Wireless
Monitoring

WiVib-4/4 Pro
Operating Manual

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CHAPTER 1 - Overview

1.1 The *WiVib-4/4 Pro* Acquisition Device

The *WiVib-4/4 Pro* is a battery powered device that measures vibration and process parameters from machinery and other mechanical systems.

The basic operation is that analog signals are digitised by the on-board analog-to-digital converter (ADC) and stored in internal memory. This data is then passed over a standard WiFi 802.11 wifi network to a host computer for processing and display. The device can be switched off under software control and woken up by the internal programmable real-time clock. Wakeup Mode, as it is called, helps to maximise battery life.

The *WiVib-4/4 Pro* is an eight-channel device allowing four standard ICP type accelerometers to be connected to channels 1 to 4 and four further DC or 4-20mA signals to be connected to channels 5 to 8.

Channels 1 to 4 allow simultaneous sampling on any or all of the channels. This enables orbits and simultaneous triaxial measurements to be made. The resolution of the ADC is 24 bits, and gains up to 50 are available. Bearing demodulation is carried out by a software algorithm on the device. Anti-aliasing of the incoming signal is performed by continuous time analog pre-filters followed by digital filtering. Incoming data is therefore oversampled, but this process is entirely invisible to the user. The final data stream is buffered in internal memory and then transferred via the wireless Ethernet under control of the host PC.

Accelerometers that provide temperature output can be accommodated by connecting the acceleration output to one of the ICP channels and the temperature output to one of the DC channels. Alternatively, DC channels 5 to 8 can be used for interfacing to 4-20mA devices or measuring other DC coupled voltages.

1.2 Communication

The *WiVib-4/4 Pro* is controlled by a set of ‘commands’ sent from a host computer or similar device via the wireless interface. All commands issued are asynchronous and force a reply from the device, either as an item of data or as a simple acknowledgement. In this way, the controlling PC should always know the activity and status of each *WiVib-4/4 Pro* on its network.

The *WiVib-4/4 Pro* can communicate on any wireless network that is 802.11b, 802.11g or 802.11n (2.4GHz) compatible. It is recommended that infrastructure mode is used (via an access point) as peer-to-peer (or ad-hoc, as it is sometimes known) is inherently less reliable.

1.3 Configuration

Network settings are programmed into the *WiVib-4/4 Pro* in one of two ways, namely

- direct cable connection to the on-board USB port using the *WiVibConfig* utility supplied by Icon Research, or
- wireless connection using the *WiVibConfig* utility (though this requires an initial connection already to have been made).

Status information relating to network communication is available from the USB port at all times. This can be displayed using the *WiVibConfig* utility.

1.4 Wireless Network

Any number of *WiVib-4/4 Pro* devices can exist on a network, and each is distinguished by its unique IP address. IP addresses can be allocated statically or can be allocated automatically by DHCP. Each *WiVib-4/4 Pro* exists on a network in a similar fashion to any other wireless device.

1.5 Important Safety and Operational Information

The WiVib-4/4 contains a certified transmitting device. Certification is subject to the following:

1. Only a single omnidirectional antenna with a maximum gain of 5dBi may be used.

2. The antenna must be installed to provide a separation distance of at least 20cm from all persons.

The WiVib-4/4 is supplied with a 5dBi antenna.

FCC warning statement:

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 may cause undesired operation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. End users must follow the specific operating instructions for satisfying RF exposure compliance. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

CHAPTER 2 – Configuring the *WiVib-4/4 Pro*

2.1 Configuration Methods

In order to communicate on a network, the *WiVib-4/4 Pro* needs to be given a unique identity, and it needs to know the server it should be talking to. Encryption, which encodes the data passing to and from it, can also be set. The process of defining these settings is called “configuration”.

The *WiVib-4/4 Pro* is configured using the *WiVibConfig* programme supplied with the unit. There are number of ways of connecting to the device for configuration purposes, but it may be preferred to use the direct USB port connection as this saves having to change the settings on your computer or laptop to match the default settings on the *WiVib-4/4 Pro*. Refer to the manual entitled *WiVibConfig User's Manual* for information on how to use the configuration tool.

Before you start, ensure that a battery is fitted to the *WiVib-4/4 Pro* or that external power has been applied. See the section on ‘Powering the *WiVib-4/4 Pro*’ for details.

2.2 Default Settings

On leaving the factory, the *WiVib-4/4 Pro* is configured with default settings. These are detailed in the table below.

Item	**Setting**
Name	*WiVibProA:<serial no>*
IP Address	192.168.101.250
Subnet Mask	255.255.255.0
Default Gateway	192.168.101.1
DHCP Enable	Off
Mode	Infrastructure
Wireless SSID	*wivibnet*
Wireless Channel	11
WEP Enable	Off
Host IP Address	192.168.101.80
Host Port Number	8000
Timeout	5 minutes

To establish a “quick-start” connection between a computer and *WiVib-4/4 Pro*, all you need to do is to program your access point to an SSID of “*wivibnet*” and an IP address of 192.168.101.xxx (where xxx is any unused address in the range 0 to 255), and assign a static IP to your computer of 192.168.101.80 (via **Control Panel … Network Connections**). For existing systems, you will need to use *WiVibConfig* to

set up appropriate IP addresses for each *WiVib-4/4 Pro*, the SSID and associated settings of the wireless network (including WEP settings, if used) and the IP address of the host computer.

2.3 Restoring Factory Defaults

Factory default settings can be re-programmed at any time. To do this, press and hold the ON/OFF button at switch-on while watching the internal LED's. After the initial LED check where the four green and red LED's flash once, the four green LED's will flash five times followed by a longer sixth flash. Release the ON/OFF button at this point. Factory defaults will now be set.

CHAPTER 3 – Modes of Operation

The *WiVib-4/4 Pro* has two modes of operation, namely *Continuous Mode* and *Wakeup Mode*. These are explained below.

3.1 Continuous Mode

Continuous Mode is when the device remains powered under the control of the ON/OFF pushbutton. It will respond to commands received over the network as long as it is powered up.

The device is turned on by pressing the ON/OFF pushbutton once. The green LED illuminates to indicate that that the unit is operating. Pressing the ON/OFF pushbutton again turns the unit off and the green LED is extinguished.

When in *Continuous Mode,* if the timeout period is reached the *WiVib-4/4* will perform a self-instructed power cycle and attempt to reconnect. A timeout is reached if no command has been received from the host computer within the timeout period. The factory default is set to five minutes, but this can be altered in software. Note that the *WiVib-8x8pro* can still be powered down by a command from the controlling application and in this case can only be switched on by pressing the ON/OFF pushbutton.

3.2 WakeUp Mode

When the device is switched off, a real-time clock remains running and this can be used to power the device up at pre-determined intervals. This is called *Wakeup Mode*. It is simply a matter of telling the device using the appropriate commands at what time it should wake up for the first time followed by the interval at which repetitive wakeups should occur. A wakeup time can be overridden by pressing the ON/OFF pushbutton.

At wakeup, the device has a limit on the time that it will remain powered up if it is unable to make contact with the network. This is to reduce battery drain when, for example, the network is temporarily down. If the device wakes up and is unable to establish communication with its network, the sequence of retries occurs as per the table below:

Retry Strategy

Mode	Sequence
Wakeup	At its wakeup interval, the *WiVib* tries to connect continuously for 40 seconds. If no connection is made, it powers down, waits for 2 minutes and tries again for 40 seconds. If no connection is made at this second attempt, it powers down and waits for the next wakeup interval when it repeats the sequence.
Continuous	The *WiVib* tries to connect continuously until the timeout interval as specified by the **TO** command is reached. The device then restarts and tries again until the next timeout interval is reached. This sequence continues indefinitely.

In summary, when in *Wakeup Mode*, the *WiVib-4/4 Pro* can be turned on in one of three ways, namely

1. using the ON/OFF pushbutton, or
2. applying a pulse to the EXT ON ('external on') input, or
3. powering up on a preset wakeup time/interval.

It can be switched off in one of three ways:

1. using the ON/OFF pushbutton, or
2. powering down as commanded by the controlling application, or
3. powering down after a timeout (as in *Continuous Mode*).

CHAPTER 4 – Physical Connections

4.1 Analog Inputs

The *WiVib-4/4 Pro* has a total of eight input channels. There are two types of channel as detailed in the table below.

Analog Input Channels

Type	Channels	Typical Usage
ICP / AC	1 - 4	ICP Accelerometers or AC dynamic signals
DC / 4-20mA	5 - 8	DC coupled process signals or 4-20mA inputs

The table below shows the input connection assignments and the jumper number associated with each channel.

Analog Input Connections

Input	Terminal	Jumper
Channel 1 Signal	CH1 +	JP1 (2-way)
Channel 1 Common	CH1 -	
Channel 2 Signal	CH2 +	JP2 (2-way)
Channel 2 Common	CH2 -	
Channel 3 Signal	CH3 +	JP3 (2-way)
Channel 3 Common	CH3 -	
Channel 4 Signal	CH4 +	JP4 (2-way)
Channel 4 Common	CH4 -	
Channel 5 Signal	CH5 +	JP5 (3-way)
Channel 5 Common	CH5 -	
Channel 6 Signal	CH6 +	JP6 (3-way)
Channel 6 Common	CH6 -	
Channel 7 Signal	CH7 +	JP7 (3-way)
Channel 7 Common	CH7 -	
Channel 8 Signal	CH8 +	JP8 (3-way)
Channel 8 Common	CH8 -	

Physical connection is by terminal connectors that can be removed from the board to make termination easier. Twelve IP67 glands are fitted to the enclosure.

Each type of input is described in detail below.

ICP / AC Inputs

These dynamic inputs incorporate an ICP interface that can be enabled or disabled by jumper selection. Each input has its own ICP interface (ie. they are not multiplexed). If the appropriate jumper is inserted, then ICP power is applied to that channel. If the jumper is not inserted, then an AC signal can be applied. The maximum input range of these inputs is +/-5V for both ICP and AC connection. This equates to a maximum input range of +/-50g for a 100mV/g accelerometer.

The nominal voltage of the ICP interface is 20V with a constant current of 2.4mA. Bias voltage checking is available and the bias voltage can be read for each channel by the application communicating with the *WiVib-4/4 Pro*.

DC / 4-20mA Inputs

These four inputs are DC coupled and are intended for accurate measurement of process signals. The signals do not pass through any of the filters or gain amplifiers that are on the ICP / AC signal paths.

The input range of these channels is 0-3V or 0-10V, depending on jumper position. Alternatively, a high-precision 100 ohm (100R) resistor can be selected by jumper to act as a load for a 4-20mA input. The voltage input range is therefore 0.4V to 2V for a 4-20mA input. Jumper positions are shown in the table below.

DC Channel Jumper Selection

Position	Range
Not fitted	0 – 3V
A	0 – 10V
B	4-20mA (100R load)

Note that accelerometers with temperature output can be connected directly to a *WiVib-4-4 Pro*. Simply connect the ICP connections to one of channels 1 to 4 and connect the third (temperature signal) wire to the positive input of one of channels 5 to 8.

4.2 External Trigger Inputs

The *WiVib-4/4 Pro* has two trigger channels. These inputs act as external trigger and the tacho inputs. They can also act as gates – refer to section Gated Inputs later in this section.

Trigger channel 1 (labelled **TRIG 1** on the main board) can have an analog signal (input label **ANA**) or a digital signal (input label **DIG1**) connected (but not both at the same time). Trigger channel 2 (labelled **TRIG 2** on the main board) can have a Namur sensor attached (input label **NAM**) or a digital signal (input label **DIG2**)

connected (but not both at the same time). Trigger options are summarised in the table below.

Trigger Channel	Input Option	Label	Comment
TRIG 1	Analog	ANA	Analog level trigger set by trimpot
	Digital	DIG1	Optically-isolated digital trigger
TRIG 2	Namur	NAM	Namur sensor compatible
	Digital	DIG2	Optically-isolated digital trigger

On trigger channel 1, jumper JP11 (labelled **TRIG1**) selects the trigger option as shown in the table below.

Channel TRIG 1 Trigger Options

Position	Trigger Mode	Input Connection
A	Analog	**ANA** on **TRIG 1** Connector
D	Digital	**DIG1** on **TRIG 1** Connector

On trigger channel 2, triggering occurs from whichever input is connected (**NAM** or **DIG2**). No jumper settings are required to select the input type.

Analog Trigger (ANA)

The analog trigger input range is +/- 25 volts and is typically used to trigger off the signals from proximity probes and other repetitive analog signals. The signal source should be connected to the terminal marked **SIG** and the common of the signal to the terminal marked **COM**. This is regardless of the polarity of the signal.

Analog Trigger Connections

Terminal	Signal
SIG	Analog Signal
COM	Common

The trigger level is set by adjusting the potentiometer RV1 until the adjacent LED illuminates. For slow trigger rates (<10Hz approximately), the LED will appear to flash whereas it will appear solid for faster rates. To optimise the adjustment of the potentiometer, wind it until the LED illuminates, and keep winding it until the LED extinguishes. Then wind the potentiometer in the opposite direction to half-way between these two points.

Note that jumper JP9 must be fitted in analog trigger mode. This means that, for analog trigger input, the trigger input is non-isolated ie. the common of the input signal is connected to the common of the WiVib-4/4.

Digital Triggers (DIG1 and DIG2)

External trigger inputs are identified by the labels **DIG1** and **DIG2**. These inputs can be isolated or non-isolated.

The signal source should be connected to terminal '**+**' and the common of the source to terminal '**-**'. When a trigger is detected, the adjacent LED will illuminate. For slow trigger rates (<10Hz approximately), the LED will appear to flash whereas it will appear solid for faster rates.

Digital Trigger Connections

Terminal	Signal
+	Logic Signal
-	Common

An external trigger requires a logic pulse and is compatible with any voltage pulse input in the range 5-24Vdc. Logic '0' must be less than 0.5V.

The trigger can be isolated or non-isolated. By inserting a jumper in JP9 (**for DIG1**) and JP10 (for **DIG2**), the trigger is non-isolated from the ground of the unit. By leaving the jumper out, the unit remains isolated.

Namur Trigger (NAM)

A two-wire Namur sensor can be fitted to the terminals marked **NAM**. The polarity of the sensor connections are marked '**+**' and '**-**'.

Namur Trigger Connections

Terminal	Signal
+	Namur +ve
-	Namur -ve

A typical type of sensor is the NCB series from Pepperl & Fuchs. These are very low power devices and so are good for battery-powered applications, though they are perfectly suitable also for when the WiVib-4/4 is externally powered. These sensors operate at a nominal supply voltage of 8V and this is supplied by the WiVib-4/4.

When a trigger is detected, the adjacent LED will illuminate.

Gated Inputs

The external trigger inputs can also act as gates to enable or disable sampling depending on the status of these inputs. This mode is set up as configured by the controlling host application. In gate mode, the application reads the logic level of one or both of the trigger inputs and makes a decision based on their status. The same logic level thresholds apply as for normal triggering.

4.3 External Switch-On Input

It is possible to switch on the unit by applying a pulse on the pins on the connector labelled **EXT ON**. The pin assignments are shown below.

External Switch Pin Assignments

Pin No	Signal
+	SIGNAL
-	COMMON

The external switch-on function requires a positive-going logic pulse and is compatible with any voltage pulse input in the range 5-24Vdc. Logic '0' must be less than 0.5V. This input is isolated. Applying a pulse to this input has the exact same effect as applying power by pressing the ON/OFF pushbutton. Unlike the ON/OFF pushbutton, the external switch does not power the unit down.

4.4 Status LED's

There are five LED's in a vertical row on the left side of the main board. The upper four are green and the lowest one is red. At switch-on, all five will illuminate briefly as an operational check. They will then illuminate dependent on the status of the *WiVib-4/4 Pro*. Details are shown in the table below.

LED Assignments

LED	Colour	Indication	Comments
LNKQ	Green	Link Quality	When connected to a network, the LED illuminates in bursts of one to five flashes depending on the WiFi signal strength.
WCON	Green	Connection Status	Indicates status of network connection. LED is off when not connected to a network, flashes intermittently when connected to a network, and stays solid when connected to a host.
SAMP	Green	Sampling	Illuminates while sampling is taking place.
USB	Green	USB Link Present	Illuminates when a USB link is established, otherwise it is off.
FLT	Red	Hardware Fault	Indicates unidentified hardware failure.

CHAPTER 5 – Powering the *WiVib-4/4 Pro*

5.1 Power Sources

The *WiVib-4/4 Pro* can be powered from internal batteries or from an external power supply in the range 10-30Vdc. The peak current drawn from the battery is approximately 400mA. Peak current drawn from a power supply set to 24Vdc is about 125mA. At 12Vdc, it is about 250mA.

Jumper JP12 (marked **PWR**) selects which power source is used as per the table below. The *WiVib-4/4 Pro* cannot be damaged if the jumper is in the wrong position for the power source connected.

***WiVib-4/4 Pro* Power**

Power Source	Jumper Position (PWR)
Battery	BAT
External 10-30Vdc	EXT

Note that the POWER switch must be in position EN (enable) for the unit to power up.

5.2 Battery Power

The batteries used must be two 3.6V lithium type 'D' cells capable of delivering high peak current. The LSH 20 from SAFT is recommended. Ensure that the batteries are inserted the correct way round in the battery holders (ie. positive to the top).

The *WiVib-4/4 Pro* contains a battery "gas gauge" that can be read by the controlling application so that charge remaining can be monitored. The batteries cannot be recharged. In addition, there are software and hardware internal battery monitors that detect low battery levels and turn the unit off before any corruption of data could occur.

The "gas gauge" is automatically reset when the batteries are changed, and the *WiVib-4/4 Pro* always assumes that fully-charged batteries have been inserted. To ensure that the "gas gauge" resets correctly, remove the exhausted batteries and wait at least 30 seconds before inserting fresh batteries.

5.3 External Power

Any DC power source in the range 10V to 30V can be used to power the *WiVib-4/4 Pro*. Simply ensure that it can supply the peak current required. Power is applied at connector J11 (marked **EXT PWR**) and the '+' and '–' terminals are clearly marked. The unit is reverse polarity protected and so cannot be damaged if the power source is temporarily connected the wrong way round. Peak current drawn from a power supply set to 24Vdc is about 125mA. At 12Vdc, it is about 250mA. Due to inrush

current at switch-on, it is recommended that a supply with at least twice the required current is used.

5.4 Switching On and Off

The pushbutton on the side of the unit turns the unit and off. The adjacent green LED indicates when the unit is running. Note that the green LED will illuminate when the unit powers up by other means, for example, when instructed by the internal real-time-clock in wake-up mode. There is a slight delay between pushing the button to power the device down and the green LED extinguishing. This is because the unit saves internal settings before powering off. Note that, if the unit suffers a programme fault, it can be forced to power down by pressing the SW-OFF (switch-off) pushbutton inside the unit.

Also note that, when power is applied to the unit, it always defaults to ON. The reason for this is that if, for example, external power is lost in the plant where a *WiVib-4/4 Pro* is installed, as soon as power is restored, the unit will power up and make a connection with the host computer in order to re-synchronise its measurement cycles.

SPECIFICATION

MEASUREMENT

Dynamic Channels

No of Channels:	4
ICP Interface:	2.4mA at 20Vdc
Other Coupling:	AC, jumper configurable
Input Voltage Range:	+/-5V
Bias/Gap Measurement:	+/-25V range for ICP bias voltage and eddy probe gap measurement
Measurements:	acceleration, displacement, bearing demod, (velocity by 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 steps from 50Hz to 40kHz)

DC Channels

No of Channels:	4
Ranges:	0 to +3V and 0 to +10V, jumper selectable
4-20mA Input Option:	100 ohm load, jumper selectable

PROCESSING

ADC:	24 bit simultaneous on channels 1-4 16 bit multiplexed on channels 5-8
Sampling Rate (chans 1-4):	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

TRIGGERS

No of Channels:	2 (one optional analog/digital option, one optional Namur/digital)
Coupling:	5V to 24V digital pulse, or Namur, or analog in range +/-20V
Available Functions:	external trigger, tacho speed, ordered data (by phase-lock-loop), gated acquisition, pre- and post-trigger delay to 32768 samples

COMMUNICATIONS

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

MECHANICAL

Enclosure:	metal, NEMA 4, IP66
Dimensions:	26cm (10.2”) x 16cm (6.3”) x 9cm (3.5”)

ENVIRONMENTAL

Operating Temperature:	-20ºC to +70ºC (-4ºF to +158ºF)

POWER

Input Power:	battery, or DC power (10 to 30Vdc)
Battery Type:	two x lithium 3.6V ‘D’ cell (Saft LSH20 recommended)
Isolation:	1500V from DC power input

Subject to change without notice

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