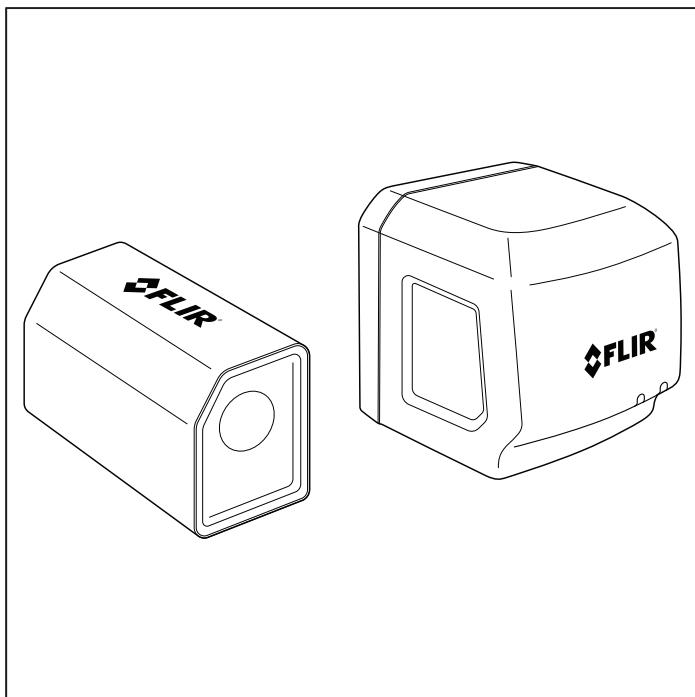




User Manual

Vibration Monitoring Solution

SV87-KIT (GW65 Remote Monitoring Gateway and SV87 Vibration / Temperature Remote Sensors)





User Manual Vibration Monitoring Solution

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1 Advisories

1.1 Copyright

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No parts of the software including source code may be reproduced, transmitted, transcribed or translated into any language or computer language in any form or by any means, electronic, magnetic, optical, manual or otherwise, without the prior written permission of FLIR Systems.

The documentation must not, in whole or part, be copied, photocopied, reproduced, translated or transmitted to any electronic medium or machine-readable form without prior consent, in writing, from FLIR Systems. Names and marks appearing on the products herein are either registered trademarks or trademarks of FLIR Systems and/or its subsidiaries. All other trademarks, trade names or company names referenced herein are used for identification only and are the property of their respective owners.

1.2 Quality Assurance

The Quality Management System under which these products are developed and manufactured has been certified in accordance with the ISO 9001 standard. FLIR Systems is committed to a policy of continuous development; therefore, we reserve the right to make changes and improvements on any of the products without prior notice.

1.3 Documentation

To access the latest manuals and notifications, go to the Download tab at: <https://support.flir.com>. It only takes a few minutes to register online. In the download area you will also find the latest releases of manuals for our other products, as well as manuals for our historical and obsolete products.

1.4 Disposal of Electronic Waste



As with most electronic products, this equipment must be disposed of in an environmentally friendly way, and in accordance with existing regulations for electronic waste. Please contact your FLIR Systems representative for more details.

2 Introduction

The FLIR Vibration Monitoring Solution allows you to monitor machinery for excessive vibration and over-temperature conditions using a mobile device exclusively (standalone) or a combination of Windows® PC and mobile device. Accelerometers in the sensors measure changes in vibration. Thermometers in the sensors measure surface temperature.

This product can check for balance issues, eccentricity, misalignment, and looseness. Examples of equipment that can be monitored are shown below.

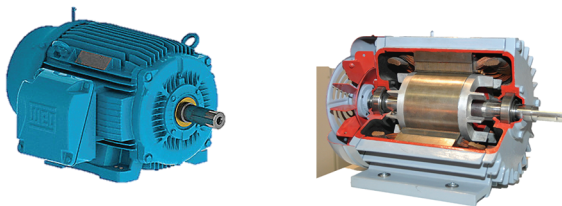


Figure 2.1 Monitoring vibration and temperature in motors.

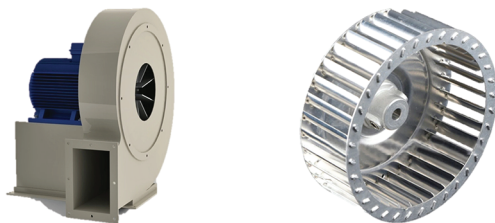


Figure 2.2 Monitoring vibration and temperature in fans.



Figure 2.3 Monitoring vibration and temperature in conveyors.

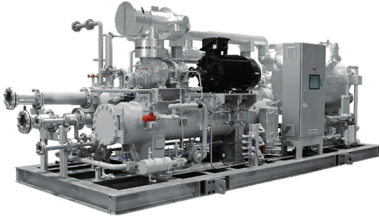


Figure 2.4 Monitoring vibration and temperature in chillers.

Vibration measurements encompass the frequency (velocity), amplitude (strength), and acceleration (intensity) of the vibration.

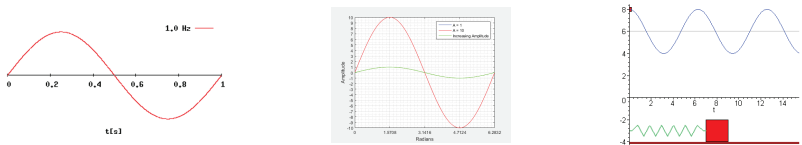


Figure 2.5 Vibration frequency (left), amplitude (centre), and acceleration (right)

Vibration measurements provide insight into potential mechanical issues. This device is well suited for identifying imbalances, eccentricity, loose parts, and misalignment. In addition, remote sensors include a surface temperature thermometer that identifies potential over-heating issues. Excessive vibration and over-temperature conditions can shorten the life of machinery and components, pose safety hazards, and create excessive noise.

Acceleration is measured in 'g' units (gravitational constant). Velocity is represented in mm/s (millimetres per second) and in/s (inches per second) units and is derived from internal calculations. Temperature measurements are presented in °C and °F units.







The remote sensors attach directly to machinery, using the supplied double-sided tape, and transmit data to the remote monitoring gateway via Bluetooth which in turn communicates to a mobile device and Windows PC. Adhesive alternatives are available commercially that could be more reliable on some machinery (see the *Specifications* section for details). The system consists of the following components:

- **GW65 Remote Monitoring Gateway.** Communicates with remote sensors over Bluetooth and transmits measurement data over Wi-Fi. Multiple gateways can be used for optimum coverage of large test sites.
- **SV87 Remote Sensors.** Attach to machinery and transmit measurement data and battery status via Bluetooth to the remote monitoring gateway.
- **Mobile application (app) for iOS and Android devices.** Communicates with the remote monitoring gateway on a Wi-Fi network.
- **Windows PC application.** Communicates with remote monitoring gateways and mobile devices on a Wi-Fi network.

3 Safety

Warnings identify conditions that expose the user to danger. For safe operation, and to avoid the potential for electrical shock and fire, read and understand all operational instructions and safety warnings and cautions. Failure to do so can cause personal injury and damage to equipment.

- Please read all safety information and user manual instructions before using these devices.
- No user serviceable equipment. Please contact FLIR for all service and repair inquiries.
- Use these devices only as described in the provided documentation. Failure to do so can impair the devices' built-in protections.
- These devices are intended for indoor use only.
- Do not use any of these devices if they appear damaged or if they do not function normally. Contact FLIR for service.
- Avoid wet or overly damp locations for installation or when using these devices.

	WARNING! Hazardous conditions.
	Double Insulation.
	Certified by ETL to North America safety standards.
	Conforms to European Union directives.
	Conforms to Australian Safety and EMC standards.
	Complies with WEEE Directives.

**WARNING**

Applicability: Class B digital devices.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced Radio / TV technician for help.

4 Product Descriptions

4.1 Product Call-Out Description

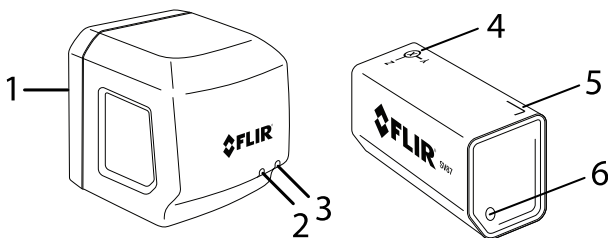


Figure 4.1 Remote Monitoring Gateway GW65 (left) and SV87 Remote Sensor (right).

1. GW65 AC plug side
2. GW65 Power LED (blue light when powered)
3. GW65 Communications LED (green for active communications; amber for inactive communications)
4. SV87 'xyz' axes graphic
5. SV87 serial number label
6. Low battery LED (glows red when battery is low)

4.2 Remote Monitoring Gateway GW65 Overview

Gateways communicate with sensors over Bluetooth and transmit measurement data over a Wi-Fi network. gateways are AC powered and can be plugged directly into an AC receptacle (100 V to 240 V AC 50 / 60 Hz).

4.3 SV87 Remote Sensor Overview

SV87 sensors attach to machinery using the supplied double-sided tape. Adhesive alternatives are available that could be more reliable on some machinery (see the *Specifications* section for details). When attached, sensors measure Acceleration in gravitational units (g) and surface temperature in °C or °F units.

Velocity data are derived from internal calculations and displayed in mm/s or in/s units (millimetres or inches per second).

Measurement data is transmitted from the sensors to gateways over Bluetooth. Sensors also transmit battery status data. Coordinates (x, y, z) for vibration axes and serial number are printed on the sensor housing.

4.4 Mobile App Overview

The mobile app is available from the App Store (iOS devices), or Google Play (Android devices). With the mobile app you can communicate with gateways over a Wi-Fi network.

The mobile app allows you to configure and organize gateways and sensors into complete test systems, link sensors into groups, document asset types and classifications, monitor readings digitally and graphically, set alarms, and more.

4.5 Windows App Overview

The Windows app (link below) allows you to monitor and control test systems from your PC. Communication takes place over a Wi-Fi network. The app displays measurement data in trend graphs and digitally. The app can send email alerts when alarm thresholds have been exceeded and can export measurement data as .csv files for use in spreadsheets.

Web link: <https://support.flir.com/product/RemoteMonitoring>.

5 Quick Steps

The Vibration Monitoring Solution is a powerful set of tools that require careful attention and a fair number of steps to set up. Once setup is complete, however, the tools are automated and do not require adjustment unless changes to the setup are needed.

Follow the quick steps in Section 5.1, below, for Standalone operation (mobile device use only), or Section 5.2 if you are using a Windows PC and a mobile device. Refer to Section 8.2, *Choosing PC-based or Standalone Control*, to help you decide which route to take.

These steps will take you through the process of establishing communication with the devices in your system. Once communication is established you can continue with the remaining sections of this manual to set up sensors and explore the other capabilities of the monitoring system.

NOTE

- The mobile device must be within 12 inches (30 cm) of the gateway during setup.
- The sensors must be kept within 5 feet (1.5 m) of the gateway during setup.

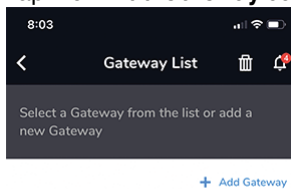
5.1 Quick Steps for Standalone Operation

1. Plug the gateway into an AC outlet. The blue power LED and amber communication LED will light. The communication LED turns green when communication is established with the Wi-Fi network.
2. Download the FLIR Remote Monitoring app for Android (Google Play) or iOS device (App Store).

3. Open the app on your mobile device and tap '**STANDALONE**' on the opening app screen.

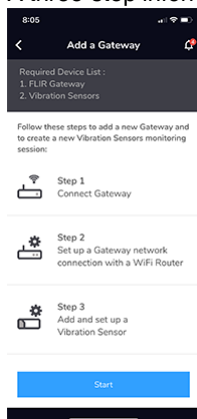


4. Tap the **+ Add Gateway** command.

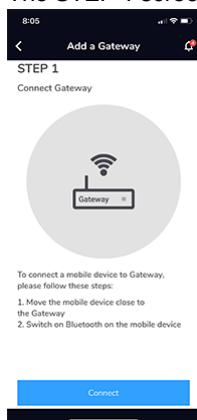


No Gateway has been configured. Please click "Add Gateway" to start a new Sensors monitoring session.

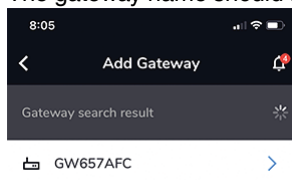
5. A three-step information screen will appear. Tap **START**.



6. The STEP 1 screen will appear. Tap **CONNECT**.



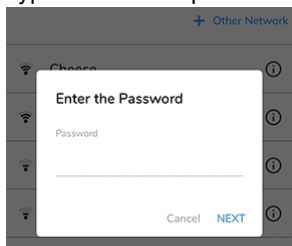
7. The gateway name should appear on the gateway list.



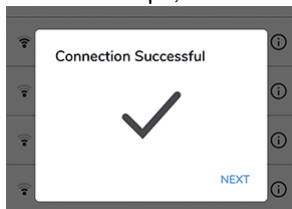
8. Tap the displayed gateway name. The STEP 2 screen will appear. Note that STEP 3 is the sensor activation step (not covered in these quick steps). See Section 9, *Mobile App*, for instructions.



9. Tap **CONTINUE**.
10. Tap the name of your network in the Wi-Fi router list.
11. Type the network password when prompted.



12. Tap **NEXT** when communication is successful. If not successful, repeat the above steps; contact FLIR if issues persist.

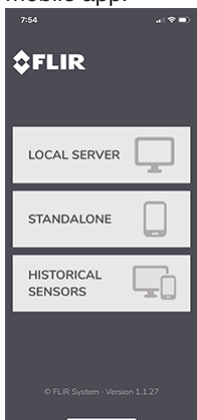


-
13. The Standalone communication is now operational, and the system is ready for adding sensors; see Section 9, *Mobile App*.

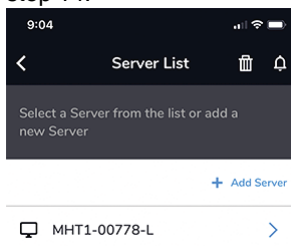
5.2 Quick Steps for Windows PC Operation

For in-depth Windows app instructions, please refer to Section 10.

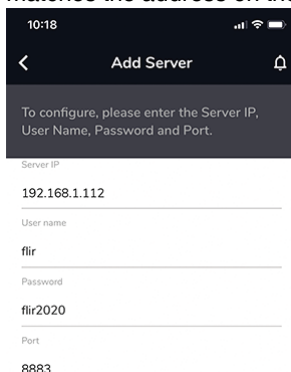
1. Connect the Windows PC to the local Wi-Fi server network.
2. Download, install and open the Windows app.
Link to app: https://support.flir.com/remote_monitoring.
3. The user name, password, IP address, and port number are shown on the app's opening screen.
4. If gateways have been connected before, you'll see them on the gateway list in the app. To export data in .csv format from an archived or active gateway, click the Export button on the opening app screen.
5. Plug the GW65 into an AC power source.
6. The blue (power) LED and amber (communications) LED will light. The communications LED is amber when not communicating to the Wi-Fi network. When communication is established, the LED will turn green.
7. Download, install, and open the **mobile app** on your smart device, and select **Local Server** from the opening screen. For Android devices use the Google Play store and for iOS devices go to the App Store to obtain the mobile app.



8. Tap **+Add Server** to begin the process of connecting to the Wi-Fi network, unless you see the PC machine name already on the Server List (as shown in the image below). If so, tap the machine name and continue with step 14.

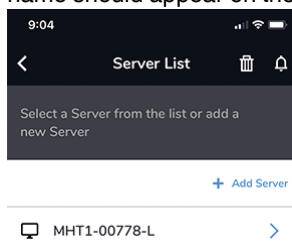


9. In the mobile app, tap on the Server IP field and type the IP address that matches the address on the Windows app screen.

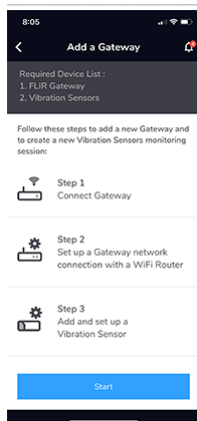
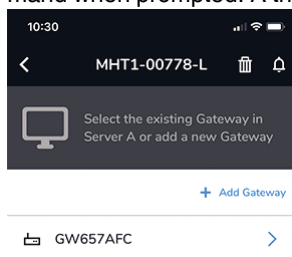


10. Tap the User Name field and type the user name that matches the user name in the Windows app screen.
11. Tap the Password field and type the password that matches the password in the Windows app screen.
12. If necessary, tap the Port field and enter the number that matches the number in the Windows app screen.

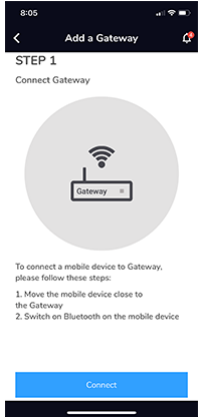
13. Tap **Continue** in the mobile app. After several seconds your PC machine name should appear on the mobile app.



14. Tap the PC name on the mobile app and tap the **+Add Gateway** command when prompted. A three-step information screen will appear.



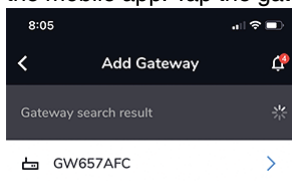
15. Tap **Start**. The STEP 1 screen will appear. Tap **Connect**.



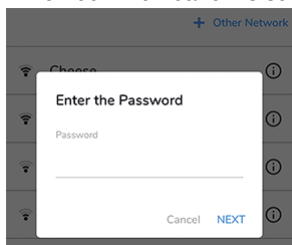
16. The STEP 2 screen will appear, tap **Continue**. Note that STEP 3 is the sensors activation step, not covered in these quick steps. See Section 9, *Mobile App*, for instructions.



17. The gateway that was powered up earlier in this procedure will appear in the mobile app. Tap the gateway name.



18. A list of Wi-Fi networks will appear, tap your network's name.
19. When prompted, type the Wi-Fi network password and then tap **NEXT**. When communication is successful, press **NEXT** again to continue.



20. The gateway that you plugged in earlier should now appear on the Windows app gateway list. Click the **Refresh** button and repeat these steps if you do not see the gateway on the list. Contact FLIR if issues persist.
21. When the gateway appears on the list, you are ready to add sensors, as explained in Section 9, *Mobile App*.

6 Sensor Installation

NOTE

Do not permanently affix sensors to assets until you've allowed sufficient time to ensure stable communication between sensors and gateways in their temporary positions.

6.1 Sensor Placement Considerations

When considering test point sensor locations, the individual parts of the equipment and its operation should be well understood. Basic rotating equipment will have a combination of bearings, shafts, shaft coupling equipment, fans, pumps, compressors, etc. Note that this unit is not suitable for monitoring bearing or gearbox vibration as this would require a higher frequency range (this product has a maximum frequency of 1 kHz).

For personal and equipment safety, do not affix sensors where they can interfere with machine operation. Affix sensors to solid metal. Refer to the dedicated section below for a list of areas where sensors should not be affixed.

6.2 Mounting the Sensors

Sensors should be placed on structural parts of the equipment that significantly respond to the overall vibration and dynamic forces (example photos below).

For best results, clean the area where the sensor is to be attached.

Confirm stable communication between sensors and gateways before committing to a permanent installation. Move the gateway closer to the sensors if necessary and use multiple gateways if greater coverage is required.

Although the maximum distance between sensors and gateway is 213 ft. (65 m), the range is affected by concrete, metal, etc. in the line-of-sight. Multiple gateways can be used for wider coverage.

Sensors must be installed where they cannot interfere with the operation of the machinery under test or where they will interfere with machine operators. Attach the sensors to the equipment using the supplied double-sided tape. Adhesive alternatives are available commercially that could be more reliable on some machinery (see the *Specifications* section for details).

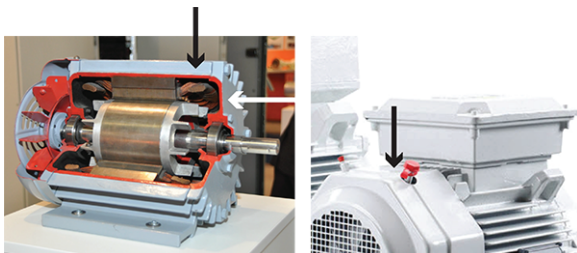



Figure 6.1 Examples of areas to place sensors.



Figure 6.2 SV87 sensors shown mounted on machinery.

6.3 Where sensors should not be placed

**CAUTION**

Do not mount sensors on the following locations:

- Motor winding areas
- Middle of motor
- Pump casing
- Cooling fan fins/covers
- Coupling belt guards, gearboxes
- Seal locations



Figure 6.3 Examples of places you should not mount sensors.

6.4 Determining the Number of Sensors to Place on Equipment

The larger the equipment under test, the greater the number of sensors required; this is because vibrations can go undetected if the sensors are positioned too far from the source of vibration. Vibration is absorbed by the equipment after travelling approximately 3.3 ft. (1 m), so you'll want to situate sensors to maximize coverage.

Ensure that coverage of equipment is sufficient regarding the number of sensors. Ten (10) sensors will work in most circumstances, given no obstruction between gateway and sensor. The key factor is obstruction since, with no obstruction, it is possible to have more than ten sensors operating normally. Use multiple gateways to accommodate more sensors and to ensure proper coverage of a test site.

For larger equipment, more sensors may be needed, as discussed earlier. Use a sufficient number of sensors to provide good surface-area coverage of assets.

6.5 Documenting Sensor Locations

It is important to document the sensor and test point locations for all equipment in a test system, as discussed in Section 7, *Mapping a Test Site*. A spreadsheet is ideal for documenting gateways, test points, sensors, sensor groups, etc.

Having accurate documentation helps locate, track, and assess equipment easily for preventive maintenance programs and servicing.

7 Mapping a Test Site

To best maintain a test site, it is important to keep a list of asset (equipment) names and their types, classifications, and locations. Depending on the size of the operation, a site map may also be needed to show machine locations and the test points where sensors are attached to assets.

7.1 Assets

The term ‘asset’ is used when referring to a piece of equipment under test.

Log as much information as possible for each asset so that maintenance and configuration can be handled quickly and accurately. Keep track of locations, names, categories, and test points/sensors.

7.2 Sensor Groups

When using the mobile and Windows apps, sensors are grouped for easy tracking and monitoring. Groups should be appropriately named for clarity and easy identification.

7.3 Test Points

A test point is a location on an asset where a sensor is attached. Test point location is a critical part of the vibration monitoring strategy. Refer to Section 6, *sensor Installation*, for important information and instructions.

7.4 Sensor Identification

Sensor serial numbers are printed on their housings. The mobile and Windows apps will show the serial number of sensors and gateway hardware when communication is established. Names of sensors and other components in the system can be customized.

8.1 Communication Basics

As discussed below, the first decision you'll make is whether to use the stand-alone method (mobile smart device exclusively) or a combination of Windows PC and mobile device.

If you'll be communicating exclusively from a mobile device, you'll need only the mobile remote monitoring app. If you'll be communicating using a Windows PC, you'll need the Windows PC app and the mobile app.

The mobile app is available from the App Store or Google Play. The Windows app is available from the FLIR website.

Web link: <https://support.flir.com/product/RemoteMonitoring>.

8.2 Choosing PC-based or Standalone Control

8.2.1 How To Decide

As mentioned, the first decision to be made when planning and configuring a test system is whether to run a standalone system or a system that incorporates a Windows PC for monitoring and control. The table below lists the advantages for each method. Block diagrams are provided later in this section showing how the system components, Wi-Fi, Bluetooth, and direct connections interact.

STANDALONE METHOD	WINDOWS PC METHOD
Simple setup and portability.	Convenient, comprehensive dashboard and monitoring console.
View measurements, trends, alarms, and FFT directly on a smart phone.	Text files (.csv) of measurement data can be exported for data analysis.
Easy updating of firmware and app.	Automatically sends email alert when alarm set points are exceeded.
Data is easily transportable and retrievable.	Unlimited data storage on PC.

8.2.2 Standalone System Block Diagram

The diagram below provides an overview of the Standalone system. Subsequent sections of the manual provide details and specifics regarding test systems that will be controlled by a smart device only.

This diagram shows how a test system is configured using a smart device. The sensor, on a monitored asset, automatically sends vibration and temperature data to the gateway every 90 seconds (via Bluetooth).

The gateway transmits sensor data to the smart phone using Wi-Fi. The smart device alerts the user to abnormal vibration or temperature readings.

Ten (10) or more sensors can pair with one gateway system depending on the severity of obstructions that exist between sensors and gateway.

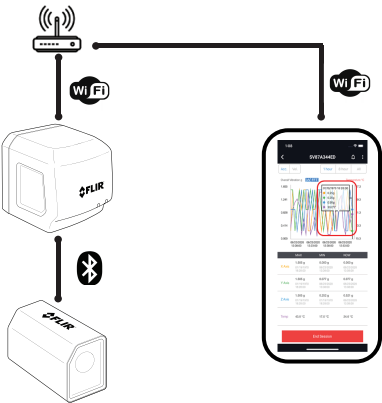


Figure 8.1 The Gateway (GW65) is shown communicating with a Wi-Fi network and a smart phone. The SV87 Sensor is shown communicating with the Gateway via Bluetooth.

8.2.3 Windows PC Operation Block Diagram

This diagram below shows how a test system can be configured using a PC. The PC provides up-to-the-minute measurement status (digitally and graphically) and alerts the user to abnormal vibration or temperature readings.

The Windows app can automatically send email when an abnormal reading is registered. The PC can also export sensor data as .csv formatted files for use in spreadsheets.

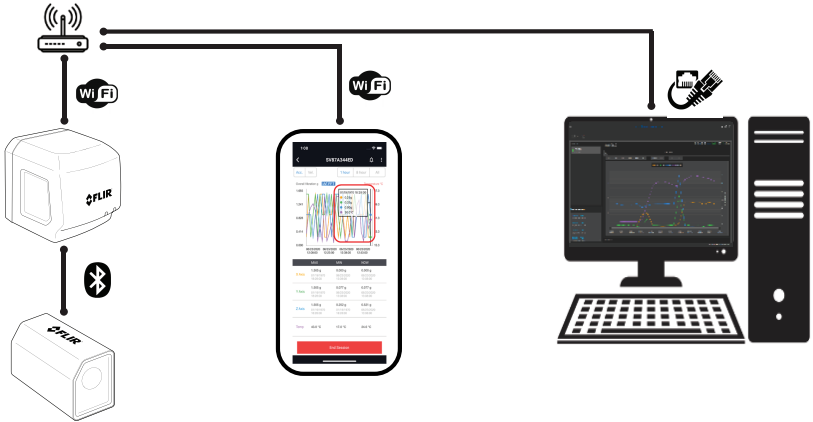


Figure 8.2 Block diagram of a system controlled by a Windows PC. The GW65 Gateway communicates with the SV87 Sensor using Bluetooth and with the smart phone through a Wi-Fi router. The PC is shown communicating with the network using a direct Ethernet connection.

8.3 Preparing a Communications System

During setup, the gateways, sensors, and mobile devices must be in close proximity. As detailed below:

- The mobile device must be within 12 inches (30 cm) of the gateway during setup.
- The sensors must be kept within 5 feet (1.5 m) of the gateway during setup.

When planning a test configuration it is useful to understand the equipment hierarchy, as you will be prompted in the applications for equipment names, classifications, types, etc. The hierarchy and definitions are as follows:

- **Group:** Sensor groups are collections of sensors in a test area.
- **Assets:** Machinery under test. Assets require names, types (pump, for example), and ISO 108616–1 classification (see chart in the apps). Photos of assets can be added by mobile device during configuration.
- **Test Points:** Location and position of sensors on an asset.

With the information covered in this section, a site map and equipment list should be created and maintained. This will ensure that you know where all gateways, sensors, and other equipment are located when performing

preventive maintenance and if you need to locate equipment quickly in an emergency. See Section 7, *Mapping a Test Site*, for more information.

8.4 Preparing the Mobile App



Figure 8.3 FLIR mobile app installed on mobile device (above, left) and opening screen (above, right).

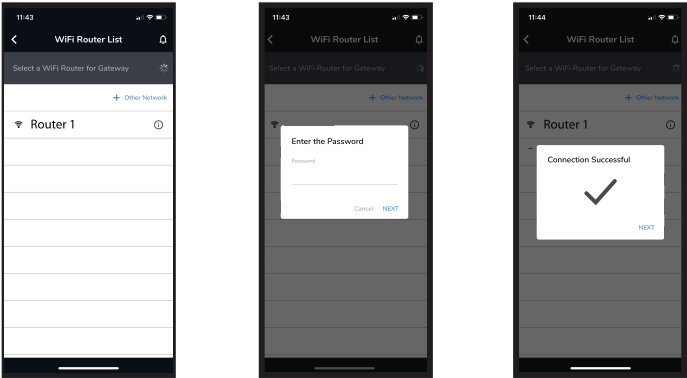


Figure 8.4 Adding a new network or selecting an existing one.

1. After downloading the mobile app, as described earlier, you'll see the FLIR app on your mobile device, as shown in Figure 8.3 above.
2. When you open the app you'll see a start-up screen (*Section 5, Figure 5.1*). Select the option for standalone operation.
3. Select a Wi-Fi network from the list or tap **+ Other Network** to add a new network (see Figure 8.4 above).

4. The next screen prompts for a network password. Enter the password and tap **NEXT**.
5. Communication to the network should now be established.
6. If you are unable to connect to the Wi-Fi network, please verify that the credentials are correct. Contact FLIR support if connection issues persist.
7. Once the setup and preparation are complete, follow the detailed instructions in Section 9, *Mobile App*.

8.5 Preparing the Windows PC App

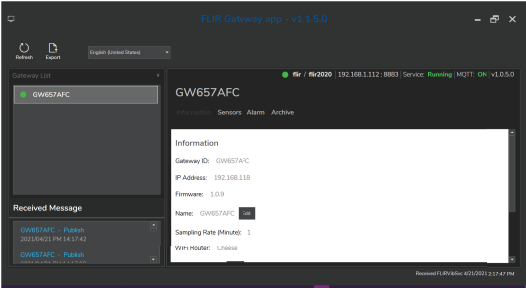


Figure 8.5 Windows PC app opening screen.

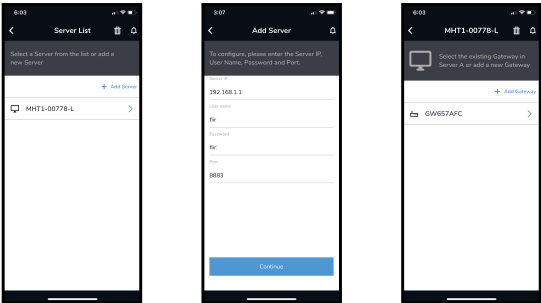


Figure 8.6 Add a new server or select an existing one. Note that references to a server indicate that the Windows PC app is being used.

To maintain a test site using a Windows PC, download the Windows app from the FLIR support site shown below. Follow the preparation steps below and then continue with the instructions in Section 10, *Windows App*.

Web link: <https://support.flir.com/product/RemoteMonitoring>.

1. Open the Windows app on your PC. The opening screen is shown in Figure 8.5 above (shown with the Information tab selected).
2. Open the mobile app on your mobile device, as described earlier.
3. Tap **+ Add Server** in the mobile app to set up a new network or select an existing one from the list as shown in Figure 8.4 above.
4. The next screen prompts for the network user name and password. Tap **Continue** when done.
5. Network connection should now be established.
6. For connection issues, verify that the credentials are correct. Contact FLIR support if connection issues persist.
7. Refer to the dedicated instructions in Section 9, *Mobile App* and Section 10, *Windows PC App*.

8.6 'Historical sensors' Option

Select the 'Historical sensors' option from the opening screen in the mobile app to view previous sensor configurations. You can also view archived, historical sensor configurations in the Windows PC app.

8.7 Preparation for sensor Placement

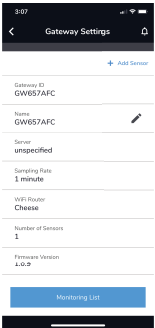
1. Once communication between all components in the system (gateways, sensors, PC and mobile devices) is established, the sensors can be moved into position temporarily. Do not permanently affix the sensors at this point.
2. With the sensors in their desired locations, allow time to ensure that the communications between all system components is stable. If you notice intermittent problems you may have to move the gateway closer to the sensors.
3. When stable communication is verified, follow the instructions in Section 6, *Sensor Installation*, for details on permanently attaching sensors to equipment. To verify stable communications, ensure that there are no connection drop-outs, weak signals, or connection display errors. Evidence of spotty communications would be gateway communication light toggling amber and green colors, alarm set points false triggering, and displayed data and graphs on mobile device or PC showing no data.

9 Mobile App Screen Set

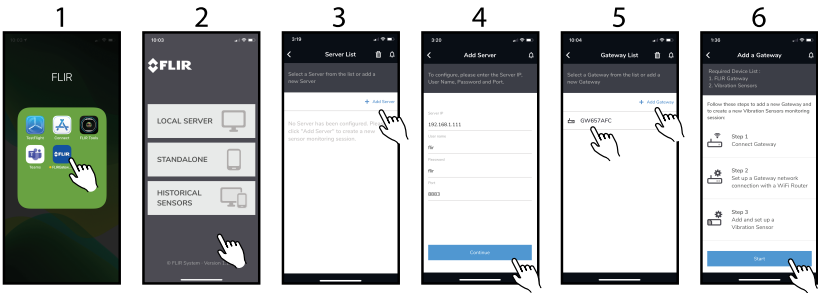
9.1 FLIR Mobile App Screens

The app is essentially the same for both **Local Server** and **Standalone modes** (Standalone mode doesn't include screens related to 'servers'). The **numbered steps below correspond to the numbered screen shots**.

NOTE: For previously configured gateways, you can skip the setup screens by tapping the **Monitoring List** box in the summary screen that appears when you start this process (shown below). You'll skip right to the sensor group list where you can select a sensor and immediately begin monitoring its status.



Tap the **Monitoring List** shortcut in the screen above when you have existing set-ups.



1. Tap the app icon to open.

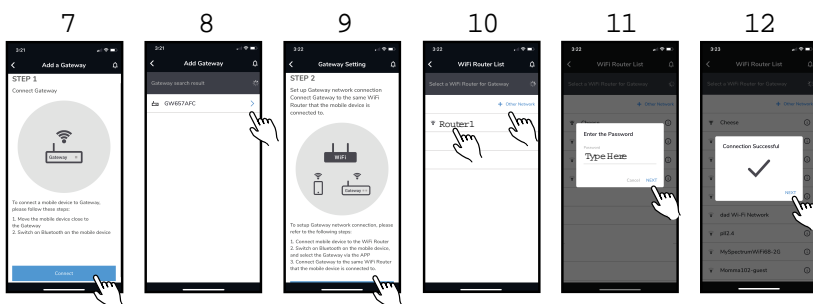
2. Tap **Local Server** to configure a system using both a Windows PC and a mobile device, tap **Standalone** to configure a system using a mobile device only, or tap **Historical sensors** to review systems configured earlier.

3. If you're running in 'Local Server' mode, tap **+ Add Server** to add a new server, or tap a server previously configured (if any). If you're running in 'Standalone' mode, the server screens will not appear.

4. Enter server credentials and tap **Continue**.

5. Tap **+ Add gateway** to add a new gateway or tap a gateway, previously configured, from the list.

6. Read the informational screen and tap **Start**.



7. Read the informational screen and tap **Connect**.

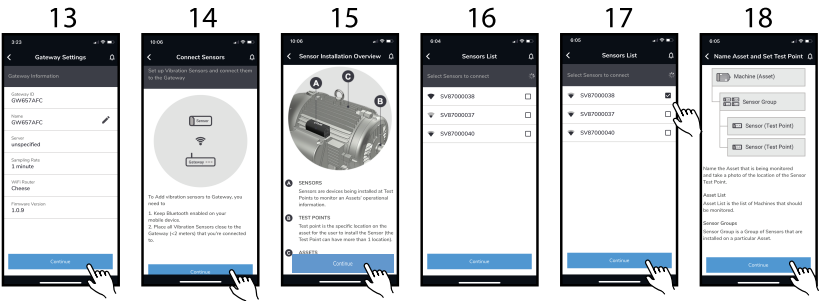
8. Tap the connected gateway from the list.

9. Read the informational screen and tap **Continue**.

10. Tap a network from the list or tap **+ Other Network** to add a new one.

11. Type a network password and tap **NEXT**.

12. Tap **NEXT**. If connection fails, check credentials. Contact FLIR if issues persist.



13. Tap the pencil icon to edit gateway name and tap **Continue**.

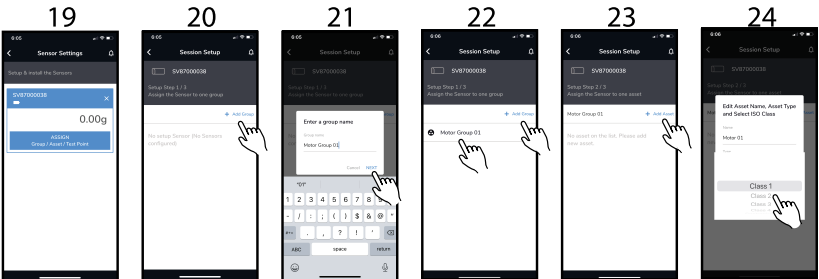
14. Read the informational screen and tap **Continue**.

15. Read the informational screen and tap **Continue**.

16. Wait for sensors to populate on the screen.

17. Tap one or more sensors to install and tap **Continue**.

18. Read the informational screen and tap **Continue**.



19. Tap the **Assign** box to begin setting up sensor groups, assets, and test points.

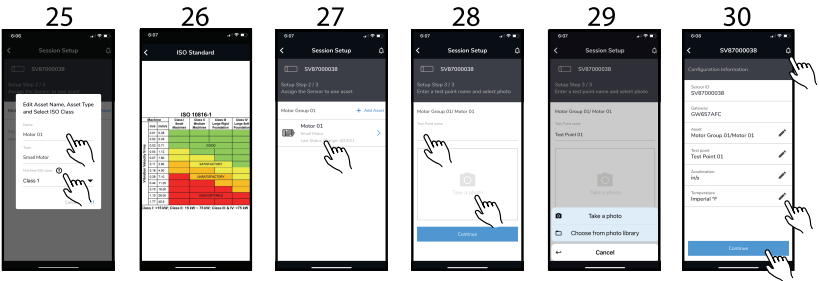
20. Tap an existing sensor group (if any), or tap + **Add Group** to add a new one.

21. Name the sensor group and tap **NEXT**.

22. Tap the group name from the list or tap + **Add Group** to add another.

23. Tap an asset from the list (if any) or tap **+ Add Asset** to add a new one.

24. Select the **ISO Class** from the pull-down menu. The alarm thresholds will automatically change to the limits specified in the ISO 108616–1 standard that match the selected Class. Select **Customize** to set the alarm thresholds manually.



25. Edit Asset Name, Type, and ISO Class. Tap the 'i' icon to view the ISO 108616–1 Standard Class table. Tap **Next**.

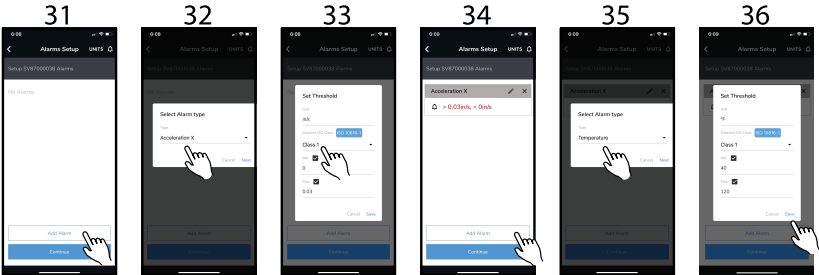
26. ISO 108616–1 Standard reference table.

27. Tap an asset from the list or tap **+ Add Asset** to add another.

28. Name a test point where a sensor will be placed and take a photo if desired. Tap **Continue**.

29. Select an existing photo from your photo library if desired.

30. Edit an item by tapping the pencil icon. Tap the alarm icon to view any alarm activity. Tap **Continue** when done.



31. Tap **Add Alarm** configure alarms. Tap the **UNITS** icon to edit the unit of measure. Tap **Continue** to skip the alarm configuration.

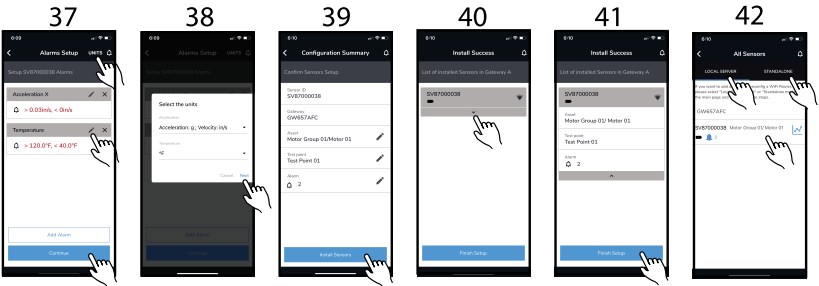
32. Select an alarm Type from the menu. Tap **NEXT**.

33. Set the alarm Thresholds. Note that when you select an ISO Class, the alarm threshold fields are automatically populated according to the ISO 108616–1 standard (you can customize if desired). Tap **Save**.

34. Tap **Add Alarm** to add another alarm, or tap **Continue**.

35. Select an alarm type from the menu. Tap **NEXT**.

36. Set alarm thresholds, Tap **Save**.



37. Edit alarm configurations or tap **Continue**.

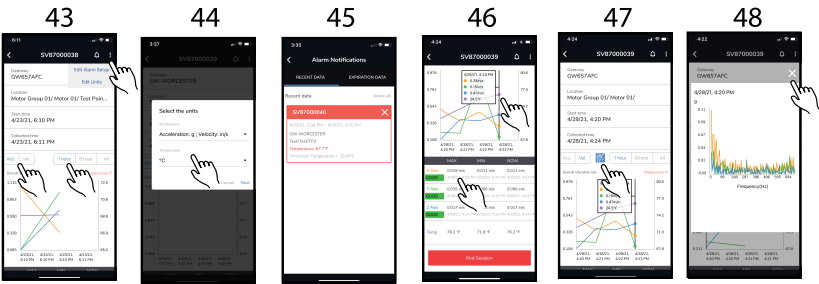
38. Edit alarm units of measure and tap **Next** or **Cancel**.

39. Tap **Install Sensors** or continue editing by tapping the pencil icons.

40. Click the arrow to expand the installed sensor information box.

41. Tap **Finish Setup**.

42. Tap **Local Server** or **Standalone** to switch between modes. Tap an installation from the list to view measurement data.



43. Tap **ACC** to view Acceleration measurement data on the trend chart graph. Tap **VEL** to view Velocity calculations on the trend graph. Tap **1 hour**, **8 hour**, or **ALL** to control the amount of data to view. Tap the three dots at the top of the screen to edit alarm configurations.

44. When you tap **EDIT UNITS** from screen 43, the units selection dialogue window will open. Edit the units and tap **Next**. When you tap on **EDIT ALARM SETUP**, the alarm setup screen will open (screen 34).

45. When you tap the alarm icon from screen 43, the alarm summary screen will open. Tap the 'X' or the **Delete All** icons to remove alarms from the summary screen. Tap the **RECENT** or **EXPIRED** tabs to view recent or historical alarm events.

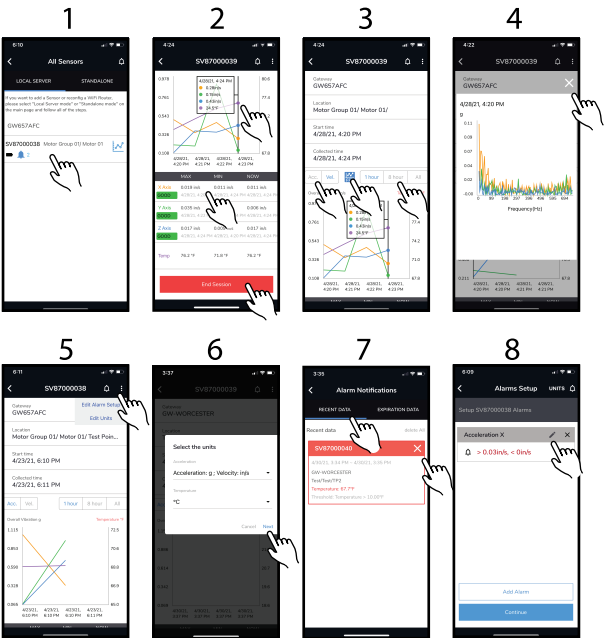
46. Tap any point on the graph to view the data point information. View the text-based **MAX/MIN** and up to the minute measurement data below the graph. Tap on an item in the MAX/MIN list to highlight it (it will appear on the graph) or tap again to remove it from the graph. Tap **End Session** to stop capturing data.

47. Tap the **FFT** icon to view the Fast Fourier Transform analyses graph.

48. FFT graph showing time domain data converted to frequency. Tap the 'X' to close the window.

9.2 Trend Charts

Trend chart screens provide a graphical representation of current and logged readings, FFT analyses, a MAX/MIN table, and editing options. The eight screens below show you how to navigate and use the trend charts screens. Refer to the previous section on the mobile app to see where the trend chart screens fit in the context of the complete app screen sequence.



1. Tap an installed sensor from the list to open the trend chart graph screens.
2. Tap anywhere on a graph line to open a measurement window with time stamp. To add or remove a measurement type from the graph, tap a measurement type in the MAX/MIN table (below the graph).
3. Tap the **Acc.** tab to view acceleration measurement data. Tap the **Vel.** tab to view the Velocity calculation data. Tap the **FFT** icon to view the FFT graph. FFT converts data from the time domain to the frequency domain.
4. FFT (Fast Fourier Transform) graph.

- 5. Tap the alarm bell icon to open the alarm summary screen (screen 7). Tap the three dots to open the alarm editing menu. Tap **Edit Alarm Setup** to open the alarm setup window (screen 8). Tap **Edit Units** to change the measurement units (screen 6).
- 6. Measurement Units setup page. Tap an arrow to open an editing menu.
- 7. Alarm notification screen. Tap the 'X' or the **Delete All** icon to remove alarms from the summary. Tap the **Recent** or **Expired** tab to see recent or historical alarm events.
- 8. Alarm Setup screen. Tap the pencil icon to edit an existing alarm or tap **Add Alarm** to setup a new alarm.

9.3 ISO 10816-1 Mechanical Vibration Sensor Alerts

Color-coded mechanical vibration alerts can be setup and viewed on the Windows and Mobile apps.

The alerts are Good (in green text), Satisfactory (blue text), Unsatisfactory (yellow text), and Unacceptable (red text), and represent the mechanical vibration measured by the sensors as compared to alarm thresholds you set in the app to match the limits shown in the ISO standard table. See the examples below.

ISO 10816-1						
Vibration Velocity Vrms	Machine		Class I Small Machines	Class II Medium Machines	Class III Large Rigid Foundation	Class IV Large Soft Foundation
	in/s	mm/s				
	0.01	0.28				
	0.02	0.45				
	0.03	0.71		GOOD		
	0.04	1.12				
	0.07	1.80				
	0.11	2.80		SATISFACTORY		
	0.18	4.50				
	0.28	7.10		UNSATISFACTORY		
0.44	11.20					
0.70	18.00					
1.10	28.00		UNACCEPTABLE			
1.77	45.9					
Class I: <15 kW; Class II: 15 kW ~ 75 kW; Class III & IV: >75 kW						

Figure 9.1 ISO 10816-1 Standard Reference Table

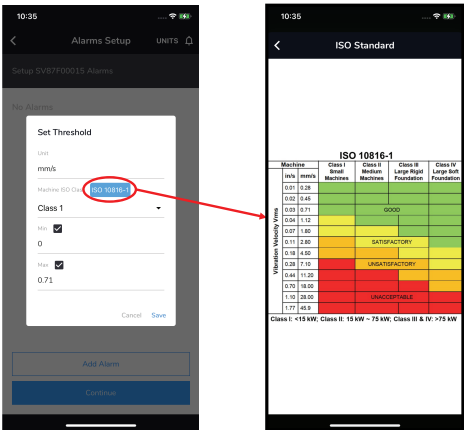


Figure 9.2 Mobile App Alarm Threshold Screen and ISO Standard Reference Table

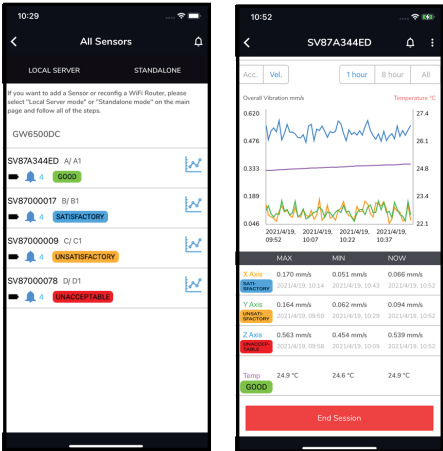


Figure 9.3 Mobile App Color-Coded Mechanical Vibration Alerts

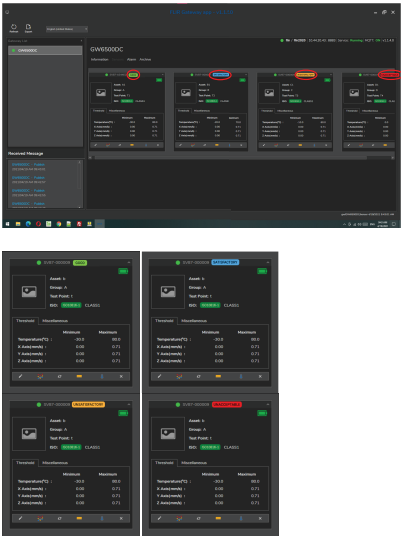


Figure 9.4 Windows App Screens Showing Sensor Alerts

10 Windows PC App

To monitor a test site using a Windows PC, download the Windows application from the FLIR support site (link below). Open the application and follow these instructions.

Web link: <https://support.flir.com/product/RemoteMonitoring>.

Ensure that all devices (mobile device, gateway, and sensors) reside on the same IP sub-network, assigned from the shared router or AP (access point). The mobile device configuration, when identifying the PC, must match the IP address shown in the Windows screen.

Note that you may need to obtain system information and credentials from your IT department to connect to a network.

10.1 Opening Windows App Screen

The call-out numbers in Figure 10.1 are explained below the diagram.

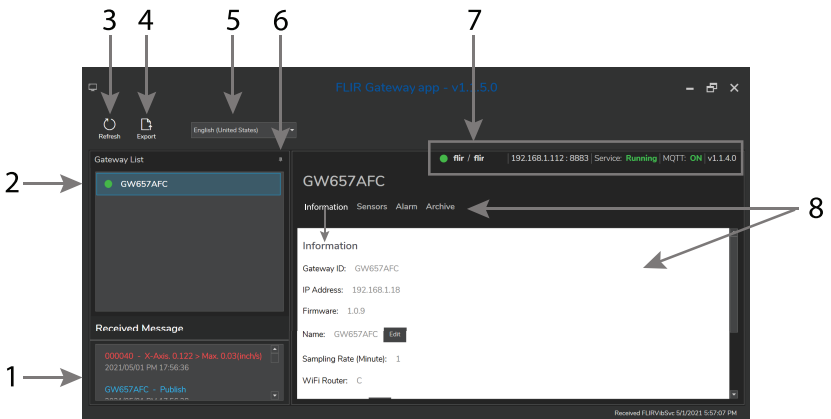


Figure 10.1 Windows app opening screen.

1. Alert messages, including alarm events.
2. Gateway list. The circle is green when a gateway is actively communicating.
3. Click to refresh the system.
4. Click to export data as CSV file.

- 5. Select local language.
- 6. Clip to collapse the gateway column to allow more room to view graphs and other data.
- 7. Credentials, including user name, password, and IP address appear here along system status and other technical information.
- 8. Information, Sensors, Alarm, and Archive tabs (Information tab is shown selected).

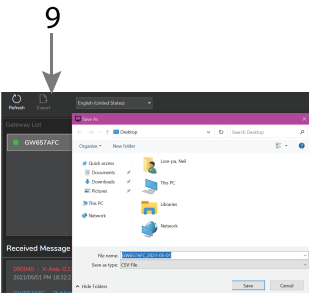


Figure 10.2 Export measurement data as CSV file

Time	Sensor ID	X g-rms(g/s)	X V-rms(mm/s)	Y g-rms(g/s)	Y V-rms(mm/s)	Z g-rms(g/s)	Z V-rms(mm/s)	Temp(°C)	Voltage(V)
2020/9/25 PM 05:17:09	SV87000005E	0.184836937	0.12559096	0.076889611	0.06938247	0.92912876	0.67134715	24.38	3.6
2020/9/25 PM 05:18:12	SV87000005E	0.18025163	0.19053948	0.088860591	0.05896583	0.937171382	0.64610478	24.3	3.6
2020/9/25 PM 05:19:16	SV87000005E	0.184926902	0.13871879	0.087668997	0.16526489	0.927675863	0.62633032	24.33	3.6
2020/9/25 PM 05:20:24	SV87000005E	0.182764515	0.17646503	0.083108608	0.10937588	0.932971391	0.61176226	24.34	3.6
2020/9/25 PM 05:21:29	SV87000005E	0.182335594	0.10722014	0.091496036	0.11124672	0.930220103	0.61550753	24.37	3.6
2020/9/25 PM 05:22:32	SV87000005E	0.185345261	0.14341034	0.078138563	0.0845235	0.9308084905	0.62889653	24.36	3.6
2020/9/25 PM 05:23:35	SV87000005E	0.194625092	0.23391894	0.074083074	0.11052909	0.928836783	0.64351775	24.42	3.6
2020/9/25 PM 05:24:38	SV87000005E	0.184027767	0.16738066	0.078440606	0.10541068	0.93003336	0.59459527	24.45	3.6

Figure 10.3 Example .csv data file.

9. Click here to save measurement data as a CSV file for use in a spreadsheet.

10.2 The Information Tab

Click the Information tab from the main screen to view details about, and edit settings for, the selected gateway.

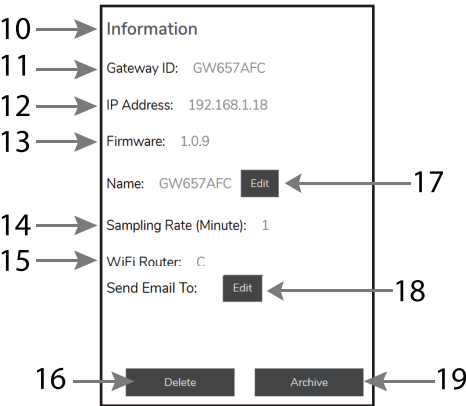


Figure 10.4 The Information tab window

- 10. Information tab heading.
- 11. Gateway identification number.
- 12. Network IP address.
- 13. Firmware version. Update gateway firmware using the instructions in the Firmware Update section.
- 14. Sample rate for MAX/MIN data logger.
- 15. Wi-Fi network name.
- 16. Delete gateway configuration.
- 17. Personalize the gateway name.
- 18. Setup an automated email alert system.
- 19. Archive the gateway.

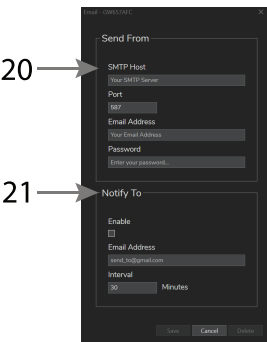


Figure 10.5 Setting up automated email alerts from the Information tab

20. When setting up an email alert system, complete this section to represent the account that email will originate from (same settings used in your email application).

21. Click the ENABLE box to activate the email system. Enter the email address to where the alerts will be sent and the desired rate at which the messages will be sent.

10.3 The Sensors Tab

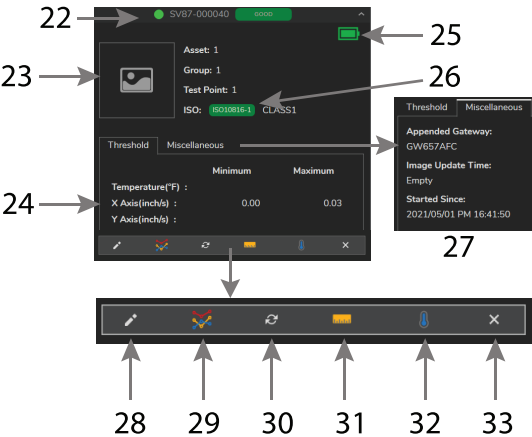


Figure 10.6 The Sensors tab windows

- 22. Sensor identification, measurement status (GOOD), connection status (green circle, active).
- 23. Sensor configuration data and photo.
- 24. Alarm threshold values.
- 25. Sensor's battery health.
- 26. Hover over the ISO standard box to see the ISO 10816–1 standard for mechanical vibration (CLASS settings automatically set the alarm thresholds according to the standard).
- 27. Click the Miscellaneous tab to open the window shown for additional information, including the time and date for when the sensor began operation.
- 28. Click the pencil to open the EDIT window (shown below in Figure 10.7).
- 29. Open the trend chart graphs windows (shown in Figure 10.8).
- 30. Click to update (refresh) the displayed information.
- 31. Click to change the displayed vibration units.
- 32. Click to change the displayed temperatures units.
- 33. Click to delete the sensor configuration.

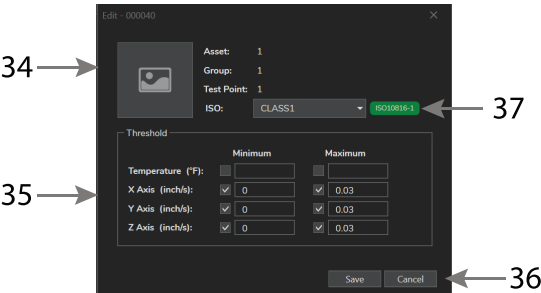


Figure 10.7 Click the edit pencil to open this sensor options screen.

- 34. Sensor data and photo.
- 35. Edit the alarm thresholds here.

- 36. Save or Cancel any edits.
- 37. Set the Class. Alarm thresholds will automatically set according to the standard limits shown in the table for the selected Class. Hover over the green box to see the ISO standard reference table. Select 'Customize' from the Class list to set the alarm thresholds manually.

10.4 The Trend Chart Screen

When you select the Trend chart icon from the sensor tab window (see Figure 10.2) the screens shown in Figure 10.8 become available.

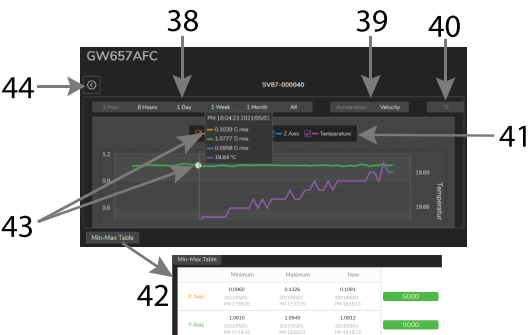


Figure 10.8 Trend Chart and MAX/MIN windows

- 38. Click a tab to select the amount of data to view.
- 39. Select Acceleration or Velocity data to display.
- 40. Set the temperature units.
- 41. Select which measurement types to display.
- 42. Click to open the MAX/MIN window.
- 43. Click any point on a graph to open the window that shows the time stamped logged data for that point.
- 44. Click to return to previous window.

10.5 Alarm Status Tab

Click the Alarm tab to view alarm activity.

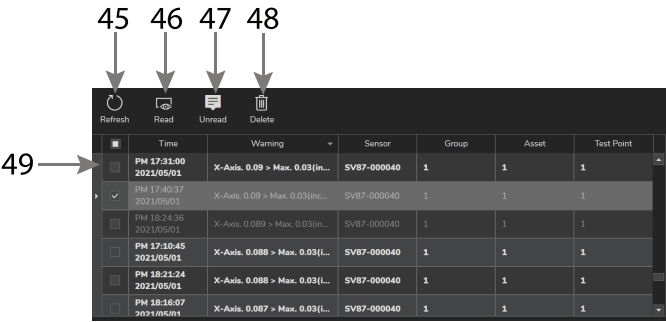
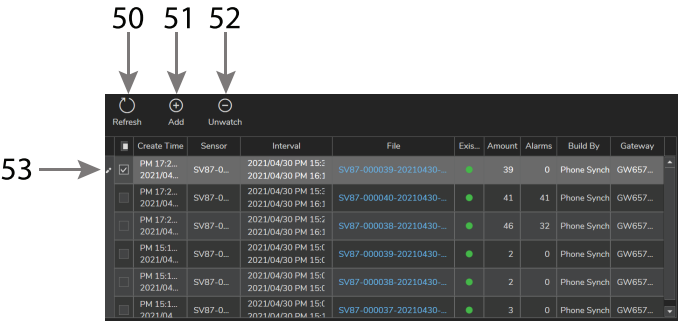


Figure 10.9 The Alarm tab

- 45. Refresh the screen.
- 46. Set an alarm event to 'read' status (the text highlight will switch off for this event).
- 47. Set an alarm event to 'unread' status (the text will highlight).
- 48. Delete an alarm event.
- 49. Select an alarm event and use the options described in steps 45 through 48 to change its status.

10.6 The Archive tab

Click the Archive tab to show the archived equipment.



- 50. Refresh the screen.

51. Add equipment to the archive.

52. Remove selected archive from view (click an archive box as shown in item 53 to select an archive).

53. Select an archive.

11 Fast Fourier Transform (FFT)

11.1 Background

In simple terms, FFT is a mathematical algorithm that converts a data presentation (graph, for example), shown as a function of time, into a data presentation shown as a function of frequency and vice versa.

This is useful in the representation of vibration measurements. For example, Velocity graphs, in the FLIR mobile and Windows apps, are derived from FFT analysis of Acceleration measurements.

11.2 Time-Domain and Frequency-Domain Methods

Time and frequency domain vibration measurement methods can both be employed to study vibration measurements.

The time domain method provides a glimpse into the source of vibration but not ideal for analyzing multiple frequency vibration signals.

The frequency domain method is more effective; especially when evaluating amplitude and phase characteristics of vibration signals. The frequency domain method is effective finding bearing defects and identifying shock pulses and friction activity.

11.3 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 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.

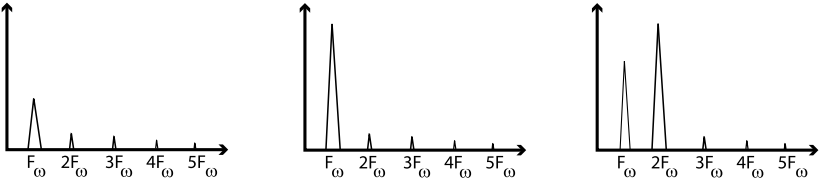


Figure 11.1 Graph on left shows a normal system; Centre graph shows a balance issue; Graph on right shows a misalignment issue.

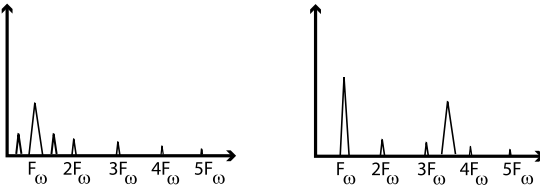


Figure 11.2 Graph on left shows a loose equipment issue (additional frequencies near the fundamental); Graph on right shows an impulse vibration (between 3rd and 4th harmonic) . Frequency of the impulse will vary from machine to machine (speed, size, etc.).

12 Toggling Standalone and Local Server Modes

Once you set up your test system as either a 'Standalone' or 'Local Server' configuration, switching to the opposite mode requires a few steps preparation. If you attempt to setup in Local Server mode, after you've setup in Standalone mode, for example, you'll receive an error message on the mobile app.

To switch from the Local Server mode to the Standalone mode, follow these steps and view the screens below.

1. Navigate to the opening mobile app screen and select Local Server mode.
2. Step to the **+ Add Server** screen, where your PC's machine name will be shown.
3. Tap the delete (trash) icon on the top of the screen When the server list opens, check the box next to the server that you want to delete.
4. Tap the **DELETE** command at the top of the screen.
5. Confirm the deletion, when prompted.
6. Now return to the mobile app opening screen, select the Standalone mode, and follow the instructions for configuring a test system in Standalone mode as previously described.

To switch from the Standalone mode to the Local Server mode, follow these steps.

1. Navigate to the opening mobile app screen and select Standalone mode.
2. Step to the **+ Add Gateway** screen, where the currently connected gateway name will be shown.
3. Tap the trash icon at the top of the screen.
4. Confirm the deletion, when prompted.
5. Now return to the mobile app opening screen, select the Local Server mode, and follow the instructions for configuring a test system in Local Server mode as previously described.

13 GW65 Field Firmware Updates

13.1 Firmware Update Procedure using the Mobile App

To update the GW65 gateway firmware, connect to the network with the mobile app, and then follow the steps below:

1. Select 'Local' or 'Standalone' mode in the app and connect to the same network as the GW65.
2. Navigate to the 'Gateway List' screen in the app and tap the 'FW Update' box.
3. When prompted, tap on an available update file and tap 'UPDATE'.
4. The app will show the 'Update Complete' message when done.
5. The GW65 will reboot and operation will continue normally. If you have questions or update issues, please contact FLIR.

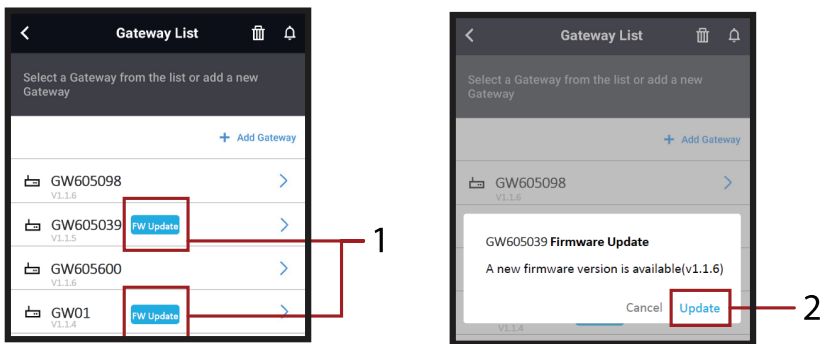


Figure 13.1 GW65 Gateway Firmware Update Using Mobile App.

14 Three-Year Limited Warranty

This product is protected by FLIR's 3-Year Limited Warranty. Visit www.flir.com/testwarranty to read the 3-Year Limited Warranty document.

15 CUSTOMER SUPPORT

Customer Support Telephone List:	https://support.flir.com/contact
Repair, Calibration, and Technical Support	https://support.flir.com

16 Specifications

16.1 GW65 Remote Monitoring Gateway Specifications

Operating and Storage Temperature	-13 °F ~ +149 °F (-25 °C ~ +65 °C)	
Operating Relative Humidity	10 ~ 95% non-condensing	
Altitude	6562 ft. (2000 m)	
Data back-up	32 MB flash memory available for power outages. 5 days of data for 4 sensors or 20 days of data for one sensor can be stored maximum.	
Power	100 ~ 240 V AC 50/60 Hz	
Bluetooth	Type:	BLE 4.2
	Gateway-to-sensor Range:	213 ft. (65 m) line-of-sight
	Antenna:	-3 dBm, single antenna, omni-directional
Wi-Fi	Type:	IEEE 802.11 b/g/n
	Frequency Range:	2.4 GHz
	Output power:	< 100 mW
	Antenna:	0 dBm, single antenna, omni-directional
	Signal strength:	-65 ~ -70 dBm
IP Rating	IP 40	
Drop-proof	3.3 ft. (1 m)	
Safety	Certifications: ETL / IC / FCC / CE / RCM	
Dimensions	2.26 in x 1.55 in x 1.82 in. (57.3 mm x 39.3 mm x 46.1 mm)	
Weight	1.2 oz. (35 g)	

16.2 SV87 Remote Sensor Specifications

Measurements	<p>Acceleration: ± 32 g (gravitational constant)</p> <p>Velocity data (mm/s or in/s) displayed in the mobile and Windows apps, derived from FFT.</p> <p>Contact temperature trend range: $-22^{\circ}\text{F} \sim +176^{\circ}\text{F}$ ($-30^{\circ}\text{C} \sim +80^{\circ}\text{C}$)</p>	
Frequency Range	10 Hz \sim 1 kHz	
Sampling rate	One data point captured / 90 seconds	
Sensor attachment method	<p>Double-sided tape (supplied). Order Tesa® 4957 double-sided general purpose PE-foam tape from your local supplier for additional tape.</p> <p>Adhesive alternatives are available on the market that could be more reliable on some machinery. Epoxy (Loctite AA 330 + Loctite SF 7387/8) may give a more rigid and long lasting bond.</p>	
Number of sensors per gateway	Ten (10) sensors will work in most circumstances, given no obstruction between gateway and sensor. The key factor is obstruction since, with no obstruction, it is possible to have more than ten sensors operating normally.	
Operating Temperature	$-22^{\circ}\text{F} \sim +176^{\circ}\text{F}$ ($-30^{\circ}\text{C} \sim +80^{\circ}\text{C}$)	
Operating altitude	6562 ft. (2000 m)	
Battery	3.6 V 2400 mAh Lithium battery (battery life: 4 years, nominal)	
Bluetooth	Type:	BLE 4.2
	Sensor-to-gateway Range:	213 ft. (65 m) line-of-sight
	Output power:	< 10 mW
IP Rating	IP 67	
Drop-proof	3.3 ft. (1 m)	
Safety	Certifications: ETL / IC / FCC / CE / RCM	
Dimensions	2.42 in x 0.95 in. (61.5 mm x 24 mm)	
Weight	1.4 oz. (28 g)	



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