KCF Technologies, Inc.

Self Powered Wireless Sensor Kit

Operating Manual

Oct. 2008

Self-Powered Wireless Sensor Kit (WSK100)

KCF Technologies Wireless Sensor Kit (WSK100) demonstrates self powered wireless sensors as a practical solution for industrial monitoring. Freely available vibration energy is captured and used as the only power source. This enables designers of wireless sensor networks to achieve the reduced installation and life cycle costs promised by wireless sensors.

Kit Includes

- USB dongle receiver/transmitter for host Ultra-mobile PC (UMPC)
- Software installed on the UMPC for sensor network and data display and archiving
- Set of three integrated wireless sensors, each including:
  - Vibration power harvester
  - Temperature sensor (in housing)
  - Acceleration sensor
  - Port for external pressure sensor
- Ratio-metric pressure sensor
- One Magnetic Base

VPH series Vibration Power Harvesting

KCF Technologies VPH series vibration power harvesters scavenge energy from a host structure and provide regulated DC power an integrated wireless sensors, eliminating battery replacement for an expected life of up to 15 years.

- **Size:** Ø63 x 67 mm cylinder
- **Design Vibration Amplitude:** 2.0 to 25.0 mm/s
- **Vibration Frequency Input Required**
  - **Model VPH100:** 120 Hz
  - **Model VPH200:** 240 Hz
  - **Model VPH300:** 360 Hz
  - **Model VPHXXX:** Custom frequency available by request between 110 to 370 Hz.
- **Operating Temperature:** -40 to 127 degrees C
- **Max Shock Tolerance:** 100g
- **Mounting Options**
  - Internal thread #10-32
  - External thread 3/8-24
  - Magnetic base

Features

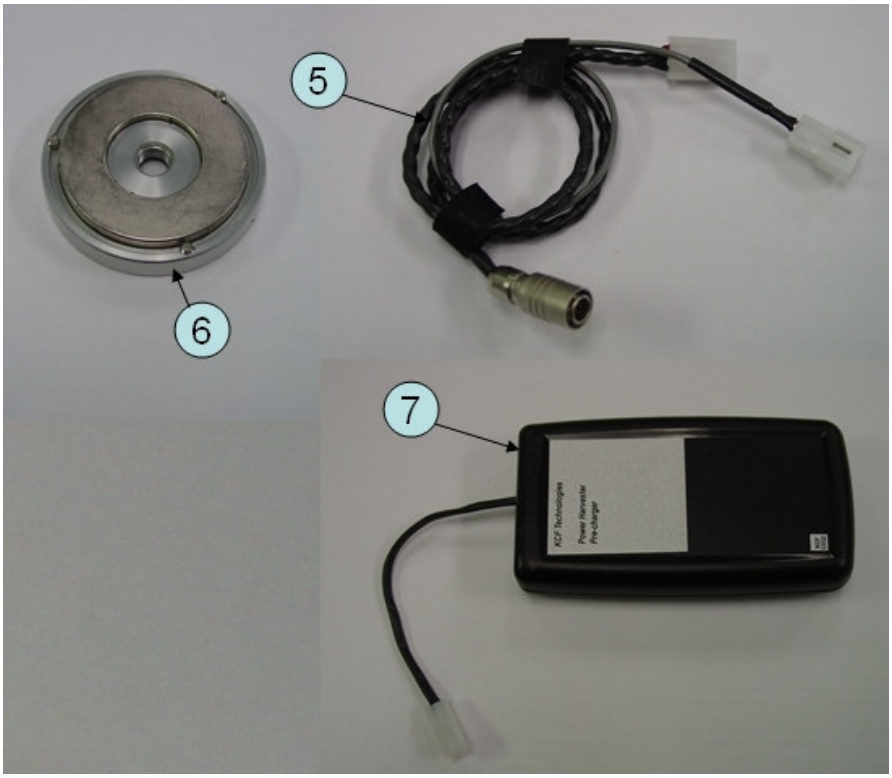
- Wireless (no data or power wire) reduces the sensor installation cost by an estimated $1000 to $3000.
- Vibration power harvesting reduces sensor life cycle costs by an estimated 70% by eliminating battery changes.
- Custom sensor boards available by request.

Performance Highlights

- Impedance optimized for maximum coupling from vibration to stored electrical energy.
- Structurally isolated for durability.

Getting to Know Your Wireless Sensor Kit

1. Ultra-mobile PC (UMPC) There is a folding stand in the back of the UMPC which allows stand as shown below.
2. Wireless Sensor Node
3. External, ratio-metric pressure sensor
4. Receiver dongle
5. Pre-charger and external pressure sensor cable
6. Magnetic base
7. Pre-charger



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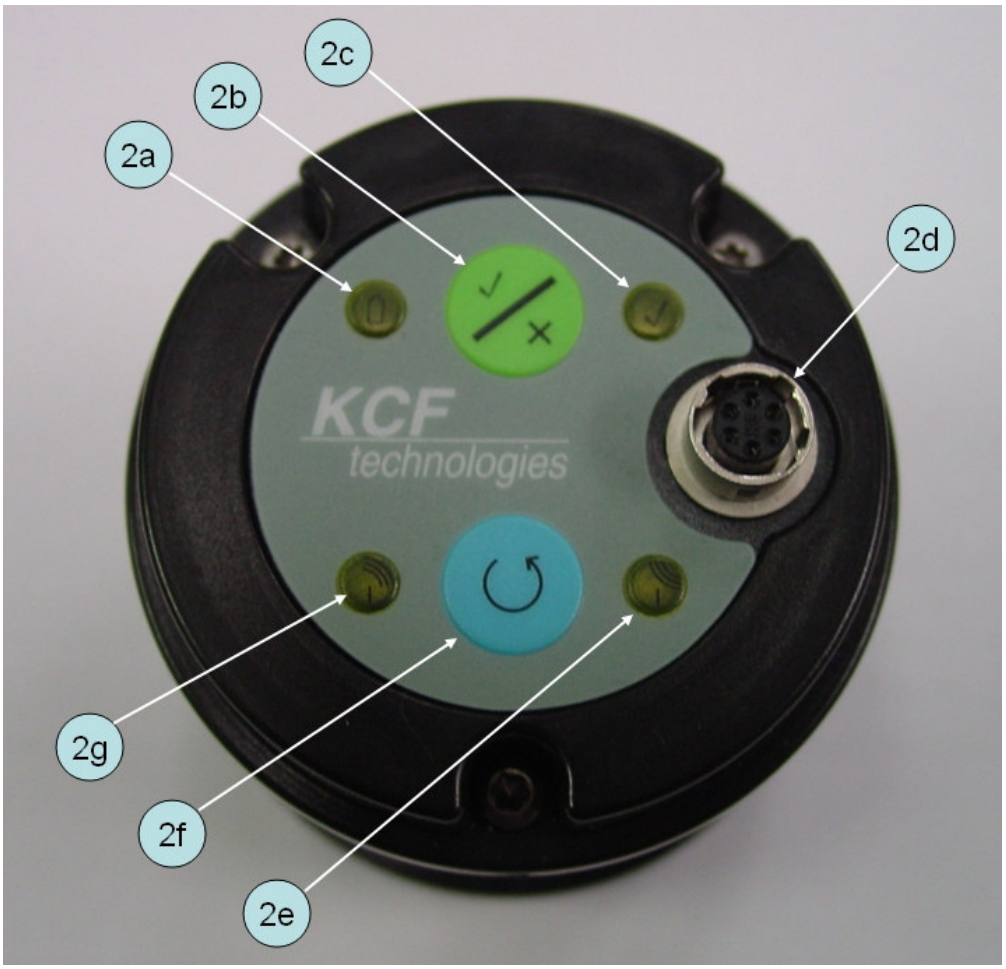
Getting to Know Your Wireless Sensor Nodes

2a. Internal storage fully charged indicator LED
2b. Button to momentarily engage harvester charging indicator LED
2c. Harvester charging indicator LED
2d. Water proof connector to pre-charge internal storage and to connect external pressure sensor
2e. Sensor board receiving indicator LED
2f. Sensor board reset button
2g. Sensor board transmit indicator LED
2h. #10-32 mounting provision (shown in next figure)
2i. 3/8-24 mounting provision (shown in next figure)

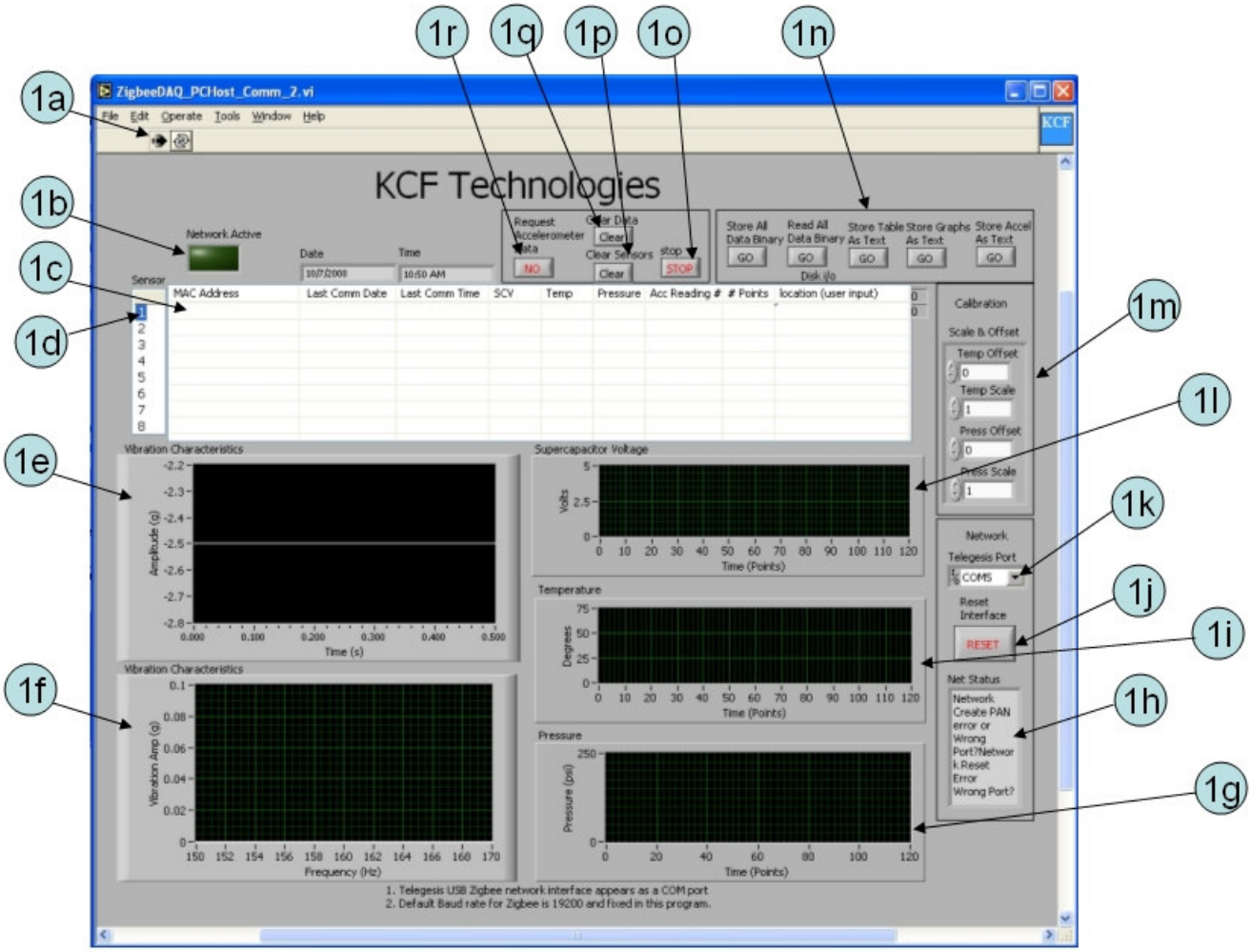


Getting Started with Your Wireless Sensor Software

To make the job of getting your sensor kit up and running easier, we recommend that you follow the following instructions in order.

1. Power up your UMPC, but do not launch the software just yet.
2. Install the transmitter/receiver dongle (4) into the USB socket located on the top, center of the UMPC (1) A red light will come on inside the dongle when it is getting power.
3. Install the pre-charge cable (5) into the connector (2d) one of the harvester nodes (2).
4. Install the pre-charger (7) into the pre-charge cable, via the two pin white plastic connector.
5. Turn the pre-charger power on. When the sensor node is fully charged (less than 5 minutes) the two Sensor board indicator LED's will blink approximately every 10s.
6. Launch the sensor monitoring software, PCHost_ZigbeeDAQ_1102.exe by double clicking on the icon. The program begins on startup.

At this point let's take a moment to explore the software shown in the following image.



1a. Run button
1b. Network active indicator light (green when network is active)
1c. List of nodes connected.
1d. Highlight blue indicates which sensor data is being displayed in 5, 6, 7, 9, and 12
1e. Latest Vibration data taken
1f. FFT of latest vibration data set
1g. Pressure data for sensor selected from table.
1h. Network status (when network is established, will read okokok.
1i. Temperature data for sensor selected from table.
1j. RESET button
1k. Com port where transmitter/receiver is installed
1l. Voltage on selected sensor node's internal super capacitor
1m. Calibration settings for temperature and pressure sensor
1n. Data saving options
1o. Stop button (does not exit display, but does stop operation)
1p. Disconnects sensors from network
1q. Clears all sensor data in buffer and on display
1r. Request last vibration data from sensors

7. Select the correct com port for the transmitter/receiver dongle (4) from the pull down list shown in (1k)
8. Select RESET (1j) After a few moments, the box (1h) should display okokok.
9. After the next transmission from the fully charged node (the node will not transmit unless it's internal super capacitor voltage exceeds 2.2 Volts) the Network Active button (1b) will blink green and if the transmission is successful, the serial number of the connected node will be displayed in the Node List (1c)

Operating Your Wireless Sensor Kit

Each harvester node is tuned to operate at a specific frequency (with a 6 Hz half power bandwidth) and will operate best when rigidly attached to a high impedance structure (large still structure) which has a frequency component at the specific frequency. The magnitude of vibration should be between 2mm/s and 10mm/s and works best at about 4mm/s.

Attachment can be via the magnetic base, or direct attachment. The magnetic base has set screws to accommodate non-flat surfaces. Once the base is secure, the harvester can be screwed onto it. The harvester should not wobble on the machine. For direct attachment, there is a female #10-32 threaded hole (2h) or the male 3/8-24 threaded portion (2i). A non-permanent thread locker is recommended.

Before the software is launched, it is recommended to pre-charge the internal super capacitor of the sensor nodes to reduce start up time and to debug the network connection. The network is a star type and the nodes should be within 75 ft of the transmitter/receiver or less, depending on what the transmission must penetrate.

Once at least one of the nodes is pre-charged fully, the software can be launched, see above for the order. After the first node appears in the list, the other nodes can be pre-charged in turn. To see the data in the graphs on the display, the node number (1d) can be highlighted by selecting it. Then the data for that node appears in the graph. Several options exist for saving the data, but only the binary save can be recalled by the program for display.

If the sensors are fully charged, they will attempt to transmit approximately every two minutes. If the internal super capacitor voltage drops below 2.2volts during a previous transmission, the sensor will wait until the super capacitor is recharged by the vibration source, before a new transmission. A temperature, pressure, and super capacitor voltage transmission takes very little energy, however a transmission of the previous vibration spectrum is energy intensive and can reduce the transmission frequency while the node recharges. To request the vibration spectrum, select the button (1r). It will switch to display "GO". After the transmission, it will revert to "NO".

Occasionally, if the all the nodes are un-powered for a significant length of time, the transmitter can attempt to locate another transmitter and can switch "channels" by itself. If you suspect this has happened, remove the dongle, charge one node and restart the software as above.