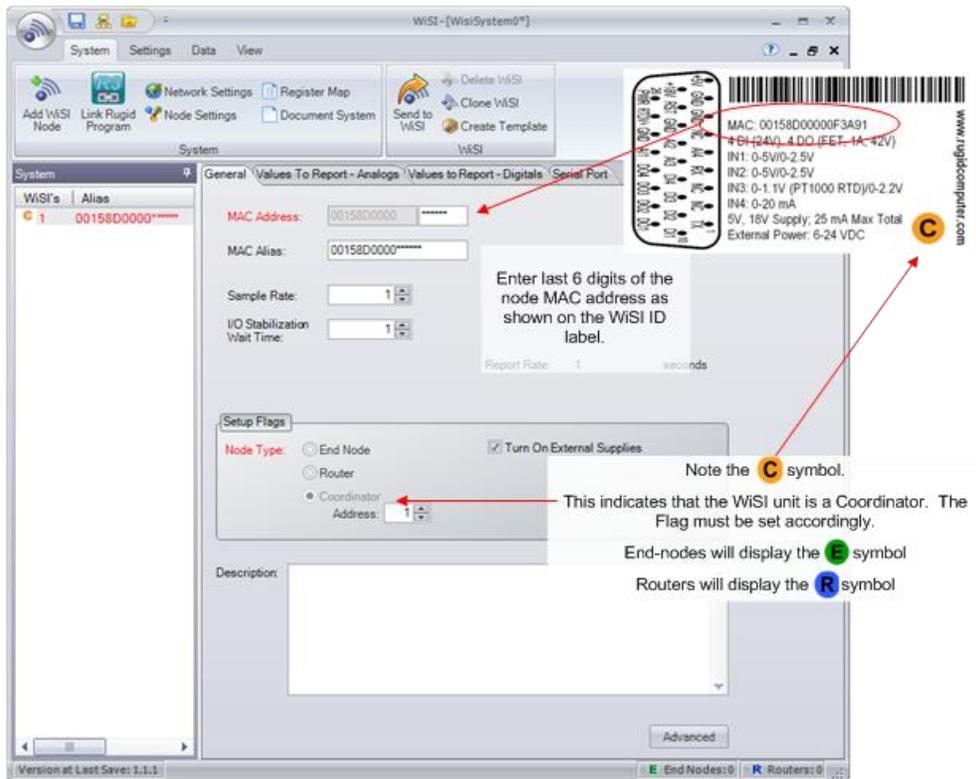
All new WiSI systems begin by selecting the ‘New System’ button on the WiSI Configuration Console. The Network Settings screen provides the opportunity to configure the Network ID and Encryption Key. The Network ID is a unique identifier that allows adjacent operational networks to segregate network traffic. The Encryption Key provides a mechanism to encrypt ‘over the air’ communication in a WiSI network.



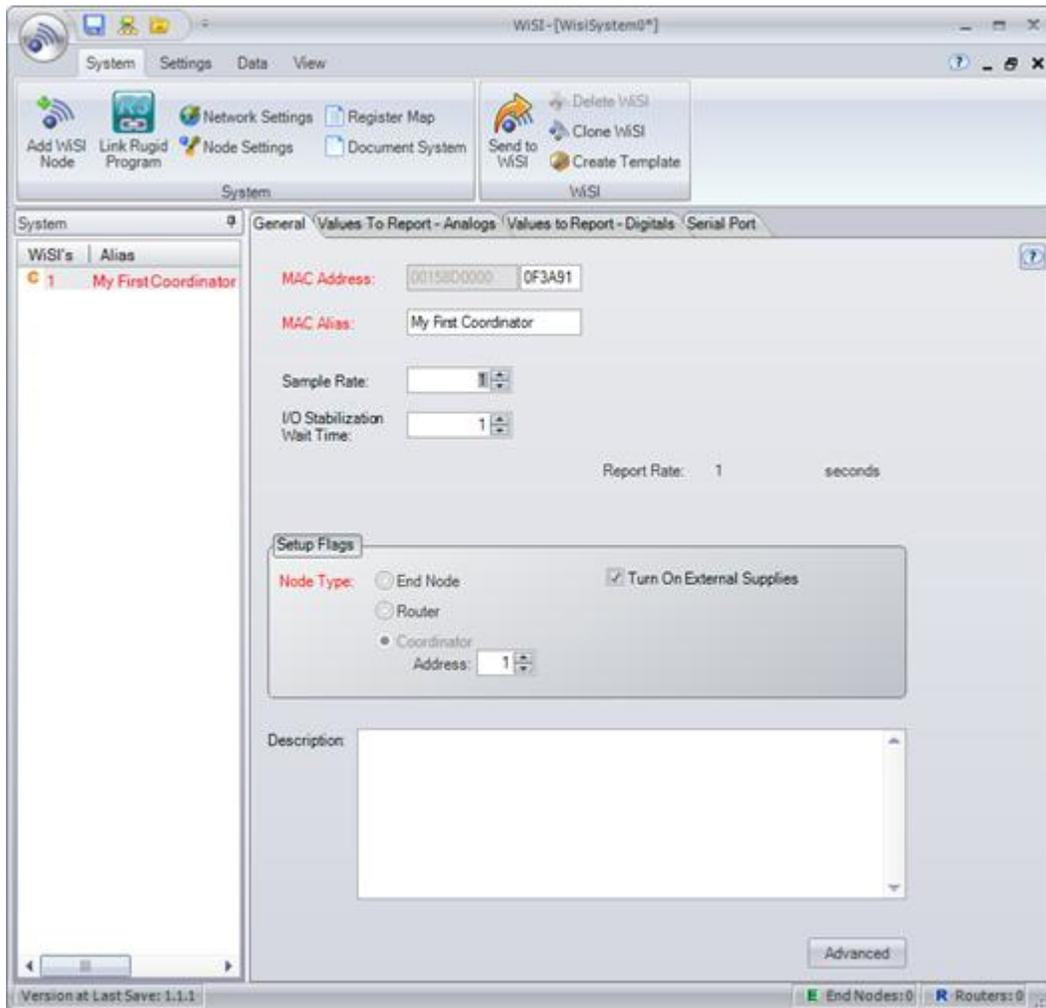
For this example, we will use the default values for the Network ID and Encryption Key. Select 'OK' to bring up the base configuration screen shown below. The WiSI Configuration Console simplifies data entry by defaulting the first 10 digits of the device MAC ID. Simply enter the last 6 digits of the MAC ID from the WiSI device label. In this example, the characters '0F3A91' will be entered to complete the MAC ID for the Coordinator.

The MAC Alias field provides an optional means to define a name which is friendlier than the MAC ID. In the second screen to follow, you will see that we have entered 'My First Coordinator' as the MAC Alias. In a real system, this name might be a customer name, or possibly its deployment location. The MAC Alias can be up to 50 characters in length.

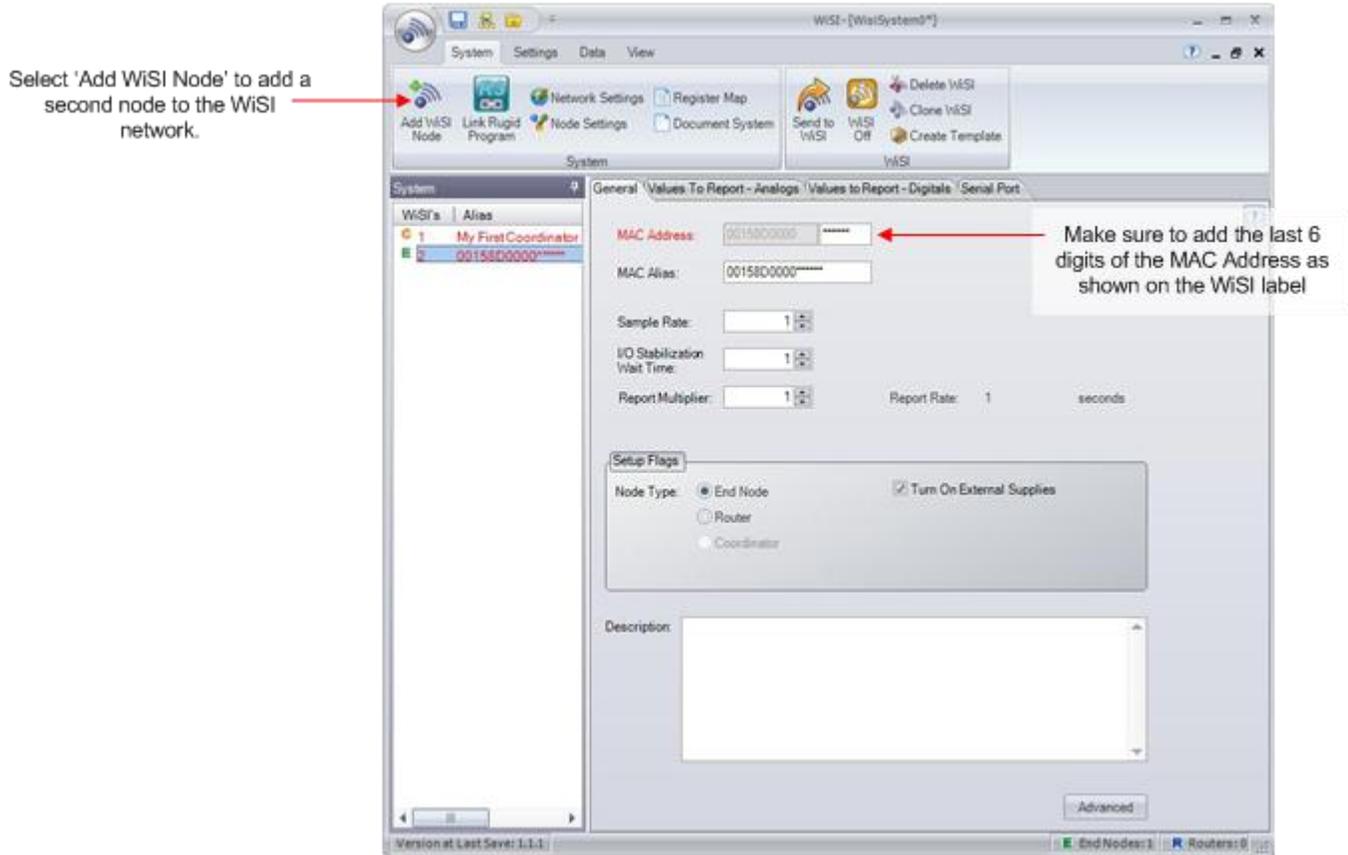
Make sure that the Node Type is set to the appropriate End Node, Router, or Coordinator, as shown on the label of the WiSI module.



The following screen shows the configuration changes which define the new Coordinator:

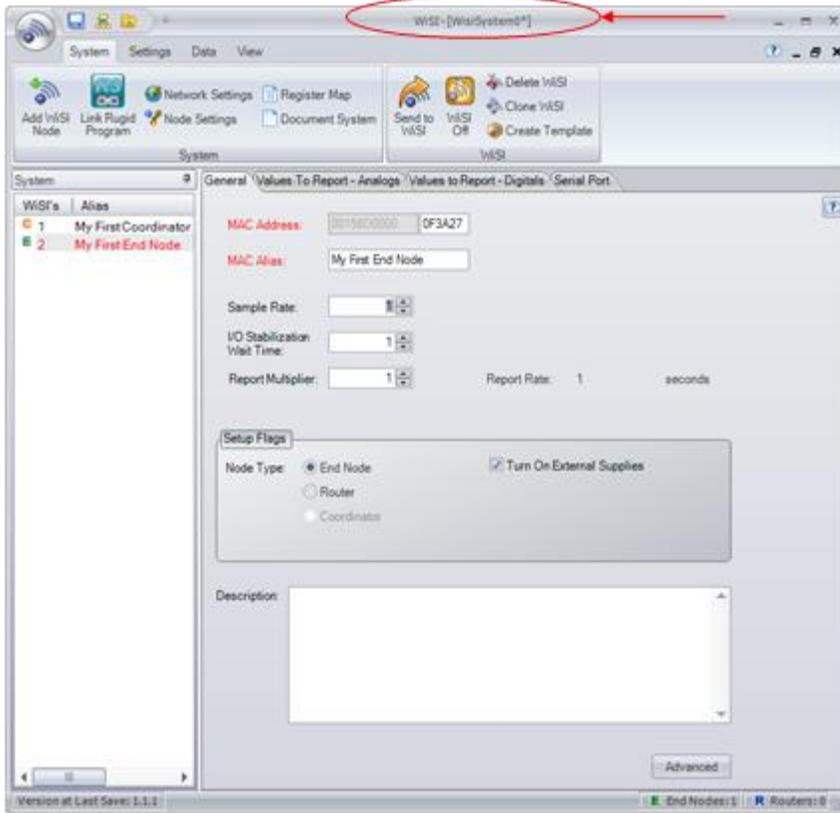


Now we will add an End Node. Select 'Add WiSI Node' which will automatically add an End-node to the WiSI network. Retrieve the WiSI End-node, and enter the last 6 digits of the MAC ID from the device label. Also, make sure that the Node Type is set to End Node. You can also enter a friendly name for the new End-node in the MAC Alias field.



### 3.3 Saving WiSI Project

The following screen defines our first WiSI project:

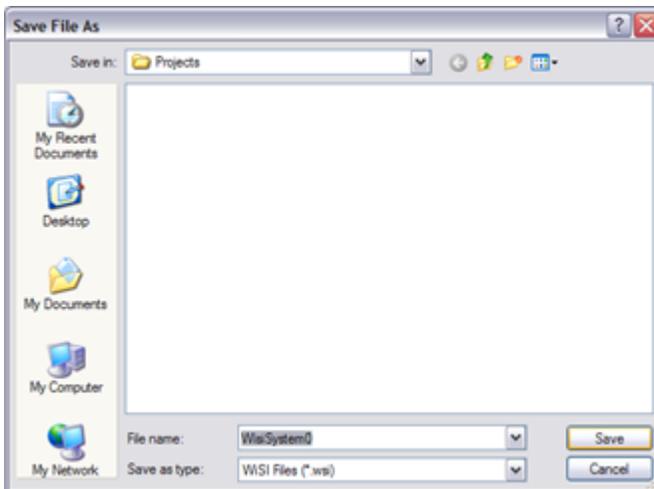


Note: The asterisk ‘\*’ behind the WiSystem0 project name. This means that changes have been made, but not yet saved.

Also, notice that the MAC Address and MAC Alias field labels are now red. This indicates that these specific fields have been changed, but not yet saved.

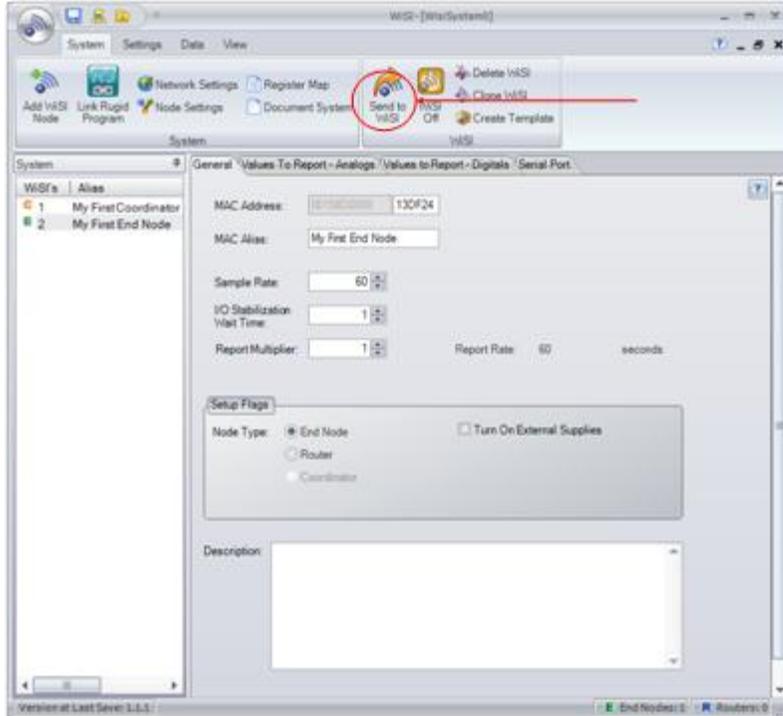
Saving the project will cause these field labels to return to black.

At this point, it is a good idea to save your project. This can be done by selecting the floppy disk symbol. This brings up the following screen: Select ‘Save’ to save the project to the project ID of WiSystem0.



### 3.4 Loading WiSI Modules

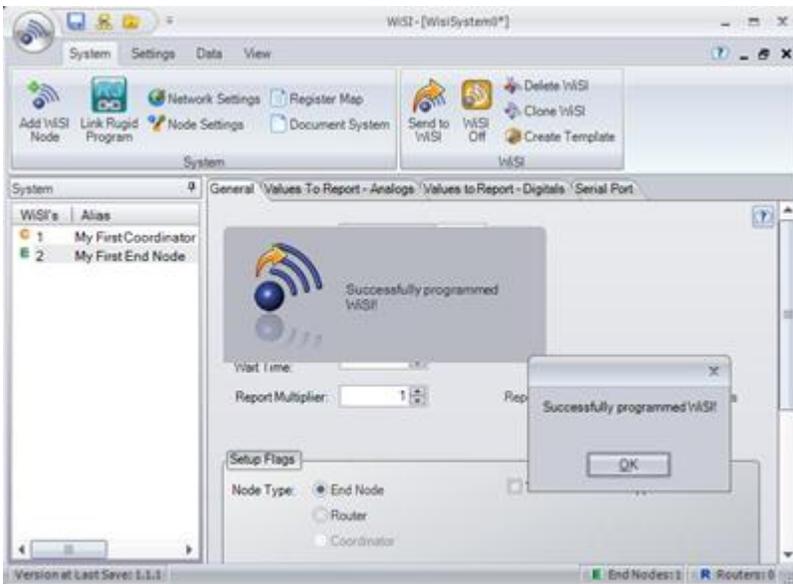
Each WiSI module must be programmed by attaching the module to the docking station, and selecting 'Send to WiSI'.



*Note: The MAC Address for the selected module must match the MAC Address of the physical module. A mismatch will generate an error.*

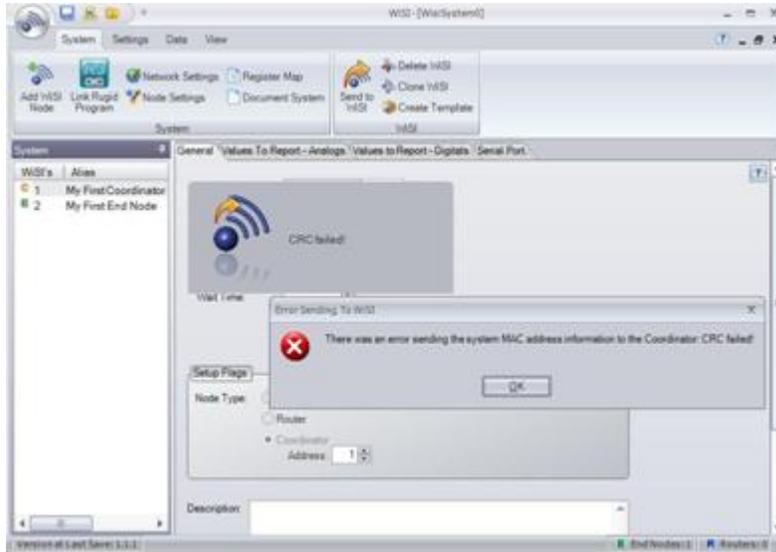
*Good Practice: The Coordinator should be the last WiSI node programmed. This is because any changes to a Router or End-node will likely require a corresponding change and thus reload of the system Coordinator.*

Successful Programming will result in the following screen:



Remove the End-node from the WiSI Docking Station, and install the Coordinator module.

Make sure that the MAC Address of the WiSI node you select to program in the WiSI Configuration Console matches the MAC Address as depicted on the label of the WiSI node installed in the Docking Station. If there is a mismatch, you will see the following error:



Acknowledge the error, and install the correct WiSI module in the Docking Station to continue with system programming.

### 3.5 Verifying WiSI System Operation

System operation can be verified after programming the Coordinator and at least one of the WiSI End-node or Router Modules. Apply power to the Coordinator and End-node or Router. The Coordinator will immediately create the wireless network with the assigned Network ID.

If a Router or externally powered End-node is used as the second WiSI node, it will immediately join the new network as soon as power is applied. You will see a short flash from the 'W' LED, indicating that the Router has joined the network.

If a solar powered End-node is used as the second WiSI node, the node network join back-off time interval (an internal factory setting) may have extended to a significant wait between network join attempts. This is intentional to extend the life of the End-node electrical energy storage. It is also possible that the solar powered End-node may have been put into a deep sleep mode for shipping or in anticipation of long term storage before deployment. In either case, if you don't immediately see a flash from the 'TX' LED indicating that the network has been joined - use the magnetic wand to stimulate a network report. There may be a delay between bringing the magnetic wand to the WiSI and the LED blinking.



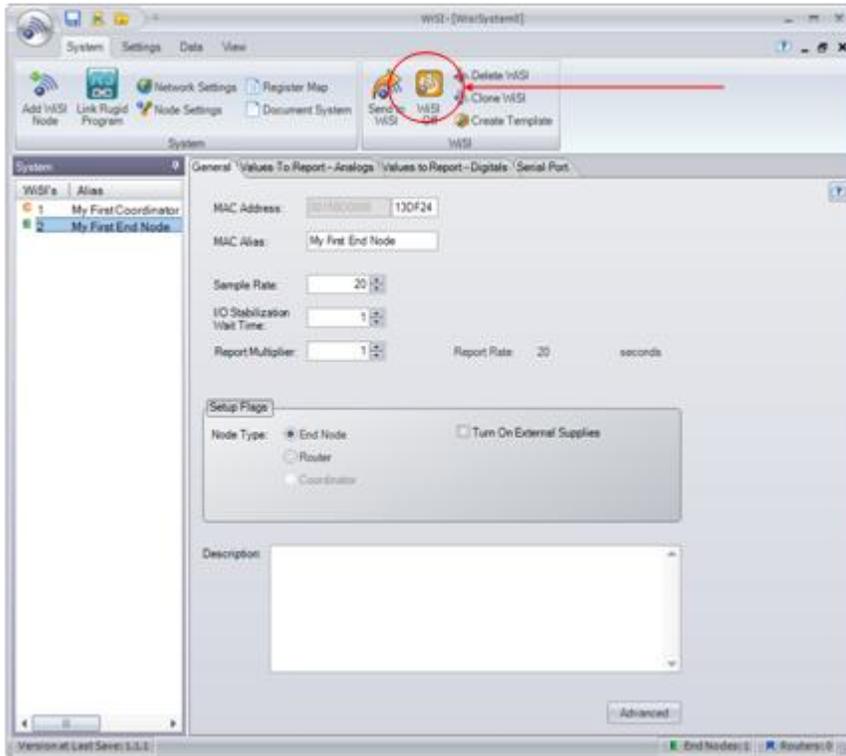
*Bringing the magnetic wand near or touching WiSI Solar Powered node near the 'TX' wireless transmit LED will force a "wake up and transmit" event.*

### 3.6 Preparing WiSI Modules for Shipping

WiSI Solar powered End-nodes radios should be turned off prior to shipping or after removal from their active wireless network.

Solar powered WiSI End-nodes will continue to transmit on their assigned interval until their stored energy is exhausted. Also, if the End-node loses contact with its Coordinator, it will begin to search for its network – at first very frequently, and as time goes by, with decreasing frequency. This broadcasting not only consumes stored energy needlessly, but can be hazardous to air carriers if the End-node is flying in a shipping container. Consequently, it is important to turn off the radio before shipping or when entering long term storage. The ‘WiSi Off’ button shown below appears whenever an End-node is selected in the WiSi Configuration Console. Simply select ‘WiSi Off’ to shut down the radio, and put the End-node into a deep-sleep state.

At any time, the End-node can be woken by touching the magnetic wand to near the ‘TX’ transmit LED.



This concludes the first WiSi Wireless Network example. You should now be able to:

- Install and run WiSi Configuration Console
- Configure a simple WiSi Network
- Start and Run a simple WiSi Network

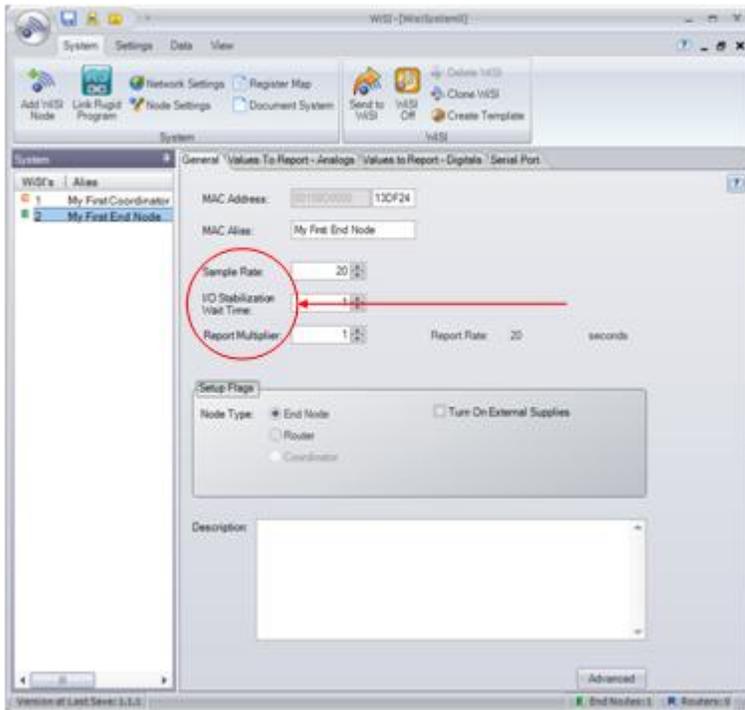
The Following sections describe additional configuration parameters which allow you to adjust the sample and reporting intervals as well as gathering and reporting of remote external sensor data.

## 4 Advanced Configuration Features

The WiSI Configuration Console provides a simple interface for configuring a wide range of performance and data gathering and reporting characteristics of the WiSI wireless network. This section describes advanced configuration capabilities of the Configuration Console.

### 4.1 WiSI – Sampling Rate Configuration

The Sample Rate, I/O Stabilization Wait Time, and Report Multiplier fields provide the ability to fine tune the frequency of data sampling and reporting to the upstream Coordinator.

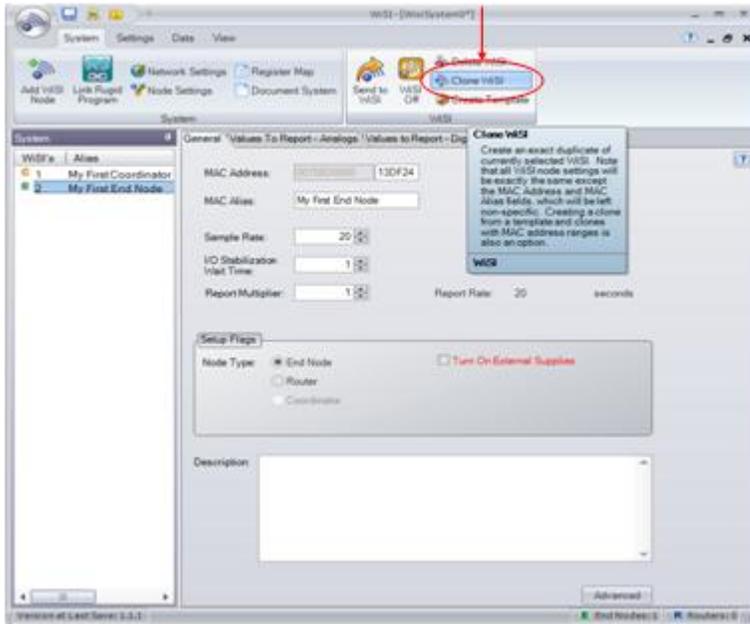




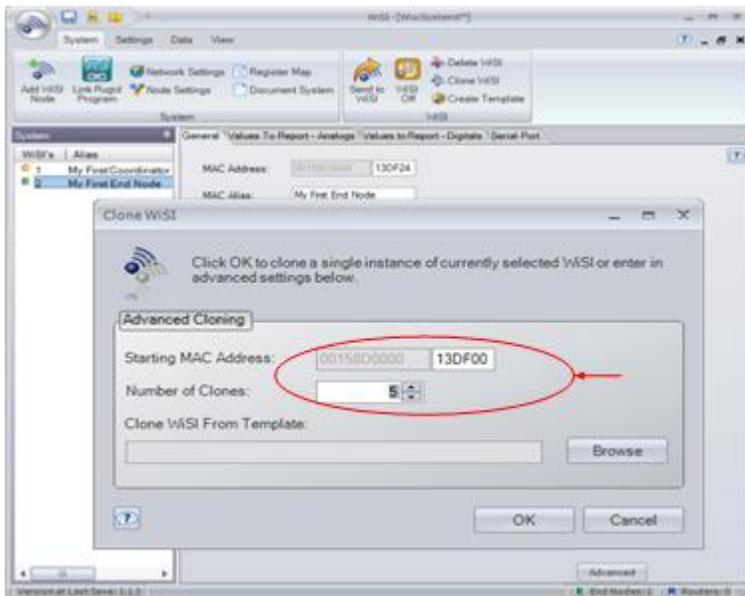
Configuration Parameter	Effect
Sample Rate	This field specifies the time period, in whole seconds, between data sampling. For the case of WiSI Solar Powered End-nodes this specifies the sleep time between waking up and sampling data.
I/O Stabilization Wait Time	This field specifies the time, in tenths of seconds, from when the external supplies are turned on until the analog samples are taken. For example, if a sensor requires 1 second to stabilize before valid output, this field would be set to 10. This field should be set to the lowest possible value that will result in accurate readings in order to conserve power. This setting is the same for all analogs and should be set based on the sensor with the longest required warm-up/stabilization time.
Report Multiplier	This field is used to specify the number of sample intervals between scheduled reporting to the coordinator. When alarming is enabled, if an alarm is detected the node will call in during the sample interval in which the alarm was detected. The node will continue to call in based on the sample rate as long as the alarm remains. If alarming is not enabled this value should be set to 1, resulting in the report rate = sample rate.

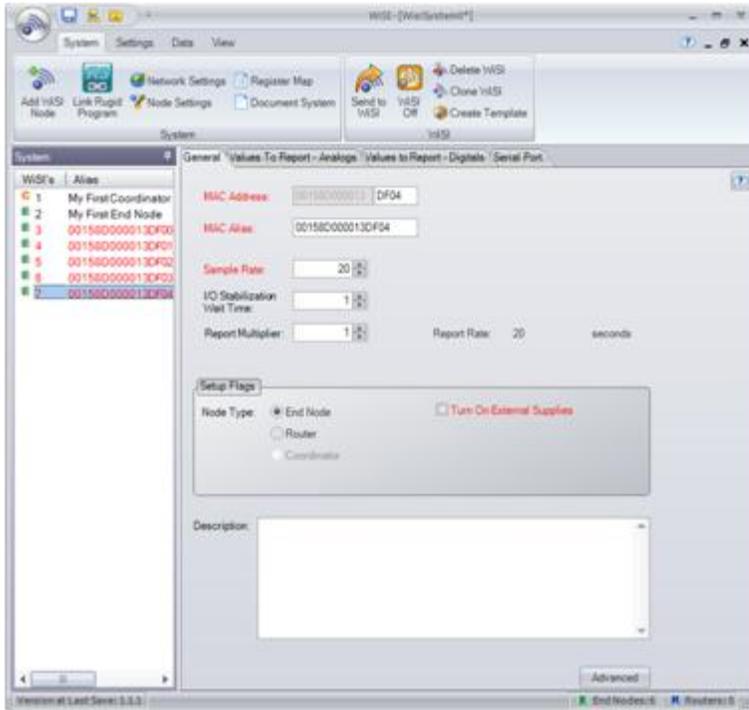
## 4.2 Cloning WiSI Nodes

The WiSI Configuration Console provides the ability to clone an already configured node. This can provide a significant time advantage when creating a large system with identical I/O configuration. The Clone feature is accessed as shown below:



In this example, we are requesting to clone the configuration of 'My First End Node' with five additional End-nodes which start at MAC Address 13DF00.



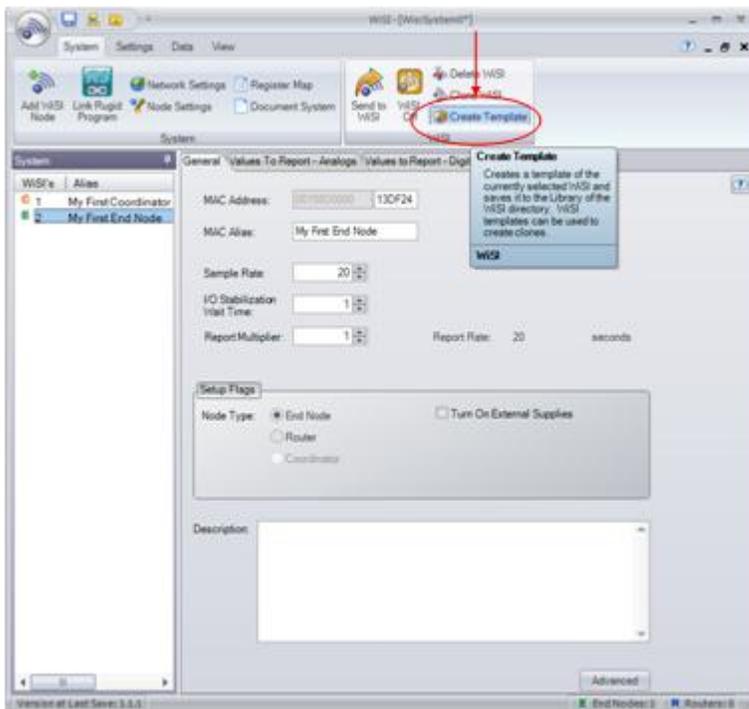


Note: Cloning can create any number of new WiSI nodes with duplicate configurations to the Clone.

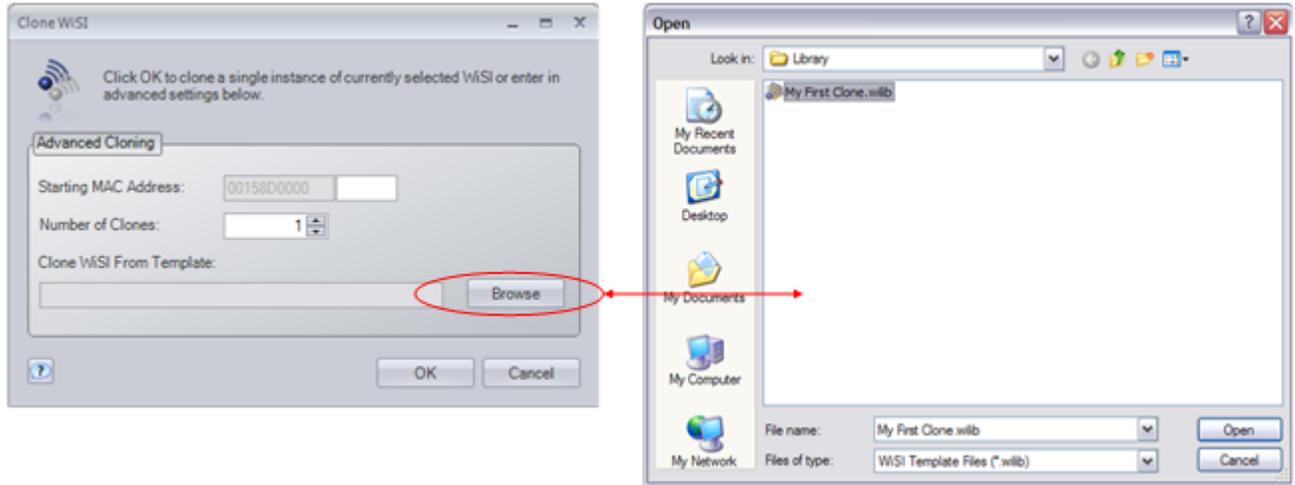
If a starting MAC Addresses is supplied, the created nodes MAC address will start at the 'Starting MAC Address' and sequentially increment.

If no starting MAC address is provided, then the new WiSI nodes will be cloned without a specific MAC address.

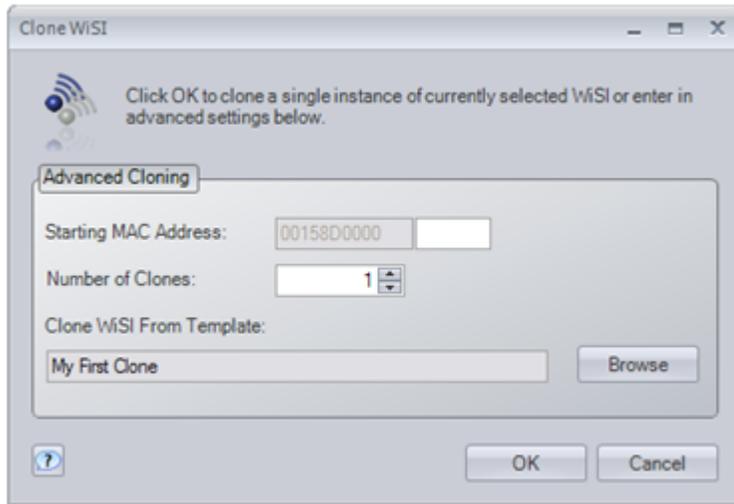
It is also possible to create a configuration template based on an existing WiSI node. This is useful for saving a common configuration across projects. Simply select the desired node to create a template from, and select 'Create Template'. Next, you will be asked to create a name for your new template, and then save it.



After you have saved a template, it is easy to create any number of WiSI nodes based on the template. Simply select Clone WiSI from the main screen, and Browse to select the desired template. Select Open after selecting the desired template.



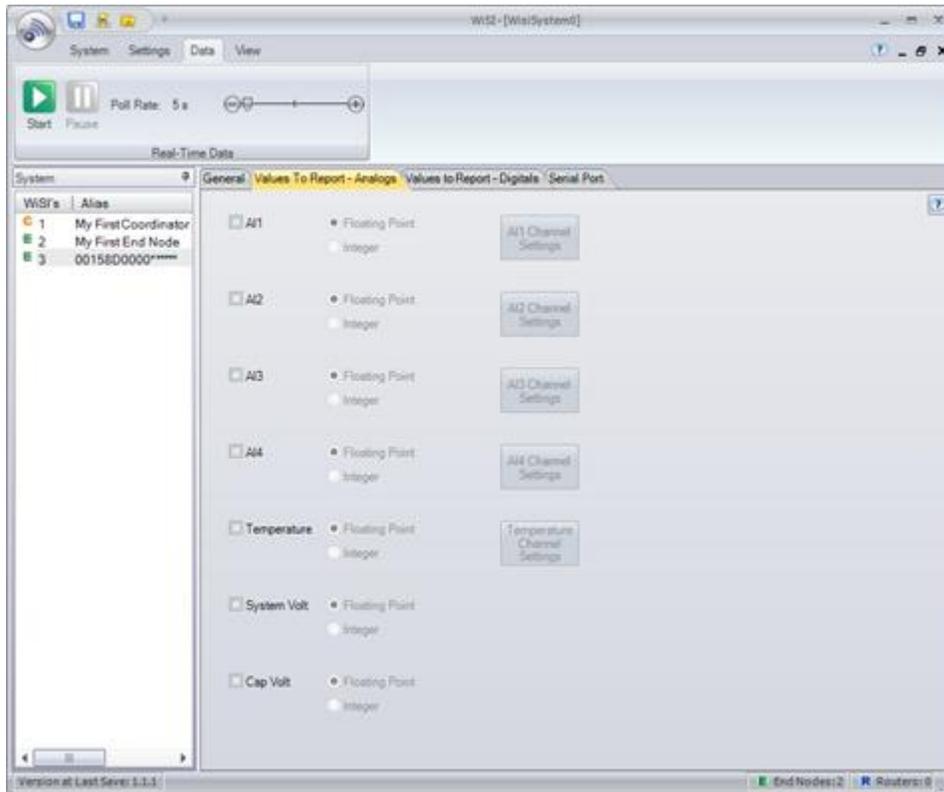
This will automatically populate the 'Clone WiSI From Template' field.



Selecting 'OK' will create the cloned WiSI node

### 4.3 WiSI Sensor Interface

Each WiSI node has the capability of gathering data from a collection of inputs. The WiSI Configuration Console makes it easy to enable only the inputs required for your particular application. The WiSI Configuration Console exposes two tabs for I/O control – one for Analog and one for Digital. The Analog configuration tab is shown in the screen below:



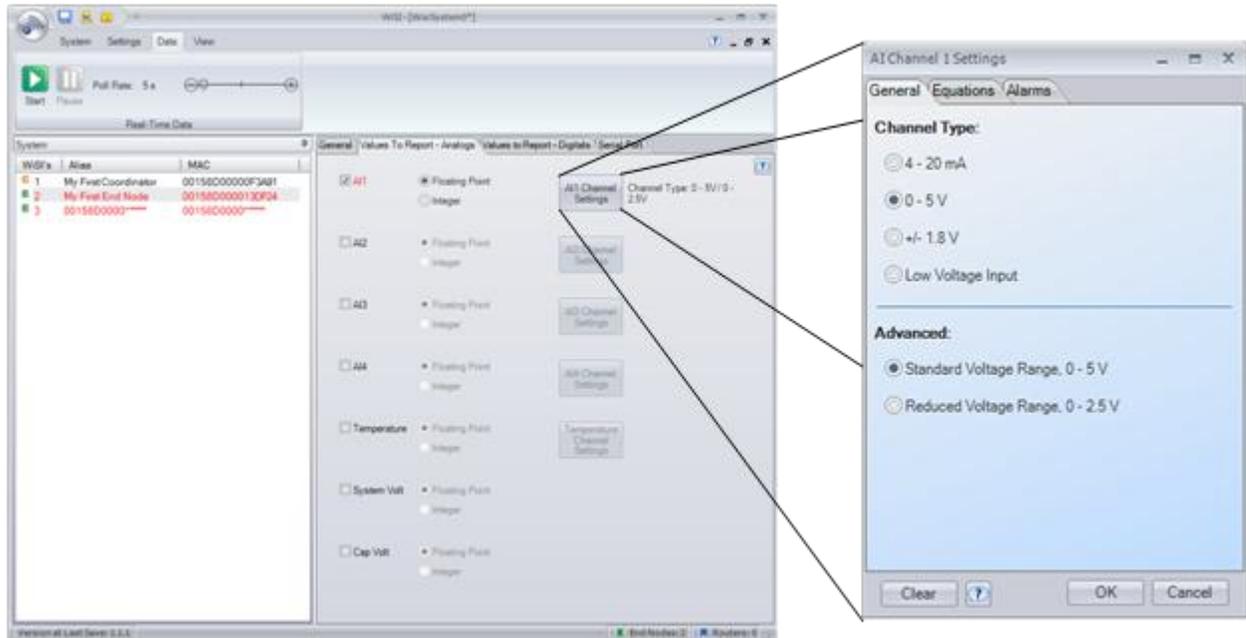
### 4.3.1 Analog Input Channel Settings

WiSI Analog Inputs come in 4 hardware versions. The specific versions are hardware dependent, and outlined on the WiSI device label as shown below:

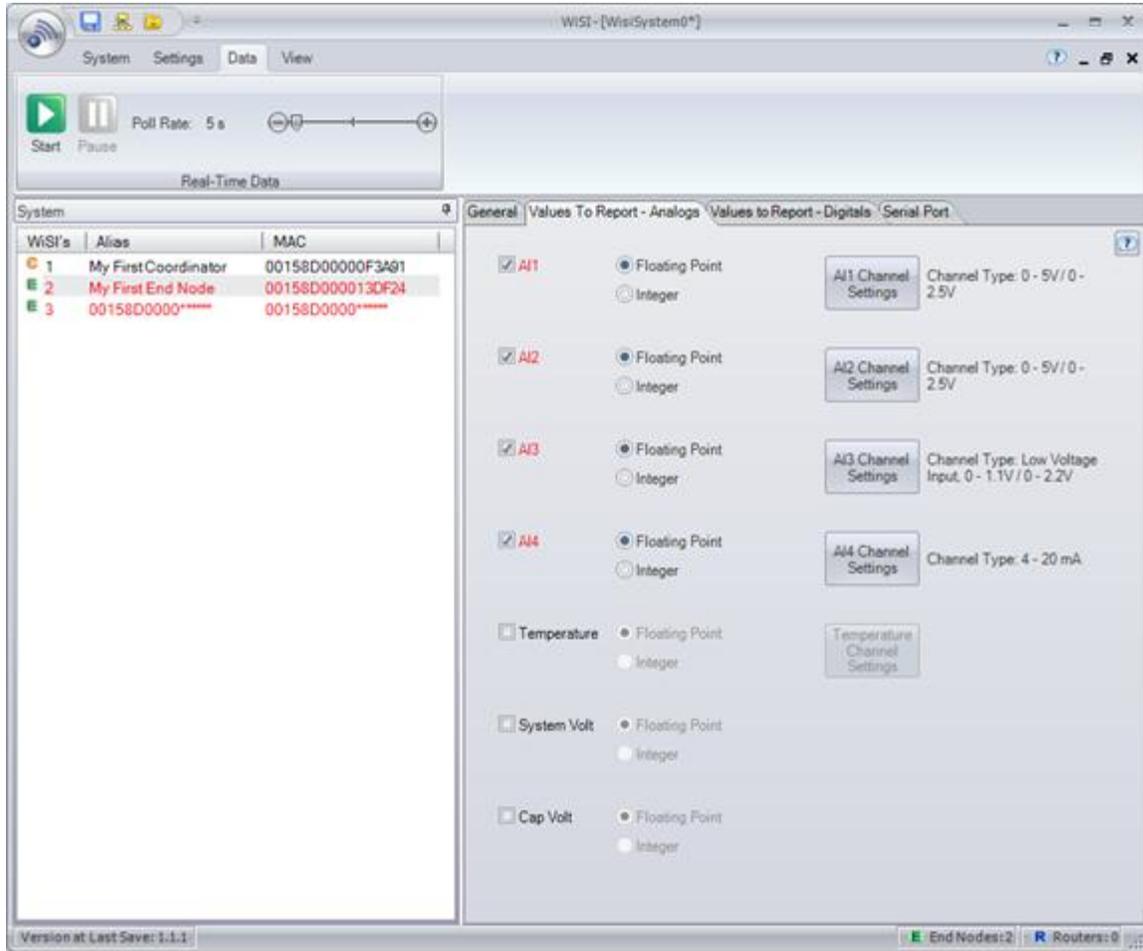


The analog section of a WiSI node as viewed in the WiSI Configuration Console must be configured to match the analog channel capabilities displayed on the node label. In the example below, the ‘AI 1’ check box has been ‘checked’. This enables selection of the ‘AI 1 Channel Settings’ button. Selecting this button brings up the ‘AI 1 Channel Settings’ screen, which allows us to select the 0-5 V setting. Now the capabilities of the End-node described in the WiSI Configuration Console matches the capability of the specific End-node as displayed on the product label.

This procedure must be followed for each of the analog channels – AI 1 through AI 4. WiSI nodes supporting various combinations of analog inputs based on the four types (4-20 mA, 0-5V, +/- 1.8v, and Low Voltage Input) are available from Rugid Computer. Contact [sales@RugidComputer.com](mailto:sales@RugidComputer.com) for further information.



For this example, the Analog Input for Channel 1 has been set to 0-5V to match the hardware capabilities of this specific WiSI node. The following screen shot shows ‘My First End Node’ analog channels configured in the WiSI Configuration Console to match the hardware capabilities of this specific WiSI node. Always make sure to set the specific analog channel configuration to match the hardware capabilities of the specific WiSI node.



Note that in the above screen shot, My First End Node in the System panel on the left is red in color. This indicates that the configuration changes to this node have not been saved. Make sure to click the save button before proceeding.

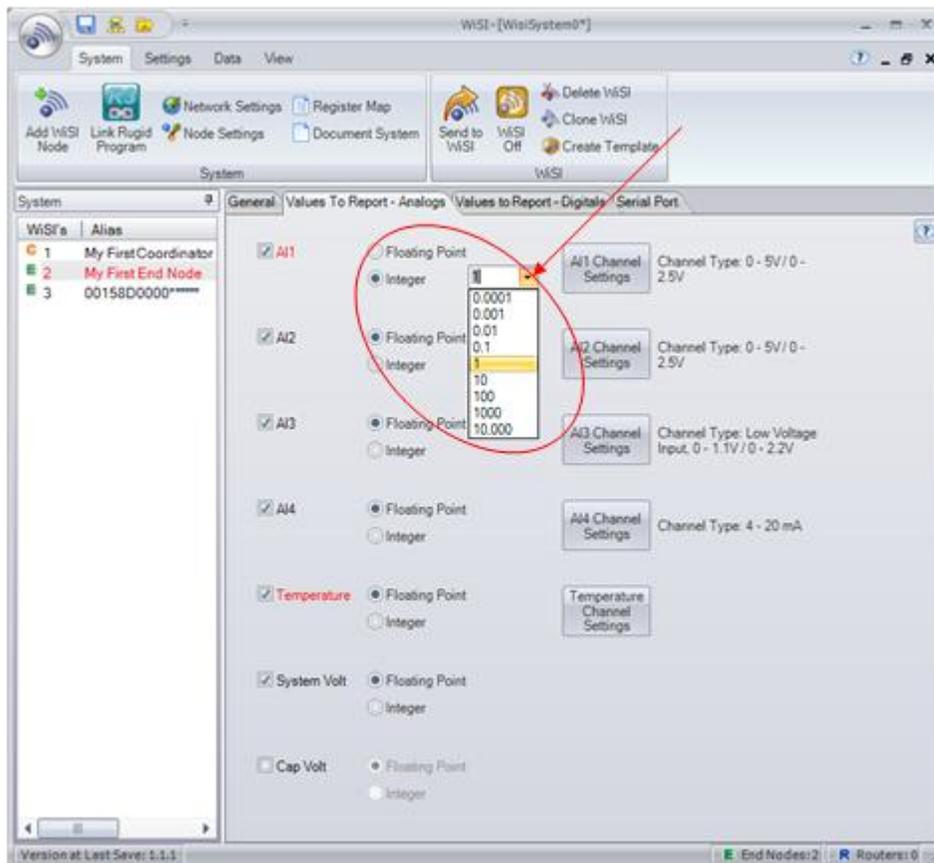
### 4.3.2 Analog Channel - Integer Versus Floating Point Data Return

The WiSI Configuration Console analog setup screen provides the option of requesting Floating Point or Integer reporting. Some Modbus implementations do not have adequate register width to support a true floating point value. If this is the case, then it is possible to specify that the analog value should be returned as an Integer. To avoid losing data precision, the Integer selection provides the ability to scale the real value by a multiplier. The multiplier can range between 0.0001 and 10,000.

Example 1: Assume that the sensor attached to AI 1 returns a value between 0.02 and 0.1 and that the Modbus controller cannot receive these floating point values. In this case, we would select a multiplier of 100 which would yield a sensor return value ranging from 2 to 10. The value received at the Modbus host for AI 1 would subsequently be divided by 100 to return to the original value.

Example 2: Assume that the sensor attached to AI 1 returns a value between 125,000 and 350,000 and that the Modbus controller cannot receive these floating point values or integers with greater than 1000. In this case, we would select a multiplier of .001 which would yield a sensor return value ranging from 125 to 350. The value received at the Modbus host for AI 1 would subsequently be multiplied by 1000 to return to the original value.

A drop down list of integer multipliers automatically appears if 'Integer' is selected as the return data type. This is shown in the following screen shot.



### 4.3.3 Analog Channel – Setting Engineering Units Conversion

The WiSI Configuration Console provides a simple solution for defining the conversion of raw Analog to Digital counts to Engineering Units.

The following screen shot demonstrates defining a sensor that returns a 0 to 5 volt signal. Zero volts represents a value of 20, and a full scale 5 volts represents a value of 120.

Example:

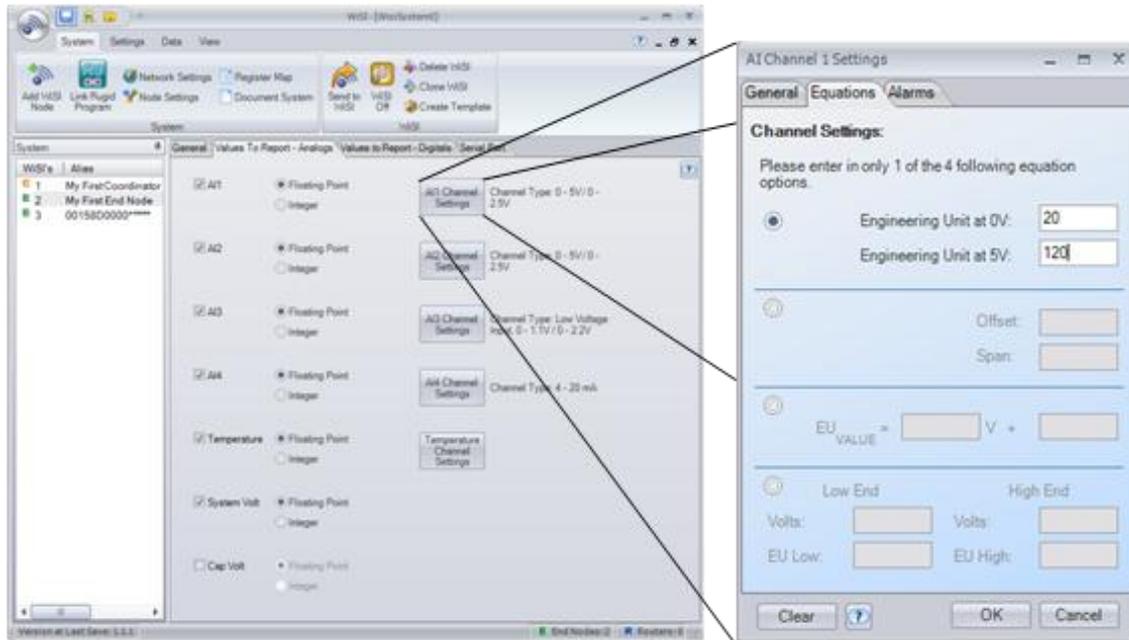
Subsequently, if the AI 1 channel senses a voltage of 2.37 Volts, the value returned through the network, and ultimately to the associated Modbus register will be:

$$(2.37/5.0)*(120-20) + 20 = 67.4$$

If the AI 1 Channel was set to Floating Point, the returned value would be 67.4

If the AI 1 Channel was set to Integer, with a multiplier of 1, the value returned would be 67

If the AI 1 Channel was set to Integer, with a multiplier of 10, the value returned would be 674

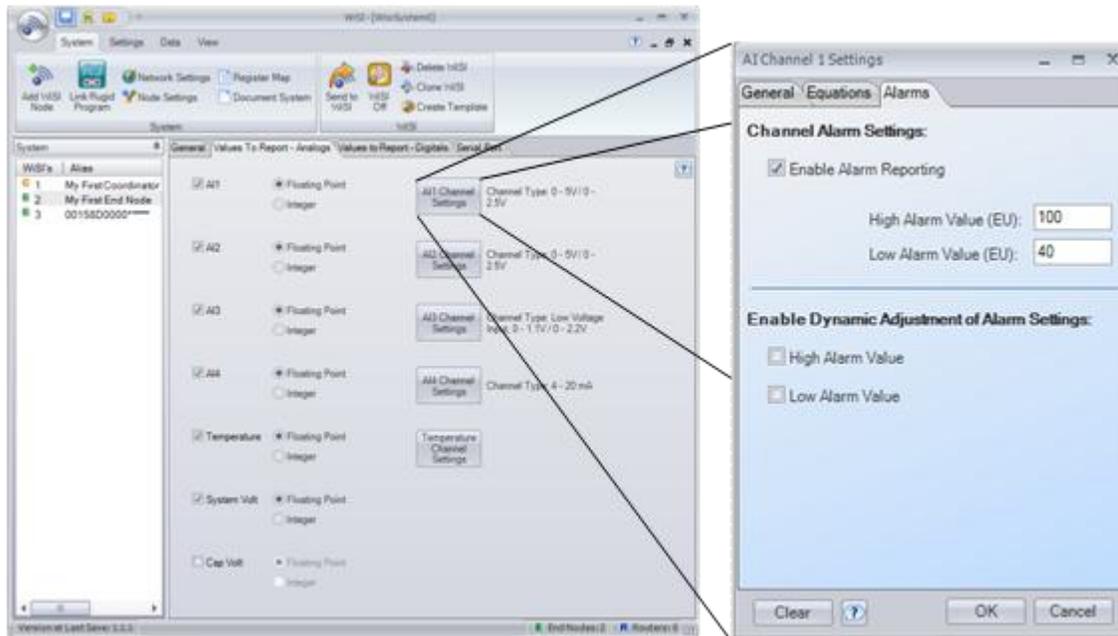


As seen in the above screen shot, the WiSI Configuration Console provides for 4 different types of Engineering Conversion equations. Select the conversion equation that most closely matches your requirements.

### 4.3.4 Analog Channel – Alarm Setting

The WiSI Configuration Console makes it easy to define an upper and lower alarm value (based on engineering units) for any of the Analog Input Channels. Selecting the Alarm tab will bring up the screen below. Each time the End-node wakes up, it compares the current value of the Analog Input against the Alarm settings for the channel. If the Current value is lower than the ‘Low Alarm Value’ or greater than the ‘High Alarm Value’, an alarm is generated and forwarded upstream to the Modbus Host. Exceeding an Analog Alarm value will not wake the End-node. However, the detection of an Alarm condition during a sample cycle will stimulate a report upstream immediately. For example, if the ‘Report Multiplier’ is set such that sensor data is sampled every 10 seconds, but only reported every 6 cycles (every 60 seconds) – an Alarm condition detection will stimulate a report during the cycle it was detected.

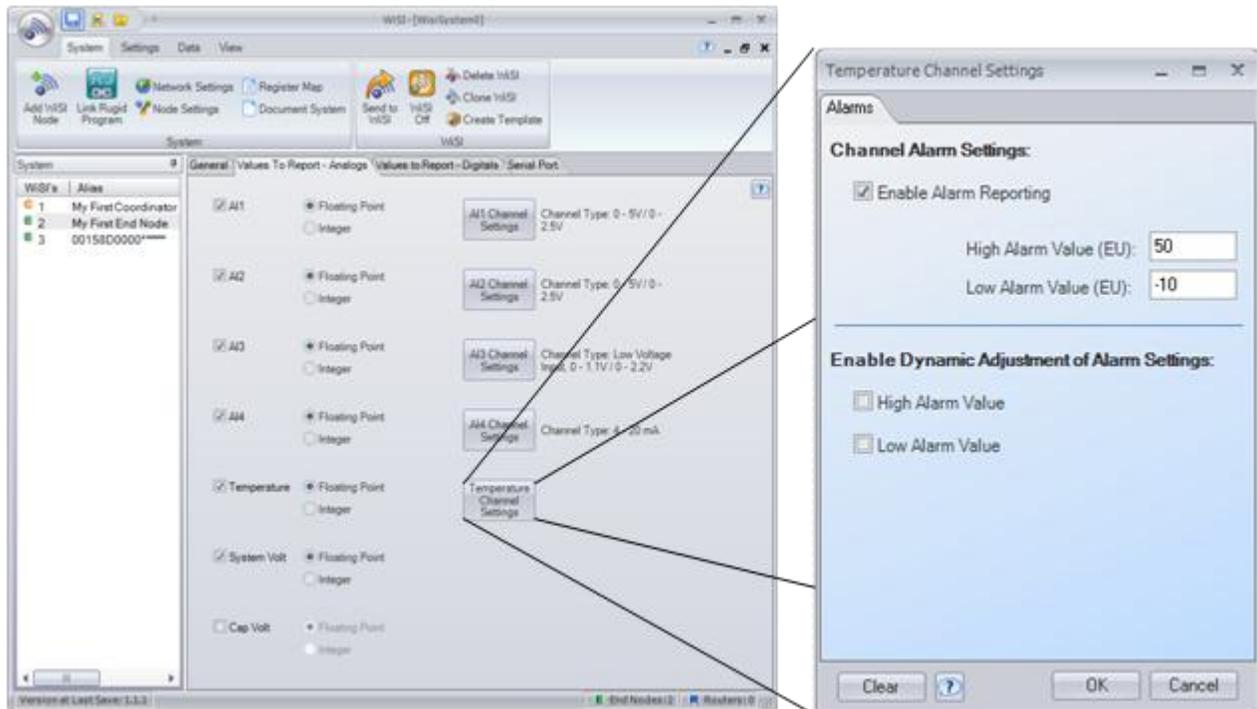
As seen on the ‘Alarm’ setting screen, it is possible to define the alarm for this analog channel to be ‘Dynamically Adjustable’. This will allow the upstream Modbus host to send down a dynamically adjustable alarm value.



### 4.3.5 WiSI Temperature Reporting

Every WiSI node contains an embedded temperature sensor that can be used to determine the environmental conditions at the node. The is returned in engineering units of degrees Celsius. The WiSI Configuration Console allows you to specify either floating point or integer representation. In the case of integer representation, the scale factor default to 100 since the temperature has a maximum resolution of .01 degrees.

In addition, it is possible to set both High and Low Alarm Values as shown in the screen shot below. In this example, an alarm would be generated if the WiSI node recorded a temperature of less than -10 degrees Celsius, or greater than 50 degrees Celsius. It is also possible to specify that either or both High or Low Alarm levels could be dynamically adjustable by checking the appropriate box.



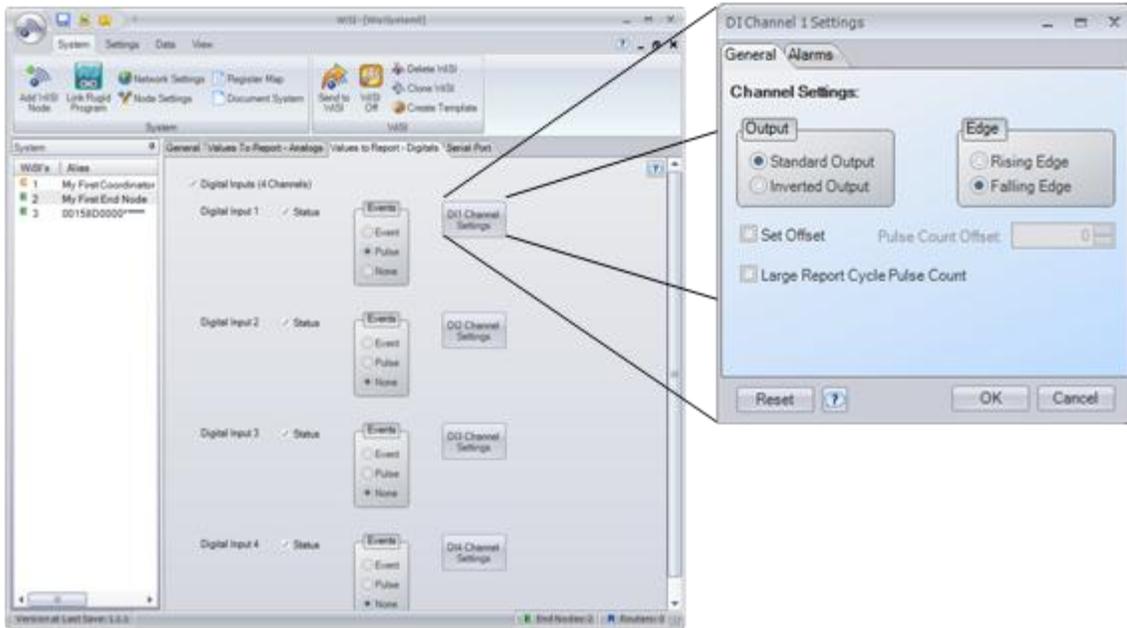
### 4.3.6 Digital I/O

Every WiSI Node can sense up to 4 digital inputs. The WiSI Configuration Console allows for the interpretation of the digital input signal in 3 different ways as described in the following table. After selecting the input type, select the Digital Input Channel Settings button to define specific characteristics of the input type.

Type	Definition
Event	<p>Event type inputs immediately wake up a sleeping End-node. The DI Channel Settings screen allows the configuration of Standard or Inverted Output, as well as defining rising or falling edge event triggering. Events trigger an immediate reporting of all WiSI End-node sensor inputs to the upstream Modbus host.</p>
Pulse	<p>Pulses will wake up a sleeping WiSI node. Configuring a digital input as a Pulse type instantiates a new Modbus register which accumulates the total counts of pulses recorded for this digital input. It also records the status of the digital input at the time of wake up. Support for Standard or Inverted signals are also provided through the DI Channel Setting screen. You must specify if the pulse is counted on the Rising or Falling edge of the digital input.</p> <p>It is also possible to define an offset pulse count through the ‘Set Offset’ check box. The purpose of this configuration parameter is to allow the replacement of WiSI node while keeping pulse counts contiguous. This feature provides the ability to set the starting point of the pulse count register at where the previous WiSI node left off.</p> <p>The standard count register only counts up to 65,535. Selecting ‘Large Report Cycle Pulse Count’ will allow pulse counts up to 4,294,967,295 counts.</p> <p>Pulses also can trigger Alarms. The DI Channel Settings – Alarm Tab allows you to set the maximum number of digital pulses allowed within a sleep cycle. Exceeding this value will result in an alarm being generated. It is also possible to define an alarm count as dynamically adjustable via the upstream Modbus interface.</p>
None	<p>None is the simplest interpretation in which the value of the digital input reported simply reflects the digital state of the input pin at the time of sampling. The only configuration possible with the ‘None’ input type is specification of the Output interpretation.</p>

Standard Output is defined as a grounded input pin equals a 1 on the digital input.

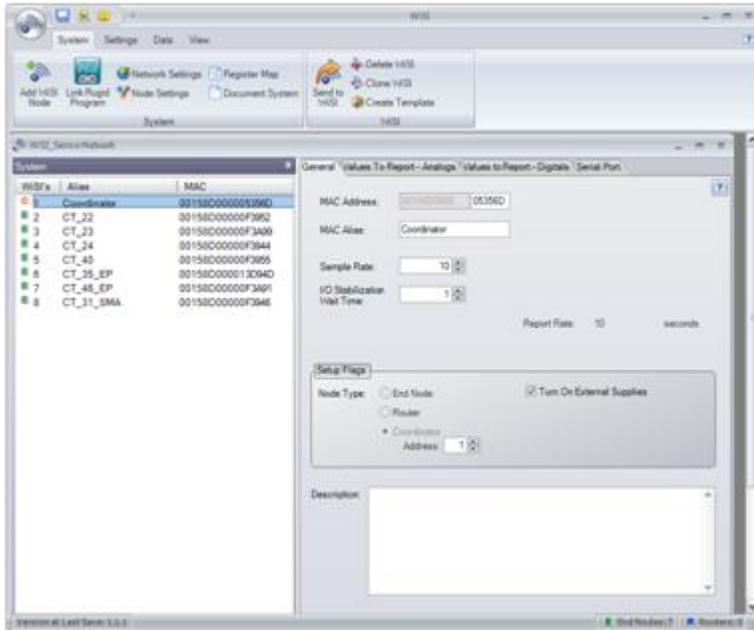
Inverted Output is defined as a grounded input pin equals a 0 on the digital input.



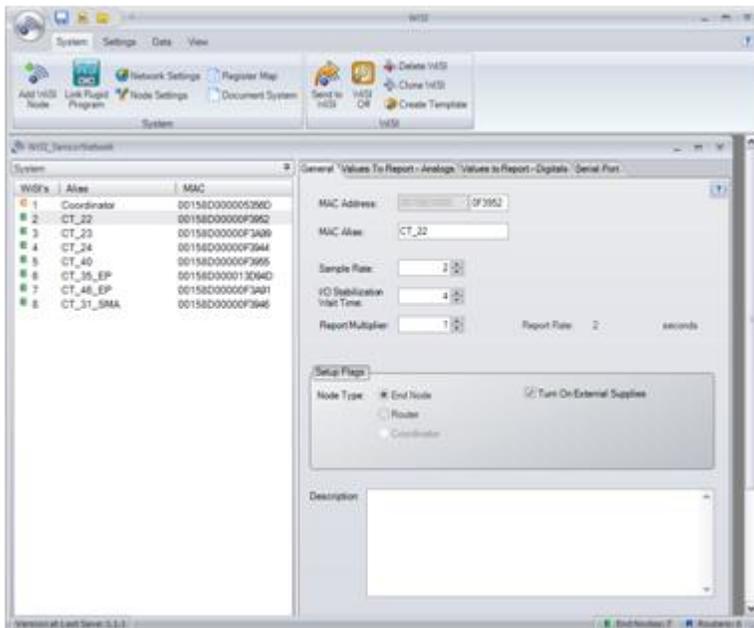
## 4.4 Viewing Sensor Data with the WiSI Configuration Console

The WiSI Configuration Console provides a quick and easy way to view real-time data gathered over the wireless network. Simply connect the Coordinator to the WiSI Configuration Console. The following example shows a WiSI wireless network consisting of a Coordinator and 7 End-nodes.

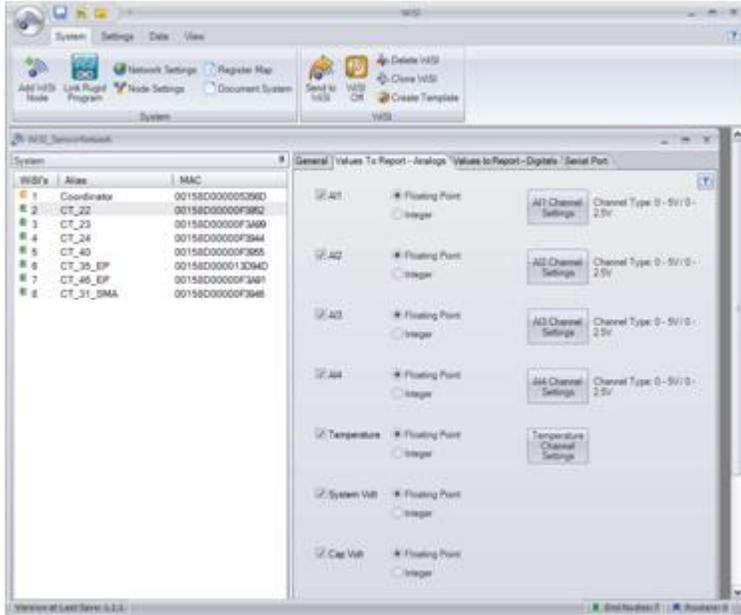
This screen shot shows the configuration of the Coordinator



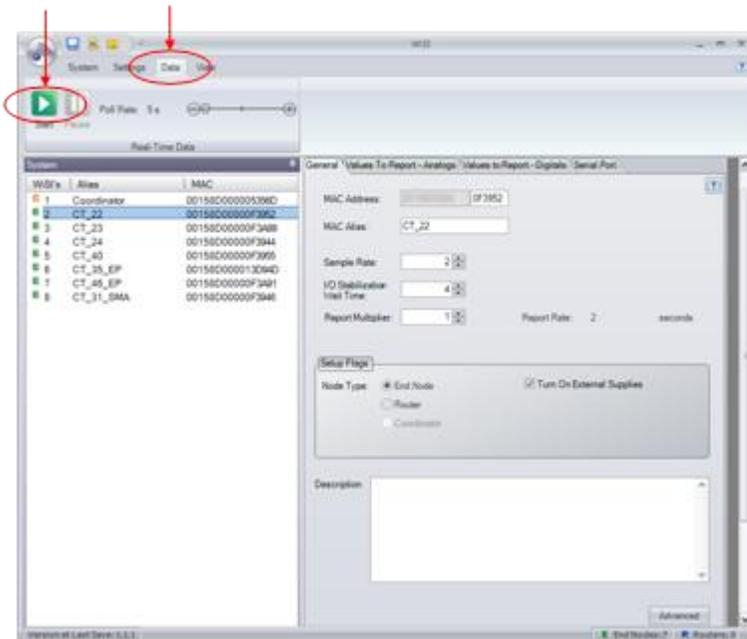
This screen shot shows the configuration of the CT-22 End-node. Note that the CT-22 End-node is configured for a 2 second sample rate, I/O Stabilization Rate of 0.4 seconds, and a Report Multiplier of 1.



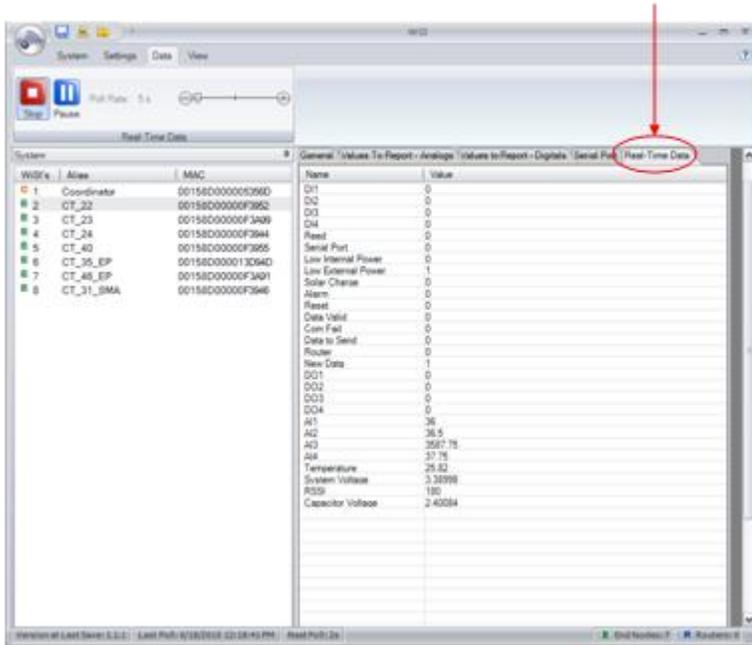
The following screen shot shows the configuration of CT-22 End-node Analog Sensor inputs. Note that this End-node is configured to report the sensor values of all 4 Analog inputs, as well as Temperature, System Voltage, and Capacitor Voltage.



Load all WiSI nodes, and apply power to start the wireless network running. Plug the WiSI Coordinator into the WiSI Docking station (or remotely via RS232 serial connection). Open the project in the WiSI Configuration Console, select the specific WiSI node of interest, and select the 'Data' tab. This will bring up the current view of the sensor inputs for the specific WiSI node. Select the 'Start' button to toggle into a data reporting mode.

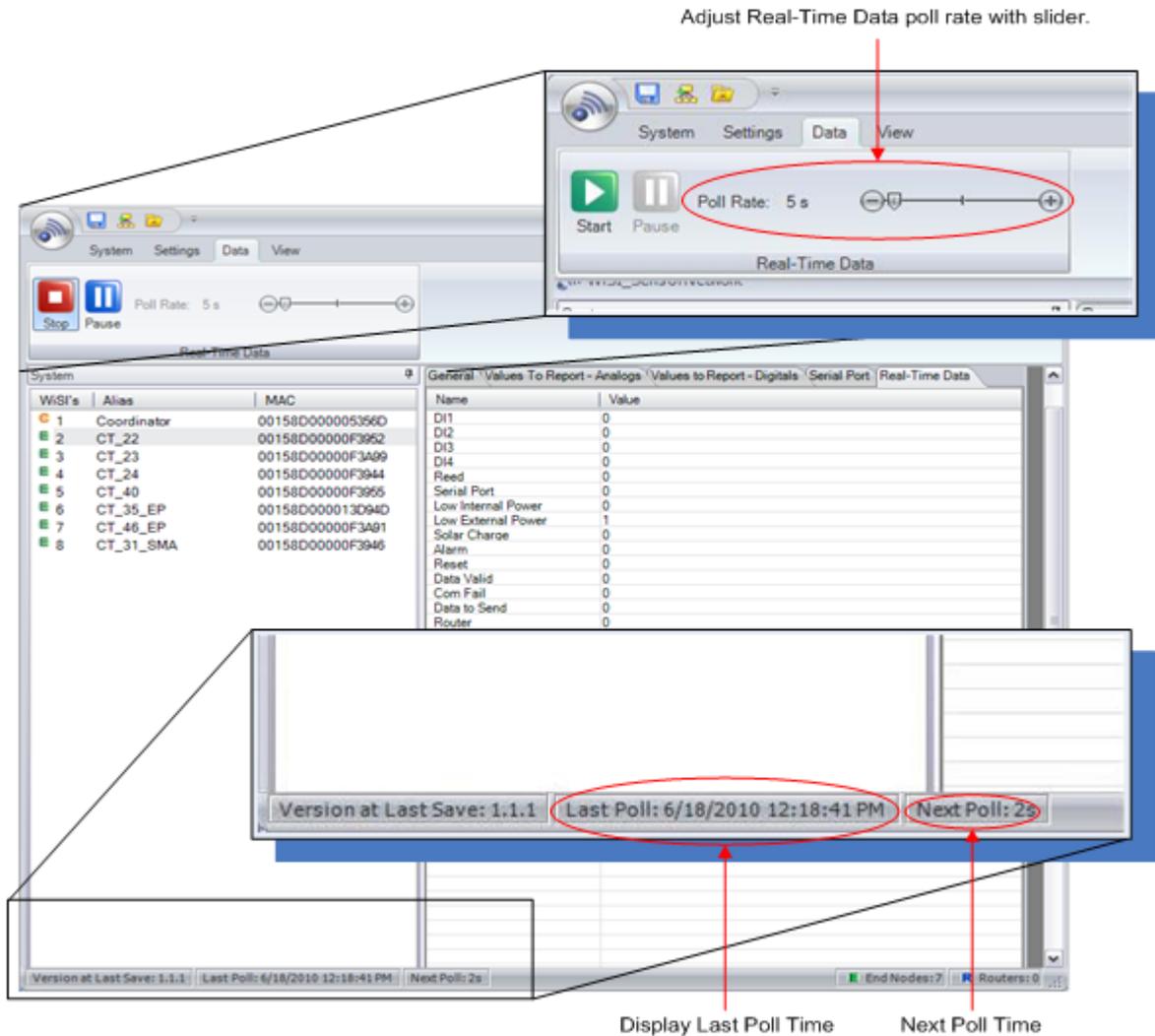


Selecting the 'Start' button will add a new 'Real-Time Data' tab to the WiSI Configuration Console tabbed display area. The following screen shows the 'Real-Time Data' tab selected on the running CT-22 End-node. All Real-Time registers are cleared to zero at startup.



Real-Time Data Name	Value
DI1	Current value of Digital Input 1
DI2	Current value of Digital Input 2
DI3	Current value of Digital Input 3
DI4	Current value of Digital Input 4
Reed	Current status of Reed Switch
Serial Port	Flags Serial Port as reason for waking up.
Low Internal Power	When capacitor voltage goes below 1.2 volts
Low External Power	When external supply voltage is less than 12.5 volts
Solar Charge	Solar charging occurring
Alarm	An alarm condition has been detected
Reset	If node has been reset – cleared after reporting
Data Valid	Not currently used
Com Fail	Set by Coordinator if node did not report within activity timeout
Data to Send	Triggered by data waiting to be sent to a node – currently only valid for Coordinator
Router	Bit set if node is a router
New Data	Bit set when an End-node sends data to Coordinator – cleared after Modbus read.
DO1	Current value of Digital Output 1
DO2	Current value of Digital Output 2
DO3	Current value of Digital Output 3
DO4	Current value of Digital Output 4
AI1	Current value of Analog Input 1
AI2	Current value of Analog Input 2
AI3	Current value of Analog Input 3
AI4	Current value of Analog Input 3
Temperature	Current node temperature in degree C
System Voltage	Radio supply voltage
RSSI	Radio Received Signal Strength Indicator – value 0 to 255
Capacitor Voltage	Current value of storage capacitor

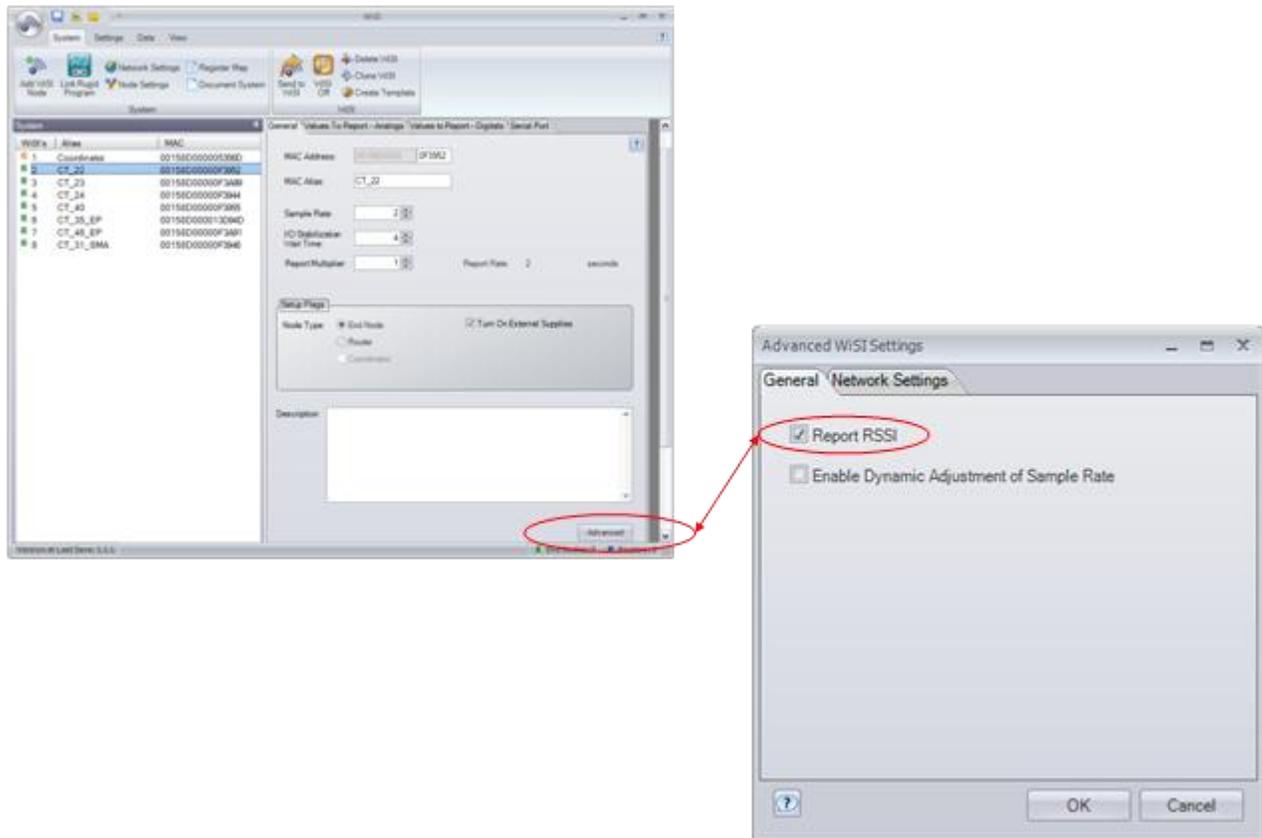
The Poll Time for retrieving Real-Time Data from the Coordinator can be adjusted with the slider. Select the 'Pause' button to stop polling and view Real-Time Data for any node in the system at the moment 'Pause' was pressed. This makes it simple to compare Real-Time data at any instant across the entire network of WiSI nodes.



## 4.5 Viewing Radio Signal Strength

It is often valuable to be able to view the Radio's signal strength for a particular WiSI node. This is useful when viewing the distributed receive signal strengths in a deployed system. Each WiSI node is capable of returning a value called the Receive Signal Strength Indicator. This is a number between 0 and 255 with higher values indicating greater received signal strength.

Enabling RSSI on a particular WiSI node will result in the receive strength indicator value being returned with each node transmission to the upstream coordinator. RSSI transmissions are enabled by default. Selecting RSSI is accessed through the 'Advanced' button on the 'General' tab as shown below:



Check 'Report RSSI' to send the Receive Signal Strength Indicator along with each transmission by the selected WiSI node.



## 5 Deploying WiSI System

### 5.1 Powering up WiSI Network

#### 5.1.1 Understanding WiSI LED's



## 6 Troubleshooting

## 7 Appendix

### 7.1 WiSI Features

- Up to 2 Mile Range At 2.4 GHz – No License Required!
- 128-Bit AES Encryption
- Solar Power With Backup Power for Running Overnight\*\*
- No Maintenance / **No Batteries** to Change!\*\*
- Switched 5 Volt and 18 Volt Supply for Powering Sensors
- Modbus Interface Provides Flexibility – View Collected Data and Dynamically Adjust System
- Low Power Indication (Available Through Modbus Interface)\*\*
- Environmental Protection IP 67 Rated Enclosure
- User Definable Alarming Conditions for AI & DI Channels
- Digital I/O mapping – 2 nodes
- Transmit LED
- Onboard Switch to Force Transmission
- Onboard Temperature Measurement
- Serial Port for Modifying Node Settings and Sending Data
- Easily Integrates With Rugid RTUs – Automatic Array Generation
- Easy Installation – Only Need to Attach Local Signal Wires
- Easy Network Setup Through **FREE** Configuration Software
- Low Power, Suitable For Energy Harvesting Applications
- Viewable Signal Strength For Installation And Debugging
- Fits Inside Standard 2" ID Pipe



## 7.2 Specifications

<b>Radio:</b> 2.4 GHz IEEE 802.15.4	
Range	Up to 4 KM / 2.5 miles
Transmit Power	+19 dBm, (79 mW)
Receiver Sensitivity	-100 dBm
Antenna Connector	Reverse Polarity SMA, 50 ohms
Antenna Tightening Torque	
Encryption	128-Bit AES, User Selectable Key
Data Rate	250 kbps
RSSI (Receive Signal Strength Indicator)	Operational between 60 and 255
<b>Networking:</b>	
Star	Up to 17 nodes
Tree *min of 1 routing node required for every 16 nodes	Up to 200 nodes*
<b>General:</b>	
Power – External Powered (EP) unit	+5 – 30 VDC
Power – Solar Powered (SP) Unit	+5 – 15 VDC
Average Power Draw ( 12 / 24 VDC)	19 mA / 9.5 mA
Operating Temperature	-20 to 70° C
Weight	0.24 kg (0.52 lb) – SP nodes 0.17 kg (0.36 lb) – EP nodes
Mounting *EP package only	2 inch ID pipe 2 x 8-32 screws*
Connector	High Density DB26
Connector Tightening Torque	0.34 – 0.49 N*m (3.00 - 4.34 in*lbf)



<b>Sensor Supplies:</b>	3 non-isolated, switched
+18 Volt Supply +5 Volt regulated	25 mA max combined load
Rise Time from switch ON	100 ms
0.25 mA current supply	
<b>Digital Inputs:</b>	4 non-isolated, sinking, wetted 3.0V
Input Voltage Rating	0 – 24 VDC
Input Current	2 mA max at 24 VDC
Input ON Level	0.89 VDC max
Input OFF Level	2.31 VDC min
Pulse Frequency *Factory adjustable	150 Hz max– sleeping nodes 150 Hz max*- non-sleeping
Pulse Width	50 $\mu$ s
<b>Digital Outputs:</b>	4 FET, sinking
Voltage Rating	42 V max
Current Rating * Each connector pin is rated for 2.5 A. 4 ground pins are provided and must all be connected when switching high currents on multiple outputs.	2 A max*
<b>Analog Inputs:</b>	4 non-isolated 12 bit, single ended
0 – 40 mA	0.04 mA min, 45 mA max
0 – 5 Volts	0.025 V min, +5.15 V max
-1.8 Volts to +1.8 Volts	-1.8 V min, +1.8 V max
0 – 2.2 Volts	0.02 V min, +2.30 V max
Accuracy	0.25% of full scale



<b>Serial Port:</b>	Single RS232
Baud Rates	4800, 9600, 38,400, 76,800, 115,200
Parity	None, odd or even
Stop Bits	1 or 2
Data Bits	5, 6, 7, 8
Inner character Timeout	
<b>Compliance</b>	2.4 GHz
FCC	FCC ID TYOJN5139M4
Industry Canada	IC:7438A-CYO5139M4
ETSI EN	EN 300 328V1.7.1 (2006/05)