Wireless and Ethernet Condition Monitoring Solutions on Standard LAN and WLAN Networks

WiVib Wireless Monitoring

Wireless and Ethernet Vibration Measurement

Icon Research Ltd

Contents

The ***WiVib*** family of vibration acquisition units from Icon Research provides wireless and ethernet multi-channel vibration monitoring on standard networks.

The ***WiVib*** range communicates via the WiFi 802.11 standard and is fully compatible with all low-cost access points and accessories used on this popular medium, including full security. Ethernet connectivity is also provided for convenient hooking up to cabled networks where they are available. The devices can be powered from permanent external power or from internal batteries. We invite you to browse the specifications of these devices to fully appreciate the powerful features available.

"I think it's great that the data comes to me, rather than me having to go and fetch it."

ICON RESEARCH

Why go with the WiVib Family ?

Monitoring of the condition of plant machinery is done in one of two ways, with walk-around data collectors or with an on-line system. For reasons of regular monitoring and reliability of data, an on-line system is usually preferred. However, the cost is often prohibitive because of the installation requirements.

This is where the ***WiVib*** family from Icon Research comes into play. ***WiVib***'s offer both ethernet and wifi connectivity. This provides a choice of installation options to optimise the installation budget. Lower cost means that less critical, but still important, machinery can be monitored.

Ethernet or Wireless - what should I be thinking about ?

ETHERNET

- make use of an existing cabled network;
- extend existing network with low-cost cabling and hubs, or install a new network where there is a concentration of machinery;
- use if network security is an issue.

WIFI

- use where there is no network infrastructure;
- quickly replace existing switch boxes previously used for walk-around data collection;
- use in remote areas.

Both options provide simple mounting of hardware—just four screws using the brackets provided with the unit.

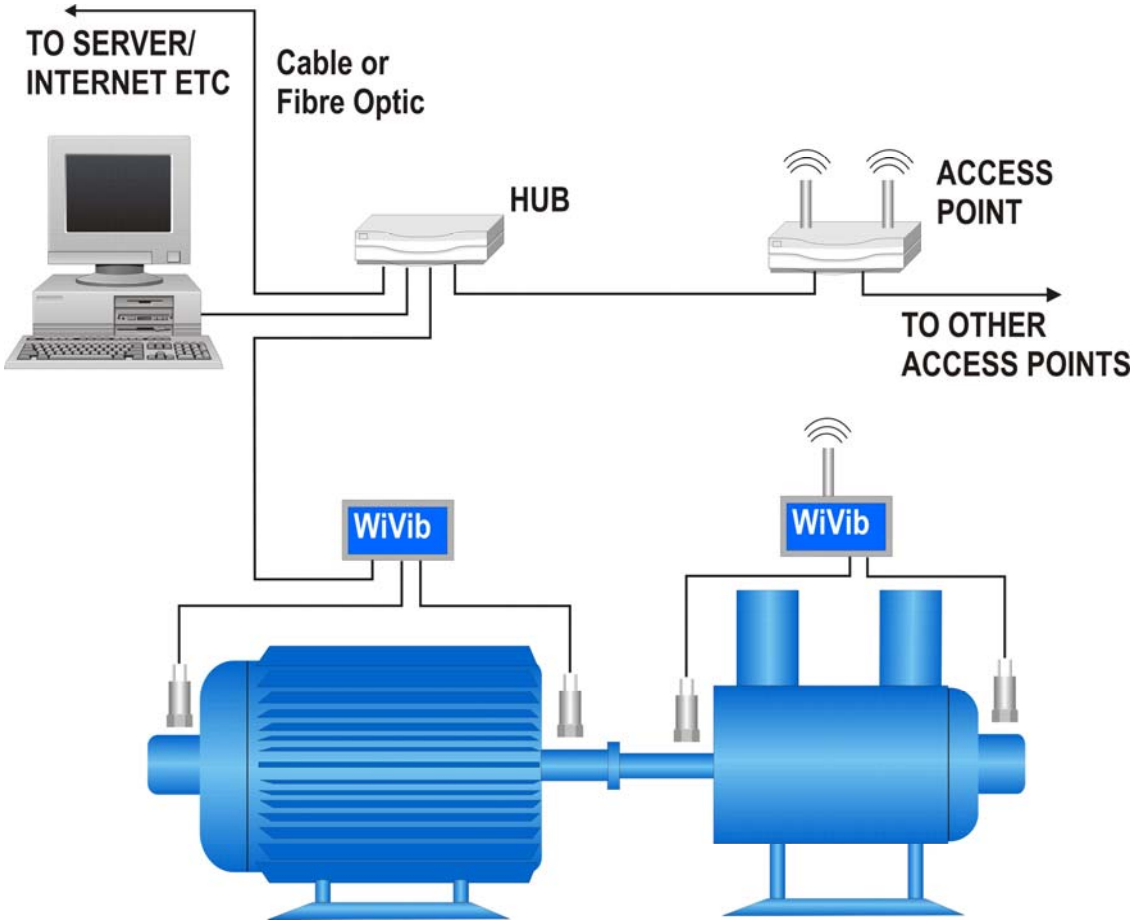
The diagram below shows the two connectivity methods. The ***WiVib*** on the left is connected into an ethernet network via a single cable. The one on the right is communicating wirelessly via a standard access point.

Typically, a ***WiVib*** on an ethernet network will be continuously powered from an external low voltage DC supply in the range 10-30Vdc. A ***WiVib*** with wireless connection can be powered externally or from batteries fitted inside the unit.

How are measurements made?

When taking measurements, ***WiVib***'s can operate in one of two modes, namely *continuous* and *wakeup*. In continuous mode, the device is permanently on and is powered by a DC supply in a range from 10V to 30Vdc. So measurements can be taken at any time.

However, when using batteries, it is important to conserve power to maximise battery life. This is where wakeup mode is used. Each ***WiVib*** contains a real-time-clock which can be instructed to wake the ***WiVib*** up at any interval varying from one minute to one day. The ***WiVib*** takes its measurements as instructed by the application and then "goes to sleep" until woken at the next interval. However, the unit can be instructed to remain on if prolonged machinery diagnostics are required. In wakeup mode, battery life measured in years can be expected.



WiVib-4/4 Pro

- *Four Dynamic + Four Process Inputs*
- *802.11b/g/n WiFi Connectivity*

WiVib-8x8 pro-E

- *Eight Dynamic + Eight Process Inputs*
- *Ethernet Network Connectivity*

WiVib-8x8 pro-EW

- *Eight Dynamic + Eight Process Inputs*
- *Ethernet or 802.11b/g/n WiFi Connectivity*

Common Features:

- *Simultaneous Acquisition on ICP Inputs*
- *Acceleration, Velocity, and Bearing Condition*
- *Up to 40kHz Bandwidth and 51200 Lines*
- *Full WEP, WPA and WPA2 WiFi security*
- *Flexible Trigger Functions*

The ***WiVib*** data acquisition units from Icon Research are a family of multi-channel vibration monitoring devices that operate on the universal ethernet and WiFi 802.11b/g/n standards. The devices offer simultaneous sampling on all dynamic channels at 24-bit resolution and up to 102.4kHz sample rate with 12800 spectral line resolution. The additional DC channels are ideal for measuring process parameters. For example, accelerometers with temperature output can be connected directly to the units enabling vibration, bearing condition and bearing temperature to be measured.

The ***WiVib's*** incorporate an ICP power supply on each of the dynamic channels so that any standard compatible accelerometer can be connected. Alternatively, the inputs can be AC coupled to interface with buffered signals from other systems. High-resolution acceleration and velocity measurements can be made, together with bearing condition using the built-in demodulator or "enveloper" as it is sometimes called. Accelerometer bias voltage checking is incorporated.

The dynamic inputs are also compatible with standard eddy current (proximity) probes allowing direct measurement of displacement, including gap voltage.

Digital and analog trigger inputs offer flexible triggering options allowing synchronised readings to be taken. The triggers can also be configured to operate as tachometer inputs, PLL's for ordered spectra, and gates for conditional initiation of measurements.

The ***WiVib-4/4 Pro*** and ***WiVib-8x8pro-EW*** operate on the universal WiFi 802.11b/g/n standard and offer full WEP, WPA and WPA2 security. Network configuration is straightforward by connecting to the on-board USB port and running the *WiVibConfig* software utility on any laptop or PC.

Power is provided by two internal 'D' size batteries or a DC supply in the range 10 to 30V. Under battery power, the device requires no connections apart from the sensors and it can be powered up and down by its internal real-time-clock.

The unit is housed in a compact rugged enclosure and is sealed to IP66. It is fitted with stainless steel brackets for easy mounting. The twelve sealed glands allow cables of varying diameter to be routed to the unit.

The ***WiVib*** family is supplied with a comprehensive suite of support software enabling the device to be configured on your network and useful measurements to be taken right away.

Refer to the specifications overleaf for full details of the ***WiVib*** devices.

WIVIB-4/4PRO TECHNICAL SPECIFICATION

MEASUREMENT

Dynamic Channels

No of Channels:	4, simultaneous
Coupling:	ICP interface or AC, jumper configurable
ICP Interfaces:	2.4mA at 20Vdc
Input Voltage Range:	10Vp-p (+/-5V when AC coupled)
Bias/Gap Measurement:	+/-25V range for ICP bias voltage and eddy probe gap measurement
Measurements:	acceleration, bearing demod, (velocity by external s/w integration)
Gain Ranges:	gain steps 1, 2, 5, 10, 20 and 50
Amplitude Accuracy:	±2% typical in passband
Demodulation Function:	digital demodulator (HP and LP bandpass filter edges programmable in steps from 50Hz to 40kHz)
ADC:	24 bit
Sampling Rate:	64Hz to 102.4kHz
Bandwidth Ranges:	0.5Hz–25Hz to 0.5Hz–40 kHz
Data Block Lengths:	256 to 32768
Spectral lines:	up to 12800

Process Channels

No of Channels:	4, multiplexed
Ranges:	0 to +3V and 0 to +10V, jumper selectable
4-20mA Input Option:	100 ohm load, jumper selectable
ADC:	16 bit
Sampling Rate:	64Hz to 25.6kHz
Bandwidth Ranges:	0.5Hz–25Hz to 0.5Hz–10 kHz
Data Block Lengths:	256 to 32768
Spectral lines:	up to 12800
Fixed Sampling Option:	200 samples at 2kHz, averaged (50/60Hz mains pickup cancellation)

TRIGGERS

No of Channels:	2 (one analog/digital, one digital/Namur)
Coupling:	digital: 3.3V to 24V digital pulse, analog: +/-25V, Namur: two-wire
Available Functions:	external trigger, tacho speed, gated acquisition, pre- and post-trigger delay to 32768 samples

PROCESSING

Processor:	ARM9 running Linux operating system
Memory:	16MByte SDRAM, 32-bit wide
Program/Settings Storage:	8 MByte dataflash and 128K EEPROM
RTC:	internal real-time-clock for time-stamping of data

COMMUNICATIONS

Network:	802.11b/g/n WiFi compatible, FCC and IC certified
Speed:	up to 54 Mbits/sec
Encryption:	WEP (64, 128 bit) and WPA/WPA2 PSK (TKIP, AES)
Wake-up Mode:	programmable from one minute to one day via internal RTC
Interface Port:	USB user port

MECHANICAL

Enclosure:	die-cast aluminium, NEMA 4, IP66, external antenna
Dimensions:	26cm (10.2”) x 16cm (6.3”) x 9cm (3.6”)
Weight:	2.6kg (6 lbs) approx
Cable Entries:	12 glands, IP68 rated
Cable Diameter:	3mm to 6.5mm

POWER

Battery

Input Power (battery);	2 x LSH20 cells (‘D’ size)
Battery Monitor:	internal battery monitor with critical level shutdown

External Power

Supply:	DC power, 10-30Vdc
Isolation	external power input isolated to 1500V

ENVIRONMENTAL

Operating Temperature:	-20ºC to +70ºC (-4ºF to +158ºF)
Compliance:	CE, RoHS

COMPLIANCE (Wireless)

FCC	CFR47 Part 15(c)
IC	RSS-210
ETSI	EN 300 328 V1.8.1

WIVIB-8X8PRO TECHNICAL SPECIFICATION

INPUTS

Dynamic Channels

No of Channels:	8, simultaneous
Coupling:	ICP interface or AC, jumper configurable
ICP Interfaces:	2.4mA at 24Vdc nominal
Input Voltage Range:	20Vp-p (+/-10V when AC coupled)
Bias/Gap Measurement:	+/-25V range for ICP bias voltage and eddy probe gap measurement
Measurements:	acceleration, bearing demod, (velocity by external software integration)
Gain Ranges:	gain steps 1, 2, 5, 10, 20 and 50
Amplitude Accuracy:	±2% typical in passband
Demodulation Function:	software demodulator (HP and LP bandpass filter edges in programmable steps from 50Hz to 40kHz)
ADC:	24 bit
Sampling Rate:	64Hz to 102.4kHz
Bandwidth Ranges:	0.5Hz–25Hz to 0.5Hz–40 kHz
Data Block Lengths:	64 to 250,000
Spectral lines:	up to 51200

Process Channels

No of Channels:	8, multiplexed
Ranges:	0 to +3V and 0 to +10V, jumper selectable
ADC:	16 bit
Sampling Rate:	64Hz to 25.6kHz
Bandwidth Ranges:	0.5Hz–25Hz to 0.5Hz–10 kHz
Data Block Lengths:	64 to 250,000
Spectral lines:	up to 51200
Fixed Sampling Option:	200 samples at 2kHz, averaged (50/60Hz mains pickup cancellation)

TRIGGERS

No of Channels:	2 (one analog/digital, one digital/Namur)
Coupling:	digital: 3.3V to 24V digital pulse, analog: +/-25V, Namur: two-wire
Available Functions:	external trigger, tacho speed, ordered data (by phase-lock-loop), gated acquisition, pre- and post-trigger delay to 32768 samples

PROCESSING

Processor:	ARM9 running Linux operating system
Memory:	64MByte SDRAM, 32-bit wide
Program/Settings Storage:	8 MByte dataflash and 128K EEPROM
Additional Storage:	up to 32GByte on-board removable USB flashdrive
RTC:	internal real-time-clock for time-stamping of data

COMMUNICATIONS

Network (LAN):	100BaseT ethernet via CAT5/6 cable (-E and -EW version)
Network (WLAN):	802.11b/g/n WiFi compatible, FCC and IC certified (-EW model only)
Speed:	up to 54 Mbits/sec
Encryption:	WEP (64, 128 bit) and WPA/WPA2 PSK (TKIP, AES)
Wake-up Mode:	programmable from one minute to one day via internal RTC
Interface Port:	USB user port

INDICATORS

LCD Display:	backlit LCD display, 7 lines x 21 characters
Relays:	2 x SPST isolated relay contacts for external LED's/indicators

MECHANICAL

Enclosure:	die-cast aluminium, NEMA 4, IP66, external antenna
Dimensions:	36cm (14.2") x 16cm (6.3") x 9cm (3.6")
Weight:	3.2kg (7 lbs) approx
Cable Entries:	12 glands, IP68 rated
Cable Diameter:	3mm to 6.5mm

POWER

Battery

Input Power (battery);	2 x LSH20 cells ('D' size)
Battery Monitor:	internal battery monitor with critical level shutdown

External Power

Supply:	DC power, 10-30Vdc
Isolation	external power input isolated to 1500V

ENVIRONMENTAL

Operating Temperature:	-20ºC to +70ºC (-4ºF to +158ºF)
Compliance:	CE, RoHS

COMPLIANCE (Wireless)

FCC	CFR47 Part 15(c)
IC	RSS-210
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Application Software for *WiVib*'s

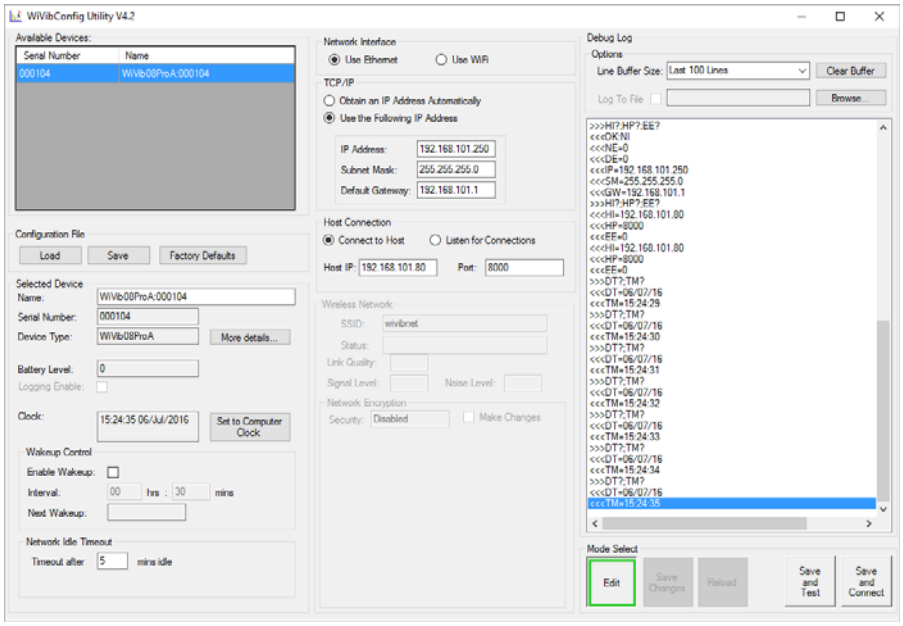
WiVibConfig

Easy-to-use tool for configuring your WiVib to work on a wireless network

Configuring your ***WiVib***'s to communicate on a wireless network is made easy with the *WiVibConfig* utility. Simply edit the network settings (eg. IP address, SSID etc) and then click **Save and Connect** to enable the ***WiVib*** onto your network. The panel on the right monitors network activity so you can quickly see if the ***WiVib*** has connected to your network, or if further editing of the settings is required. Security settings can be entered and modified as required.

Configurations can be saved to file and reloaded so you don't have to re-type all of your settings each time you introduce a new ***WiVib*** onto your network.

Communication is via a cable from any USB port on your laptop or PC.



WiVibScope

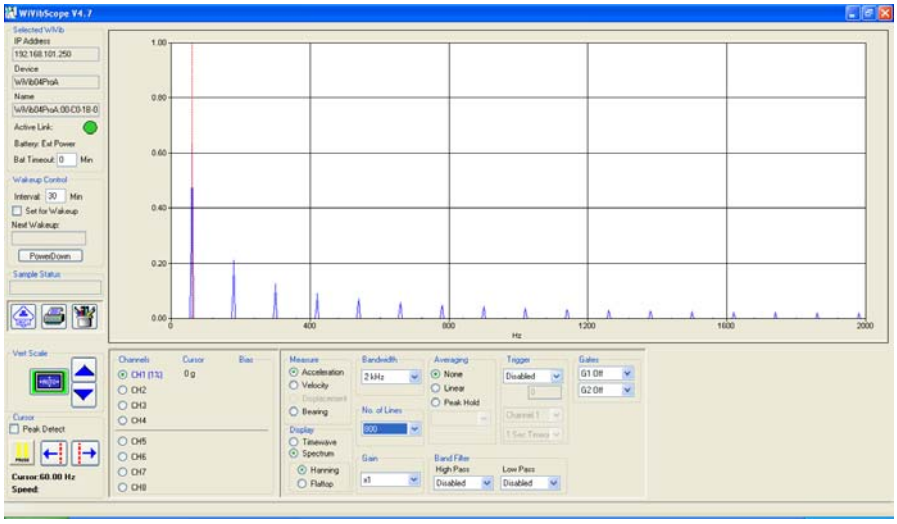
Turns your WiVib into a fully featured spectrum analyser

WiVibScope enables both time and spectrum graphs to be displayed from any selected channel of a ***WiVib*** . Measurements can be displayed in standard engineering units such as g and ips as well as user-defined units. Simply select the ***WiVib*** and the channels that you want to monitor and live traces stream to the high-resolution display.

Zoom and cursor with readout function are provided.

Settings such as number of spectral lines, bandwidth etc are easily changed with drop-down menus. Any acquisition setting (eg. gain, integration to velocity etc) can be adjusted also.

WiVibScope is ideal for detailed analysis, system checks and installation setup. Both continuous and wakeup modes are supported.



Application Software for *WiVib's*

WiVibTrend Lite

Easy plant monitoring and analysis with OPC interface

WiVibTrend Lite provides the core functionality of on-line monitoring systems with features such as trending, alert/alarm indication and full analysis capability. It can support any number of channels with multiple measurements (for example, velocity vibration and bearing condition) being available on each channel. An OPC server is incorporated for export of measurement data to factory-wide systems.

Its straightforward setup-and-go interface means that you can be logging and trending within minutes of loading the application.

A moving chart-recorder updates current measurements while historical pan and zoom functions let you examine previously measured data.

This application is ideal for smaller stand-alone wireless on-line systems while larger installations can utilize the OPC feature.

WiVibTrend Lite supports a simple *Plant … Machine … Point … Measurement* hierarchy. Alerts and alarms are indicated on the hierarchy and summarised in the table underneath. The red/yellow/green traffic light summary lets you know the status of your plant at a glance.

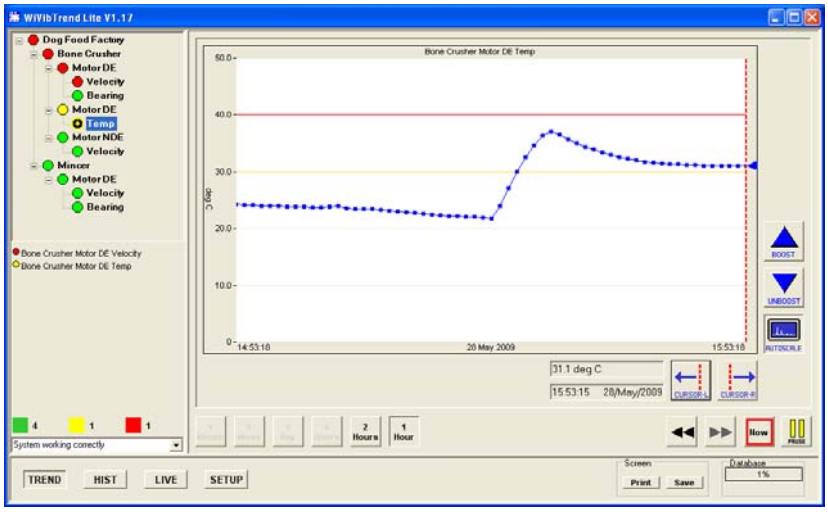
The application supports wakeup and continuous modes on the ***WiVib***'s, so you can choose how often you want to scan your machinery. This can be from several times a minute to once a day.

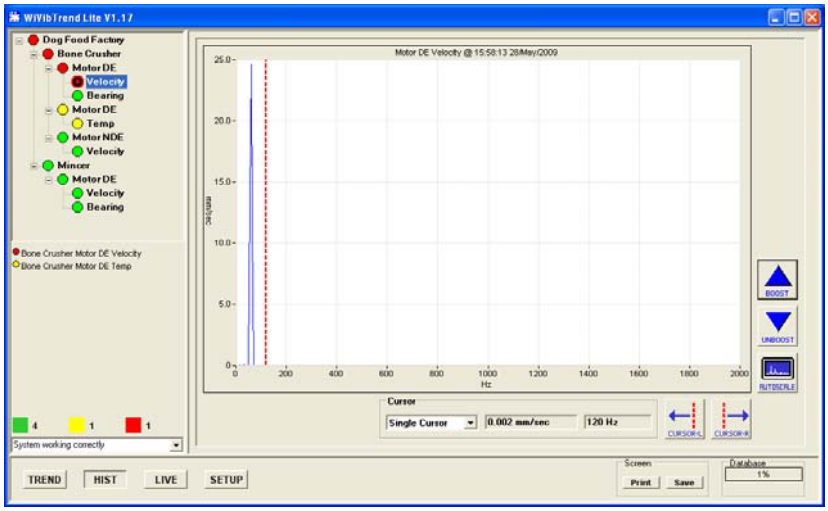
A historical trace, such as a spectrum, can be viewed by selecting the time at which it was gathered on the trend graph. Alternatively, live/latest spectra can be viewed with full cursor readout.

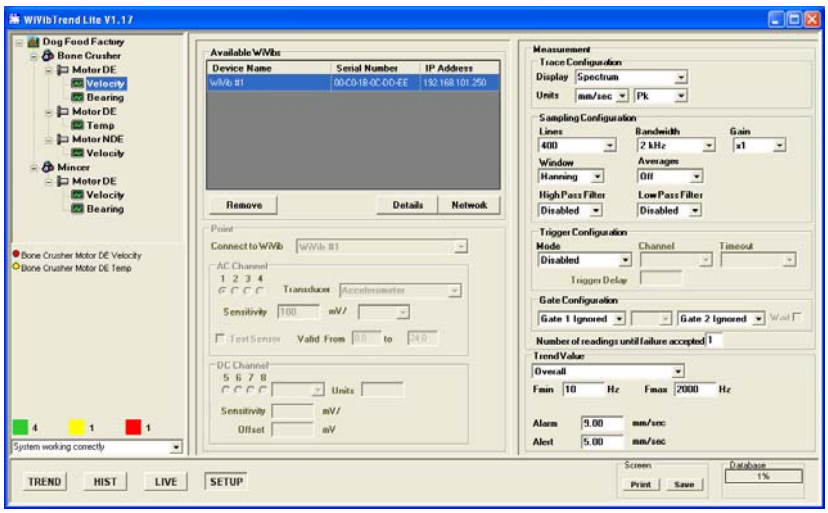
Setting up the machine hierarchy is very straightforward. First, use *WiVibConfig* to connect your ***WiVib***s to the network and then use the single screen setup in *WiVibTrend Lite* to specify what you want to measure and when.

Hardcopies of trends and traces can be printed, or traces can be written to file for emailing or inserting in reports.

WiVib hardware and *WiVibTrend Lite* software combine to produce a powerful machinery monitoring package that is low-cost, quick to install and easy to use. *WiVibTrend Lite* has been developed by Icon Research to exploit the advantages that wireless monitoring brings to industry. You can get started with a single ***WiVib*** and be monitoring your plant within minutes.







Integrating *WiVib's* With Your System

System Integration

WiVib users may wish to interface their ***WiVib*** devices to applications other than those supplied by Icon Research. There are three basic methods by which a systems integrator can gain access to a ***WiVib*** and the measurements that it takes, namely:

1. Accessing the *WiVibTrend Lite* OPC Server
2. Controlling the ***WiVib*** Server
3. Programming the ***WiVib*** directly

The options are listed by ease of implementation (easiest first). The trade-off is usually the flexibility of the solution versus the time and effort to implement it. However, Icon Research is always available to assist regardless of which interface method is chosen.

1. Accessing the *WiVibTrend Lite* OPC Server

WiVibTrend Lite provides the user with the means to configure measurements, and provides a simple display of the data that has been taken. It makes use of an embedded copy of the ***WiVib*** Server to control the sampling process.

The OPC Server component of *WiVibTrend Lite* allows the contents of the samples taken to be easily exported to external systems by means of the standard OPC interface.

When enabled, the OPC server runs in the background of *WiVibTrend Lite*, and provides OPC tags for the information that is provided by *WiVibTrend Lite* locally.

Using this method the integrator has just to configure his existing OPC clients to request the required tags from the *WiVibTrend Lite* OPC Server.

The structure and contents of these tags can be found in the *WiVibTrend Lite OPC DA Server Data Dictionary*, and include:

- Status information for all levels of the system hierarchy;
- Values, and alarm status, for all of the trends;
- Traces for both time domain and spectrum measurements;
- Status information for the WiVibs and sensors to detect failures in the monitoring equipment.

2. Controlling the WiVib Server

The ***WiVib*** Server provides the means to control a network of ***WiVib*** devices and thus realise a surveillance system by performing the following tasks:

- Scheduling when the ***WiVib*** is to be sampled.
- Controlling the sampling of the required measurements.
- Processing the samples by scaling them to the correct units and performing post sampling processes such as FFTs and integration.
- Testing the sensors and checking the sampled data for validity.
- Deriving trend values from the samples.
- Determining alarm conditions.

Using this method enables the integrator to concentrate on the user interface for the setup of the measurements and the display of the results, without having to have a detailed knowledge of how to control the ***WiVib***.

The Server is controlled by means of an XML document which contains the definitions of the measurements and the order in which these measurements are to be taken. Once the route of measurements has been sampled, the same document is returned to the application with these definitions and the results of the sampling process.

The Server can operate in a number of different ways, which allow for wide variety of design options.

The Server can be provided either as a .NET assembly for direct linking to the designers application, or as a self contained Windows Service which may run on the same machine as the application or on a remote machine as required.

For transfer of data, the XML document can be passed to the server either across an open TCP socket connection, through a defined Message Queue, or into a shared folder.

These configuration options along with the description of the XML document can be found in the *WiVibServer Programmer's Manual.*

3. Programming the *WiVib* Directly

When using this method, individual instructions are sent to the device using the specified ***WiVib*** command set. This therefore offers the most flexible and efficient interface to the ***WiVib*** devices but it also involves the integrator with the most amount of effort to implement and verify.

The protocol that is required to control the ***WiVib*** is contained within the *Programmers Manual* for the corresponding device.

We suggest this method should only be used if the ***WiVib*** Server does not provide the specific functionality that you require for your system.

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