EXTECH®

USER MANUAL

Vibration Meter with built-in ISO Alarm
VB460

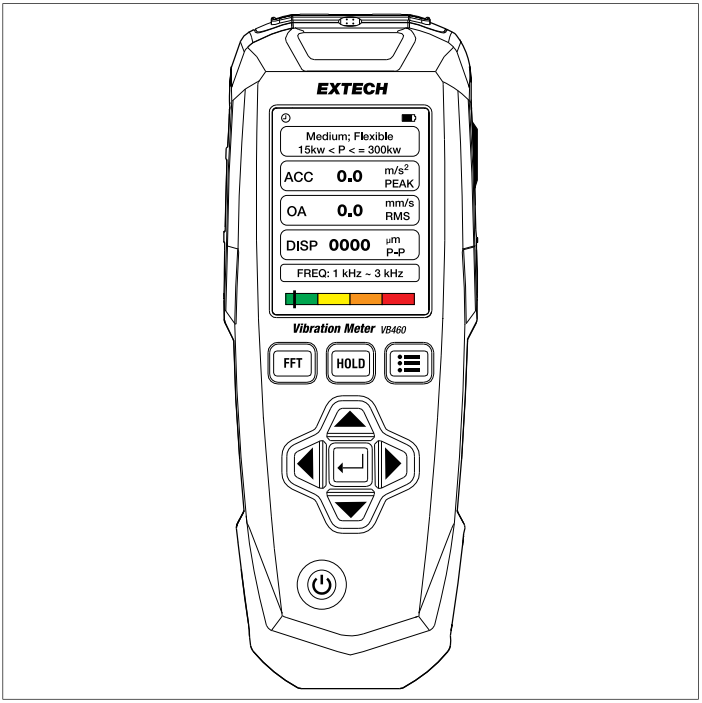


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1 Introduction

Thank you for selecting the handheld Extech VB460 Vibration Meter. The VB460 is a portable, battery powered instrument that measures vibration acceleration, velocity, and displacement, useful for inspecting mechanical equipment, such as fans, pumps, compressors, and motors.

This device is shipped fully tested and calibrated and, with proper use, will provide years of reliable service. Please visit the Extech website to obtain the latest version of the user manual, translations, and customer support.

Features:

- High sensitivity sensor measure vibration Acceleration (peak), Velocity (RMS), and Displacement (peak-to-peak).
- Three interchangeable probe tips (long tip, short tip, and magnetic).
- Color 2.8 in. TFT display.
- Color-coded ISO alarms.
- FFT (Fast Fourier Transforms) graph displays.
- Display Hold feature freezes displayed reading.
- Menu-driven interface for selecting machine type, frequency range, unit of measure, APO, and ISO standard.
- Rechargeable 3.7 V lithium-ion polymer battery.
- Auto Power OFF (APO) feature conserves battery energy.
- Complies with EMC (CE, FCC), battery safety, and environmental regulations including WEEE, RoHS, Reach, PROP 65, and TSCA.

2 Safety Warnings

WARNING

- Use extreme care when testing mechanical devices. Damage to the meter and sensor, and injury to persons can occur if this device is used in a manner not specified in this user manual.
- To avoid injury, do not touch exposed rotating parts or transmission system components of the machinery under test.
- Do not take measurements on equipment where the measurement range is known to be outside the specified range of this device.
- Do not use this device if it appears damaged or behaves abnormally.
- Do not use this device if the sensor or its cable appears damaged.
- Do not attempt to open or disassemble this device; there are no user-serviceable parts.
- To avoid damage to the device, use only a standard DC 5 V charger to recharge the battery. Do not use power supplies or adapters of other voltages to charge the battery.
- Do not store or use this device in environments with high temperature, high humidity, flammability, explosiveness and strong electromagnetic fields.

3 Description

3.1 Meter Description

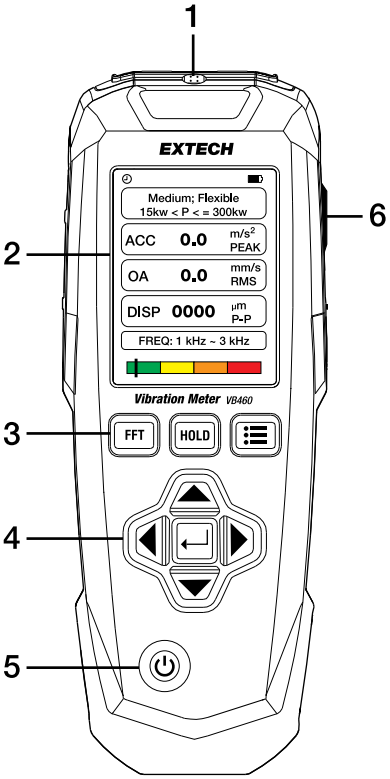


Figure 3.1 Meter Description

1. Keyed sensor jack (align the arrow at the meter top with the arrow on the probe plug).
2. Color TFT display.
3. Three control buttons (see button section below).
4. Four navigation arrow buttons and Enter (center) button.
5. Power ON/OFF button.
6. USB compartment.

The tilt stand and tripod mount are located on the back of the meter.

3.2 Sensor and Attachments

The sensor attaches to the port at the top of the VB460. Note that the sensor plug and meter jack are keyed so that the sensor can only be inserted in one orientation. Match the arrow at the top of the meter with the arrow on the sensor plug. Do not force the sensor plug into the jack. Refer to Figure 3.2, below.

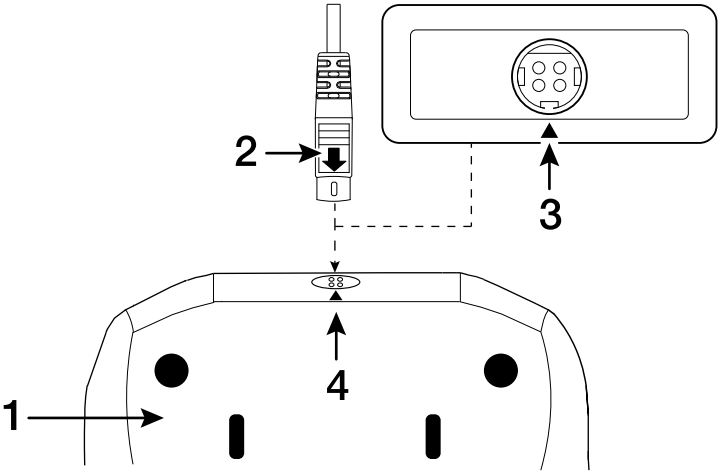


Figure 3.2 Plugging the sensor into the keyed meter jack. Line up the arrow on the meter top with the arrow on the sensor plug. Refer to the numbered descriptions below.

1. Meter back.
2. Alignment arrow on sensor jack.
3. Alignment arrow on meter top (shown as a breakout).
4. Alignment arrow on meter top.

In Figure 3.3, below, from left to right, the sensor is shown without an attachment, with the short tip attachment, with the long tip attachment, and with the magnetic attachment. The accessory attachments screw directly onto the sensor. The sensor can be used without an accessory attached.

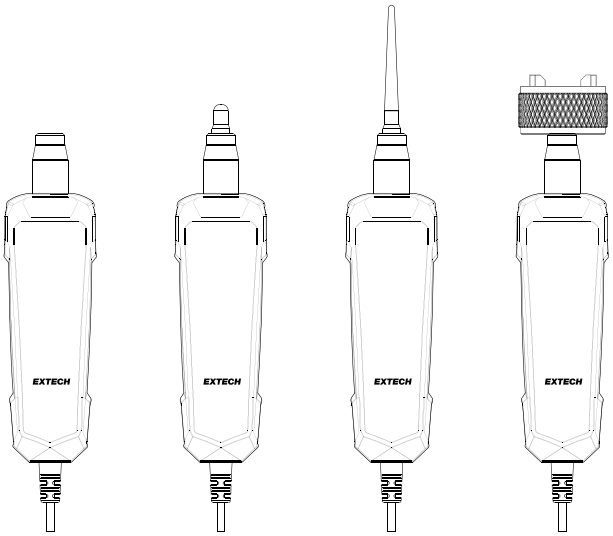


Figure 3.3 Sensor (on left) and sensor shown with attachments (short tip, long tip, and magnetic).

The short tip probe is the most commonly used tip, suitable for a wide range applications with a good response. Under normal conditions, try this probe first.

The long tip probe is suitable for measurements in narrow spaces, difficult to reach areas, and on unusual machine configurations.

The magnetic sensor is good for attaching to flat object surfaces and provides stable readings.

3.3 Magnetic Attachment Installation Examples

The magnetic sensor accessory screws onto the VB460 sensor base. The magnetic side of the accessory attaches to the machinery under test. In Figure 3.4, below, the magnetic sensor is shown placed on a curved surface (on left) and a flat surface (on right). Refer to the numbered descriptions below.

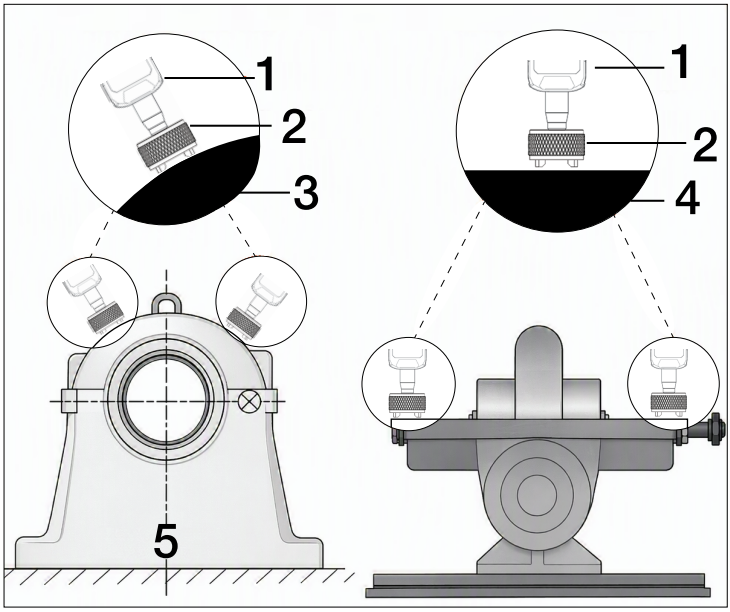


Figure 3.4 Magnetic sensor placement examples.

1. Sensor housing.
2. Magnetic sensor accessory.
3. Curved surface.
4. Flat surface.
5. Shaft center line.

3.4 Button Descriptions

	Firmly press to switch ON/OFF.		Press to open Main Menu (see dedicated Menu section).
FFT	Press to show Fast Fourier Transform graph.	◀▶▼▲	Press to scroll left, right, down, up.
HOLD	Press to freeze/unfreeze readings.		Enter button. Press to confirm menu selections.

3.5 Display Description

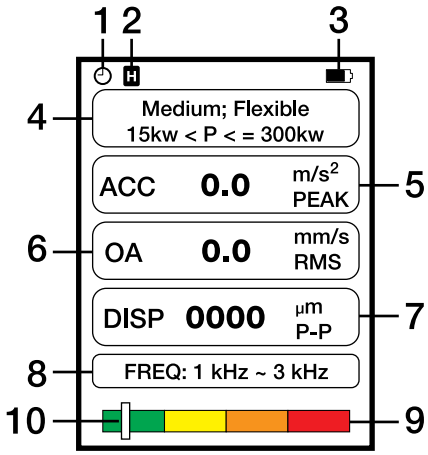


Figure 3.5 Display description.

1. APO enabled (disable in the main menu).
2. Display Hold enabled (press HOLD button).
3. Battery status.
4. Machine type (select in the main menu).
5. Acceleration reading (PEAK) in m/s^2 (metric) or ft/s^2 (imperial) units. Select metric or imperial units in the main menu.
6. Velocity reading (RMS) in mm/s (metric) or ft/s (imperial) units ('OA' is 'Overall Value', a common term in vibration analysis).
7. Displacement reading (Peak-to-Peak) in µm (metric) or mil (imperial) units.
8. Frequency range (select in the main menu).
9. Color-coded ISO alarm chart.
10. Alarm cursor moves from green towards red as the vibration increases.

4 Meter Power

4.1 Rechargeable Battery

The meter is powered by an internal 3.7 V lithium-ion polymer rechargeable battery. The battery status indicator is located on the top right of the VB460 display. Charge the battery when the status icon indicates low battery voltage. Charge the battery by connecting a USB cable to the meter (compartment on right side of meter) and to a 5 V commercial charger. See the Maintenance section for additional battery information.

4.2 Auto Power OFF (APO)

The APO function is enabled by default. The meter automatically powers off 5 minutes of inactivity. When the auto power-off function is active, the screen displays the auto power-off icon ◴ (upper left). This function can be disabled in the main menu.

5 Operation

5.1 Preparation

Plug the sensor into the jack at the top of the meter, as explained in Section 3.2. If needed, attach one of the accessories to the sensor by screwing it into the threaded hole at the top of the sensor.

5.2 Power the Meter

Short press the power button to switch the VB460 ON or OFF. If the meter does not switch ON or if the battery status icon indicates low battery voltage, charge the battery. Refer to the Maintenance section for battery charging instructions.

5.3 Main Menu

Press the Menu button to open or close the menu. The options listed below will appear. Refer to the dedicated Main Menu section for complete details. Use the arrow buttons to scroll and press the Enter button to confirm a selection.

- **Machine type.**
- **Frequency range.**
- **Unit of measure.**
- **Auto Power OFF.**
- **Firmware version.**

5.4 Taking Measurements

⚠ **CAUTION**
Keep a distance of at least 3.3 ft. (1 m) from strong electromagnetic sources such as welding machines and variable-frequency drives. Do not use the meter if the ambient temperature is > 140°F (60°C).

Ensure that the measurement surface is level and free of oil, dirt, rust, and roughness. Touch the sensor tip or place the magnetic sensor on the main load-bearing parts of the equipment, such as the bearing housing or spindle end cover, and avoid vibration-damping structures such as rubber feet.

Apply 5 to 10 N (Newtons) of pressure to prevent shaking, and maintain constant pressure to reduce signal attenuation. To ensure consistency and accurate measurement comparisons, maintain the same measurement point and direction.

To minimize measurement errors, align the sensitive axis of the sensor with the main vibration direction of the equipment. Do not tilt by more than 15°. See Sections 3.2 and 3.3 for additional sensor and sensor attachment information.

Read the measurement results on the display. See Figure 3.5, above.

5.5 Display Hold

Press the Display Hold (HOLD) button to freeze or unfreeze the displayed readings. The **H** icon will appear when Data Hold is enabled.

6 Main Menu

6.1 Main Menu Overview

In the Main Menu, select the machine type and frequency range that best matches the equipment under test. Enable/disable APO, select imperial or metric units, and view the VB460 firmware version in the Main Menu.

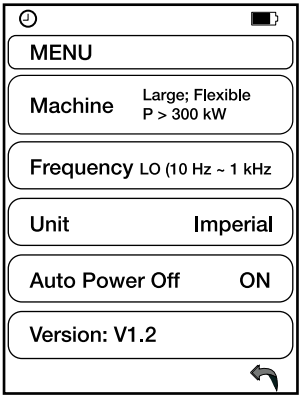


Figure 6.1 Main Menu.

6.2 Opening and Navigating the Menu

Press the Menu button to open or close the menu. Use the arrow buttons to scroll and press the Enter button to confirm a selection.

6.3 Machine Type Options Menu

1. Press the Menu button to open the menu.
2. Scroll to the Machine Type option and press Enter.
3. Scroll to the appropriate machine type and press Enter.

The available machine types are listed below. Note that ‘rigid’ and ‘flexible’ refer to the type of machine foundation.

- Large Machine: Rigid, P > 300 kW.
- Large Machine: Flexible, P > 300 kW.
- Medium Machine: Rigid, 15 kW < P ≤ 300 kW.
- Medium Machine: Flexible, 15 kW < P ≤ 300 kW.
- Small Machine: < 15 kW.

6.4 Frequency Range Menu Options

1. Press the Menu button to open the menu.
2. Scroll to the Frequency option and press Enter.
3. Scroll to the appropriate frequency range, listed below, and press Enter.

- LO: 10 Hz to 1 kHz.
- HI: 1 kHz to 3 kHz.

6.5 Unit Menu Options

1. Press the Menu button to open the menu.
2. Scroll to the Unit option and press Enter.
3. Scroll to Metric or Imperial and press Enter.

6.6 Auto Power OFF (APO) Menu Options

1. Press the Menu button to open the menu.
2. Scroll to the APO option and press Enter.
3. Scroll to OFF or ON and press Enter.

7 Fast Fourier Transform (FFT)

7.1 Background

Fast Fourier Transform (FFT) vibration analysis converts complex, time-domain vibration data into a frequency-domain spectrum. By distributing the raw vibration signal into individual frequencies and their amplitudes, engineers can pinpoint specific mechanical faults like unbalance, misalignment, or bearing wear.

While taking measurements, press the FFT button to view the FFT graph. The x-axis represents the frequency and the y-axis represents the amplitude.

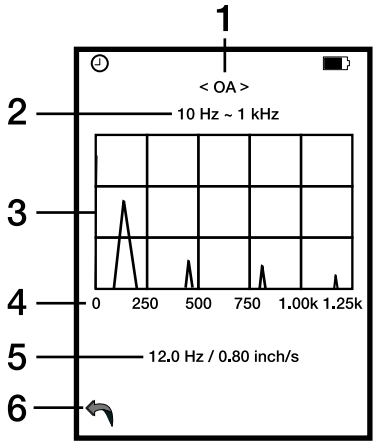


Figure 7.1 FFT graph. See numbered list below for explanations.

1. Use the left or right arrow button to toggle OA (Velocity) and ACC (Acceleration) modes.
2. Select the frequency range (see Main Menu).
3. FFT graph. The x-axis represents the frequency and the y-axis represents the amplitude.
4. x-axis scale label (frequency).
5. Real-time measurement.
6. Press the FFT button to return to the measurement screen.

7.2 Determining Machine Defects by Vibration Characteristics

Each defect causes vibrations having unique characteristics. You can determine, more easily, the root cause of a problem if you understand these characteristics, and that's where FFT comes in handy.

You can determine a lot about an asset, even when it is working normally, by looking at FFT data graphs. For example, in normal operation, the shaft rotation frequency (fundamental) will be represented on the graph on the left (in Figure 7.2, below), followed by a series of harmonics whose amplitude will be approximately a third the amplitude of the fundamental.

Additional signals are present in a normal system representing the vibrations of the structure that the machine is mounted on.

For faulty systems, the following changes in FFT graphs may appear.

- Shaft balance issues cause large radial variations and marked increase in amplitude of the fundamental frequency.
- Misalignments are shown as an increase in frequency amplitude at the 2nd harmonic.
- Looseness is evidenced by a marked increase in the number of harmonics. If there is looseness in the main support of the asset, an increase in the fundamental frequency amplitude will also be noticed.

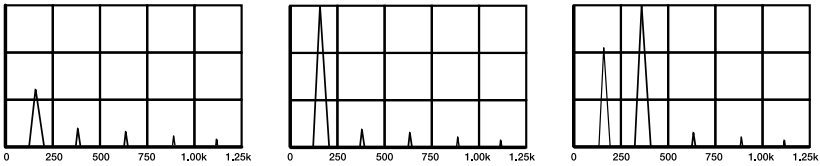


Figure 7.2 Graph on left shows a normal system; Center graph shows a balance issue; Graph on right shows a misalignment issue.

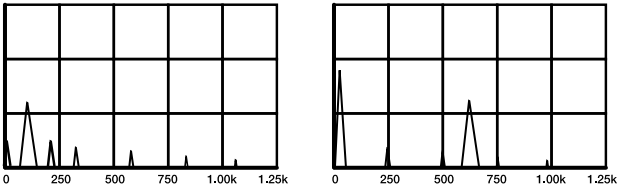


Figure 7.3 Graph on left shows a loose equipment issue (additional frequencies near the fundamental); Graph on right shows an impulse vibration (between 3rd and 4th harmonic). Frequency of the impulse will vary from machine to machine (speed, size, etc.).

8 Maintenance

8.1 General Care

The VB460 requires no special maintenance. There are no internal or external user-serviceable parts. Do not attempt to open the meter. The VB460 is a precision instrument and should be protected from impact, heavy shock, moisture, high voltage, magnetic fields, oil contamination, and dusty environments. To prevent meter damage or performance degradation, do not expose the meter to extreme environmental conditions.

8.2 Recharging the Battery

To charge the lithium battery, connect a USB cable to the USB jack on the right side of the VB460 (under the protective flap) and to a 5 V commercial charger. While charging the lightning bolt icon will flash next to the battery status icon (upper right side of screen).

The battery is not user-serviceable and cannot be replaced by the user. Contact customer support for assistance.

8.3 Cleaning

Wipe the meter housing and sensor with a damp cloth, and mild detergent, as necessary. Do not use solvents or abrasives. To prevent damage or performance degradation, keep the meter dry. Do not immerse in liquid; this meter is not waterproof.

9 Appendix

9.1 Large Machine Vibration Classification (ISO10816-1/20816-3)

	Large Machine P > 300 kW	
Foundation	Rigid	Flexible
ISO Standard	ISO 20816–3 Group 1 ISO 10816–3 Group 1 and 3	
GOOD	0 to 2.3	0 to 3.5
SATISFACTORY	2.3 to 4.5	3.5 to 7.1
UNSATISFACTORY	4.5 to 7.1	7.1 to 11
UNACCEPTABLE	7.1 to 11+	11+

9.2 Medium Machine Vibration Classification (ISO10816-1/20816-3)

	Medium Machine 15 kW < P < ≤ 300 kW	
Foundation	Rigid	Flexible
ISO Standard	ISO 20816–3 Group 2 ISO 20816–3 Group 2 and 4	
GOOD	0 to 1.4	0 to 2.3
SATISFACTORY	1.4 to 2.8	2.3 to 4.5
UNSATISFACTORY	2.8 to 4.5	4.5 to 7.1
UNACCEPTABLE	4.5 to 11+	7.1 to 11+

9.3 Small Machine Vibration Classification (ISO10816-1)

	Small Machine P < 15 kW
Foundation	n/a
ISO Standard	ISO 10816–1 Class 1
GOOD	0 to 0.71
SATISFACTORY	0.71 to 1.8
UNSATISFACTORY	1.8 to 4.5
UNACCEPTABLE	4.5 to 45

9.4 Max. Allowable Vibration for Motors > 1 HP (NEMA MG1-12.05)

Speed (RPM)	Peak-to-Peak Displacement Amplitude (µm)
3000 to 4000	25.4
1500 to 2999	38.1
1000 to 1499	50.8
≤ 999	63.6

Note: For AC motors, use the maximum synchronous speed; for DC motors, use the maximum power speed; for series and universal motors, use the operating speed.

9.5 Max. Allowable Vibration for Large Induction Motors (NEMA MG1-20.52)

Speed (RPM)	Peak-to-Peak Displacement Amplitude (µm)
≥ 3000	25.4
1500 to 2999	50.8
1000 to 1499	63.6
≤ 999	76.2

Note: The above two standards were established by the National Electrical Manufacturers Association (NEMA).

9.6 Max. Allowable Vibration for Form-Wound Squirrel-Cage Induction Motors (API STD 541)

Synchronous Speed (RPM)	Peak-to-Peak Displacement Amplitude (µm)	
	Flexible Foundation	Rigid Foundation
720 to 1499	50.8	63.6
1500 to 2999	38.1	50.8
≥ 3000	25.4	25.4

Note: This standard was established by the American Petroleum Institute (API).

9.7 Shaft Speed Vibration Frequency Issues and Possible Causes

9.7.1 1 x Frequency

Main cause: Imbalance

Other possible causes: Eccentric bushing (gear or pulley), Shaft misalignment or bent shaft (if axial vibration is high), Drive belt fault, Resonance, Reciprocating force.

9.7.2 2 x Frequency

Main cause: Mechanical looseness.

Other possible causes: Misalignment (if axial vibration high), Reciprocating force, Resonance, Drive belt fault (if the frequency is twice the belt speed).

9.7.3 3 x Frequency

Main cause: Misalignment. Usually accompanied by misalignment and excessive axial clearance (looseness).

9.7.4 < 1 x Frequency

Main cause: Oil whirl (frequency < 1/2 x frequency)

Other possible causes: Drive belt defect, Interference vibration, Low-order resonance, ‘beat’ vibration.

9.7.5 Equal to Power Supply Frequency

Main cause: Armature fault.

Other possible causes: Electrical faults, broken rotor bars, rotor eccentricity, three-phase imbalance, and air-gap asymmetry.

9.7.6 2 x Power Supply Frequency

Main cause: Torsional pulse (uncommon, unless resonance is caused by impact).

9.7.7 High Harmonics

Main causes: Gear defects, fluid dynamics, mechanical looseness, reciprocating force.

Other possible causes: N × frequency, where N is the number of defective gear teeth, N × frequency, where N is the number of pump or fan blades.

Notes: 2×, 3×, or 4× frequency may occur; if looseness is severe, higher harmonic frequencies may appear.

9.7.8 High Frequency (Non-Harmonic)

Main cause: Poorly lubricated bearing.

Other possible causes: Random high-frequency vibration caused by cavitation or turbulence, Improper lubrication of journal bearings (vibration caused by friction).

Notes: Bearing vibration may be unstable in both amplitude and frequency.

10 Specifications

10.1 General Specifications

Display	2.8 in. color TFT
Meter power	3.7 V lithium-ion polymer battery (rechargeable)
Charging voltage	5 V DC
Sensor type	High sensitivity piezoelectric transducer
Operating conditions	14 to 122°F (-10 to 50°C)
Charging conditions	32 to 113°F (0 to 45°C)
Storage conditions	-4 to 140°F (-20 to 60°C)
Dimensions	2.7 x 1.8 x 7.3 in. (70 x 46 x 185 mm)
Weight	9.5 oz. (270 g)
Safety / Certifications	EMC (CE, FCC) Battery safety, and environmental: WEEE, RoHS, Reach, PROP 65, TSCA. CE: EN 61326–1 FCC: Part 15b
Supplied equipment	Sensor, sensor attachments (long tip, short tip, magnetic), USB cable, user documentation, carrying case.

10.2 Measurement Specifications

Acceleration (Peak, RMS * √2)	
Range	0.33 to 655.84 ft/s^2 (0.1 to 199.9 m/s^2)
Resolution	0.01 ft/s^2 (0.1 m/s^2)
Frequency	LO: 10 Hz to 1 kHz; HI: 1 kHz to 3 kHz
Accuracy	Metric: ±(5% + 2 digits); Imperial: ±(10% + 5 digits)
Velocity (RMS)	
Range	0.004 to 7.870 in/s (0.1 to 199.9 mm/s)
Resolution	0.001 in/s (0.1 mm/s)
Frequency	10 Hz to 1 kHz
Accuracy	±(5% + 2 digits)
Displacement (Peak-to-Peak, RMS * 2√2)	
Range	1 to 1999 µm (0.039 to 78.701 mil)
Resolution	1 µm (0.001 mil)
Frequency	10 Hz to 1 kHz
Accuracy	±(5% + 2 digits)

11 Customer Support

Customer Support Local Telephone List:

https://support.flir.com/contact

Returns (RMA):

https://customer.flir.com/Home

12 Warranty

Teledyne FLIR warrants this Extech brand instrument to be free of defects in parts and workmanship for two years from date of shipment. To view the full warranty text, please visit the support site, link below.

https://www.flir.com/support-center/warranty/

EXTECH®

USER MANUAL

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Customer support
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