Echo® Wireless Vibration System

A Simple, Affortable, 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

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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

Echo® Wireless Vibration Sensor

Wireless Vibration Sensor

Model 670A01

- 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 (RVL) 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.

Wireless Junction Box

Model 672A01

- Converts existing sensors to wireless
- Runs independently or with existing junction box
- Uses 24 VDC or battery power

EchoPlus® Wireless Junction Box

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.

Receiver

Model 673A01

- Requires no repeaters, gateways, or mesh
- Outputs to ethernet
- Installs easily

Echo® Wireless Receiver

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.

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 5,000 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

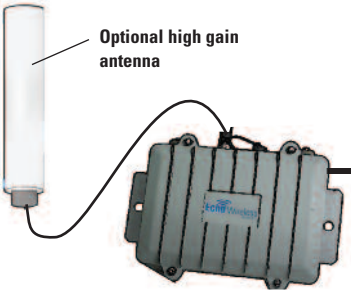
Actual distances can vary widely based on conditions

Receiver has DHCP or static IP addressing

Typical Configuration 1

EchoPlus® Wireless Junction Box

See page 3 for more information

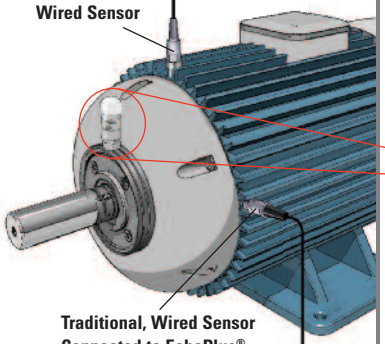


Echo® Receiver

See page 3 for more information

Process 24 VDC power or 6-13 VDC battery power

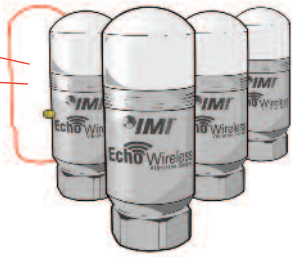
Monitored Machinery

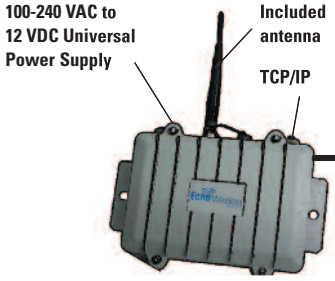


Typical Configuration 2

Echo® Wireless Vibration Sensors

See page 2 for more information



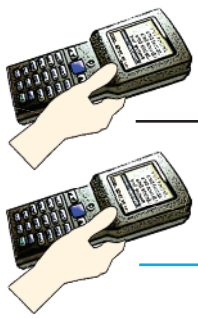


Echo® Receiver

See page 3 for more information

Vibration Analysis Using Data Collector

EchoPlus® Wireless Junction Box & Echo® Wireless Vibration Sensor



Data collector connects directly to:

- EchoPlus® Wireless Junction Box via standard BNC connector
- Echo® Wireless Vibration Sensor with optional RV output and 070A86 cable

See page 2 for more information

Wireless transmission stops while analog acceleration output is acquired via BNC. After handheld data collection, device returns to regular transmission schedule

Transmissions temporarily paused during handheld data collection

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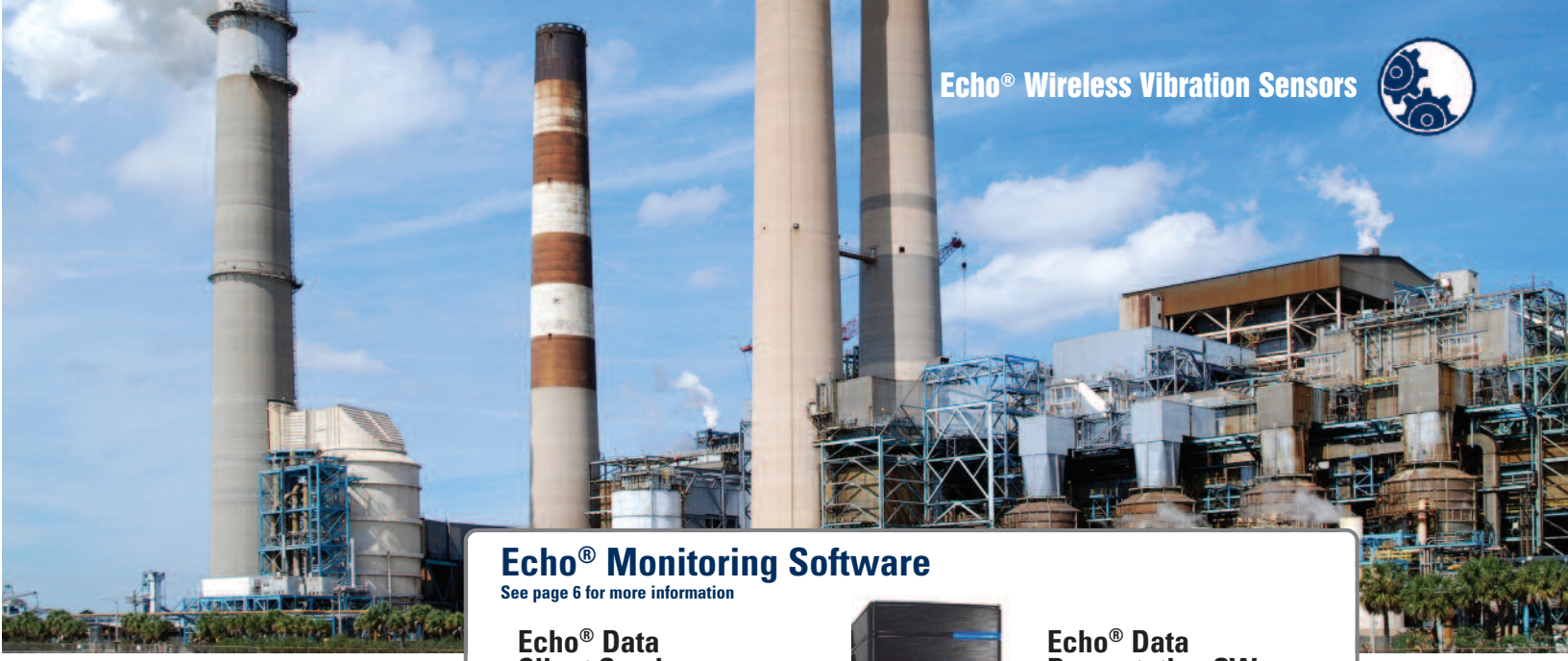


Echo® Monitoring Software

See page 6 for more information

Echo® Data Client Service

- Collects transmission
- Formats data
- Stores in database
- Generates alarm email
- Integrated or standalone Modbus TCP/ICP Server interface

Echo® Data Presentation SW

- Trend plots
- Status
- Alarms
- Reports
- Echo® sensor configuration utilities

Echo® Sensor Data

Ethernet TCP/IP

MS SQL Server 2005

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 LAN

- Trend plots
- Status
- Alarms
- Reports
- Sensor configuration

Echo® Data Presentation SW

Access to SQL Database through internet with VPN

- Trend plots
- Status
- Alarms
- Reports
- Sensor configuration

Echo® Monitoring Software

Echo® sensor data is stored by the Echo® Data Client Service software in a Microsoft SQL 2005 database. The database structure is available from IMI® so it can be accessed by users directly using any ODBC compliant application. The Echo® Data Client Service can also be configured as a Modbus TCP/IP Server to service Modbus requests from an existing Modbus Client application. The Modbus capability can coexist with the SQL database capability or function as a standalone application without the SQL database. However, the SQL interface is required if the Echo® Data Presentation Software is to be used.

Echo® Wireless Monitoring Software

Echo® data can also be exported from the Echo® Data Presentation Software to a tab delimited spreadsheet file that is suitable for use with Excel or other data viewing applications for post processing. Contact IMI® to discuss other interfaces to legacy condition monitoring programs and plant monitoring systems.

Echo® Monitoring Software
Model 600A20

Echo® Data Client Service

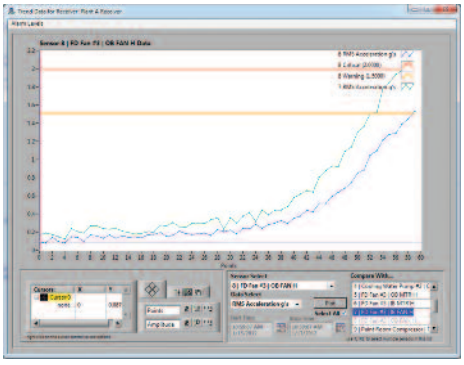
- Installs locally or on a server
  It is highly recommended that the service is installed on a dedicated PC or Server running 24/7
- Runs continuously whether a user is logged on or not
- SQL Database interface and/or Modbus TCP/IP
- Provides email alerts if SQL interface is enabled
- Service Status application runs from notification tray to view service / receiver status

Echo® Data Presentation Software

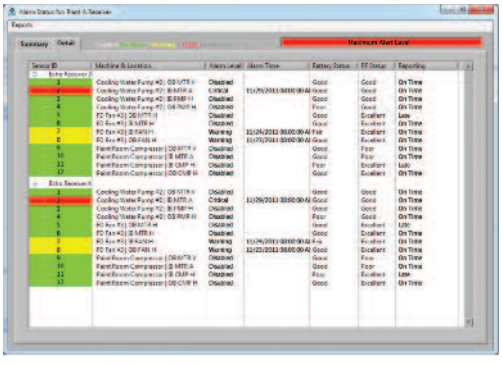
- Runs in single or multi-user environments, and does not affect the Data Client Service that collects
  Ideally a dedicated PC would also be used to run the Presentation Software continuously for constant monitoring of the alarm display
- Provides data alarms, trend plots and history
- Provides sensor status and configuration utility
- Live data window to view receiver activity

The Echo® Monitoring Software provides two major functions

- Collect transmission data reported by the receiver and store in the SQL database and/or Modbus response file
- 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.



Sensor Vibration Trend Plot



Sensor Alarm Panel

Sensor Status Window

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Technical Specifications

Measurements	Details
Echo® RMS Velocity (±3 dB)	4 Hz to 2.3 kHz
Echo® RMS Acceleration (±3 dB)	2.2 kHz to 15 kHz
EchoPlus® RMS Velocity (±3 dB)	4 Hz to 2.3 kHz, may be limited by sensor FR
EchoPlus® RMS Acceleration (±3 dB)	2.2 kHz to 15 kHz, may be limited by sensor FR
True Peak Acceleration	of 2 kHz HP filtered acceleration
Battery voltage at maximum load	For battery status report
System Information Provided	
Date	
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 HFE detection
Derived Peak Acceleration	1.414 x RMS Acceleration
True Peak Acceleration	3.7 sec time sample @ 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 and Average Power (dB)
Radio & Standard	**Specifications**
Radio Standard	Proprietary
Modulation	Narrowband FSK
Transmission Range	~250' to >1 mile radius, installation dependent
Transmission Interval	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	RS-232 (Echo® sensor requires optional 070A87 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 @ 3 meas/day, 1% miss rate, measurement spaced	~400
Sensors per receiver @ 3 meas/day, 5% miss rate, measurements	~2,000
Antenna	Integral 1/2" Ceramic
Performance	
RMS Velocity	Analog Integration, FFT Sum
Velocity HP Filter	2 Hz, 1-pole RC
Velocity LP Filter	2400 Hz, 3-pole Chebyshev
Velocity Resolution	0.001 ips rms
Velocity Range	4.0 ips rms
Echo® Velocity Linearity (0 to 1 ips rms)	<1%
Echo® Velocity Linearity (0 to 4 ips rms)	<8.5%
EchoPlus® Velocity Linearity (0 to 1 ips rms)	<1%
EchoPlus® Velocity Linearity (1 to 4 ips rms)	<7%
Derived peak velocity	1.414 x RMS Velocity
RMS Acceleration (HP filtered)	Time Sample Average @ 61.4 kHz
Acceleration HP Filter	2 kHz, 4-pole Chebyshev
Acceleration LP Filter	15k Hz, 3-pole Chebyshev + 1-pole RC
Acceleration Resolution	0.005 g
Echo® Acceleration Range	20 g pk
EchoPlus® Acceleration Range	40 g pk (for 100 mV/g accelerometer)

Performance	Specification
Echo® Acceleration Linearity (0 to 20 g pk)	<1%
EchoPlus® Acceleration Linearity (0 to 20 grms)	<1%
Derived Peak Acceleration	1.414 x RMS Acceleration
Minimum True Peak Acceleration Pulse Width	~50 s
Modified Crest Factor (~2 kHz HPF)	True Peak / RMS Acceleration, Maximum Value = 16
ADC/dynamic range	16 bit / >90 dB
Residual Vibration Level (RVL)	
If RVL = 0	Collect on normal transmission period
If RVL > 0	Check at normal transmission period and collect data only if RMS velocity ≥ RVL
Operation Status Indicator	LED
Echo® Sensor Activation/Deactivation	Magnetic Switch
Environmental	
Echo® Mechanical Shock Limit	1,000 g through mounting base
Temperature Range	-20° to 70° C (-4 to 158° F)
Humidity	5% - 100%
Echo® Enclosure Rating	IP 66
Echo® Electrical	
Echo® Power	7.2V Lithium Battery (073A20 battery replacement kit)
Replaceable	Yes
Battery Operating Temperature	-60° to 85° C (-76 to 185° F)
Battery Life	>5 years @ 3-measurements per day, room temperature
Electrical Isolation (Case)	$>10^8$ ohm
Echo® Physical	
Dimensions	
Base Assembly	1-3/8" Hex
Housing	1.66" Dia
Height (overall)	4.40"
Weight (including battery pack)	450 g (15.9 Oz)
Mounting Thread	1/4-28 Female
Mounting Torque	2 to 5 ft-lb
Sensing Element	Piezo Ceramic Shear
Material	
Base	304L Stainless Steel
Housing Material	304L Stainless Steel
Housing Cap	Polycarbonate
Mechanical Isolator	Urethane
Mounting	1/4-28 Stud
Sealing	O-ring
EchoPlus® Parameter	
Channels per Box	8
Channels Active	User selectable in any combination
Channel ID	Individual factory set unique ID per channel
Sensors Supported	ICP® (≤2 sec settling time, 10, 50, 100, 500 mV/g)
Sensor Power Supplied	24 VDC @ 2.2 mA constant current
Channel Gain	Set per channel for sensor normalization (Default set for 100 mV/g 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® Physical	
Enclosure Rating	NEMA 4X, IP 66
Input Connector	Terminal strip
Enclosure Material	Fiberglas
Size (Height x Width x Depth)	8 x 6 x 4 in (203 x 152 x 102 mm)
Weight	2.88 lb (1.3 kg)
Cord Grips	10 Individual, PGME07

All specifications are at room temperature unless otherwise specified

Echo® Receiver Measurements

Receiver Identification	Specification
Receiver ID	Factory set unique, readable using supplied utility software
MAC Address	Factory set unique, supplied by factory
IP Address	Dynamic (default), static capable using supplied utility software
Radio & Standard	
Radio Standard	Proprietary Extended Range RF
Modulation	Narrowband FSK
Minimum Noise Floor	-155 dBm
Radio Sensitivity	-145 dBm
Frequency ISM Band	902 - 928 MHz ISM Band
Number of RF Bands	12 (Default RF Band 1)
Number of RF Bands	12 (User selectable)
RF Data Receive Rate	20 bps
Number of receivers handled by a single computer	Limited Only by End User Network and Computer Hardware
Sensors per receiver @ 3 meas/day, 1% miss rate, measurements spaced	~400
Sensors per receiver @ 3 meas/day, 5% miss rate, measurements spaced	~2,000
Electrical	
Power/RS232 Connectors (interchangeable)	12 VDC, 15 W max, Using supplied AC power adapter
Power	PN CBL-0043 (supplied with receiver)
RS-232	Model number 009M201 (Optional)
LED	Power indicator
Physical	
Enclosure Material	Die Cast Aluminum
Size Overall (Length x Width x Height)	8.4 x 7.2 x 2.1 in (213 x 182 x 53 mm) (without mounting bracket)
Weight (without mounting bracket)	2.84 lb (1.23 kg)
Weight (with mounting bracket)	3.76 lb (1.71 kg)
Antennal Connector	N-female
Ethernet Connector	RJ-45 Waterproof (with mating connector cover)
Interface	Ethernet TCP/IP packet containing XML text
Antenna supplied	916 MHz, Whip SMA w/N connector adapter
Enclosure Rating	MIL-STD-810 Method 506.4 Procedure 1 Blowing Rain MIL-STD-810F, Method 510.4, Procedures I and II, Sand & Dust

Echo® Wireless Accessories

- Programming and antenna cables
- Multiple antenna options
- Replacement batteries

Echo® RV Output Cable
Model 070A86

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.

Echo® Programming Cable
Model 070A87

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.

Echo® Receiver Serial Cable
Model 009M201

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.

Echo® RV Shorting Cap
Model 070A88

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.

Echo® Replacement Battery Kit
Model 073A20

Model 073A20 is a battery replacement kit that includes a battery pack, O-ring, silicon grease, foam compressor and instructions.

Low Loss Antenna Cable
Model 009M205

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

009M205/002 (2')	009M205/025 (25')	009M205/075 (75')
009M205/004 (4')	009M205/030 (30')	009M205/100 (100')
009M205/010 (10')	009M205/040 (40')	
009M205/020 (20')	009M205/050 (50')	

900 MHz Antenna, 8 dBi
Model 070A91

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

900 MHz Antenna, 6 dBi
Model 070A90

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

900 MHz Antenna, 13 dBi
Model 070A92

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

Wireless Vibration Measurements? We Do!

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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.

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