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LEGEND SERIES™

HVAC/R

REFRIGERANT ANALYZER OPERATION MANUAL



Manual Part Number:
5-06-7000-81-1, 7-08-1234-
40-0

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069706 Rev. A

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For Your Safety:

PLEASE READ THIS MANUAL IN ITS ENTIRETY BEFORE ATTEMPTING INSTALLATION OR OPERATION! Attempting to operate this tool without fully understanding its features and functions may result in unsafe conditions.

Analyzer Warnings

- **REFRIGERANT BLEND WARNING:** This refrigerant analyzer is approved for specific refrigerant testing and should not be used with substances outside the scope of the device. Cross-contamination with other refrigerant types causes severe damage to the A/C system, to service tools, and equipment. Do NOT attempt to adapt the unit for another refrigerant. Do NOT mix refrigerant types in a system or in the same container.
- **SAMPLE HOSE WARNING:** Replace the sample hose AS SOON AS LIQUID, OIL OR RED SPOTS (DISCOLORATION) BEGIN TO APPEAR ON THE INSIDE DIAMETER OF THE SAMPLE HOSE OR WHITE FILTER ELEMENT. Failure to properly maintain and replace the sample hose will result in severe damage or inaccurate results.
- **FLAMMABILITY WARNING:** Some systems may contain flammable refrigerants such as hydrocarbons. Failure to follow the manual can result in serious injury or death. Less than 2 grams of refrigerant are vented with each sample. This analyzer is designed with sealed heat sources and without sparking components.
- **SAMPLE INPUT WARNING:** DO NOT attempt to introduce liquid or samples heavily laden with oil into the vapor sampling hose configuration. Damage caused to the instrument due to the use of the wrong hose configuration on the wrong port will void the warranty!
- **BATTERY CHARGING WARNING:** When charging the internal battery with the supplied power supply, the power supply may become warm. If the power supply becomes warm, unplug the cord immediately! When charging multiple analyzers, allow the charger to cool between each battery.
- **AIR SENSOR WARNING:** The air detection sensor is a chemical fuel cell sensor that will eventually expire. The user must return the unit to an approved vendor in order to replace the air detection sensor whenever the instrument indicates as such. Failure to replace the air detection sensor will result in non-functionality of the instrument.
- **POWER SOURCE WARNING:** Connection to power sources greater than 13VDC could cause “out of warranty” damage.
- **OPERATIONAL WARNING:** If the equipment is used in a manner not specified by the manufacturer, the protection by the equipment may be impaired.

General Cautions



- **ALWAYS** wear eye and skin protection when working with refrigerants. Escaping refrigerant vapors will present a freezing danger. Do NOT direct refrigerant escaping from the sample hose toward exposed skin or toward the face.
- **ALWAYS** turn the compressor or power source *OFF* before connecting the instrument to an HVAC/R system.



- **ALWAYS** inspect the sample hose before each use. Replace the hose if it appears cracked, frayed, obstructed or fouled with oil.
- **DO NOT** direct refrigerant vapors venting from hoses towards the skin.



- **DO NOT** disassemble the instrument. There are no serviceable components internal to the instrument and disassembly will void the warranty.
- **ALWAYS** place the analyzer on a flat and sturdy surface.
- To reduce the risk of electrical shock, do NOT disassemble the instrument; do not use the instrument in wet or damp areas.
- Some systems may contain hydrocarbons or flammable refrigerants. This analyzer is designed with sealed heat sources and without sparking components. Ensure adequate ventilation and always take proper precautions when working with refrigerants.



- **DO NOT** breathe refrigerant and lubricant vapor or mist. Exposure may irritate eyes, nose, and throat. If accidental system discharge occurs, immediately ventilate the work area. There must be adequate ventilation when operating this device.



- **DO NOT** utilize any hose(s) other than those supplied with the instrument. The use of other hose types will introduce errors into the refrigerant analysis and instrument calibration.
- **ALWAYS** verify that the refrigerant does not contain or will not emit heavy loads of oil or liquid.



- **NEVER** admit any sample into the instrument at pressures in excess of 500 *psig*.
- **NEVER** obstruct the air intake, sample exhaust or case vent ports of the instrument during use.
- **DO NOT** utilize the coupler supplied on the service end of the Sample Hoses for any application other than with this instrument. The coupler supplied is a modified version that does not contain a check valve and is not suitable for any other refrigerant application.

WELCOME

Thank you for purchasing the *Legend Series*[™] Refrigerant Analyzer.

The *Legend Series*[™] Refrigerant Analyzer is designed for determining the purity of common gaseous refrigerants. It has many features to offer the user, which will be described in this manual. We recommend that all personnel who use this instrument read this manual to become more familiar with its proper operation.

1

INTRODUCTION AND OVERVIEW

General

Contamination of refrigerants either in storage cylinders or HVAC/R system can lead to component corrosion, elevated head pressures and system failures when utilized by unsuspecting technicians. The ability of the technician to determine refrigerant type and purity is severely hampered by the presence of air when attempting to utilize temperature-pressure relations. The development of various substitute refrigerants further complicates the ability of a technician to identify refrigerant purity based upon temperature-pressure relationships.

The *Legend Series*[™] HFC Refrigerant Analyzer will provide a fast, easy and accurate means to determine refrigerant purity in refrigerant storage cylinders or directly in an HVAC/R system. The instrument utilizes non-dispersive infrared (NDIR) technology to determine the weight concentration of many common refrigerants.

The instrument is supplied complete with a ¼" Flare Vapor Sampling Hose, ¼" Flare Liquid Sample Hose, Hose Extensions for ease of connection, a High-Pressure Liquid Sample Trap Assembly, a 100-240 VAC power transformer, built in rechargeable Lithium-Ion battery, thermal printer, and all required plumbing housed within a rugged, portable, storage case.

Sample gas is admitted into the instrument through the supplied sample hose and presented to the sensing device. The instrument provides the user with a digital display of refrigerant purity or identified refrigerant. The instrument only considers the weights of the refrigerant and contaminants in the total mixture. Air is measured, and displayed, separately. Other contents such as refrigerant oil, moisture and dye are not considered contaminants.

The instrument interfaces with the user via a full color graphic LCD, audio indications and soft key command buttons. Alarm indications are provided to alert of instrument fault conditions or contaminated refrigerant presence.

1.1 Features

The *Legend Series*™ HFC Refrigerant Analyzer is the most precise portable instrument ever manufactured for field applications to determine the purity of gaseous refrigerants in the HVAC/R market.

Features Include:

- Quickly and accurately determines refrigerant purity
- Advanced ergonomic design
- Analyzes percentage purity
- Identifies specific refrigerants
- Displays percentage AIR independent of the refrigerant sampled
- Multiple Languages:
 - English, German, Spanish, French, Italian, Portuguese, Chinese, Japanese, Korean and Russian
- Vapor or Liquid Sampling
- Easily prints test results with built-in printer
- Uses Standard 2.25" (57 mm) thermal paper
- Improved oil resistance with user replaceable hose assembly
- Full Color Graphic LCD with on-screen instructions
- Ultra-fast test time
- Internal, rechargeable Lithium-Ion battery for cordless operation in any location
- USB Port for test data storage and software updates (USB Drive not included)
- All accessories stored in hard shell carry/storage case

1.2 Legend Series™ HFC Components

Legend Series™ HFC Base Unit

The *Legend Series™* HFC unit houses the Full Color Graphic LCD, Infrared Bench, Electrical Connections, and Rechargeable Battery. The device is factory calibrated and completes an air calibration to confirm infrared signals before testing. These components require no maintenance, therefore **there are no serviceable components internal to the instrument, and disassembly will void the warranty.**



Legend Vapor Sample Hose

The 6.5-foot (2 meter) Sample Hose is constructed of polyurethane ether. The hose is provided with an instrument inlet port mating connector on one end and a brass flow restrictor on the other end. The brass flow restrictor screws into the ¼" Flare coupler. The sample hose is considered a consumable maintenance part. A spare Sample Hose is also provided. Maximum pressure is 500 psig (35 Bar).



Analyzer End

Service End

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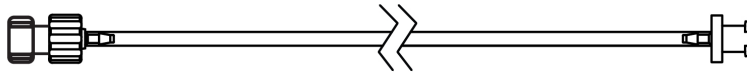
1/4" Flare Coupler

The 1/4" Flare coupler is designed for easy connection to a cylinder or HVAC/R system. The coupler can be used for vapor or liquid sampling. Liquid sampling will require the use of the liquid sample hose and liquid sample syringe.



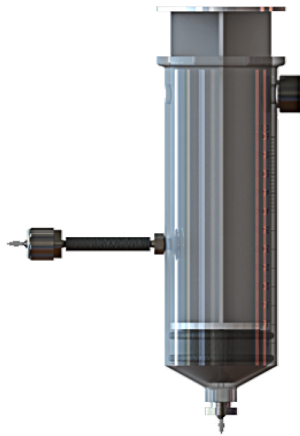
Sample Hose Extensions

The sample hose extensions allow the user to easily connect and disconnect the hose assembly to the analyzer. The extension is connected directly to the analyzer and the sample hose connects to the male ferul on the opposite end.



Liquid Sample Trap

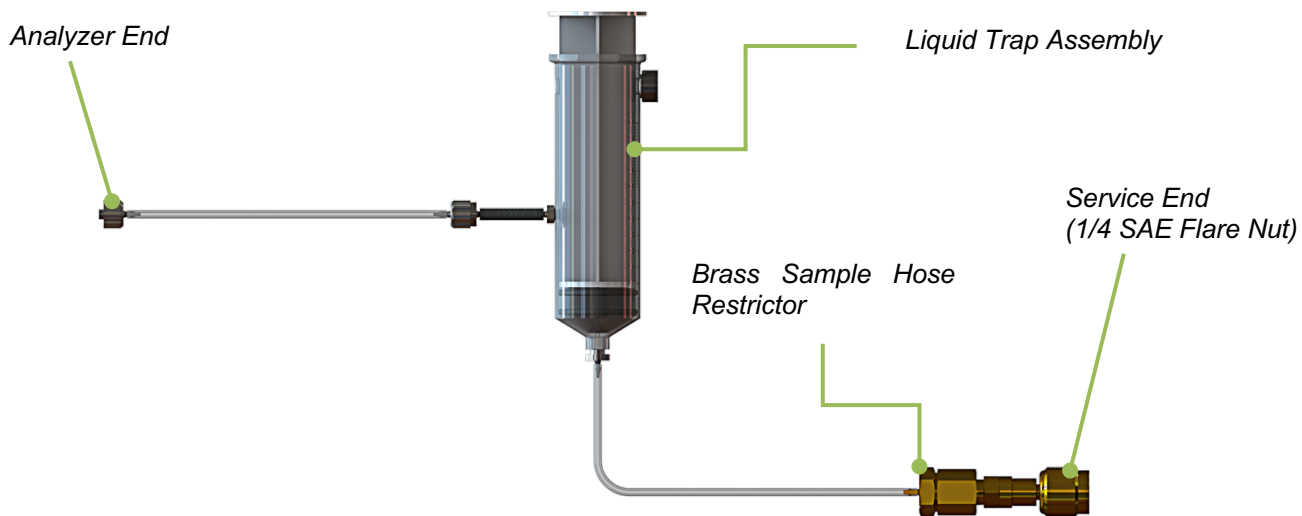
The liquid sample trap is designed as a barrier to oil or liquid refrigerant entering the analyzer. During liquid sampling, the syringe will collect oil which may be present in the liquid sample and act as the catalyst for refrigerant to change phases from liquid to vapor. Liquid sampling will provide a more accurate analysis of multicomponent refrigerants.



Liquid Sample Hose

The 6.5-foot (2 meter) Liquid Sample Hose configuration is constructed of a polyurethane tube with an oil reservoir. A Brass Sample Hose Restrictor acts to transform Liquid refrigerant to Vapor at the sample connection point while the Liquid Sample Trap assembly collects oil and provides a means of expulsion after the test is complete. The syringe is provided with a magnet for attaching it to the tank, an instrument inlet port mating connector on one end and a ¼" SAE female flare coupling nut on the service end. The maximum pressure is 500 psig (35 Bar).

NOTE: The analyzer will indicate "Error #5" if the analyzer does not receive a good sample due to obstructed flow or lack of flow. If this occurs the Brass Sample Hose Restrictor may need to be replaced.



AC Power Adapter

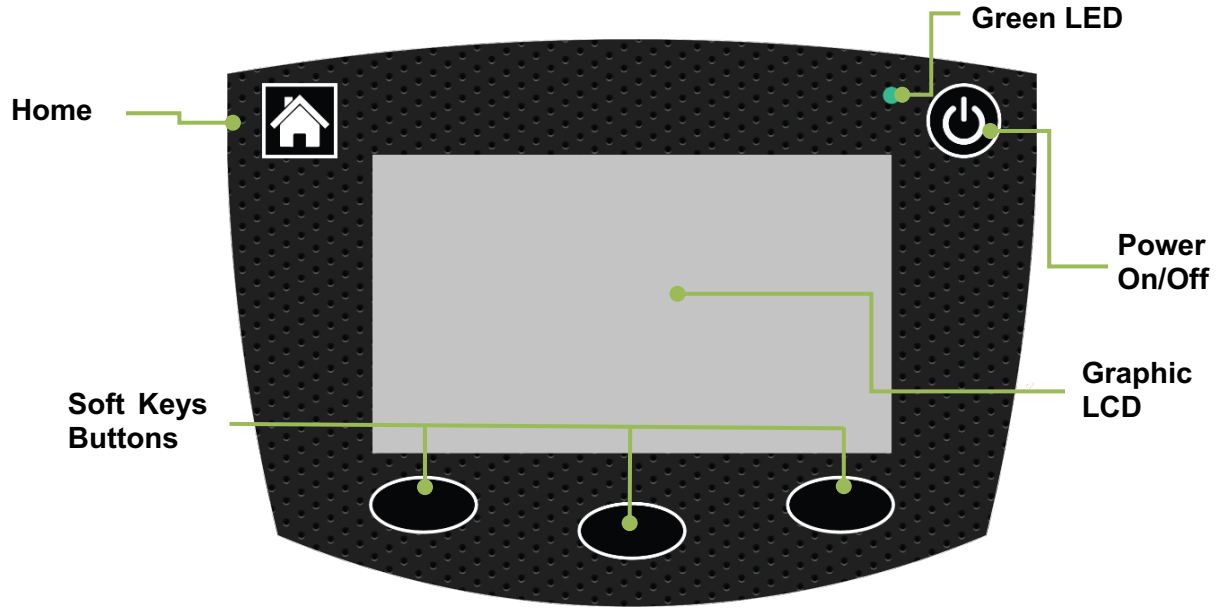
The *Legend Series*™ is powered via a rechargeable Lithium-Ion battery. You can also power the unit with the AC Power Adapter which converts a standard 100-240VAC 50/60Hz wall outlet to 12VDC, 1.6A. This AC Power Adapter will charge the battery when connected to the analyzer.



NOTE: Use of any other power source may cause damage to the unit and void the warranty.

Control Panel

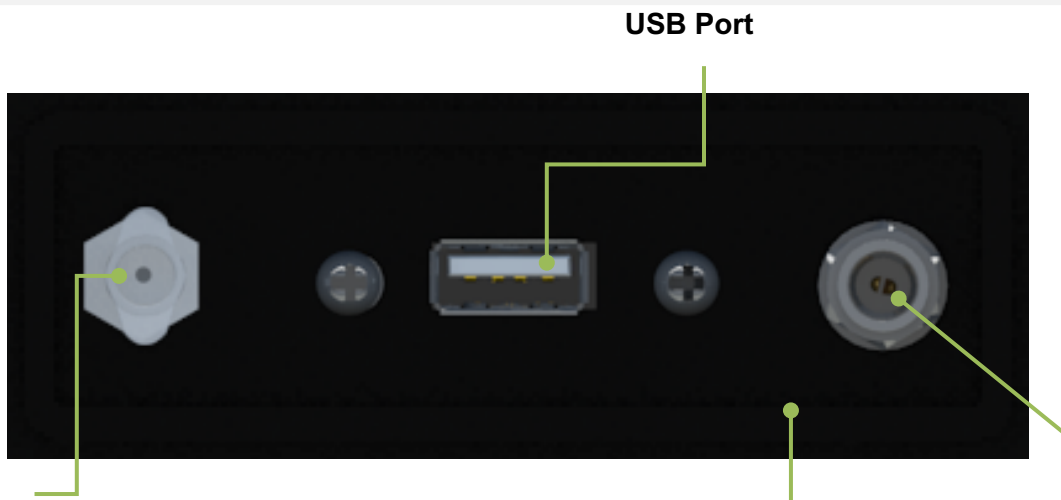
The Control Panel serves as the main user interface. The Control Panel features three soft key buttons. The current function for each button is displayed above the Soft Key Buttons on the full color graphic LCD. A Home button and a Power button are also found at the top of the control panel.



Back Panel Connections

The connections located on the back panel are illustrated below.

CAUTION: The sample outlet port should never be obstructed. Keep the sample outlet port free and clear at all times. Do not operate near open flames.



Hard-Shell Storage/Carrying Case

The hard-shell storage/carrying case is custom fit to the *Legend Series*[™]. It provides rugged protection for the instrument, as well as convenient storage for all components. The enclosure is general purpose and is *not* watertight.

2 LEGEND SERIES™ HFC OPERATION

2.1 First Use

The *Legend Series*™ HFC has a built in Lithium-Ion battery. Prior to first use **charge the battery for a minimum of 2 hours** with the included AC Power Supply. The analyzer will function and charge the battery when the AC Power Supply is connected.

2.2 Power On the Analyzer


Press the upper right power button  and the splash screen shown in **(Figure 1)** will appear. Press the right soft key for 'Next' and the device will warm up as shown in **(Figure 2)**. Warm up will take approximately 30 seconds.



Figure 1

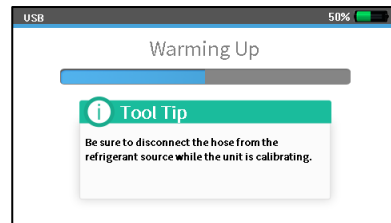


Figure 2

Once the analyzer warms up, the screen in **(Figure 3)** will appear offering the option to change settings or start an analysis. If you wish to adjust factory 'Settings', select the left soft key and refer to section **3 Maintenance & Troubleshooting**.

To begin an analysis, select the right soft key to 'Start.' Next use the left and right soft keys to scroll through available refrigerant options and the center soft key to select the refrigerant you wish to test **(Figure 4)**.

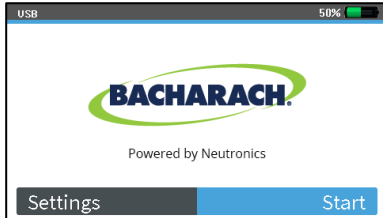


Figure 3

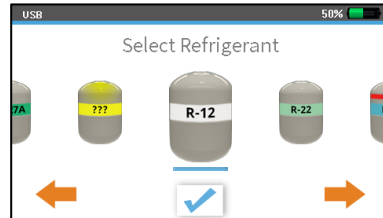


Figure 4

2.3 Calibration

Each time the *Legend Series*[™] HFC begins a new test cycle it must complete an air calibration. The calibration takes 30 seconds and pulls fresh air into the unit via an internal pump. This fresh air purges any excess refrigerant from the unit and ensures accurate test results. Calibration **REQUIRES** the ¼" Flare Vapor sample hose be connected to the device and disconnected from the refrigerant source.

Once the sample hose is connected to the analyzer, press 'Start' to begin an air calibration, as shown in **(Figure 5)**. This will begin the calibration process and display the Calibrating screen shown in **(Figure 6)**.

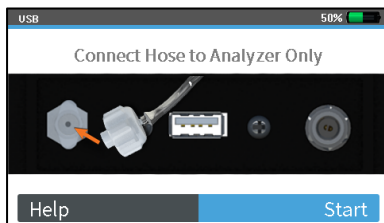


Figure 5

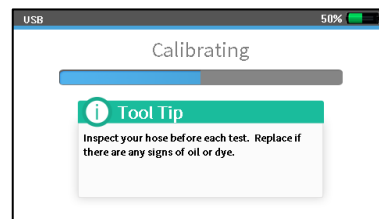


Figure 6

2.4 Testing the Refrigerant

After the air calibration is complete, the instrument is ready for to begin the refrigerant analysis. The analyzer will direct you to connect the hose to a refrigerant source as shown in (Figure 7). Open the refrigerant source valve, if equipped, and allow the refrigerant to flow for a few seconds. Next press the 'Test' button to begin the test. The Testing screen shown in (Figure 8) will display.

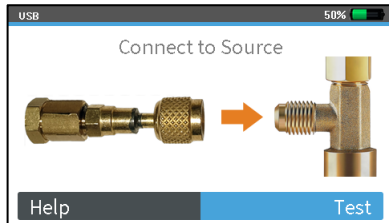


Figure 7

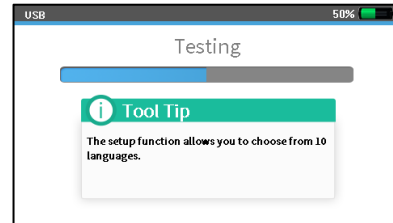


Figure 8

TIP: A refrigerant source with a pressure <30 psig (2 Bar) may require additional flow time to generate an accurate result. Low pressure samples will take more time to fill the sample bench and require this additional flow time before the user presses 'Test.'

2.5 Viewing the Test Results

Upon completion of analysis, the *Legend Series™ HFC* will display (Figure 9). Close the refrigerant source valve if equipped, and then disconnect the coupler from the refrigerant source. Select 'Results,' which will display the test results (Figure 10). The percentage displayed for each refrigerant indicates the total purity weight of that refrigerant, equaling 100%, with air measured independently. Pressing 'Print' will print the test results. Pressing 'Print Prior 5 Results' will print the last 5 tests completed.

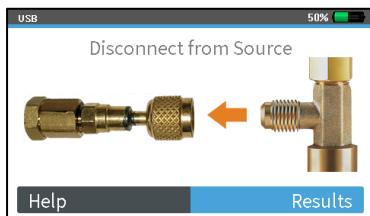



Figure 9

R-410A			
R-22	0.0%	R-143a	0.0%
R-32	0.0%	Hydrocarbons	0.0%
R-125	0.0%	Unknown	0.0%
R-134a	0.0%	Air	0.0%

Figure 10

Verify the hose is disconnected from the refrigerant source and press 'Exit' to return to the main screen (Figure 11). When you are ready to power down the device press the power button  and the powering down screen will appear (Figure 11a).

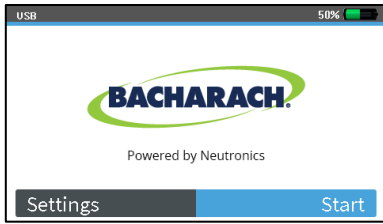


Figure 11



Figure 11a

2.6 Understanding Test Results

The Legend Series™ HFC is designed to analyze or identify a wide array of refrigerants. Before sampling a gas, you should select the refrigerant you anticipate testing to accurately align the calibration (Figure 12). If the wrong base refrigerant is selected the analyzer will still provide accurate single component refrigerant outputs but may not confirm the refrigerant matches the refrigerant selected (Figure 13).

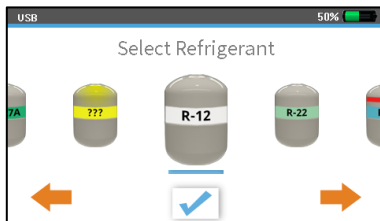


Figure 12

R-410A	
R-22	0.0%
R-32	0.0%
R-125	0.0%
R-134a	0.0%
R-143a	0.0%
Hydrocarbons	0.0%
Unknown	0.0%
Air	0.0%

Buttons: Exit, Print Prior S Results, Print

Figure 13

The refrigerant analyzer is designed to provide visual cues after analysis is complete. There are six possible result screens that may display. After an analysis, a user may find the refrigerant is as EXPECTED, IMBALANCED, CONTAMINATED, DILUTED, an IDENTIFIED refrigerant, or UNKNOWN. Explanation of each possible result is defined below.

Expected Refrigerant:

Refrigerant analyzed and found to be within an acceptable composition range of the selected gas will define the results as that refrigerant and display a **green** screen (**Figure 14**). In this example, R-410A is confirmed with some slight composition shift. The R-410A is still within composition specification of AHRI Standard 700 which qualifies it as R-410A.

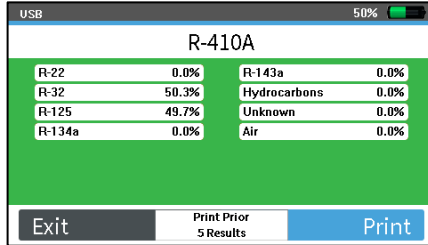


Figure 14

Imbalanced Refrigerant:

Refrigerant analyzed and found to have the required components but outside the AHRI Standard 700 acceptable range will display as Imbalanced with a **yellow** screen (**Figure 15**). In this example, Imbalanced R-410A is confirmed with composition shift. The R-410A has the correct components but is too far outside the acceptable range to be considered ideal.

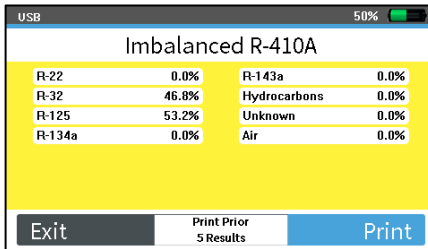


Figure 15

Contaminated Refrigerant:

Refrigerant analyzed and found to be contaminated has the expected base components, but some other refrigerant(s) is present diluting the entire sample. This refrigerant would have a **red** screen to indicate it is unacceptable and should not be recovered with pure gas or reused (**Figure 16**). In this example, Imbalanced R-410A is contaminated with R-22.

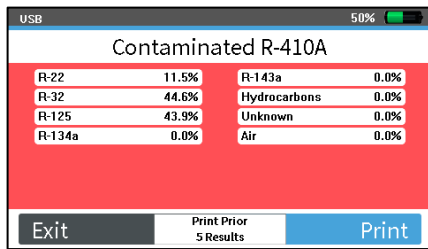


Figure 16

Diluted Refrigerant:

Refrigerant analyzed and found to be diluted will have the expected base components with any level of Air present in the sample. This refrigerant would have a **yellow** screen to indicate the Air has contaminated the sample (**Figure 17**). Air can be removed from refrigerant but can be harmful if present inside a system. Air left in a system can alter P/T curves, lead to moisture accumulation and acid buildup. Both will cause a system to work inefficiently and lead to possible system failure. In this example, Diluted R-410A is contaminated with Air.

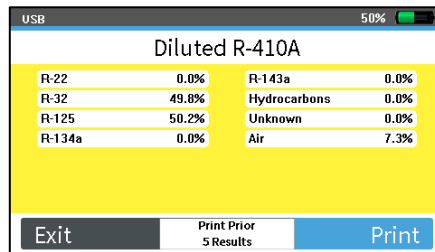


Figure 17

Identified Refrigerant:

Refrigerant analyzed and found to be an identified gas will not display composition of the refrigerant. Instead, the analyzer confirms the refrigerant matches the expected identified gas with a **green** screen and provides channel data to reference as a “fingerprint” model of that gas (**Figure 18**). In this example, R-1234yf is Identified as R-1234yf. The channel output provides a “fingerprint” of this gas. This channel data can be documented and used for future cross reference to confirm the quality of the identified refrigerant.

Note: The channel data is representative of the IR signal detected. It is not representative of any specific refrigerant, is not measured as a % by weight and only indicates an optical response. Channel data should be used as a reference to help improve accuracy of Identified Refrigerants.

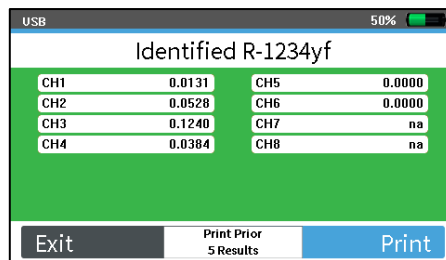


Figure 18

Unknown Refrigerant:

Refrigerant analyzed and found to be an Unknown gas is a gas that does not match any of the refrigerants directly measured by the device. A yellow screen will appear to indicate caution as the gas is unknown (**Figure 19**). If you believe the sampled refrigerant should be measured by the device restart the analysis and confirm you select the appropriate refrigerant before calibration. Unknown refrigerant should be handled with care as there is no certainty to what refrigerant is present.

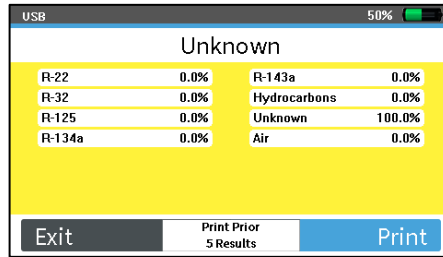


Figure 19

If an error message appears at all during or after analysis. Refer to section **3 Maintenance and Troubleshooting**.

3 MAINTENANCE & TROUBLESHOOTING


3.1 Replacing the Sample Hose Assembly.

In the event the analyzer displays an Error #3 or Error #5 this may be an indication the sample hose needs replacing. This will occur when the integrated flow restrictor becomes clogged with oil, debris, or sealant. It can also occur if there is inadequate flow of refrigerant in a cylinder or refrigerant source. Replacement hoses for both the vapor and liquid sample hose are provided in the kit. Additional replacements are listed on the spare parts list in section 4 **Appendices**.

To replace the Sample Hose Assembly, follow the instructions below:

- 1) Disconnect the sample hose from the refrigerant source and Analyzer
- 2) Remove the brass restrictor end (with hose attached) from the coupler and discard. Be sure to use a backing wrench as not to damage the coupler.
- 3) Check for signs of oil and debris in the coupler.
- 4) If oil or debris is present, use a cleaner which ONLY contains, Tetrachloroethylene and carbon dioxide, follow safety instructions on the can and spray all parts of the coupler with the cleaner to remove any oil. DO NOT soak the part for more than 60 seconds.
- 5) Allow coupler to dry. Check coupler for oil once again. Failure to clean the oil out of the coupler will result in premature obstruction of the new sample hose.
- 6) Install the brass end of the new sample hose assembly into the coupler and lightly tighten, usually finger tight is sufficient.

3.2 Information Screens

An “Information” icon  or ‘Help’ indication will appear at various points throughout the testing process. This button will provide additional information or tips about the command screens to help complete your analysis.

3.3 Software Updates

Software updates may be made available to improve operating performance or add additional features. Some updates will be provided at no charge to improve operating efficiencies while others will be optional, paid upgrades, to add new refrigerants or functions.

The *Legend Series*™ HFC has a USB update port located on the Back-Panel Connections. This port should not be used for any other purpose other than to install factory updates or when saving test data to an external USB Drive. **IF YOU DO NOT REGISTER THE ANALYZER, WE WILL NOT BE ABLE TO INFORM YOU OF ANY SOFTWARE UPDATES!**

3.4 Settings

Pressing the 'Settings' button as shown in (Figure 18) will provide access to various device settings as shown in (Figure 19).

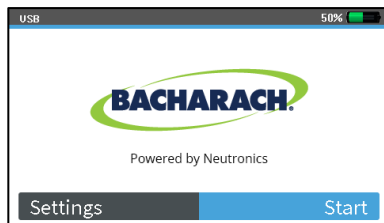


Figure 18

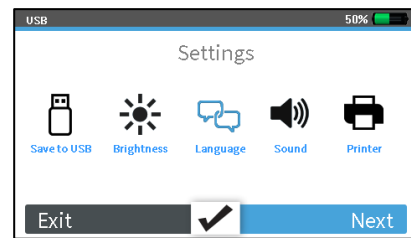


Figure 19

Using the 'Next' button, scroll to the desired setting you wish to change.

Use the button to select the setting and the left button to return to the previous screen.

- **Save to USB:** This feature can be activated when an external USB drive is connected in the USB port on the top of the device. With the USB drive in place, selecting 'Save to USB' will save all test data to the USB drive. The data is extracted in .txt (text file) and can then be extracted for electronic file management.
- **Brightness:** Enhances or dims the brightness of the LCD screen.
- **Language:** Change the language to one of 10 available languages.
 - **English (default)**
 - German
 - Spanish
 - French
 - Italian
 - Portuguese
 - Chinese
 - Japanese
 - Korean
 - Russian
- **Sound:** Turns sound ON or OFF
- **Printer:** Information on how to load the printer paper

When finished adjusting the settings, press 'Exit' to return to the home screen.

3.5 Error Messages

In the unlikely event an Error message is displayed on the screen, follow the on-screen prompt associated to the Error. Error messages that will appear include:

Error #1: The air or gas readings were unstable.

- Solution: Rerun test
- Solution: If problem persists contact manufacturer

Error #2: The air or gas readings were excessively high.

- Solution: Rerun test
- Solution: If problem persists contact manufacturer

Error #3: The air calibration resulted in a low sensor output.

- Solution: Prevent refrigerant from flowing into the unit through the sample inlet during air calibration.
- Solution: Verify no oil contamination is present in sample hose or sample filter
- Solution: Verify that the air intake and the exhaust are not obstructed
- Solution: Verify that the white filter is correctly plugged into the rubber grommets.
- Solution: Allow any refrigerant in the atmosphere to dissipate before performing air

Error #4: The unit is beyond the operating temperature range.

- Solution: Move the unit to an area where the ambient temperature is within the specified operating range.

Error #5: The refrigerant sampled has an excessively large amount of air or there was a little or no sample flow due to a closed valve or plugged sample filter. This is the code to prompt the user to change the brass filter. This should be considered more as a prompt than an actual error.

- Solution: Verify the refrigerant source is open and flowing.
- Solution: Verify the sample filter is not plugged with debris or oil.
- Solution: Replace brass sample filter.

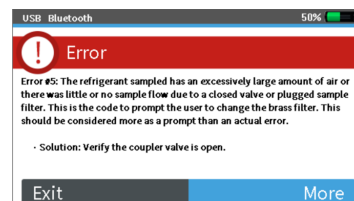
Error #6: The air sensor has expired and must be replaced before the analyzer can be used.

- Solution: If problem persists contact manufacturer

Error #7: The gas pressure is out of range

- Solution: Verify the SAMPLE EXHAUST port is not obstructed.

If an Error message reappears, contact your local service department.



4 APPENDICES

4.1 Spare Parts List

PART NUMBER	DESCRIPTION
5-06-7000-81-1	Operating Manual
6-01-6000-74-0	AC Power Supply
6-01-6001-23-1	Liquid Sample Hose
6-02-6001-17-0	Liquid Sample Trap
6-02-6001-41-1	Sample Hose Extensions
6-02-6001-42-0	Vapor Sample Hose
6-02-6001-54-0	1/4" Flare Coupler

4.2 Specifications

SAMPLE PARAMETERS:	Vapor or Liquid depending on hose configuration, oil-free
PRESSURE:	Max Pressure 500 psig (35 Bar) Low Pressure samples <30 psig (2 Bar) will require additional flow time for accurate analysis
HFC MODEL:	Analyzed Refrigerants (displays % purity): <ul style="list-style-type: none"> R-22, R-32, R-134a, R-404A, R-407C, R-410A, Hydrocarbons (HC) and Air Identified Refrigerants (NO % purity): <ul style="list-style-type: none"> R-12, R-1234yf, R-408A, R-409A, R-417A, R-421A, R-421B, R-422A, R-422B, R-422C, R-427A
SENSOR TECHNOLOGY:	Non-Dispersive Infrared (NDIR)
REFRIGERANT SAMPLE SIZE:	2 grams per sample
POWER:	Power Supply: Input: 90-264VAC, 50-60HZ Output: 12VDC, 1.6 AMP Built in Lithium-Ion Battery:
OPERATIONAL TEMPERATURE:	50-120°F (10-49°C)

Note: "HC" refers to "Hydrocarbons". Hydrocarbons are flammable contaminants such as R290, R600, R600a, R152a etc.