Echo® Wireless Vibration System

A simple, affordable, effective wireless vibration system

Why use valuable manpower to collect vibration data on healthy machines? Why settle for measurements once a month when you can have them multiple times daily? Why have people venture into unsafe areas to collect routine measurements? Echo® Wireless Vibration Sensors can safely “look” at the machine’s health several times per day and provide immediate notification when warning or critical levels are reached. This frees up technical experts, like certified vibration analysts, for higher value tasks such as fault analysis.

- Transmits long distances
- Batteries last over 5 years
- Eliminates expensive cable runs
- Runs stand alone or with junction box
- Stores data in ODBC format
- Installs easily
- Requires no repeaters, gateways, or mesh
Echo® Wireless Vibration System

Performance
The Echo® Wireless Vibration System has been tested, and found to perform very well, in a number of different types of plants including: power, steel, food processing, paper, chemical, and automotive. The system has performed reliably and provided accurate and useful data regarding machinery health.

Fault Detection
The Echo® Wireless Vibration Sensor and the EchoPlus® Wireless Junction Box make the set of overall vibration measurements, listed below, that are sure to provide early warning of most common machine faults. In addition to these measurements, Echo® provides accurate battery status. Using a user programmable vibration threshold, Echo® can detect if the machine is not running, and if not, skip a measurement to conserve battery power. It also has an optional Raw Vibration Output (requires optional Model 070A86 cable) for use with a portable data collector.

- RMS Velocity - for “Balance-of-plant” faults such as imbalance, misalignment, and flow problems
- RMS Acceleration - for higher frequency faults and high frequency energy (HFE) detection such as high speed gear mesh, broken rotor bars, and loss of bearing lubrication
- True Peak Acceleration - for bearing, gear, and impulsive faults, including looseness
- Crest Factor - for fault severity indication

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Model 670A01
Wireless Vibration Sensor
- Batteries last over 5 years
- Transmits long distances
- Eliminates expensive cable runs

Product shown at actual size

The Echo® Wireless Vibration Sensor is a stand alone, battery powered, industrial vibration sensor. At the default setting of three measurements per day (user programmable) battery life is greater than 5 years. A Raw Vibration (RV) output version includes an integral connector that can be used with an optional cable and a standard vibration data collector for fault analysis. The sensor can be programmed via RS-232 to set the transmission (collection) interval and a Residual Vibration Level (RLV) if desired. Echo® has an LED that provides visual feedback on the status of the sensor, including: on, off, measuring, transmitting, or changing states. The sensor has an embedded magnetic switch and can be activated or deactivated by holding a strong magnet next to the sensor. Upon activation, the sensor makes and transmits a set of measurements.

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The EchoPlus® Wireless Junction Box is an 8-channel junction box that instantly converts installed industrial sensors to wireless operation. This incredibly economical device periodically powers each sensor, makes the same set of overall measurements as Echo®, and transmits them wirelessly. The default transmission interval is 8-hours but is user programmable. Additionally, it operates as a standard junction box allowing full data collection with a portable data collector at the box. It can be powered using either standard 24 VDC or any battery between 6 and 13 VDC. The unit can be used by itself or in conjunction with an existing junction box by simply jumping wires between them.

Model 672A01
Wireless Junction Box
- Converts existing sensors to wireless
- Runs independently or with existing junction box
- Uses 24 VDC or battery power

The Echo® Receiver is a stand alone unit that communicates point-to-point with Echo® Wireless Vibration Sensors and EchoPlus® Wireless Junction Boxes. Operating in the 916 MHz range, using an ultra-narrow bandwidth filter with Extended Range RF (ERRF) technology, it has unprecedented -145 dBm sensitivity and can detect and decode RF signals as low as about a millionth of a billionth of a milliwatt. This results in very long distance point-to-point communications in plants, eliminating the need for repeaters or complicated mesh networks. Actual tests in a typical power plant achieved successful signal transmission distances of over 1/3 mile and even through buildings. Outdoor tests have achieved transmission distances measured in miles, and transmissions are at only 0.75 mW ERP using very little battery power.

Model 673A01
Receiver
- Requires no repeaters, gateways, or mesh
- Outputs to ethernet
- Installs easily
**Echo® Wireless Vibration System**

The Echo® Wireless Vibration System is simple in design, easy to install, cost effective, and flexible in configuration. With 12 independent RF bands and over 400 points per receiver, the system can monitor over 5000 points even within the same RF coverage area. Outside the same coverage area, the number is even higher. Stand alone Echo® Sensors and EchoPlus® Junction Boxes can be mixed and matched as desired. EchoPlus® and optional RV Echo® provide a raw vibration output via cable to a data collector for detailed fault analysis. Echo® Monitoring Software provides standard monitoring features such as: machine status, reports, trend plots, and email alerts. It can be run single or multi-user at no additional charge per user.

**Direct point to point transmission typical distance = 1/3 to 1/2 mile radius**

Actual distances can vary widely based on conditions.

**Typical Configuration 1**

*EchoPlus® Wireless Junction Box*

See Page 3 for More Information

**Typical Configuration 2**

*Echo® Wireless Vibration Sensors*

See Page 2 for More Information

**Typical Configuration 3**

*Echo® Wireless Vibration Sensors & EchoPlus® Wireless Junction Box*

(shown with optional RV sensor & cable)

Data collector connects directly to optional RV wireless vibration sensor or wireless junction box

Receiver has DHCP or static IP addressing

Optional high gain antenna

100-240 VAC to 12 VDC Universal Power Supply

Includes antenna

TCP/IP

Resumes transmission upon completion of analysis

Receiver

See Page 3 for More Information

Process 24 VDC power or 6-13 VDC battery power

Monitored Machinery

Traditional, Wired Sensor

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Echo® Wireless Vibration System

Echo® Monitoring Software
See Page 6 for More Information

Echo® Data Client
- Collects Transmissions
- Formats Data
- Stores in Database
- Generates Alarm Email

Echo® Data Presentation SW
- Trend Plots
- Status
- Alarms
- Reports
- Echo® sensor configuration utilities

Server instance is fully functional SW that also stores sensor transmissions in database

Ethernet
TCP/IP

Echo® Sensor Data

MS SQL Server 2005

Echo® Data Presentation SW
Access to SQL Database through internet with LAN
- Trend Plots
- Status
- Alarms
- Reports
- Sensor Configuration

All monitor stations, either through LAN or remote access, have all the same functionality as server system, but do not store data

Echo® Data Presentation SW
Access to SQL Database through internet with VPN
- Trend Plots
- Status
- Alarms
- Reports
- Sensor Configuration

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Toll-Free in USA 800-959-4464 716-684-0003
Echo® Monitoring Software

Echo® sensor data is stored in a Microsoft SQL Express 2005 database or other existing SQL database. The format is available from IMI so it can be accessed by users directly using any ODBC compliant application. The data can also be exported to a tab delimited spreadsheet file that is suitable for use with Excel or other data viewing applications for post processing. Additionally, IMI is working on interfaces to legacy condition monitoring programs and plant monitoring systems. Contact IMI for details.

Model 600A20
Echo® Monitoring Software
- Installs locally or on a server
- Runs single or multi-user
- Provides alarms, trend plots, and e-mail alerts

The Echo® Monitoring Software provides two major functions
- Collect transmission data reported by the receiver and store in the SQL database
- Present Echo® sensor data to the user through an intuitive and concise interface that includes:
  - Configuration utilities to setup a machinery database and set alarms levels
  - Tabular displays to view live and historical data.
  - System level sensor status display to warn of low batteries, low RF signal, or missed measurements
  - Alarm reporting - graphically via system status screens and electronically via email
  - Single and multi-sensor plot displays with alarm levels to show trends
  - Hardcopy report generation for last transmission and alarm events
  - Additional utilities to query and program Echo® Sensors, EchoPlus® Junction Boxes, and Echo® Receivers.

A: Sensor Vibration Trend Plot
B: Sensor Alarm Panel
C: Sensor Status Window

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## Echo® & EchoPlus® Measurements

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Echo® RMS Velocity (±3 dB)</strong></td>
<td>4 Hz to 2300 Hz</td>
</tr>
<tr>
<td><strong>EchoPlus® RMS Acceleration (±3 dB)</strong></td>
<td>4 Hz to 2300 Hz, may be limited by sensor FR</td>
</tr>
<tr>
<td><strong>EchoPlus® RMS Velocity (±3 dB)</strong></td>
<td>4 Hz to 2300 Hz</td>
</tr>
<tr>
<td><strong>True Peak Acceleration</strong></td>
<td>2.2 kHz to 15 kHz</td>
</tr>
<tr>
<td><strong>Battery Voltage at Maximum Load</strong></td>
<td>For battery status report</td>
</tr>
</tbody>
</table>

### System Information Provided

- **Time:**
  - Sensor ID: Factory set unique ID
  - RMS Velocity:
  - Derived Peak Velocity: 1.414 x RMS Velocity
  - RMS Acceleration: 2 kHz high pass filtered for improved HF detection
  - Derived Peak Acceleration: 1.414 x RMS Acceleration
  - True Peak Acceleration: 3.7 x rms samples @ 61.4 kHz sample rate, 2 kHz HPF
  - Filtered Crest Factor: True Peak / RMS Acceleration, Maximum Value = 16
  - Battery Status: 4 levels, status based on previous transmission @ max load
  - RF Status: 4 levels
  - Noise Power: Background noise level (dBm)
  - Average Power: Average transmission power (dBm)
  - Average SNR: Difference between Noise Power and Average Power (dB)

### Radio & Standard Specification

- **Radio Standard:** Proprietary Narrowband FSK
- **Modulation:**
  - Transmission Rate: 250 kbps to 1 mile radius, installation dependent
- **Transmission Interference:** Programmable from 12 sec to 24 hours in 4 sec increments (default = 8 hours)
- **Certifications:** FCC, IC
- **Minimum Noise Floor:** -155 dBm
- **Radio Sensitivity:** -145 dBm
- **Frequency Band:** 900 MHz ISM Band
- **Number of RF Bands:** 12 (User selectable)
- **Maximum Power (ERP):** 0.75 mW
- **Signal Attenuation:** 45 dBm, user selectable for sensors close to receiver
- **RF Data Rate:** 20 bps
- **Programming:** HS-232 (EchoPlus® sensor requires optional 10/100 Ethernet adapter. EchoPlus® uses standard 9-pin serial cable.)
- **Number of receivers handled by a single computer:** Limited Only by End User Network and Computer Hardware
- **Sensors per receiver IQ:**
  - Channel 1: User selectable in any combination
  - Channel 0: Individual factory set unique ID per channel
- **Sensors Supported:**
  - TCP/IP (2 sec settling time, 10, 50, 100, 500 m/s; fixed)
  - Sensors with supplied utility software
- **Channel Gain:** Set per channel for sensor normalization (default set for 100 m/s RMS accelerometer)
- **Buffered Sensor Analog Output:**
  - BNC, push SELECT SENSOR
- **Sensor Select timeout:** 15 min of non-use
- **External DC Power:** 24 VDC ± 1 V
- **External Battery Power:** (battery not supplied)
  - 6 to 13 VDC
- **Over Voltage Protection on Battery Terminals:**
  - 14 to 30 VDC (Fuse auto resets after voltage removed)
- **Reverse Polarity Protection:** Yes
- **Transmission Interval:** Programmable in 4 sec increments up to 24 hours, default = 8 hours, minimum dependent on the number of active channels

### EchoPlus® Parameter

- **Channels per Box:** 8
- **Channels Active:** User selectable in any combination
- **Sensors with supplied software:** Individual factory set unique ID per channel
- **Sensors with supplied utility software:** Individual factory set unique ID per channel
- **Sensors:**
  - Linear = ±3% of reading, 0 to 100 g pk
  - Dynamic = ±2% of reading, 0 to 100 g pk
- **NEMA 4X, IP 66**
- **Temperature:** 0°C to 50°C
- **Humidity:** 0% to 100%
- **Enclosure Rating:** IP 68

### Performance

- **Echo® Acceleration Linearity:**
  - at 0 and 20 g pk
  - ±1%
- **EchoPlus® Acceleration Linearity:**
  - at 0 and 20 g pk
  - ±1%
- **Derived Peak Acceleration:**
  - 1.414 x RMS Acceleration
- **Minimum True Peak Acceleration (±2 kHz HPF):**
  - -50 m/s²
  - True Peak / RMS Acceleration, Maximum Value = 16
  - A/D dynamic range: 16 bit / 32 bit

### Environmental

- **Mechanical Shock Limit:**
  - 1000 g through mounting base
- **Temperature Range:**
  - -20°C to 100°C (14°F to 158°F)
  - Battery Life:
    - 5 years of 3 measurements per day, room temperature
  - Electrical isolation (Case):
    - >70 dB

### Echo® Physical

- **Dimensions:**
  - Base Assembly: 1-3/8” Hex
  - Housing: 1.68” Dia
  - Height (overall):
    - 4.20”
  - Weight (including battery pack):
    - 450 g (15.9 oz)
  - Mounting Thread: 1/4-28 Newell
  - Mounting Torque: 2 to 5 lb-ft
  - Sensing Element:
    - Piece Ceramic Shaped
  - Base:
    - 304L Stainless Steel
  - Housing Material:
    - 304L Stainless Steel
  - Housing Cap:
    - Polycarbonate
  - Mechanical Isolator:
    - Uni-angle
  - Mounting:
    - 1/4-28 Stud
  - Sealing:
    - O-ring

### EchoPlus® Electrical

- **Power:**
  - 7.2 Volt Lithium Battery (070A87 adapter, supplied with receiver)
  - Replaceable: Yes
- **Battery Operating Temperature:**
  - 60°C to 85°C (-14°F to 185°F)
- **Battery Life:**
  - >5 years of 3 measurements per day, room temperature
- **Electrical isolation (Case):**
  - >70 dB

### Echo® Receiver Measurement

- **Output Power:**
  - 2.2 kHz to 15 kHz
  - May be set to 4 Hz to 2300 Hz
  - Limited only by sensor FR
  - Sensors per receiver IQ:
    - 3 measurement/sec/channel, 5% miss rate, measurements spaced
  - Sensors per receiver IQ:
    - 3 measurement/sec/channel, 5% miss rate, measurements spaced
  - Sensors per receiver IQ:
    - 3 measurement/sec/channel, 5% miss rate, measurements spaced

### Technical Specifications

- **Radio Standard:** Proprietary Extended Range RF
- **Modulation:**
  - Narrowband FSK
  - Minimum Noise Floor:
    - -155 dBm
  - Radio Sensitivity:
    - -145 dBm
  - Frequency Band:
    - 900 MHz ISM Band (supplied with receiver)
  - Number of RF Bands:
    - 12 (Default RF Band 1)
  - Number of RF Bands:
    - 12 (User selectable)
  - RF Data Rate:
    - 20 bps
  - Number of receivers handled by a simple computer:
    - Limited Only by End User Network and Computer Hardware
  - Sensors per receiver IQ:
    - 3 measurements/day, 5% miss rate, measurements spaced
  - Sensors per receiver IQ:
    - 3 measurements/day, 5% miss rate, measurements spaced
  - Power Input:
    - 12 VDC, 15 W max, Using supplied AC power adapter
    - Power:
      - 12 VDC, 15 W max, Using supplied AC power adapter
      - PN 003 (supplied with receiver)
      - PG-232 (Model number 003M201 (Optional))
      - LED: Power indicator
- **Enclosure Material:**
  - Die Cast Aluminum
  - Size Overall:
    - Length x Width x Height:
      - 9.4” x 2.7” x 2.1” (239 x 68 x 53 mm)
      - (without mounting bracket)
  - Weight:
    - Without mounting bracket:
      - 2.84 lb (1.23 kg)
      - Weight (with mounting bracket):
        - 3.7 lb (1.71 kg)
  - Antenna Connector:
    - N Female
  - Ethernet Connector:
    - RJ-45 Waterproof (with mating connector cover)
  - Interface:
    - Ethernet TCP/IP packet containing XML text
  - Antenna supplied:
    - 1500 Hz, Whip SMA w/N connector adapter
  - Enclosure Rating:
    - NEMA STD-601 Method 506.4
    - MIL-STD-810 Method 506.1
    - IP 68
    - NEMA STD-601 Method 506.4
    - MIL-STD-810 Method 506.1
    - IP 68
    - NEMA STD-601 Method 506.4
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    - MIL-STD-810 Method 506.1
    - IP 68
Echo® Wireless Accessories

**Model 070A86**
Echo® RV Output Cable
Model 070A86 is a 4-pin mini connector to BNC power adapter and cable. When used in conjunction with a portable data collector, this cable converts standard sensor power to low voltage power required by Echo® Wireless Vibration Sensors. It also allows normal cabled broadband data collection when used with the RV Echo® Sensor, Model RV670A01.

**Model 070A87**
Echo® Programming Cable
Model 070A87 is a special RS-232 adapter cable with a DB9 connector to a Micro USB connector that allows serial communication with Echo® Wireless Vibration Sensors. The cable’s Micro USB connector mates with a Micro USB connector in the in the sensor and is used to read and program the units.

**Model 070A88**
Echo® RV Shorting Cap
Model 070A88 is a shorting cap that is used with the RV670A01 Echo® Wireless Vibration Sensor for normal wireless use. When removed, a Model 070A86, Echo® RV Output Cable can be used to obtain Raw Vibration output from the sensor for input to a portable data collector for diagnostic analysis.

**Model 073A20**
Echo® Replacement Battery Kit
Model 073A20 is a battery replacement kit that includes a battery pack, O-ring, silicon grease, foam compressor, and instructions.

**Model 009M205**
Low Loss Antenna Cable
Model 009M205 is a high performance, low loss antenna cable with N-Male to N-Male connectors. x is the length in feet. Valid Models are as follows:

- 009M205/002 (2’)
- 009M205/004 (4’)
- 009M205/010 (10’)
- 009M205/020 (20’)
- 009M205/025 (25’)
- 009M205/030 (30’)
- 009M205/040 (40’)
- 009M205/050 (50’)

**Model 009M201**
Echo® Receiver Serial Cable
Model 009M201 is a special RS-232 serial cable with a DB9 connector to a MIL style bayonet connector that allows serial communication with Echo® Receivers. The cable’s MIL style connector mates with a MIL style connector on the receiver and is used to read and program the units.

**Model 009M205**
Low Loss Antenna Cable
Model 009M205/xxx is a high performance, low loss antenna cable with N-Male to N-Male connectors. x is the length in feet. Valid Models are as follows:

- 009M205/002 (2’)
- 009M205/004 (4’)
- 009M205/010 (10’)
- 009M205/020 (20’)
- 009M205/025 (25’)
- 009M205/030 (30’)
- 009M205/040 (40’)
- 009M205/050 (50’)

**Model 070A91**
900 MHz Antenna, 8 dBi
Model 070A91 is an 800/900 MHz, 8 dBi omnidirectional antenna & bracket for use with the Echo® Wireless Vibration System.

**Model 070A90**
900 MHz Antenna, 6 dBi
Model 070A90 is an 800/900 MHz, 6 dBi omnidirectional antenna & bracket for use with the Echo® Wireless Vibration System.

**Model 070A92**
900 MHz Antenna, 13 dBi
Model 070A92 is a 900 MHz, 13 dBi directional Yagi antenna with N female connector.

**Antennas, Low Loss Antenna Cable, and Antenna Accessories are available through many commercial outlets. Contact IMI for details.**

**Wireless Vibration Measurements? We Do!**

**IMI Sensors** designs and manufactures a full line of accelerometers, sensors, vibration switches, vibration transmitters, cables and accessories for predictive maintenance, continuous vibration monitoring, and machinery equipment protection. Products include rugged industrial ICP® accelerometers, 4-20 mA industrial vibration sensors and transmitters for 24/7 monitoring, electronic and mechanical vibration switches, the patented Bearing Fault Detector, high temperature accelerometers to +900 °F (+482 °C), 2-wire Smart Vibration Switch, and the patented Reciprocating Machinery Protector. CE approved and intrinsically safe versions are available for most products.

Visit [www.imi-sensors.com](http://www.imi-sensors.com) to locate your nearest sales office.