NJM0071-029

MicroWIS™ User Guide

DRAFT COPY

Invocon, Inc.

Innovative Concepts in Systems Engineering

FCC Notice:

The MicroWIS™ Sensor Unit and PC Interface Unit of the MicroWIS system are subject to the following certification.

> This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that my cause undesired operation.

CAUTIONARY NOTE TO USER:

Changes or modifications to the any piece of equipment in the MicroWIS system are not expressly approved by the manufacturer and could void the user's authority to operate these units under the Regulations promulgated by the Federal Communications Commission.

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Document Overview

This document will lead you through the steps necessary to collect and view data using the MicroWIS Units.

The MicroWIS is manufactured by Invocon, Inc. For more information about this product and other Invocon products please refer to the Contact Information section at the end of this document.

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1.0 INTRODUCTION

1.1 SYSTEM DESCRIPTION

The Micro-Wireless Instrumentation System (MicroWIS) is a wireless data acquisition network to measure and transmit temperature data via a wireless link to a transceiver plugged into a PC. A Windows 95 Graphical User Interface allows easy installation, programming, and downloading of data from each unit. The system measures and transmits two temperatures, one on the MicroWIS unit itself, and an external temperature via a two-wire resistive temperature device.

A maximum of 32 units, each with a unique node ID can coexist in a single network. A MicroWIS unit's sample/transmit rate is programmable by the user via setup commands sent from the PC to the transceiver which broadcasts the commands to the units. The measured temperature data is packetized, encoded and sent to the transceiver which decodes and time stamps the data, handles the communication protocol, and sends the data to the PC for plotting and logging. Received temperature data packet is checked and acknowledged for correctness, otherwise the unit will retransmit the data.

The remote temperature sensing units will take measurements of both internal and external temperature at sampling intervals according to the latest setup command received from the controller. The external and internal temperatures will be represented with 14-bit and 10-bit resolution respectively. The data packet in addition to these data will include error detection bits and 8-bits to uniquely identify each node.

With 8 bits dedicated to the ID field, up to 256 unique IDs are available which are assigned serially and hard coded to the unit during manufacturing and could not be changed by the user. This necessitates reuse of the assigned IDs. The responsibility for preventing a network configured with identical IDs is with the user.

This type of setup would result in multiple units with identical IDs to be seen by the controller as a single unit. Such as setup will result in data, which will be hard to interpret because it will be shown as if coming from the same unit. Another concern would be the calibration file which is organized and identified by the unit's ID.

The setup command which basically sets the sample/transmit rate of the remote units, is global. There is no individual or group setting of the sample/transmit rate. Since a network can accommodate up to 32 remote units and they are all set to the same sample/transmit interval, this may imply a high probability of packet collisions at the controller. However, even though the intervals are identical, the transmissions are made asynchronous and randomized by setting the unit's internal counters reference to a unique start time during manufacturing. Every sensor unit's internal counter are shipped with a setting equivalent to a default rate of 1sample/minute, and they are transmitting a fixed size packet at a fixed transmission rate of 111000 bps. This essentially limits the transmissions to bursts of roughly 1.1 milliseconds.

However, this alone doesn't eliminate the possibility of collisions at the controller (all sensor units are transmitting asynchronously at the same carrier frequency of 916.5MHz in half-duplex mode). Collision will result in errors on the received packets from the units. The unit's transmissions require acknowledgment from the controller, If they don't receive the acknowledgment they will retransmit up to 3 times, but every time their transmit start time will be delayed to minimize the collision probability. The delay duration which is in milliseconds range will be calculated based on a hashing function with the unit's ID as input to randomize the delays. The sensor units have an internal timer for controlling the wait duration to receive the acknowledgment, which the controller will send if the error detection algorithm indicates no error. Whenever the user changes the sample/transmit interval and sends the new setup to the controller, the controller will wait until the next interval (according to the existing setup) and then transmit the new setup command to the sensor units. The command transmissions are not acknowledged.

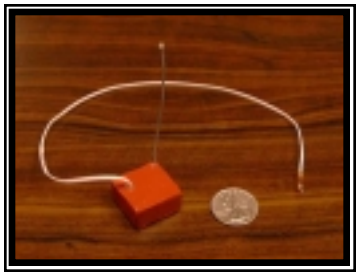
The MicroWIS network is operating in the shared ISM band and in the presence of other wireless devices. The sensor units and the controller are communicating in a half-duplex mode utilizing about 2MHz bandwidth. The data is modulated onto the carrier via Amplitude Shift Keying technique. The units exhibit high tolerance to interference due to its burst type transmission (1.1-millisecond duration). The units transmit power are about 0.75 milliwatt, which satisfies the FCC 's 1 milliwatt maximum power requirement for non-spread-spectrum transmissions. With such low transmit powers the unit can reliably communicate at distances of up to 100 feet (none-line-of-sight) and several hundred feet direct-line-of-sight.

1.2 SYSTEM SOFTWARE

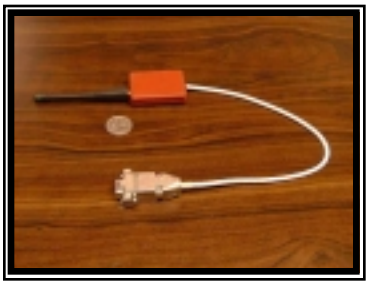
The MicroWIS™ Graphic User Interface is a Windows-based program that offers a simple way to configure, display, and store data for the MicroWIS Temperature Units. The simplest operating mode requires 2 mouse-clicks: one to open the program, and one to terminate. However, many options are available for users to customize the system configuration. The following document details the features of the software and provides a quick guide on how to setup and run a simple, multiple-unit, micro-wireless data acquisition network.

2.0 INSTALLATION

2.1 HARDWARE INSTALLATION



The Sensor Unit can be placed in any location within 100 feet of the PC Interface Unit for reliable operation.



The PC Interface Unit plugs into an available Serial Port of a Laptop or desktop PC.

2.2 SOFTWARE INSTALLATION

Operating system requirement : Windows® 95 or Windows®98.

CD installation:

- Insert the setup disk into the CD-ROM drive of a laptop computer or PC.
- Double-click on **Setup.exe** to start the installation.
- Follow the instructions to complete the installation.

3.0 FEATURES

The MicroWIS Graphic User Interface (GUI) processes incoming data from the MicroWIS units, displays the data in graphical form, and saves the data to a text file for each unit. After a preset time (selected by the user) has elapsed, the GUI closes all the files and starts a new set of files with the same preset number. The GUI can automatically detect and add new MicroWIS units to the network. Once a new unit is added, the GUI configures the unit to the most recent configuration. A new unit may be added while the other units are operating. The features of the MicroWIS Graphic User Interface are described as follows:

- **Data of First 16 nodes** tab. This page consists of a grid table that displays the most recent internal temperatures, external temperatures, and the time stamps of the first 16 MicroWIS units added to the network.

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- **Data of Last 16 nodes** tab. This page consists of a grid table that displays the most recent internal temperatures, external temperatures, and the time stamps of the last 16 MicroWIS units added to the network.

- **Chart Display** tab. This page displays the internal/external temperatures of all units in the network. If desired, the graphical displays of individual units may be disabled. A zoom feature for X and Y is also available by clicking and selecting and area to be viewed.

- **Setup system** tab. This page includes the following options:

Sample rate:	A list of available sample rates. The default value is 1 sample/minute.
Send setup parameters command:	Sends the new sample rate to all units in the network.
Serial port:	Serial port options to establish communication between the PC and MicroWIS units. Default port is Com1.
Selective Listening:	The unit IDs accepted by the GUI. This gives the user the capability to disable the GUI from displaying the data of individual nodes currently in operation.
File Length:	The time length between closing files. Default 5 minutes.
Display options for fast sample rates:	**At fast sample rates, the PC can only process a limited number of units. Therefore, a user must disable the grid table or Chart displays or both. The limits are as follows for the PGSC*:** At 1 sample/ 1 second: • Maximum 4 units with both Grid table and Chart. • Maximum 8 units with Chart only. • Maximum 12 units without Chart and Grid table. At 1 sample/ 2 seconds: • Maximum 8 units with both Grid table and Chart. • Maximum 16 units with Chart only. • Maximum 24 units without Chart and Grid table. At 1 sample/ 4 seconds: • Maximum 16 units with both Grid table and Chart. • Maximum 32 units with Chart only. • Maximum 32 units without Chart and Grid table. At 1 sample/ 8 seconds:

- Maximum 32 units with both Grid table and Chart.

***Note: These limits are preliminary estimates based on laboratory testing.**

X-axis Show time/Sample number: **Two options for displaying the timestamps or the sample numbers on the graphs. Regardless, the timestamps are saved to the files for all units.**

Graph data: A command to open a chart program for viewing data files.
Only closed data files may be opened with the "Graph Data" feature.

Note : See section 5.0 (About the Chart program) for further details.

- **1-16 tab** (lower right hand)
  This page shows the first 16 active units in the network.

- **16-32 tab** (lower right hand)
  This page shows the last 16 units added to the network.

  Clear traces: A command that causes the graphs for the first 16 or the last 16 units to be hidden.

Files tab: a page shows the binary files for all units.
All the files are in the same directory as the executable program. The following files are created once the MicroWIS program is executed:

MWisBin_(date_time).bin: The accumulated binary data file for all units in the network.

MWis_XX_(date_time).txt: An ASCII file added once a MicroWIS unit is detected in the network. This file records the time stamps, internal temperatures (Celsius), external temperatures (Celsius), counts (used for calibration). This data file must be selected when viewed with Chart program. This file is **comma delimited**. XX indicates the unit's ID.

MwisSamplePerNode.txt: A text file recording the date and time when the number of samples per file is changed.

MwisSampleRate.txt: A text file recording the date and time when the sample rate is changed.

4.0 A SAMPLE SETUP

- Connect a MicroWIS Interface Unit to serial port 1 of a laptop or PC. If serial port 1 is not available, connect to serial port 2. Place one or multiple MicroWIS units a distance varying from 10-20 feet from the computer. The units are assumed to be active.
- Select the **MicroWIS.exe** file to bring up the MicroWIS Graphical User Interface.
- If using serial port 2, click **Setup system** tab. Under **Serial port**, select **Comm 2** (default is Comm 1).
- Click the **Chart Display** tab.
  The MicroWIS temperature unit data will be displayed on the chart screen and on the grid table.

  The defaults are as follows:

Sample rate:	1 sample/1 minute
Number of samples per file:	500 - At the above sample rate, a new set of files will be created after running the program 500 minutes.
Graphs:	Without data symbols
X axis:	Timestamp
Calibration:	Enabled
Node ID accepted:	1 to 500

  The setup parameters can be changed as desired.

- Click on the command **Click Here to Exit Program** or go to **File** menu and click on **Exit** to terminate the program.

The acquired data files can be viewed using Graph Data command.

5.0 ABOUT THE CHART PROGRAM

MicroRecorder (Used for **MicroRecorder** units):

Select to graph (2-40000 samples)**:**	An option to view a desired number of samples entered by the user.
Graph the last data acquisition:	An option to view only the data acquired from the last data acquisition. This is the default value.

Graph all data: An option to view all data from the memory of the unit. The total number of samples is 43498 samples.

Graph 1st data file: Graph internal and external temperatures of a data file.

Graph 2nd data file: Graph internal and external temperatures of a data file. Use this command if you already graphed one data file and you want to graph another data file for comparison.

MicroWIS: (Used for **MicroWIS** units)

Graph 1st data file: Graph internal and external temperatures of a data file.

Graph 2nd data file: Graph internal and external temperatures of a data file. Use this command if you already graphed one data file and you want to graph another data file for comparison.

Applied to **either MicroRecorder or MicroWIS units:**

Display Options: A user can make any trace visible or invisible by placing/removing a checkmark on a check-box under **Ext** (external temperature trace) or **Int** (internal temperature trace) for each unit.

To graph a data file:

File menu → Open a file to graph: To select a file to graph.

***Note**: Multiple chart programs can be opened to view data of more than 2 units if desired.

6.0 VIEW DATA FILES WITH OTHER PROGRAMS

The **Mwis_XX_(date_time).txt** can be viewed with other programs such as NotePad, Microsoft Excel, or PSI plot.

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Feel free to contact us with any comments, suggestions, or questions you may have about the Micro-Wireless Instrumentation System.