



**YELLOW JACKET**  
**P51-870 TITAN™ User Manual**  
**UPC# 40870, 40875**

**Note:** These Instructions do not cover the manifold attached to the instrument.

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## Chapter 1: Before You Start

### **Contacting Ritchie Engineering:**

To order accessories, receive assistance, or locate the nearest YELLOW JACKET distributor.

### **Safety Information:**

Use the instrument only as specified in this manual. Otherwise, the protection provided by the instrument may be impaired. Refer to safety information in Table 1-1.

A Warning identifies conditions and actions that pose hazards to the user. A Caution identifies conditions and actions that may damage the instrument or the equipment under test.

Table 1-1. Safety Information

 **Warning**

To avoid personal injury or death, follow these guidelines:

- |  |  |
|--|--|
| <ul style="list-style-type: none"><li>• Most governments and legal authorities require that HVAC technicians be trained and certified in the safe and proper operation of HVAC tools, such as this instrument. Since this tool may be connected to many types of equipment through a limitless combination of hoses and fittings, proper training is the most important element of using this tool safely.</li><li>• Read the entire User Manual before using the instrument.</li><li>• Use the instrument only as described in the User Manual, otherwise the protection provided by the equipment may be impaired.</li></ul> | <ul style="list-style-type: none"><li>• Do not use the instrument if it is damaged. Before you use the instrument, inspect the case. Look for cracks or loose components</li><li>• The instrument contains no internal user-serviceable parts; Do not open the instrument. Have the instrument serviced only by Ritchie Engineering Co. or authorized service centers.</li><li>• Do not use the instrument if it operates abnormally. Protection may be impaired. When in doubt, have the instrument serviced.</li></ul> |
|--|--|

<ul style="list-style-type: none"><li>• Do not operate the instrument around explosive gas, vapor, or dust.</li><li>• Various refrigerants have been intentionally excluded for very significant safety reasons. Never use refrigerants in this instrument that are not listed in the Set-up menu.</li><li>• The refrigerant database in this unit may include refrigerants classified as flammable. If such refrigerants are selected, the operator may need additional certifications and/or training. Consult your government and legal authority and comply fully with all requirements.</li><li>• Always wear eye and skin protection when working with refrigerants. Escaping refrigerant vapors will present a freezing danger. Do not direct refrigerant vapors venting from hoses towards the skin.</li><li>• Maximum Working Pressure: 700 psia (4.83 MPa)</li><li>• Because this instrument allows for various inputs including electrical and mechanical, care must be taken to observe any ways that an electrical shock hazard could develop. Example: Wet or humid conditions, along with a damaged thermocouple or vacuum sensor, could allow an electrical path across the instrument and over wet hoses. Keep all interconnected equipment clean, organized, and in proper condition. Do not use the instrument if you are not qualified to recognize potential electrical faults.</li></ul>	<p>To avoid damage to equipment, follow these guidelines:</p> <ul style="list-style-type: none"><li>• Do not allow pressures beyond the specifications listed in this manual.</li><li>• Be aware that internal pressures can change unintentionally when equipment is stored with pressure in the system during temperature changes. If sub-cooled liquid refrigerant is trapped in a hose or manifold with no room for expansion, it may result in dramatic pressure variations with seemingly small temperature changes. Pressures can reach high enough levels to cause damage to the instrument's internal pressure transducers. Release liquid refrigerant from the hoses and manifold when disconnecting from a system.</li><li>• Do not attempt to introduce liquid or samples heavily laden with oil into the instrument.</li><li>• Do not use this instrument on systems containing leak sealing chemicals. These leak sealants can collect and harden in the instrument, causing permanent damage.</li></ul>
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## Chapter 2: Getting Started

### Getting to Know Your P51-870 TITAN™:

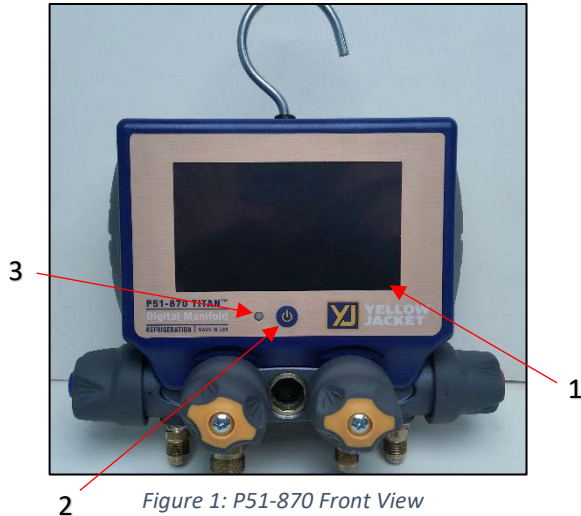


Figure 1: P51-870 Front View

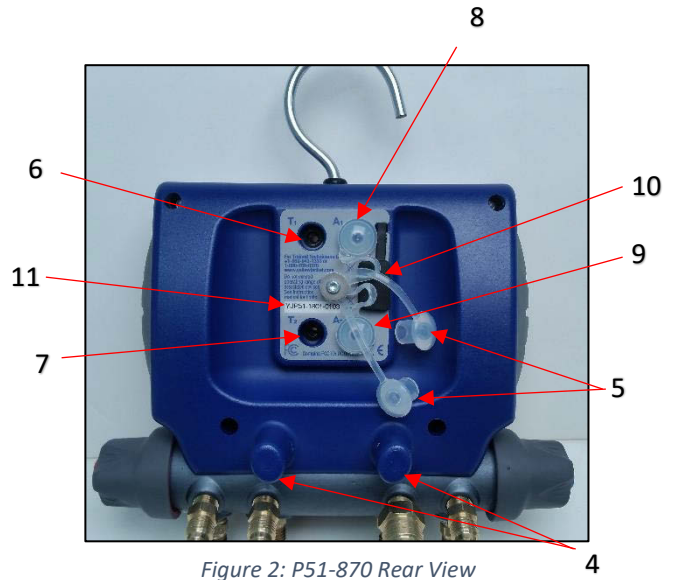


Figure 2: P51-870 Rear View

1. Touchscreen Display
2. Power Button
3. RGB LED
4. Temperature Clamp Mounting Pegs
5. Silicone Plugs
6. T1 Connector
7. T2 Connector
8. A1 Connector
9. A2 Connector
10. Micro-USB Connector
11. Serial Number/Bluetooth ID

### Turning the instrument On and Off:

Press and release the power button, located at bottom center of the display. The YJ logo will appear briefly on startup. The current firmware version and Serial Number are displayed at the bottom left and right corners of the display respectively on power up. The instrument will then proceed to the Modes Menu.

At any time during operation, press and hold the power button for 3 seconds to turn off the instrument.



Figure 3: Powering on the Device

### Interacting with the device:

The P51-870 TITAN™ features a 4.3" full color resistive touchscreen for improved usability and durability. To interact with the device, use a finger or stylus to touch anywhere on the screen. All interactive buttons are conveniently displayed with the same golden yellow color as seen in Figures 4 & 5. The only exception to this rule is the interaction with the gauge and graphs in Pressure/Temperature mode.

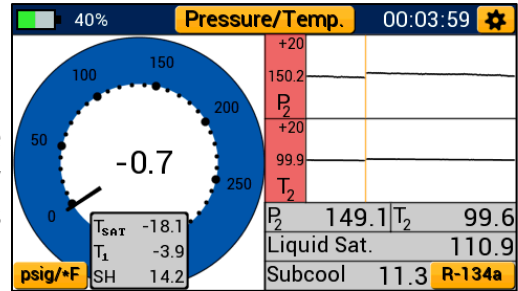


Figure 4: Pressure/Temperature Mode Interaction

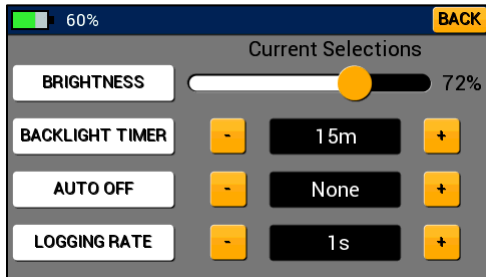


Figure 5: Device Settings Interaction

Resistive touchscreens are resistant to impact and various chemicals, compatible with all types of stylus, and are not susceptible to grease and moisture. While more durable, a resistive touchscreen requires a larger input force to register a touch than other common touchscreen types. Using a fine tipped stylus or fingernail can greatly improve interaction with the device. For instructions on touchscreen calibration, see page 21.

### Connecting and Using the Temperature Clamps:

Two (67010) temperature clamps, pictured in Figure 6, are supplied with the P51-870 TITAN™ and can be used to monitor system temperature, superheat and subcooling. To connect the sensors to the device, remove the clear silicone plugs from the back of the device covering connectors T1 and T2. Insert the male temperature clamp connectors into either the T1 or T2 connectors (shown in Figure 7 below). Attach the clamps to the point on the system where it is desired to measure temperature. Ensure that both jaws of the clamp are well secured and the metal temperature probe on the upper jaw is flush with the surface to be measured.



Figure 6: 67010 Included Temp Probes

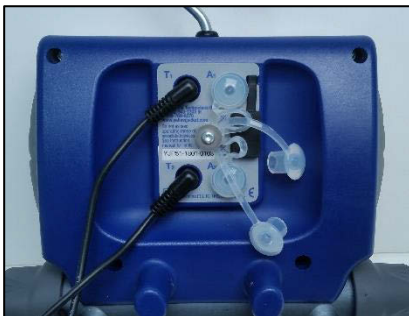


Figure 7: Connecting the Temp Probes

When not in use, the temperature clamps can be conveniently stored by attaching the clamps to the two mounting pegs located on the back of the device.

### Connecting and Using the Vacuum Sensor:

The P51-870 TITAN™ includes a (67030) YJ vacuum sensor, pictured in Figure 8, which can be used with this unit to measure the current depth of vacuum within a system. To connect the vacuum probe to the device, remove either of the two clear silicone plugs on the back of the device covering the A1 and A2 connectors.



Figure 8: 67030 Vacuum Sensor



Figure 9: Connecting the Vacuum Sensor

Insert the vacuum probe connector into either the A1 or A2 audio connectors as shown in Figure 9. The P51-870 TITAN™ will prioritize the A1 connector but can measure through the A2 connector. Connect the vacuum probe to a system during evacuation to monitor the system pump down. Ensure that the vacuum probe is tight to the system and at a significant distance from the vacuum pump such that it does not disturb the vacuum measurements.

### Interpreting the Battery Life Indicator:

This instrument utilizes a 2000mAh rechargeable lithium ion battery. It is equipped with a battery level indicator displayed in the top left corner of all screens (shown in Figure 10). At full charge, the battery will appear solid green and will indicate 100% charge to the right of the indicator. As the charge is drained, the green bar will decrease in width. When the battery life indicator turns red, the device charge is at 10% or less and needs to be plugged into a power source immediately.

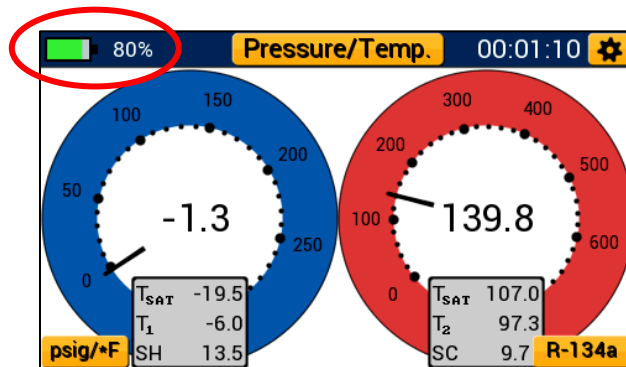


Figure 10: Battery Life Indicator

This device is rated for 4 hours of battery life with full backlight brightness and 80 hours with no backlight. To properly maximize battery life, make use of both auto off and auto dimming



features accessible in the device settings menu (see Pages 22-23). The most influencing factor on battery life is the backlight intensity, be sure to adjust the backlight level accordingly depending on your current viewing conditions.

### **Charging the Battery:**

To ensure maximum battery life, make sure the P51-870 TITAN™ is charged before and after each job session. To charge the device, remove the micro-usb cover and connect the manifold to a power source via the provided data transfer cable as pictured in Figure 11. When connected to a power source, the LED will turn a solid green. It takes approximately 2.5 – 3hrs to reach full charge from dead battery. Once the device has reached full charge, the green LED will shut off indicating the charge is complete.

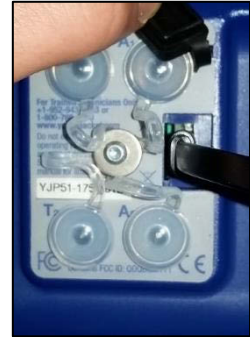


Figure 11: Charging the Battery

### **Operating the Backlight:**

This instrument is equipped with an adjustable backlight and backlight auto dimming capabilities. When the backlight dims during use, a touch anywhere on the screen or a quick press of the power button can be used to wake up the device and power the backlight on.

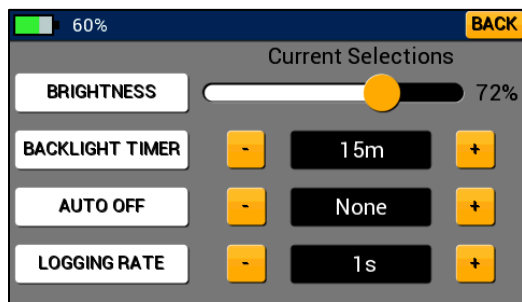


Figure 12: Backlight Settings

To help conserve battery life, make sure to use the backlight timer feature in device settings (Figure 12). This feature allows the user to set intervals for how long the backlight should remain on after the last user input. The backlight timer can be adjusted from 5 seconds to 15 min. See page 22 for instructions on adjusting the backlight level and timer.

### **Datalogging:**

The P51-870 TITAN™ digital manifold can be used to gather and record live system readings for later analysis. From the moment the device is powered on, it begins to record all current data inputs including Pressure, Temperature, and Vacuum. The logging rate can be adjusted anytime through the device settings menu (see Page 22).

After completing a job, the datalog files can be accessed by connecting the instrument to a PC. To connect the P51-870 TITAN™ to a PC, connect the provided data transfer cable to the micro-usb port on the back of device shown in Figures 13 and 14. Plug the opposite end into the usb port on a PC. Ensure that the device is powered on, the PC will attempt to open the device as a flash drive.

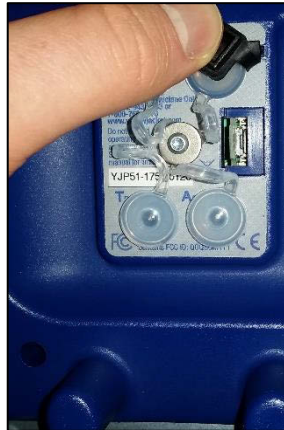


Figure 13: Micro-USB Location



Figure 14: Connecting to the Micro-USB

Datalog files are stored as .csv files and are named with the following date/time convention: last number of year, work week, last three digits of serial number, letter convention preventing duplicates. See Figure 15 for example of stored datalog files.

Ex. 50<sup>th</sup> week of 2017 with device serial number ending in 127, 4<sup>th</sup> datalog file; 750127AD

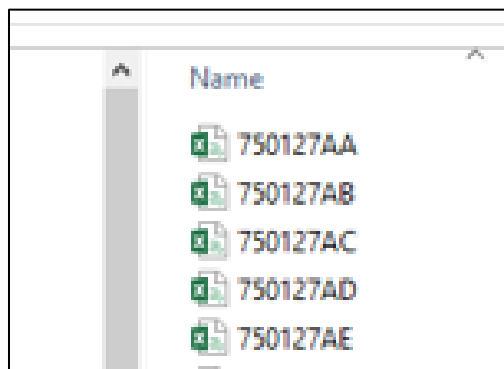


Figure 15: P51-870 as Removeable Drive

These files cannot be modified while stored on the device but can be copied from the drive to the PC and modified using any application compatible with .csv files (Microsoft Excel, notepad, etc.).

When the device is nearing full storage capacity, the device will prompt the user with remaining datalog time at current sampling rate. Selecting “Yes” will clear all datalog files stored on the device. If selecting “NO”, the device will proceed to normal startup and retain all stored datalog

files. If the device reaches max storage and has not been cleared, it will cease to log data until all files have been cleared from the device.

***Interpreting the RGB LED:***

The LED on the front face of the device can display a variety of colors during normal operation. Below is a list of various colors and flashing schemes encountered during normal use.

- Flashing Blue: The P51-870 TITAN™ flashes blue every time it stores a datalog sample. If the logging rate is set to a larger time increment, the LED will not flash blue as often.
- Flashing Red: When the device reaches low charge, or falls below 10% battery charge, the LED will flash red every time a datalog sample is taken (at the same rate as flashing blue).
- Flashing Violet: The instrument will flash a violet color every 1 second when connected and transmitting data via Bluetooth to a device.
- Solid Red/Blue: The LED will turn a solid red or blue when the power button is pressed and held (usually when powering on/off). Powering on the device will display a solid blue LED, powering off will display a solid red LED.
- Solid Green: The LED will remain a solid green color when connected to a power source and charging. When the device reaches full charge, the solid green light will shut off regardless if it remains connected to a power source.
- Solid Violet: If the instrument is placed into updater mode, the LED will turn a solid violet color and the display will shut off (if the device is powered on). This mode is not intended for normal use; to exit updater mode, hold the power button for 3 seconds or until the LED powers off.

## Chapter 3: Modes of Operation

### Modes Menu

The P51-870 TITAN™ will always start up on the Modes Menu shown in Figure 16 below. Tap any of the three buttons labeled “Pressure/Temperature, Evacuation, Pressure Hold” to start a Pressure/Temperature, Evacuation, or Pressure Hold session respectively. The general settings menu can be accessed by tapping the gear icon in the upper right-hand corner.

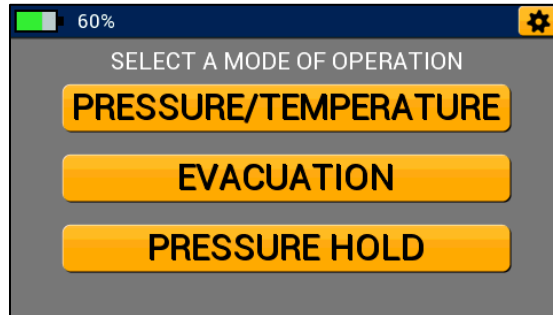
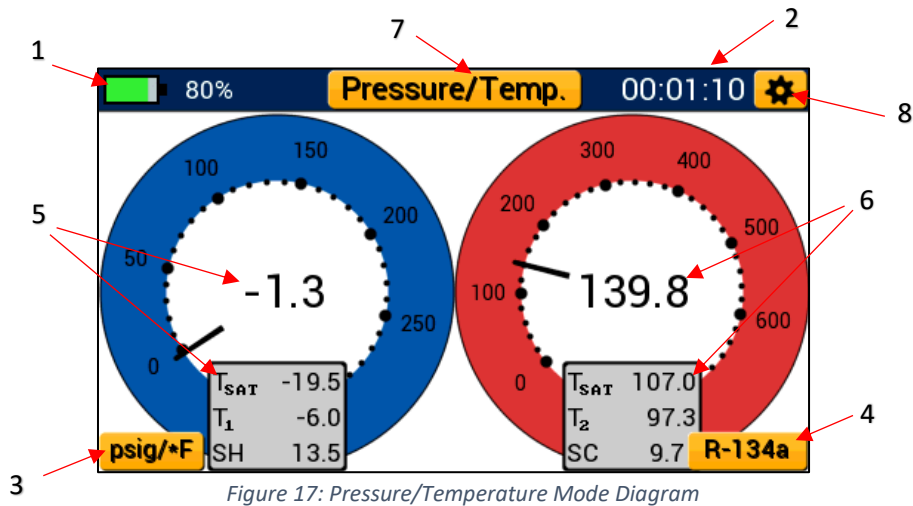


Figure 16: Modes Menu

### Pressure/Temperature Mode

#### **Overview:**

The P51-870 TITAN™ Pressure/Temperature mode can be used to accurately diagnose and service any system with compatible refrigerant. Pressure/Temperature mode features high and low side digital analog gauges that can be converted to a graphical form for superior data evaluation. This mode can be used to monitor system high and low side pressure, system temperature, vapor saturation and liquid saturation temperatures, and calculated system superheat and subcool.



1. Battery Level Indicator
2. Session Timer
3. Currently Selected Pressure & Temperature Units – Unit Settings Menu Shortcut
4. Currently Selected System Refrigerant – Refrigerant Settings Shortcut
5. Low Side Pressure & Temperature Measurement
6. High Side Pressure & Temperature Measurement
7. Current Mode Selection – Modes Menu Button
8. General Settings Button

***Interpreting the Pressure Analog Gauges:***

Pressure/Temperature mode features a set of fully functional digital analog pressure gauges. Each gauge operates on a linear scale with minor divisions indicated by small dots and major divisions by larger dots respectively. When adjusting the selected pressure unit, the gauge face will update accordingly to reflect that unit of measure. High and low side pressure is displayed in a digital format at the center of each blue and red analog gauge respectively. Each gauge needle adjusts in real time and can be used to observe fluctuations in pressure as if utilizing a real analog gauge. All temperature readings are conveniently displayed below each gauge as T<sub>sat</sub> (saturation Temperature), T<sub>1</sub>/T<sub>2</sub> (system temperature), and SH/SC (superheat & subcool).

***Interpreting the Pressure and Temperature Line Graphs:***

Each digital analog gauge can be transformed into a line graph (shown in Figure 18) by tapping anywhere within the center of the gauge. While in graph mode, both system pressure and temperature are plotted on a linear scale and are denoted as P<sub>1</sub>/P<sub>2</sub> and T<sub>1</sub>/T<sub>2</sub>. The pressure and temperature graphs utilize an orange leader line to plot new data from left to right. Old data is conveniently displayed to the right of the leader line such that it can be compared to newer data

as it is recorded. Any old data will be replaced by newer data as the leader line advances to the right, each graph completely overwrites every 100 seconds (approx. 1.5 minutes).

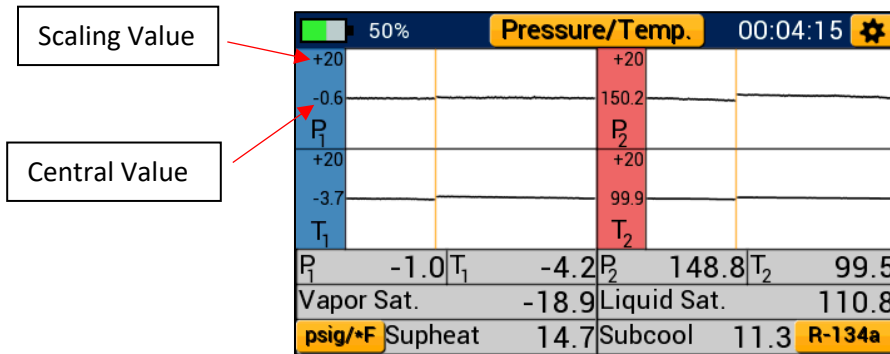


Figure 18: Pressure/Temperature Line Graphs

Each line graph centers on the first pressure or temperature measurement recorded when beginning a new plot, this value is displayed adjacent to the plot line to the left of each graph. Above this, a scaling value is displayed. The scaling value sets the upper and lower bound of each graph based on the current central value.

Ex. First Reading = 150.2 psig  
 Scaling Value = 20 psi  
 Upper Boundary = 150.2 psig + 20 psi = 170.2 psig  
 Lower Boundary = 150.2 psig – 20 psi = 130.2 psig

While in line graph format, pressure, system temperature, saturation temperature and calculated superheat and subcool are displayed in a table format below each set of graphs. Each graph can be transformed back into a gauge at any time by tapping anywhere within the graph.

**Operating Pressure/Temperature Mode:**

While on any modes screen (or the modes menu), tap the settings icon in the upper right-hand corner to access the general settings menu. Additionally, the unit settings and refrigerant settings menus can be quickly accessed by tapping their respective buttons in the lower left and right-hand corners respectively (or through the general settings menu). Finally, the modes menu can be accessed by tapping the modes button at the top center of the display labeled with the current mode of operation. The session timer displayed in the top right corner of the display begins to increment the moment pressure/temperature mode is selected. Use the session timer to track the length of a pressure/temperature session.

**NOTE:** Before connecting to the system, make sure to zero the pressure transducers at ambient pressure to ensure accurate pressure readings. To read about the transducer zeroing process, see page 20.

## Evacuation Mode

### Overview:

Once the refrigerant has been recovered from the system, the P51-870 TITAN™ can be used to accurately monitor the system evacuation. Evacuation mode displays the current vacuum pressure in digital, analog, and graphical form, percent change per minute, estimated time remaining, target vacuum level, and the vacuum hold timer.

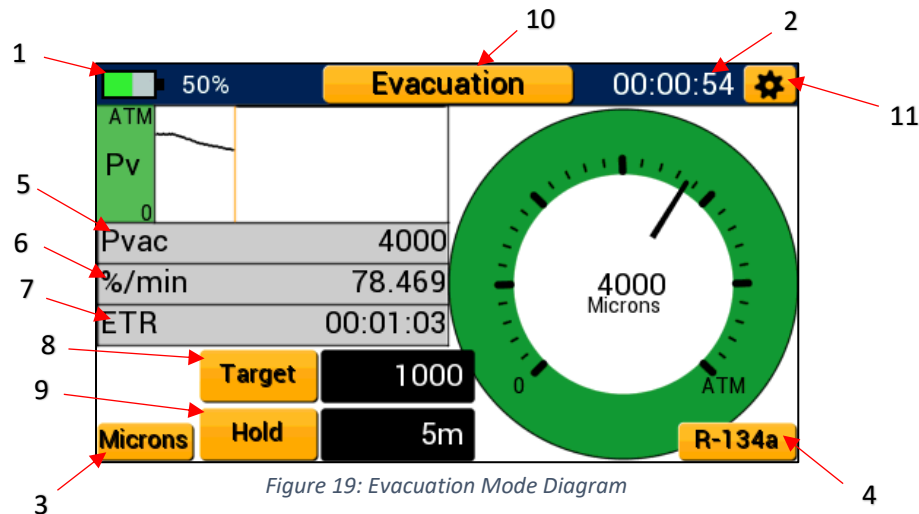


Figure 19: Evacuation Mode Diagram

1. Battery Level Indicator
2. Session Timer
3. Currently Selected Vacuum Unit – Unit Settings Menu Shortcut
4. Currently Selected Refrigerant – Refrigerant Settings Menu Shortcut
5. System Vacuum Pressure
6. Percent Change per Min.
7. Estimated Time Remaining
8. Target Vacuum Level Button
9. Vacuum Hold Timer Button
10. Modes Menu Button
11. General Settings Button

System vacuum pressure is displayed in real time as a digital representation as denoted by Pvac, analog as represented by the green analog gauge, and a graphical format as a logarithmic line graph. While evacuating the system, the P51-870 TITAN™ will display 100000microns from atmosphere down to the 100000micron vacuum level after which it will accurately measure and display down to 5 microns.

### Interpreting the Evacuation Gauge:

Evacuation mode features a fully functional digital analog vacuum gauge on the right side of the display. The evacuation gauge operates on a logarithmic scale from atmosphere (ATM) to 0 microns. A digital reading and currently selected vacuum units are displayed at the center of the gauge. The needle of the evacuation adjusts in real time and can be used to visualize fluctuations

in vacuum pressure during a system evacuation. Because the evacuation operates on a logarithmic scale, the resolution of the needle movement increases in a deeper vacuum meaning small fluctuations in vacuum pressure become more apparent in a deeper vacuum.

***Interpreting the Evacuation Graph:***

In addition to the evacuation gauge, evacuation mode also features a fully functional evacuation line graph like those in Pressure/Temperature mode. Unlike the pressure and temperature graphs, the evacuation graph features a logarithmic y-axis. This means that the evacuation graph captures the full scale of an evacuation but is more precise in a deep vacuum allowing the user to observe small fluctuations in vacuum pressure. An orange leader line is used to plot new data from left to right. This function allows the user to compare old data to newer data as each measurement is recorded and displayed. The line graph fully overwrites the old data every 200 seconds (approx. 3.5 minutes) and will begin again from the left side of the graph.

***Operating the Evacuation Mode:***

Before beginning an evacuation, connect the YJ vacuum probe (67030) to either the A1 or A2 connectors on the back of the device. Connect the vacuum probe to the system at a sufficient distance from the vacuum pump such that it will not disturb the vacuum reading. Use the “Target” and “Hold” buttons to set the target vacuum level and vacuum hold timer respectively. Pressing each of these buttons will cycle between a range of available values, with the last value selected being automatically saved. Target vacuum level can be adjusted in 6 increments: 200, 300, 400, 500, 750, 1000microns (or equivalent selected vacuum unit). Vacuum hold timer can be adjusted in 7 increments: 1m, 3m, 5m, 10m, 15m, 30m, None.

The session timer, displayed in the top right corner will begin incrementing the moment evacuation mode is entered. Use the session timer to monitor the overall length of the evacuation session. While evacuating a system the %/min will change to reflect the current % change in vacuum pressure every minute. A larger number will indicate a faster evacuation rate than a lower number. Additionally, the estimated time remaining is denoted by ETR and will adjust based on the current %/min and the target vacuum level setting.

Once the set target vacuum level has been reached, the vacuum hold timer will start to deplete. When the hold timer reaches zero, an alarm will sound indicating the evacuation has been completed. In addition, the user will be prompted to start a pressure hold test as shown in Figure 20. By tapping the button “Begin Pressure Hold Test?” the user will be taken to the pressure rise setup screen and the alarm will be silenced. If the button is not selected, the user will remain on the evacuation screen. To silence the alarm, adjust the desired target vacuum level and continue



the evacuation or select a new mode of operation. If the vacuum hold timer is not desired, simply tap the Hold button until NONE is displayed.

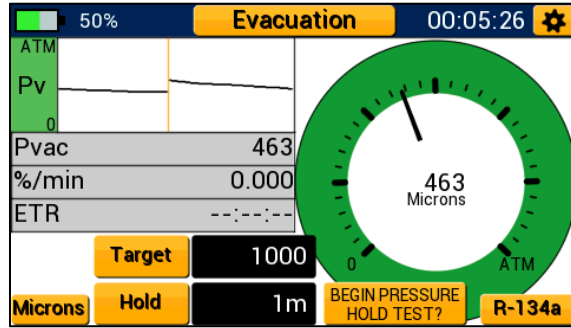


Figure 20: Evacuation - Pressure Hold Test Prompt

**NOTE:** Using the vacuum hold timer can help to ensure that all refrigerant has been evacuated from the system and the system is free of non-condensables. Refrigerant and non-condensables can cause the vacuum level to rise in a system giving a false positive during a leak test when no leak is present.

## Pressure Hold Mode – Pressure Decay Test

### Overview:

The P51-870 TITAN™ can be used to monitor a system leak through a drop in positive pressure. The pressure decay test displays the current system pressure (Pc), the initial pressure (Pi), the change in pressure (Pi-Pc), the Limit Pressure (Limit), and the Rate of Change (%/min).

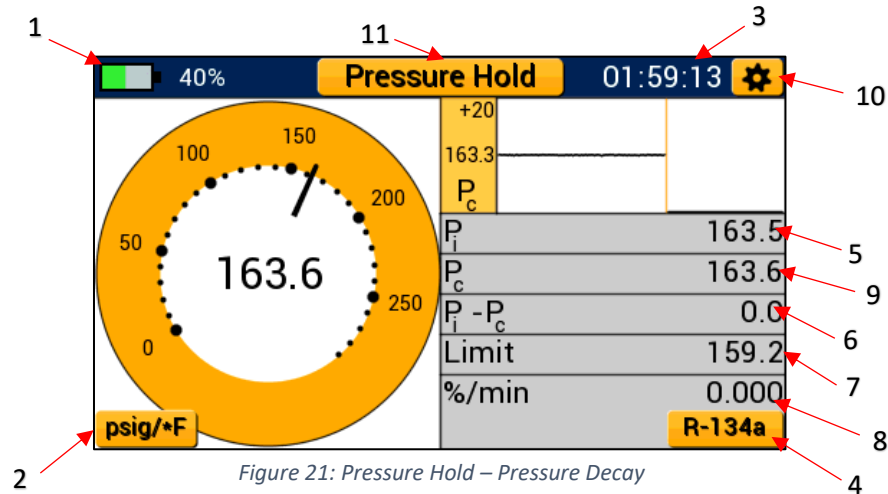


Figure 21: Pressure Hold – Pressure Decay Test Diagram

1. Battery Indicator
2. Currently Selected Units – Unit Settings Menu Shortcut
3. Hold Timer
4. Currently Selected Refrigerant – Refrigerant Settings Menu Shortcut
5. Initial Pressure ( $P_i$ )
6. Change in Pressure ( $P_i - P_c$ )
7. Pressure Limit (Limit)
8. Rate of Change (%/min)
9. Current System Pressure ( $P_c$ )
10. General Settings Button
11. Currently Selected Mode – Modes Button

Live system pressure is measured and compared to initial pressure readings to determine if the system has lost pressure over time. Current system pressure is displayed as a digital analog gauge, a line graph, and in a digital format displayed at the center of the analog gauge.

**Interpreting the Pressure Decay Gauge:**

Pressure Decay mode features a digital analog pressure gauge on the left of the display. This gauge operates on a linear scale with minor divisions displayed as small dots and major divisions displayed as larger dots respectively. The current system pressure is displayed in a digital format at the center of the analog gauge. Both the current pressure measurement and gauge face will update to reflect the currently selected pressure unit. The needle of the pressure decay gauge adjusts in real time and can be used to visualize any fluctuations in system pressure as if using a real analog gauge.

**Interpreting the Pressure Decay Graph:**

Pressure Decay mode also features a line graph which plots current system pressure readings in real time. System pressure is plotted on a linear scale and is denoted as  $P_c$ . The current system pressure graph utilizes an orange leader to line to plot new data from left to right. Old data is conveniently displayed to the right of the leader line such that it can be compared to newer data.

Any old data will be replaced by newer data as the leader line advances to the right, the line graph will completely overwrite every 200 seconds (approx. 3.5 minutes).

The line graph centers on the first pressure measurement recorded when beginning a new plot, this value is displayed adjacent to the plot line to the left of the graph. Above this, a scaling value is displayed. The scaling value sets the upper and lower bound of the graph based on the current central value.

Ex. First Reading = 163.3 psig  
 Scaling Value = 20 psi  
 Upper Boundary = 163.3 psig + 20 psi = 183.3 psig  
 Lower Boundary = 163.3 psig – 20 psi = 143.3 psig

**Operating the Pressure Decay Mode:**

To conduct a pressure decay test, select “Pressure Hold” from the modes menu, the device will advance to the pressure hold test setup menu seen in Figure 22. This menu allows the user to adjust the allowable change in pressure and pressure decay test duration.

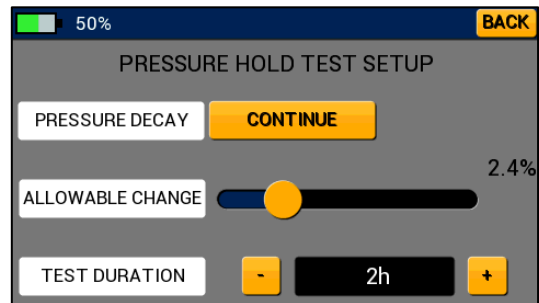


Figure 22: Pressure Decay Test Setup Menu

Allowable change is measured as a percent of the initial system pressure the system can drop before the P51-870 TITAN™ deems the pressure decay test a failure. To adjust the allowable change percent, drag the slider bar until the desired percent change is displayed. The test duration sets the length of time the pressure decay test will be conducted. If the pressure has not dropped below the limit pressure within the test duration, the P51-870 TITAN™ deems the pressure decay test a pass. Tap the + and – buttons to adjust the test duration value. When all desired settings have been set, select the continue button to advance to the pressure decay test. The Back button can be used to return to the modes menu.

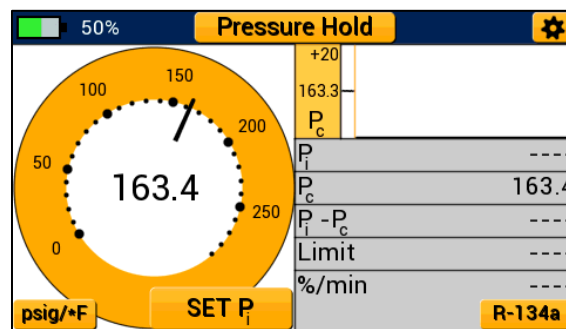


Figure 23: Pressure Decay Test – Set Pi

Ensure the system is properly charged to the desired test pressure and is connected to the manifold low side transducer. Once the system is ready for the pressure decay test, tap the Set Pi button to begin the test (shown in Figure 23). The current system pressure will be stored as Pi and is displayed within the table directly below the pressure decay graph.

During the pressure decay test,  $P_c$  will adjust as the current system pressure changes.  $P_i - P_c$  will adjust to reflect the change between the initial system pressure and current system pressure. Limit will display the limit pressure as determined by the percent allowable change. System pressure dropping below this value within the time limit as set by the test duration will trigger a failure. The rate of change as denoted by  $\%/min$  displays the percent change in system pressure per minute. A large leak will be indicated by a larger  $\%/min$  value, conversely a smaller  $\%/min$  indicates a small system leak.

If the system pressure falls below the limit pressure within the test time limits, the P51-870 TITAN™ will display a “FAIL” notice (Figure 24) and the buzzer will sound indicating the test is complete. To silence the buzzer, exit the pressure decay test by selecting the modes button. If the pressure decay test ends before the system pressure falls below the limit pressure, the device will display a “PASS” notice and the buzzer will sound indicating the test is complete (Figure 25).

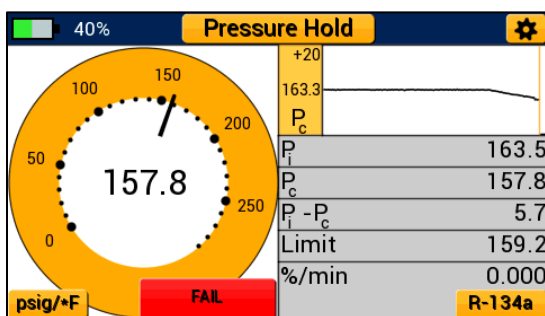


Figure 24: Pressure Decay Test - FAIL

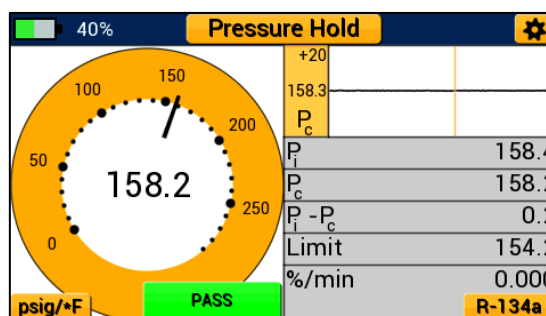


Figure 25: Pressure Decay Test - PASS

## Pressure Hold Mode - Pressure Rise Test

### Overview:

Pressure hold mode can also be used to monitor the system for a rise in vacuum pressure. A pressure rise test can be helpful to determine if the system has a leak or there are non-condensables and refrigerant remaining within the system. The pressure rise test displays the current system vacuum pressure ( $P_{vac}$ ), the percent change per minute ( $\%/min$ ), the initial pressure ( $P_i$ ), the Limit pressure and test duration.

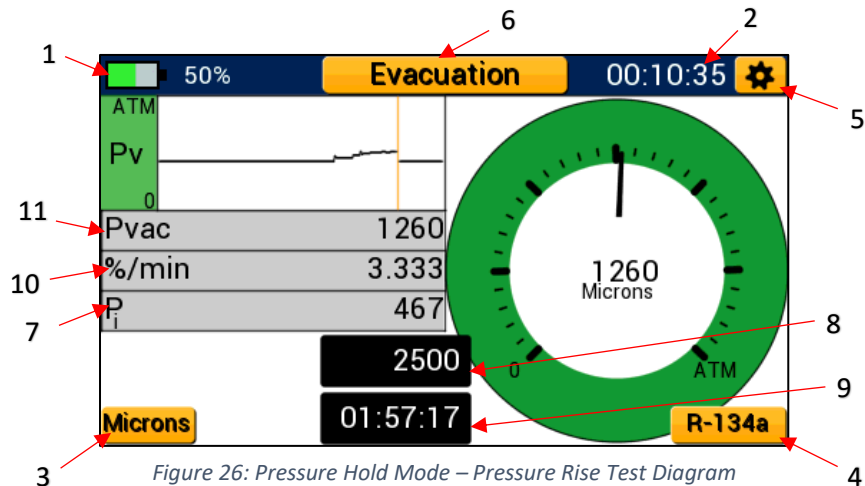


Figure 26: Pressure Hold Mode – Pressure Rise Test Diagram

1. Battery Life Indicator
2. Session Timer
3. Currently Selected Vacuum Units – Unit Settings Menu Shortcut
4. Currently Selected Refrigerant – Refrigerant Settings Menu Shortcut
5. General Settings Button
6. Currently Selected Mode – Modes Menu Button
7. Initial Pressure (P<sub>i</sub>)
8. Pressure Limit
9. Test Duration
10. Percent Change per minute (%/min)
11. Current System Vacuum Pressure (P<sub>vac</sub>)

Live system vacuum pressure is measured and compared to initial vacuum pressure readings to determine if the system has gained pressure over time. Current system vacuum pressure is displayed as a digital analog gauge, a line graph, and in a digital format displayed at the center of the analog gauge.

#### ***Interpreting the Pressure Rise Gauge:***

The pressure rise test features the same fully functional digital analog vacuum gauge as evacuation mode. The pressure rise gauge operates on a logarithmic scale from atmosphere (ATM) to 0 microns. A digital reading and currently selected vacuum units are displayed at the center of the gauge. The needle of the pressure rise gauge adjusts in real time and can be used to visualize fluctuations in vacuum pressure during a pressure rise test.

#### ***Interpreting the Pressure Rise Graph:***

In addition to the pressure rise gauge, the pressure rise test also features the same line graph as evacuation mode. The pressure rise graph plots in real time and features a logarithmic y-axis. This means that the pressure rise graph captures the full scale from atmosphere to deep vacuum but features more precision in a deeper vacuum. An orange leader line is used to plot new data from left to right. This function allows the user to compare old data to newer data as each

measurement is plotted. The line graph fully overwrites the old data every 200 seconds (approx. 3.5 minutes) and will begin again from the left side of the graph.

### **Operating the Pressure Rise Test:**

The pressure rise test can be accessed through completion of an evacuation (See page 13). Once the evacuation has been completed, the device prompts the user to conduct a pressure hold test. If the button is selected, the user will be brought to the pressure rise test setup screen shown in Figure 27. The pressure rise setup screen allows the user to adjust the allowable vacuum pressure (allowable change) and test duration.

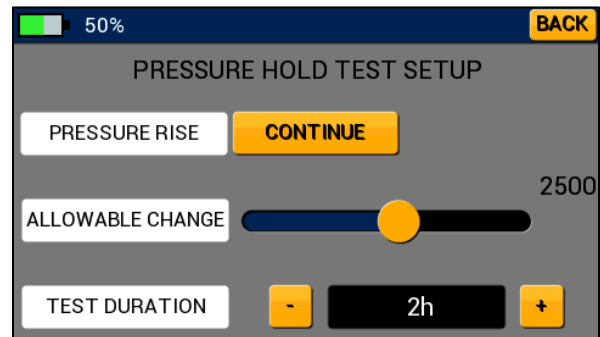


Figure 27: Pressure Rise Setup Menu

Allowable change sets the maximum allowable system vacuum pressure above which the P51-870 TITAN™ will indicate a failure. Tap and drag the slider bar to adjust the allowable vacuum pressure until the desired value is displayed. The test duration sets the length of time the pressure rise test will be conducted. If the system vacuum pressure has not risen above the limit pressure within the test duration, the P51-870 TITAN™ deems the pressure rise test a pass. Tap the + and – buttons to adjust the test duration value. When all desired settings have been set, select the continue button to advance to the pressure rise test. The back button can be used to return to the previous evacuation screen.

After selecting the continue button, the pressure rise test commences immediately setting the current vacuum pressure as the initial system pressure. During the pressure rise test, current system vacuum pressure (Pvac) will be monitored and compared to the limit pressure (Set by allowable change). The session timer will continue to increment from the previous evacuation through the pressure rise test. The percent change per minute (%/min) will display the change in system vacuum pressure every minute. A large %/min value indicates a rapid change in pressure, conversely small value indicates a small fluctuation in vacuum pressure. The test duration timer will continue to deplete until the pressure rise test is complete.

If Pvac rises above the limit pressure within the time limit set by test duration, the device will indicate a “FAIL” and the buzzer will sound (Figure 28). To silence the buzzer, exit the pressure rise test by selecting the modes menu button. If test duration timer fully depletes before Pvac rises above the limit pressure, the device will indicate a “PASS” and the buzzer will sound to indicate the test is complete (Figure 29).

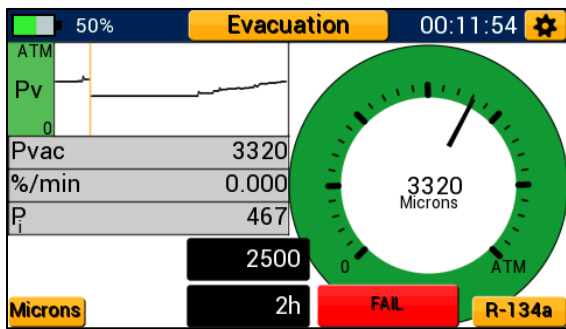


Figure 28: Pressure Rise Test - FAIL

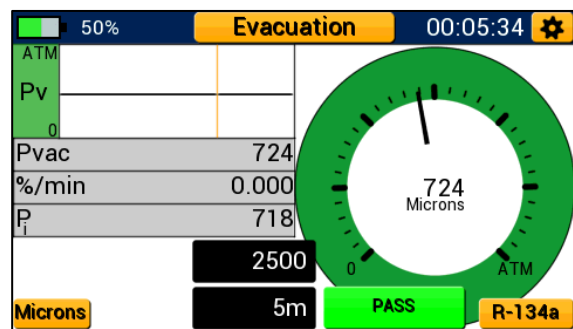


Figure 29: Pressure Rise Test - PASS

## Chapter 4: Settings

### Settings Menus Overview

The P51-870 TITAN™ settings menus are separated into four menus: unit settings, refrigerant settings, device settings, and general settings. While on any modes screen or the modes menu, the general settings menu can be quickly accessed by tapping the gear icon in the top right corner. Unit and refrigerant settings can also be accessed by tapping the buttons in the bottom left and right-hand corners of each modes screen.

### General Settings Menu

The general settings menu, shown in Figure 30, allows the user to adjust system refrigerant, enter the units and device settings menus, zero the pressure transducers, and calibrate the touchscreen display. To access either the units or device settings menus, tap on the appropriate button. The exit button in the bottom left corner can be used to return to the previous screen at any time.

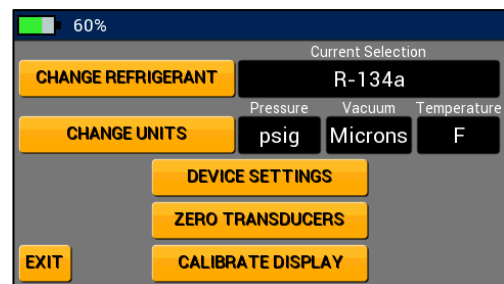


Figure 30: General Settings Menu

### Zeroing the Pressure Transducers:

To ensure accurate pressure readings, the pressure transducers should be re-zeroed before every job. To correctly zero the pressure transducers, first remove any pressure from the manifold and ensure all knobs are open such that the manifold is at current atmospheric pressure. Next, navigate to the general settings menu and tap the “Zero Transducers” button.

If the zeroing was successful, the button will flash green. If the zeroing was unsuccessful the button will flash red. A common issue when zeroing transducers is residual positive pressure within the manifold. The P51-870 TITAN™ will not zero transducers if the manifold contains pressure exceeding 30 psia.

### Calibrating the Touchscreen:

If the touchscreen seems unresponsive or poorly aligned, it may benefit to re-calibrate the display. The touchscreen display can be re-calibrated one of two ways: through the general settings menu or interaction with the power button. To calibrate the display through the general settings menu, navigate to the general settings menu and tap the “Calibrate Display” button. Follow the onscreen prompts to power the device off and on. When the device has been powered on it will prompt calibration. Tap the three flashing dots as they appear on the screen.

To calibrate the display through interaction with the power button, when the device is powered on, press the power button three times in quick succession (this should power the device off). Power the device back on and it will prompt calibration. As before, tap the three flashing dots as they appear on the screen. When the calibration is complete the device will startup normally.

**NOTE:** Once the calibration has been prompted, you cannot return. The display must be re-calibrated to continue normal operation. Using a fine tipped stylus can help to increase the accuracy of the calibration.

### Refrigerant Settings Menu

The refrigerant settings menu, shown in Figure 31, can be accessed either by tapping on the “Change Refrigerant” button in the general settings menu or by tapping the button in the bottom right corner of any modes screen labeled with the currently selected refrigerant. To change currently selected refrigerant, tap and drag the slider bar to the page containing the desired refrigerant. Tap the name of the new refrigerant selection, the device will automatically return to the previous screen with the new selection saved as the current refrigerant. The currently selected refrigerant is always displayed in the box to the right of the change refrigerant button in general settings or as the refrigerant button label on any modes screen. To exit the refrigerant menu without saving a new selection tap the back button in the upper right corner.

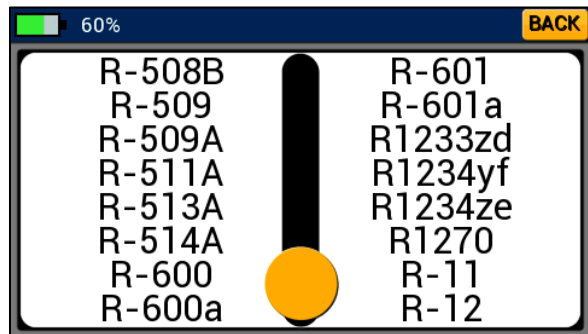


Figure 31: Refrigerant Settings Menu

### Unit Settings Menu

The unit settings menu, shown in Figure 32, can be used to quickly change currently selected units. This menu can be accessed by either tapping the “Change Units” button in the general settings menu or by tapping the button in the bottom left corner of any modes screen labeled with the currently selected unit. To select a new pressure, vacuum, or temperature unit, tap the desired unit within the corresponding list. Once

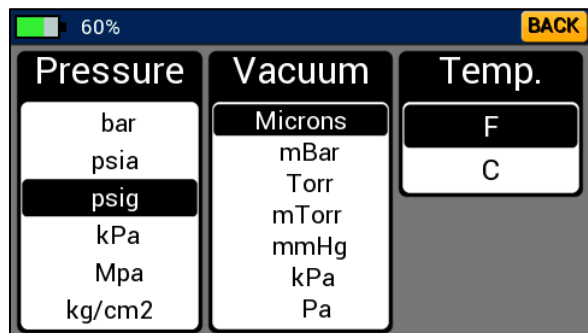


Figure 32: Unit Settings Menu



the desired units have been selected, tap the back button in the upper right corner to save new selections.

**Pressure Units:**

Pressure units are used to display pressure measurements while in pressure/temperature and pressure decay mode. This unit can be adjusted to one of six pressure units: psig, psia, bar, kg/cm<sup>2</sup>, MPa, and kPa.

**Temperature Units:**

Temperature units are used to display temperature measurements while in pressure/temperature mode. This unit can be adjusted to one of two temperature units: °F, and °C.

**Vacuum Units:**

Vacuum units are used to display vacuum measurements while in evacuation mode. This unit can be adjusted to one of seven vacuum units: Microns, Pa, kPa, mmHg, mTorr, Torr, and mBar.

**Device Settings Menu**

The device settings menu, shown in Figure 33, can be used to adjust a variety of device settings including display brightness, backlight timer, auto off timer, and logging rate. To access the device settings menu, tap the “Device Settings” button in the general settings menu. To adjust the display brightness, tap and drag the slider bar next to brightness until the desired brightness is displayed. To adjust the backlight timer, auto off timer, or logging rate, tap the + and – buttons until the desired time is displayed. Tap the back button in the upper right corner to save new device settings and return to the general settings menu.

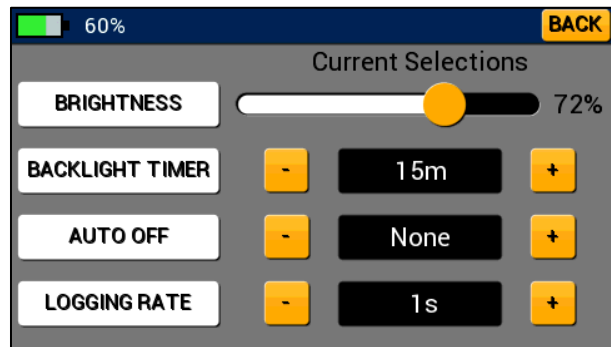


Figure 33: Device Settings Menu

**Brightness:**

Brightness can be used to adjust the intensity of the LCD backlight in a range of values from 6 to 100%. Increasing the backlight intensity may help viewability in different lighting but will also decrease the battery life.

**Backlight Timer:**

The backlight timer sets the duration of the backlight since last user input. If the backlight timer is set to a higher value, the backlight will remain on for a longer period but at the cost of decreased battery life. After the backlight turns off, it can be toggled on at any time with a quick press of the power button or a tap of the touch screen. The backlight timer can be adjusted in eight increments: 5s, 15s, 30s, 45s, 60s, 5m, 10m, and 15m.

***Auto Off:***

The auto off timer will automatically power the unit down if there has been no user input for the selected duration of time. This feature can be used to significantly increase the battery life of the manifold. The Auto Off Timer can be set to four increments: 15m, 30m, 1hr, and None. Selecting None will prevent the unit from auto powering off.

**NOTE:** If attempting to capture datalogs for an extended period, ensure that the Auto off timer is set to none. If the auto off timer is not set to none, the device will power off after the set time interval and any additional datalogging information will be lost.

***Logging Rate:***

Logging rate sets the time interval for how often a data sample is stored. It may be tempting to set the logging rate to the lowest possible time interval (1s) but this may result in extremely large datalog files making it difficult to analyze the information. Be sure to set the logging rate to an appropriate interval for the conditions being tested. The logging rate can be set to thirteen different time intervals: 1s, 5s, 10s, 30s, 1m, 5m, 10m, 30m, 1hr, 2hr, 6hr, 12hr, and 24hr.

## Chapter 5: Mantooth App Integration

### **Overview:**

The P51-870 TITAN™ features a Bluetooth low energy radio and is fully compatible with both the iOS and Android Mantooth™ Apps V3.0 or later. The Mantooth app in conjunction with the P51-870 TITAN™ can be used to remotely monitor system pressure, temperature, vacuum, and perform target superheat and subcool calculations. Additionally, the Mantooth app can generate its own datalog files and job reports.

### **Operation of the Mantooth App with the P51-870 TITAN™:**

Before the P51-870 TITAN™ can be used with the Mantooth App, the Mantooth App must be installed and updated to version 3.0 or newer on the desired mobile device. Before using the Mantooth App, ensure that the manifold is paired to the desired mobile device.

For Android devices, navigate to the Bluetooth utility and make sure the manifold is powered on. The P51-870 TITAN™ should appear in the available devices menu as the name of the device followed by the serial number (Ex. YJP51-1801-0103) as seen in Figure 34. Select the appropriate device and it should appear in the paired devices menu.

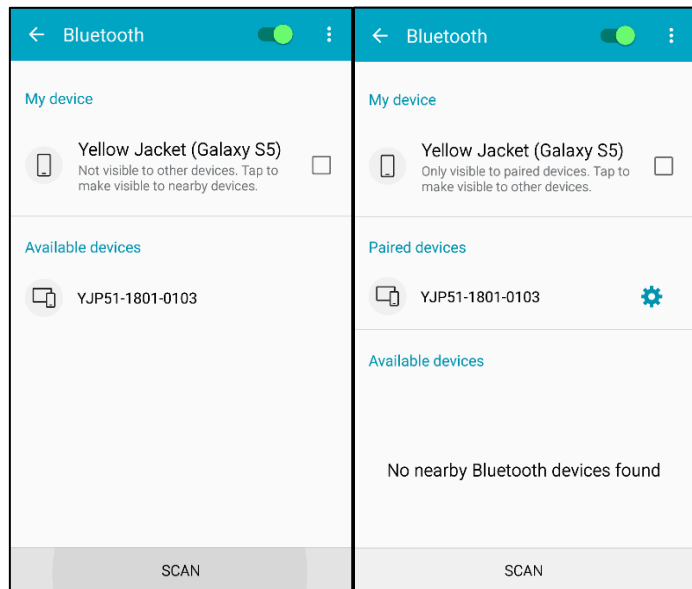


Figure 34: Android-Pairing a P51-870 TITAN™

For iOS devices, the manifold does not need to be paired through the Bluetooth utility. The P51-870 TITAN™ will be available to connect through the Mantooth App if the device is powered on and the Mantooth App is updated to version 3.0 or newer.

For instructions on operating the Mantooth App, selecting or adjusting settings, retrieving datalog files, generating job reports, and all other features of the Mantooth App, please see the Mantooth User Guide by following the hyperlink below.

When the P51-870 TITAN™ is connected to a mobile device via Bluetooth, the LED will flash violet every second.

## Chapter 6: Maintenance

### **Overview:**

Basic operator maintenance is covered in this chapter. For more extensive maintenance and for repair, contact Ritchie Customer Service. See Chapter 1 for contact information.

### **General Maintenance:**

Since this instrument may be used in the presence of a wide range of chemical liquids and vapors, it is recommended that the case be cleaned often with a damp cloth and mild detergent such as dish soap.

Although the resistive display is tough and suitable for typical industrial use, take care when cleaning the display as clarity is a critical component of this instrument:

- Normally, the display can be cleaned as one would clean plastic eyeglass lenses: Use a soft, 100% cotton or microfiber cloth and water or eyeglass lens cleaning solution. Do not use paper products.
- If the display is very dirty, generously soak a soft cloth with warm, soapy (dish soap) water and place the cloth for a couple of minutes over the display to loosen any stubborn dirt. Wipe off excess water with a clean, less dampened, 100% cotton or microfiber cloth, and complete the cleaning using the normal display cleaning method described above.
- DO NOT place the device under running water, always use a dampened cloth to transport liquid to and from the device.

### **Replacement Parts:**

If parts are damaged please see Table 6-1 for replacement part numbers.

<b>UPC#</b>	<b>Description</b>
67030	Vacuum Sensor
67010	Temperature Probe
67012	USB Cable
10146	Replacement Backpack
21990	(3) 60" RYB (standard Fittings); (1) 60" Y (3/8" str x 3/8" 45° Quick Coupler)
18160	BBA-60 CHARGING HOSE
29985	3-PAK HBVV-60 -RYB-
29425	R410A-BV60 EU BLUE HOSE
29465	R410A-BV60 EU RED HOSE

## Chapter 7: Device Specifications

<b>Table 7-1: Physical Specifications</b>	
Maximum Pressure	700 psia (48.3 bar)
Operating Temperature	140 to -4°F (60 to -20°C)
Storage Temperature	140 to -4°F (60 to -20°C)
Battery Life	4 hrs continuous Backlight
	80 hrs no Backlight
Size	Approx. 7.5" x 8.5" x 4.25"
Weight	2.63 lbs

<b>Table 7-2: Instrument Specifications</b>	
Working Pressure	0 – 700 psia (48.3 bar)
Pressure Sensing Resolution	0.1 psi, 0.1 bar, 1 kPa
	0.001 MPa, 0.01 kg/cm <sup>2</sup>
Pressure Sensing Accuracy	0.5% of full scale at 77°F (25°C)
	1% of full scale 55 to 130°F (13 to 54°C)
	2% of full scale -40°F to 248°F (-40 to 120°C)
Temperature Sensing Range	Sensing element: -40 to 266°F (-40 to 130°C)
	Max Cord temp: 176°F (80°C)
	Max Clamp Temp: 203°F (95°C)
Temperature Sensing Resolution	0.1°F or °C
Temperature Sensing Accuracy	±0.36°F (±0.2°C)
Vacuum Sensing Range	5 to 100000 microns
Vacuum Sensing Resolution	1 micron

## Chapter 8: Troubleshooting Guide

Table 8-1: P51 Troubleshooting			
Model(s)	Problem	Possible Cause(s)	Possible Solution(s)
P51-860 P51-870	Screen does not display anything	Screen is auto-dimming, backlight is off	Check backlight auto-dimming timer (P51-870 only) Tap power button or anywhere on display to power on backlight (P51-870 only)
		Device is not powering on	Make sure manifold is sufficiently charged
		Screen is damaged	Contact technical support
P51-860	Screen has dimmed	Backlight has turned off	Tap power button to power on backlight Check backlight auto-dimming timer in device settings
		Screen is damaged	Contact technical support
P51-870	Screen not responding to touch	Display not calibrated properly	Recalibrate display (see User Manual/Quick Start Guide)
		Display is damaged	Contact technical support
		Device is connected to PC	Disconnect from PC
P51-860 P51-870	Device not responding to button press	Buttons/overlay damaged Device is connected to PC	Contact technical support (P51-860 only) Disconnect from PC
P51-860 P51-870	Pressure Transducers won't zero	Manifold is under pressure Pressure transducers damaged	Make sure manifold is vented to atmosphere Contact technical support
P51-860 P51-870	Temperature reading incorrect/not displaying	Temperature clamp barrel connector not fully seated in back of manifold	Check temperature clamp connections on back of manifold
		Temperature clamp/cable damaged	Call technical support
		Temperature clamp jacks damaged	Call technical support
		Clamp not properly attached to system	Check clamp connections to system
		Low-Side and High-Side readings reversed	Make sure T1 is attached to system low-side, T2 to system high-side
Wrong PT readings mode selected	Make sure Tsy mode is selected (P51-860 only)		
P51-860 P51-870	Vacuum reading incorrect/not displaying	Vacuum probe barrel connector not fully seated in back of manifold	Check vacuum probe connections on back of manifold
		Vacuum probe/cable damaged	Call technical support
		Vacuum probe jacks damaged	Call technical support
		Probe not properly attached to system	Check vacuum probe connections to system
		Vacuum probe plugged into wrong jack	Make sure vacuum probe is plugged into A1 or A2 jacks (P51-870 only)

P51-860 P51-870	Pressure readings incorrect	Pressure transducers not zeroed properly	Make sure pressure transducers are zeroed before use
		Pressure transducers damaged	Call technical support
P51-860 P51-870	Manifold not holding pressure/vacuum	Knobs are open	Check position of knobs
		Manifold damaged/leaking	Call technical support
		Hose connections not tightened properly	Check hose connections
P51-860 P51-870	Device not recognized when connected to PC	USB cable not connected properly	Check USB connection to P51 manifold and PC
		Device not powered on	Power on P51 manifold for data transfer
		USB cable damaged	Use alternate USB cable
		Manifold damaged	Call technical support
P51-860 P51-870	Unable to save new data logs	Device memory full	Upload existing datalogs and clear system memory (upon next power up)
		Manifold damaged	Call technical support
P51-860 P51-870	Manifold not charging, LED not solid green	USB cable not connected properly	Check USB connection to P51 manifold and power source
		USB cable damaged	Use alternate USB cable
		Device fully charged	No action
		Manifold damaged	Call technical support
P51-860 P51-870	Unable to establish Bluetooth connection	Device is not powered on	Make sure P51 manifold is powered on
		Bluetooth not enabled on mobile device	Enable Bluetooth on the mobile device
		ManTooth App old version	ManTooth app must be version 3.0 or newer
		Manifold not paired to mobile device	Pair manifold with mobile device using Bluetooth settings utility (Android only)
		Manifold not within range of mobile device	Ensure manifold and mobile device are within range (~400 ft)
P51-860 P51-870	Bluetooth connection lost	Manifold has been powered off	Adjust auto-off timer
		Mobile device has moved out of range	Move mobile device back into range of manifold
P51-860 P51-870	LED is flashing red and device is powering off immediately	Battery charge is critically low	Charge manifold battery
P51-860 P51-870	LED is solid purple and screen does not display anything	User has entered updater mode	Hold power button for 3 seconds until LED powers off