

Ultimate Bar Graph Engine Analyzer

(UBG-16)

Operating Instructions

OI 0505991

5/5/99

Rev. B: 3/10/00

You must read this manual before installing or operating the instrument. This manual contains warranty and other information that may affect your decision to install this product and/or the safety of your aircraft.



Electronics International Inc. ®

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Important Notice

******* MUST READ *******

If you think it is not important to read this manual, you're wrong! This manual contains important operating information that may affect the safety of you, your aircraft and passengers.

Read the Warranty / Agreement. There is information in the Warranty / Agreement that may alter your decision to install this product. **If you do not accept the terms of the Warranty / Agreement, do not install this product.** This product may be returned for a refund. Contact Electronics International inc. for details.

The pilot **must** understand the operation and limitations of this product before flying the aircraft. Do not allow anyone to operate the aircraft that does not know how to properly interpret and operate this product. Keep the Operating Manual in the aircraft at all times. If you do not thoroughly understand the operation of this product, contact a knowledgeable flight instructor for training.

This Instrument only displays the parameters for the function(s) being monitored. The pilot is responsible for interpreting the data and determining if an engine or aircraft system anomaly exists. When using this instrument the pilot's diagnostic ability is limited to his/her interpretation of the displayed data and the there observation skills.

If after reading this manual you do not have the knowledge to interpret the displayed data to operate the aircraft safely or to detect engine and/or aircraft system problems, contact a knowledgeable instructor for training.

The ability for this product to respond to an engine or aircraft system anomaly is directly related to how that anomaly affects the reading of the function(s) being monitored (i.e.: if an engine fire does not affect the engine RPM, the RPM reading will not change).

If you detect a problem using this instrument, it is your responsibility to take appropriate action to insure the safety of the flight. Practice simulating problems to build your skills and to understand the relationships between problems and their affects on the displayed data. To insure you are taking appropriate action contact a knowledgeable flight instructor for training.

This manual does not make any recommendations as to specific exhaust gas temperature(s) at which to lean your engine. Check the airframe and/or engine manufacturer's recommendations to properly lean your engine. It is the pilot's responsibility to lean the engine properly.

It is possible for any instrument to fail thereby displaying inaccurate high, low or jumpy readings. Therefore, you **must** be able to recognize an instrument failure and you **must** be proficient in operating your aircraft safely in spite of an instrument failure. If you do not have this knowledge, contact the FAA or a knowledgeable flight instructor for training prior to flying the aircraft with this instrument.

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Warranty / Agreement

Electronics International Inc. warrants this instrument and system components to be free from defects in materials and workmanship for a period of one year from the user invoice date. Electronics International Inc. will repair or replace any item under the terms of this Warranty provided the item is returned to the factory prepaid.

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6. Electronics International Inc. is not responsible for shipping charges or damages incurred under this Warranty.
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8. **You must read the entire installation and operating instructions. If you do not agree to and accept the terms of this warranty/agreement and the responsibilities set forth in these manuals, DO NOT install this product. Contact E.I. for a refund.**

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Introduction

Congratulations on purchasing the Ultimate Bar Graph Engine Analyzer (UBG), one of the most sophisticated diagnostic tools available in general aviation. You can learn the basic operation of the UBG in the first few minutes of hands-on operation. Although the UBG is simple to operate, its capabilities are numerous.

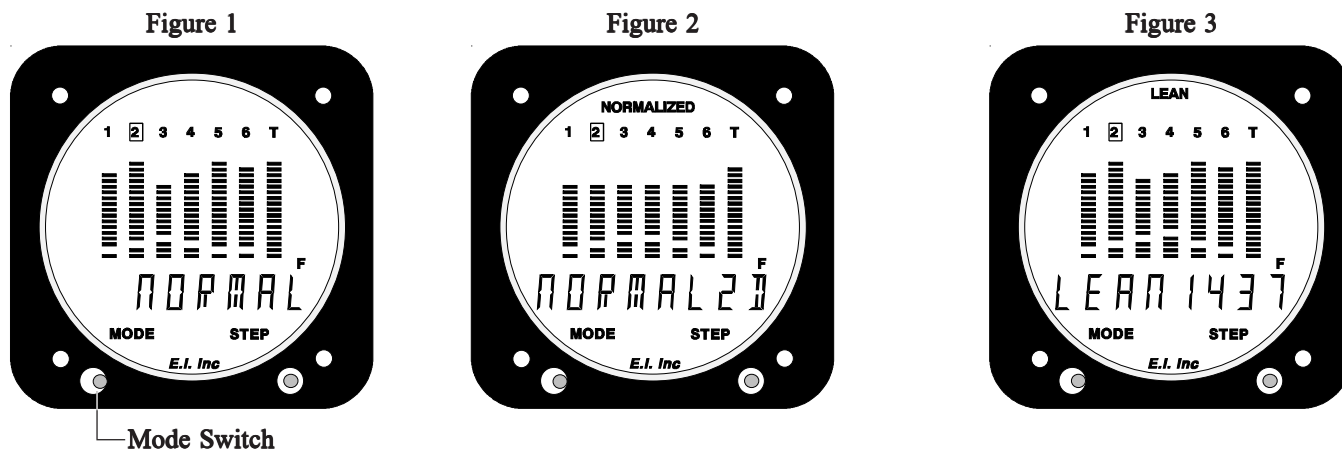
The UBG is shipped from the factory with all of the programmed limits turned off. This allows you to learn the basic operation of the UBG without having to deal with alarms or programming limits. As you become comfortable operating the UBG, you can start using more of its features.

Mode Selector Switch:

Each time the Mode Switch is pressed to the right, the UBG will advance to the next operating mode. There are three modes of operation: Normal, Normalized and Lean. The top of the display will indicate in which mode the UBG is operating. In the Normal Mode (figure 1), there is no indication at the top of the display. In the Normalized Mode (figure 2), the word "NORMALIZED" appears at the top of the display, and in the Lean Mode (figure 3) the word "LEAN" appears.

Also, when switching between the three operating modes, "NORMAL", "NORMALZD" or "LEAN" appears in the digital display when entering a mode, for as long as the Mode Switch is held to the right. This allows you to see what mode the UBG is entering even if the top of the display is not visible.

The left position of the Mode Selector Switch is used for programming, which will be covered later in this manual.



Normal Operating Mode:

In the Normal Operating Mode, the EGTs are indicated by the height of the lit bars in each of the columns. The CHTs are indicated by the height of the blanked bars in each of the columns. A CHT of 300°F will cause the second bar from the bottom to be blank. The scaling of the blanked CHT bars is 33°F per bar.

The Bar Graph Display allows visual comparison of EGTs and CHTs at a glance. It also allows you to see where the EGTs and CHTs are operating in their normal operating range (i.e., high EGTs will be displayed with many bars lit in a column and low EGTs will be displayed with few bars lit in a column).

The scaling and range of the EGT columns of bars may be customized to accommodate any engine or pilot's preference (see the "Programming the Range of the EGT Columns of Bars" section of this manual).

Step Switch:

When operating in the Normal or Normalized Operating Mode, each time the Step Switch is pushed to the right the UBG will advance the digital display to show the next temperature or function. Each time the Step Switch is pushed to the left the digital display will show the previous temperature or function.

Each time the Step Switch is pushed to the right, the UBG indicates the following temperatures or functions in the digital display:

1. Displaying the EGTs and CHTs:

The EGTs and CHTs will be indicated in the digital display, beginning with cylinder #1. The left side of the digital display will indicate exhaust gas temperatures and the right side of the digital display will indicate cylinder head temperatures. The lit box around a specific cylinder number (located at the top of the columns) coincides with which cylinder is being digitally displayed. Each time the Step Switch is pushed to the right the next cylinder will be displayed.



2. Displaying a Temperature on the 7th Column of Bars:

If installed in a 4 or 6-cylinder engine, after the last EGT channel has been displayed on the UBG, push the Step Switch once to the right to digitally display the temperature on the 7th column of bars (if the 7th column is activated). The 7th column of bars may be used to display EGT and CHT (on a 7-cylinder engine), or TIT or Oil Temperature (on a 4 or 6-cylinder engine), or it may be turned OFF. Installation and programming of the UBG will determine what, if any, function will be displayed on column 7.

The scaling and range of the 7th column of bars may be customized (independent of the EGT columns) to accommodate any engine or pilot's preference (see "Programming the Range of the 7th Column of Bars").



3. Displaying Other Temperatures and/or Functions Digitally:

There are a total of 16 input channels on the UBG. The columns of bars can display EGT, CHT, TIT or Oil. Other functions will be indicated only in the digital display. While viewing the digital readout for the last column of bars, push the Step Switch to the right to display the next temperature or function connected to the UBG's input channels.

Note: While viewing OAT, the digital display may be toggled between degrees F and degrees C by pushing the Mode Switch to the left.



4. Displaying the Shock Cooling Rate:

While the last monitored temperature or function is being displayed, push the step switch once to the right to see the Shock Cooling Rate in the digital display. This is the rate (in degrees F per minute) at which the indicated cylinder head temperature is cooling. Normally, cooling will occur only during descent. The Cylinder Number inside the lit box at the top of the columns is the programmed shock cooling cylinder being displayed.

Note: An aircraft engine can not be shock cooled when cylinder head temperatures are below 300°F. For this reason, the UBG-16 will display "-00" when the CHT drops below 300°F.



A Shock Cooling Limit and the cylinder to be monitored for shock cooling are programmable (see "Programming the Shock Cooling Limit and Cylinder").

5. Displaying the Peak EGT and Cylinder:

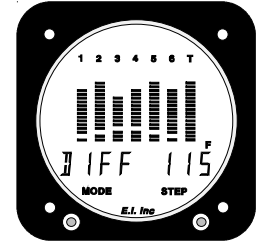
While the Shock Cooling Rate is being displayed, push the Step Switch once to the right to display the Peak EGT achieved during the last leaning session. The cylinder number inside the lit box at the top of the columns is the cylinder which first reached peak EGT. If you have not leaned the aircraft during this flight, the Peak EGT from the last time you leaned your engine will be retrieved from long-term memory and will be displayed.

Note: When viewing Peak EGT, the display may be toggled between Profile and Peak EGT by pushing the Mode Switch to the left. While showing Profile, each cylinder's fuel/air mixture distribution is displayed in the Bar Graph Display. This is an advanced feature of the UBG and is described in detail at the back of this manual.



6. Displaying the EGT Difference:

While the Peak EGT is being displayed, push the Step Switch once to the right to display the difference between the hottest and coldest EGT. A programmable limit may be set to alert you when the EGT Differential Limit is exceeded (see “Programming the EGT Differential Limit”).



Scanning Through the Channels Automatically:

When operating in the Normal or Normalized Operating Mode, by pushing and holding the step switch to the right until the word “SCAN” appears in the digital display, you may set the UBG to automatically scan the digital display through the various temperatures and/or functions being monitored. The length of time a temperature or function will be displayed is programmable. To cancel the Scan operation, push the step switch to the right or left, or push the Mode Switch to the right.



If a limit is violated while operating in the Scan Mode, the scan will stop and the UBG will display the channel with the violation.

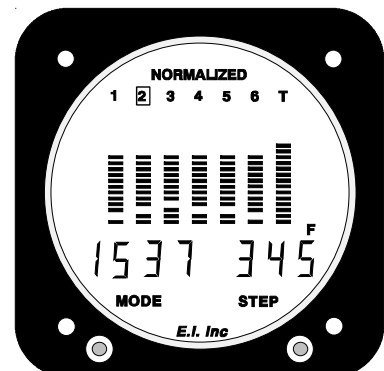
When operating in the Scan Mode only, the Scan Rate may be programmed by performing the following steps:

1. Push and hold the Mode Switch to the left until the word “PROGRAM” appears in the digital display. When the Mode Switch is released, the word “SCAN R. X” will appear in the digital display. The number blinking (X) in the right portion of the digital display is the Scan Rate in seconds.
2. Push the Step Switch right or left to increase or decrease the Scan Rate.
3. To exit this programming mode, push and hold the Mode Switch to the left until the word “END” appears in the digital display.

Normalized Operating Mode:

The purpose of the Normalized Operating Mode is to be able to compare current engine operation to prior engine operation.

Once the height of the EGT columns has been normalized (brought to the same level), any abnormal change in the engine’s EGTs will show up as an abnormally high or low column of bars. In this way you can see temperature trends over weeks, months or years. The Bar Graph Display provides a graph of long-term trend, allowing you to spot problems easily.



It is recommended that the EGT columns be normalized while operating your aircraft in normal cruise flight, with the engine leaned. When operating in the **Normalized Mode only**, the EGT bars may be normalized on the UBG display by performing the following steps:

1. Push and hold the Mode Switch to the left until “PROGRAM” appears in the digital display. Release the Mode Switch and the digital display will show “Normalize N”.
2. Push the Step Switch right or left to change the “N” to a “Y” ("NO" to a "YES").
3. To exit this programming mode, push and hold the Mode Switch to the left until the word “END” appears in the digital display.

Note: The TIT column of bars will not be affected by normalizing the EGT columns.

Normalizing brings the EGT columns to the same height and stores the data in memory. Once the EGTs are normalized, each time you operate your aircraft in normal cruise flight with your engine leaned, you may put the UBG into its Normalized Operating Mode and look for abnormally high or low columns of bars. Many problems occur slowly over time. The UBG’s Normalized Operating Mode helps you spot these problems as they occur.

Lean Operating Mode:

This manual does not make any recommendations as to specific exhaust gas temperature(s) at which to lean your engine. Check the airframe and/or engine manufacturer’s recommendations to properly lean your engine. It is the pilot’s responsibility to lean the engine properly.

We recommend leaning your engine in cruise. A rich running engine wastes fuel and tends to run rough. Good leaning techniques result in cleaner combustion chambers with fewer lead salt deposits on the pistons and exhaust valves. Also, proper leaning means less spark plug fouling, longer life for the plugs, reduced maintenance costs and a considerable fuel savings. Furthermore, proper leaning at cruise during cool or cold weather aids in raising engine and oil temperatures to desirable minimums in order to evaporate the water and acids out of the oil. Water and acids attack the insides of an engine, causing rust and corrosion.

When you enter the Lean Operating Mode of the UBG, the right portion of the digital display will show the current EGT for the cylinder which peaked first the last time you leaned your engine. The word “LEAN” will be displayed in the left portion of the digital display. The UBG will not activate the Lean Operating Mode until the hottest EGT has raised 10°F.

Most engines will exhibit a 200 to 350°F rise in EGTs before a cylinder reaches peak. Start the leaning process by rough leaning your engine near peak EGT (pull the mixture back to a predetermined setting or use a fuel flow instrument). Experience should be your guide. Do not lean past peak EGT during rough leaning.



Note: It is not recommended to lean an engine for peak EGT above 75% power setting.

Next, slowly lean your engine by pulling the mixture out a very small amount. When the increase in temperature slows to less than one degree per second, once again lean the engine a very small amount. The slower you lean, the more accurate the results will be.

When any cylinder reaches its peak (hottest) EGT and starts to decrease in temperature, the digital display will blink the word “PEAK” in the left portion of the display and the hottest (Peak) EGT reached will be displayed in the right portion of the display. The cylinder number inside the lit box at the top of the columns is the first cylinder to reach peak EGT. That cylinder number will blink, indicating the cylinder is now operating on the lean side of peak. Also, the external warning light will blink.

Push the Step Switch to the right or left to acknowledge the peak and to stop the blinking of the word “PEAK” in the digital display as well as the blinking of the External Warning Light. At that time the current EGT will be displayed in the right portion of the digital display.



1. False Peaks:

As you lean your engine, a dip in an exhaust gas temperature could occur for many reasons (e.g., mixture linkage issues, non-linearity in fuel servo or carburetor mechanism, a small change in the pitch of the aircraft, a small change in the air distribution as the engine torque and/or RPM changes, etc.). This dip in an EGT can cause engine analyzers to indicate a false peak.

After the Peak EGT is found, continue to lean gradually. If the Peak EGT indication is actually only a dip (false peak), the EGT will once again start to increase. When it increases above the false peak the UBG will switch back to the leaning mode (the left portion of the digital display will show “LEAN”). This capability is essential in eliminating false peaks.

2. Leaning on the Rich Side of Peak:

Once the first cylinder to reach peak is found and you have stopped the blinking by pushing the step switch, enrichen the mixture and push the Mode Switch to the left to cause the digital display to show the Temperature Below Peak EGT for that cylinder (e.g., “PEAK - 25”). Displaying the Temperature Below Peak EGT makes it very easy to set the mixture to a specific EGT on the rich (or lean) side of peak.

Note: Each time the Mode Switch is pushed to the left, the right portion of the digital display will alternate between displaying the current EGT and the Temperature Below Peak.

Note: As you enrichen the mixture, the exhaust gas temperatures of all of the cylinders will decrease. This will cause the cylinder numbers above all of the columns of bars to blink. A blinking cylinder number indicates that cylinder’s EGT has decreased from the highest temperature it achieved.



3. Alternate Method for Leaning on the Rich Side of Peak:

The following method will work only if the peak EGT is near the same temperature for every flight, which is common for many engines operating on the rich side of peak.

Once the first cylinder to reach peak is found and you have enriched the mixture to your normal exhaust gas temperature during cruise, note the normal operating temperatures for each cylinder. Set each cylinder's High EGT Limit at its normal operating temperature plus 15°F.

Thereafter when you lean, simply rough lean the engine until you see a High Limit Warning displayed on the UBG. Enrichen the mixture slightly until the High Limit Warning goes out . . . you're done! You do not have to enter the Lean Operating Mode nor do you have to look at the UBG display to perform this leaning method.

4. Leaning on the Lean Side of Peak:

Once the first cylinder to reach peak is found, continue to lean the mixture and push the Mode Switch to the left to cause the digital display to show the Temperature Below Peak EGT for that cylinder (example: "PEAK -25). Displaying the Temperature Below Peak EGT makes it very easy to set the mixture for a specific EGT on the lean side of peak.

As each cylinder begins to run on the lean side of peak, the cylinder number above the appropriate column of bars will blink. You easily can see as each cylinder reaches peak and you can see the status of each cylinder (whether it's on the rich or lean side of peak) at a glance.



Note: The UBG eliminates false peaks on all cylinders, including TIT.

Note: The Step Switch may be used to display the Temperature Below Peak for any cylinder. This can be an invaluable tool in helping to lean your engine properly on the lean side of peak.

Note: Each time the Mode Switch is pushed to the left, the right portion of the digital display will alternate between displaying the current EGT and the Temperature Below Peak.

5. Method for Checking the Mixture Setting when Operating on the Lean Side of Peak:

If you are running all of the cylinders on the lean side of peak, you can do a quick check on your mixture setting by performing the following:

A. Enter the Lean Operating Mode.

B. Very slowly enrichen the mixture until peak EGT is found. Since all of the cylinders are running on the lean side of peak, all of the EGTs will rise. The first cylinder to reach peak will be the richest cylinder.

C. Push the Mode Switch twice to the left to acknowledge the peak and to cause the display to show the Temperature Below Peak.

D. Lean the mixture to a desired Temperature Below Peak for the richest cylinder.

Alarms:

The UBG offers up to 16 High and 16 Low Alarms (one high and one low alarm for each input channel), one EGT Differential Alarm and one Shock Cooling Alarm. These alarms are part of the UBG's awesome power to detect most problems automatically, the moment they occur. The UBG performs a full analysis on all temperatures and functions every one-half second . . . a much faster and more accurate method of detecting problems than downloading data to a computer and analyzing it every six months to try to find an engine problem, as with other bar graph units.

1. High and Low Alarm Annunciators:

If any one of the programmed High or Low Limits is violated, the UBG will blink a "H" or "L" on the left side of the display. Also, the External Warning Light will blink.

2. EGT Differential Alarm Annunciator:

If the difference between the hottest and coldest EGT violates the programmed EGT Differential Limit, the UBG will blink a "D" on the left side of the display. Also, the External Warning Light will blink.

3. Shock Cooling Alarm Annunciator:

If the programmed Shock Cooling Limit is violated, the UBG will blink a "S" on the left side of the display. Also, the External Warning Light will blink.



4. Finding the Channel on which a Programmed Limit has been Violated:

If one of the temperatures or functions monitored on the UBG has violated a programmed limit, put the UBG into the Scan Mode (hold the Step Switch to the right until the digital display shows "SCAN"). The digital display will jump to the temperature or function that has the problem (a limit violation). Each time the UBG is put into the Scan Mode, the next temperature or function with a problem will be displayed.

If you are viewing the temperature channel or function which is violating a high or low limit, a high or low bar will be blinking in the digital display.

Note: When viewing the EGT Difference or Shock Cooling, a high bar will be blinking in the digital display.

5. Canceling all Active Alarms for 10 Minutes:

To cancel all active alarms for 10 minutes, push and hold the Step Switch to the left until the word “CANCEL” appears in the digital display. Any new alarm (i.e., an alarm set after this step is performed) will be displayed and will not be affected by the 10-minute cancellation of alarms.



6. Activating all Canceled Alarms:

To activate all canceled alarms, push and hold the Step Switch to the right until the word “SCAN” appears in the digital display.

Programming the 34 Limits:

The 34 pilot-programmable limits allow you to customize the UBG to your engine. Trend analysis and problem detection is done automatically every one-half second. You are alerted as soon as a limit is violated.

While programming limits, keep in mind that setting limits just outside normal operating ranges allows potential problems to be detected early, without causing a false warning. Not only are false warnings annoying, but they can desensitize you to warnings in general. This in itself could cause a problem.

The “Work Sheet for Setting High and Low Limits” located at the back of this manual may be helpful in setting proper limits.

Programming the High and Low EGT and CHT Limits:

It is recommended that EGT and CHT limits be set just outside each cylinder’s normal operating range so problems can be detected without causing a false warning.

Exhaust gas temperatures are directly related to your engine’s ability to produce power. If any cylinder has a problem producing power (fouled plug, burned or stuck valve, broken ring, intake leak, plugged injector, timing problem, bad mag, etc.) the exhaust gas temperature for that cylinder will be abnormally high or low, depending on the problem. Each of your engine’s cylinders operates differently and has a “normal” operating temperature of its own. The UBG is capable of being programmed to take into account each cylinder’s individual operating temperature. When selecting and programming the EGT limits on the UBG, it is assumed your engine does not have a current problem and it is operating properly.

1. Selecting the High EGT Limits:

At 75% power, lean your engine to peak EGT. Record the EGT readings for each cylinder. Program the High Limit for each cylinder 40°F above the recorded readings for that cylinder. This is only a

recommended limit. As you get to know your engine's normal operating temperatures, you may want to adjust these limits accordingly.

2. Selecting the Lower EGT Limits:

In normal cruise, at low altitude, adjust the mixture full rich and wait for the EGTs to stabilize. Once the EGTs have stabilized, record the EGT readings for each cylinder. Program the Lower Limit for each cylinder 40°F below the recorded readings for that cylinder. This is only a recommended limit. As you get to know your engine's normal operating temperatures, you may want to adjust these limits accordingly.

During climbs, the cylinder head temperatures will rise rapidly until the heat absorbed by the combustion walls is dissipated through the engine's cooling fins. At this point, the CHTs will stabilize. Any change in throttle, mixture, cowl, OAT or airspeed will affect the CHTs and their rate of change. Since rate and trend information can be interpreted easily on the UBG digital display, changing any one of these parameters to stabilize, slow or reduce the CHT is possible with almost immediate results.

Cylinder head temperatures are related to your engine's ability to produce power. If any cylinder has a problem producing power (fouled plug, burned or stuck valve, broken ring, intake leak, plugged injector, timing problem, bad mag, etc.) the cylinder head temperature for that cylinder may or may not be abnormally high or low, depending on the extent of the problem. Generally, we have not found cylinder head temperatures to be a good tool for detecting problems. However, CHTs are a good indicator of excessively high power settings.

Each of your engine's cylinders operates differently and has a normal operating temperature of its own. The UBG is capable of being programmed to take into account each cylinder's individual operating temperature. When selecting and programming the CHT limits on the UBG, it is assumed your engine currently does not have a problem and it is operating properly.

3. Selecting the High CHT Limits:

Near the middle or end of a long climb, preferably on a hot day, record the CHT readings for each cylinder. Program the High CHT Limits for each cylinder 40°F above the recorded reading for that cylinder.

Note: The High CHT Limits should not be set higher than the maximum limit allowed for your aircraft.

4. Selecting the Lower CHT Limits:

The CHT Low Limits should be set to 150°F. Operating your aircraft with CHTs below 150°F is not recommended. The large difference between the combustion temperatures and low CHT temperatures can cause engine damage.

High and low EGT and CHT limits may be set for each cylinder displayed on the UBG. When operating in the Normal Mode only, the EGT and CHT limits may be set by performing the following steps:

A. Select the cylinder on which the limits are to be programmed.

B. Press and hold the mode switch to the left until the word “PROGRAM” appears in the digital display. Release the Mode Switch. “SET H” will appear on the left side of the UBG display. Also, “EGT” will appear in the left portion of the digital display and the right portion will show the current high limit. The digit on the far left will be blinking.

C. Use the Step Switch to increase or decrease the digit which is blinking. The EGT Limits can be set from 0 to 1990°F in 10°F increments and the CHT Limits can be set from 0 to 499°F in 1°F increments (although the CHT limit will be converted down to an even number).



D. Use the Mode Switch to blink a specific digit.

E. To change functions, push the Mode Switch to the right (or left) until the digital display shows the function you wish to program. The functions will appear in the following order:

1. EGT High Limit.
2. EGT Low Limit.
3. CHT High Limit.
4. CHT Low Limit.
5. Upper EGT Bar Trip Point (programmed on cylinder #1 only).
6. Lower EGT Bar Trip Point (programmed on cylinder #1 only).

Note: Setting a limit to “000” will disable the limit and any alarms.

F. To exit this programming mode, push and hold the Mode Switch to the left until the word “END” appears in the digital display.

Programming the Range of the EGT Columns of Bars:

The range of the EGT columns of bars may be customized to accommodate any engine or pilot preference. This is done by programming the temperatures at which the Upper and Lower Bars come on (Trip Points). The objective in setting the Trip Points is to get the height of the EGT bars low in their columns during a climb, and high in their columns when the engine is leaned or near peak EGT.

1. Selecting the Upper EGT Bar Trip Point:

At 75% power, lean your engine to peak EGT. Record the EGT temperatures for each cylinder. Program the Upper EGT Bar Trip Point 50°F above the recorded highest EGT temperature. As you get to know your engine's normal operating temperatures, you may want to adjust this Trip Point.

2. Selecting the Lower EGT Bar Trip Point:

In a normal cruise power condition, at low altitude, adjust the mixture to full rich and wait for the EGTs to stabilize. Once the EGTs have stabilized, record the EGT temperatures for each cylinder. Program the Lower EGT Bar Trip Point 100°F below the lowest recorded EGT temperature. As you get to know your engine's normal operating temperatures you may want to adjust this Trip Point.

When operating in the Normal Mode only, the Upper and Lower Bar Trip Points may be set by performing the following steps:

1. Select cylinder #1 using the Step Switch.
2. Press and hold the mode switch to the left until the word "PROGRAM" appears in the digital display.
3. Push the Mode Switch to the right several times until you see "BAR" in the left portion of digital display and "SET H" on the left side of the UBG display. The right portion of the digital display will show the current Upper EGT Bar Trip Point. The digit to the far left will be blinking.
4. Use the Step Switch to increase or decrease the digit that is blinking. The Upper and Lower Bar Trip Points can be set from 0 to 1990°F in 10°F increments.
5. Use the Mode Switch to blink a specific digit.
6. To program the Lower Bar, push the Mode Switch to the right until the UBG shows "SET L" on left side of the UBG display.



7. To exit this programming mode, push and hold the Mode Switch to the left until the word “END” appears in the digital display.

Programming the High and Low Limits and Range of the 7th Column of Bars:

The 7th column of bars may be used to display EGT and CHT on a 7-cylinder engine, TIT or Oil Temperature, or it may be turned off. A High and Low Limit may be programmed for whatever temperature is displayed on the 7th column of bars.

If the 7th column is used to display TIT or Oil Temperature, the range of the 7th column of bars may be customized to accommodate any temperature, engine or pilot preference. This is done by programming the temperatures at which the Upper and Lower Bars come on (Trip Points).

If the 7th column is used to display EGT and CHT for a 7 cylinder engine, see “Programming the High and Low EGT and CHT Limits” above. Otherwise, when operating in the Normal Mode only, perform the following steps:

1. Select the 7th column using the Step Switch.
2. Press and hold the mode switch to the left until the word “PROGRAM” appears in the digital display. Release the Mode Switch and “SET H” will appear on the left side of the UBG display. Also, “TIT” or “OIL.T” will appear in the left portion of the digital display and the right portion will show the current Height Limit. The digit to the far left will be blinking.
3. Use the Step Switch to increase or decrease the digit that is blinking. The High and Low Limits and Trip Points can be set from 0 to 1990°F in 10°F increments.
4. Use the Mode Switch to blink a specific digit.
5. To change functions, push the Mode Switch to the right (or left) until the digital display shows the function you wish to program. The functions will appear in the following order:
 - A. “TIT” or “OIL.T”, High Limit.
 - B. “TIT” or “OIL.T”, Low Limit.
 - C. Upper Bar Trip Point.
 - D. Lower Bar Trip Point.



Note: Setting a limit to “000” will disable the limit and any alarms.

6. To exit this programming mode, push and hold the Mode Switch to the left until the word “END” appears in the digital display.

Programming the High and Low Limits for Other Temperatures or Functions:

It is recommended that high and low limits be set just outside the normal operating range for your engine so problems can be detected without causing a false warning. False warnings are annoying and can desensitize you to warnings in general. This could cause a serious delay in taking note of a warning which is an alert to a real problem.

A High and Low Limit may be set for any temperature or function displayed on the UBG. When operating in the Normal Mode only, the High and Low Limits may be set by performing the following steps:

1. Select the temperature or function on the digital display.
2. Press and hold the mode switch to the left until the word “PROGRAM” appears in the digital display. Release the Mode Switch. “SET H” will appear on the left side of the UBG display. Also, the High Limit will appear in the right portion of the digital display and the digit to the far left will be blinking.
3. Use the Step Switch to increase or decrease the digit that is blinking. The limits are set as shown in the chart following this section.
4. Use the Mode Switch to blink a specific digit.
5. To display the Low Limit, push the Mode Switch to the right until “SET L” appears on the left side of the UBG display.



Note: Setting a limit to “000” will disable the limit and any alarms.

6. To exit this programming mode, push and hold the Mode Switch to the left until the word “END” appears in the digital display.

Temp or Function	Display Range / (Resolution)	High and Low Limit Range / (Resolution)
EGT	0 to 1999°F / (+/- 1°F)	0 to 1990°F / (+/- 10°F).
CHT	0 to 999°F / (+/- 1°F)	0 to 499°F / (+/- 1°F, converted down to an even number).
T.I.T.	0 to 1999°F / (+/- 1°F)	0 to 1990°F / (+/- 10°F).
Oil Temp	0 to 999°F / (+/- 1°F)	0 to 499°F / (+/- 1°F, converted down to an even number).
O.A.T.	0 to 999°F / (+/- 1°F)	0 to 499°F / (+/- 1°F, converted down to an even number).
Carb Temp	0 to 999°F / (+/- 1°F)	0 to 499°F / (+/- 1°F, converted down to an even number).
Cowl Temp	0 to 999°F / (+/- 1°F)	0 to 499°F / (+/- 1°F, converted down to an even number).
Temp	0 to 1999°F / (+/- 1°F)	0 to 1990°F / (+/- 10°F).
Oil Pressure	0 to 999 / (+/- 1 psi) Readings below 5 psi display as 0 psi.	0 to 499 psi / (+/- 1 psi, converted down to an even number).
Fuel Pressure	0 to 99.9 / (+/- .1 psi) Readings below 1.0 psi display as 0 psi.	0 to 49.9 psi / (+/- 0.1 psi, converted down to an even number).
Manifold Pressure	0 to 99.9 / (+/- .1 "Hg.) Readings below 1.0 "Hg. display as 0 "Hg.	0 to 49.9 "Hg. / (+/- 0.1 "Hg., converted down to an even number).
Gyro Vacuum	0 to 99.9 / (+/- .1 "Hg.) Readings below 1.0 "Hg. display as 0 "Hg.	0 to 49.9 "Hg. / (+/- 0.1 "Hg., converted down to an even number).
R.P.M.	0 to 4990 RPM / (+/- 10 RPM)	0 to 4990 RPM / (+/- 10 RPM).
Fuel Flow	0 to 99.9 GPH / (+/- .1 GPH) Readings below 0.5 GPH display as 0 GPH.	0 to 49.9 GPH / (+/- 0.1 GPH., converted down to an even number).
Bus Volts	0 to 99.9 V / (+/- 0.1 V) Readings below 0.5 V display as 0 V.	0 to 49.9 V / (+/- 0.1 V, converted down to an even number).
Amps	0 to 999 A / (+/- 1 A) Readings below 5 A display as 0 A.	0 to 499 A / (+/- 1 A, converted down to an even number).
EGT Differential	0 to 999 'F / (+/- 1 'F)	0 to 499 'F / (+/- 1 'F, converted down to an even number).
Shock Cooling	0 to 99 'F / (+/- 1 'F)	0 to 99 'F / (+/- 1 'F, converted down to an even number).

Programming the Shock Cooling Limit and Cylinder:

Sudden cooling of the CHT (known as shock cooling) is a common problem in some engines. In others, it is rare. Shock cooling an engine can result in bent pushrods due to exhaust valves sticking, burned valves, spark plug fouling, broken piston rings, cracked cylinders at the spark plug and valve ports and warped exhaust valves.

A shock cooling limit may be set to alert when an engine's CHTs are cooling too rapidly. In one Lycoming document, it is recommended that the CHTs decrease no more than 20°F per minute. In another of its documents, Lycoming recommends a decrease of no more than 40°F per minute.

You may want to start with a Shock Cooling Limit of 30°F per minute. When operating in the Normal Mode only and displaying Shock Cooling ("SCOOL"), the Shock Cooling Limit may be set by performing the following steps:

1. Press and hold the mode switch to the left until the word "PROGRAM" appears in the digital display. Release the Mode Switch. "SET" will appear on the left side of the UBG display. Also, "S.COOL-XX" will appear in the left portion of the digital display and the right portion will show the current Shock Cooling Limit ("XX"). The digit to the far left will be blinking.

2. Use the Step Switch to increase or decrease the digit that is blinking. The Shock Cooling Limit can be set from 0 to 99°F per minute in 1°F increments.

3. Use the Mode Switch to blink a specific digit.

4. To set the cylinder to be monitored, push the Mode Switch to the right until the digital display shows "S.C. CH X". The right portion of the digital display will show the current cylinder ("X") on which the shock cooling rate is monitored. Use the Step Switch to change the cylinder number. You should monitor one of the front, unobstructed cylinders.

5. To exit this programming mode, push and hold the Mode Switch to the left until the word "END" appears in the digital display.

Note: Setting a limit to "000" will disable the limit and any alarms.



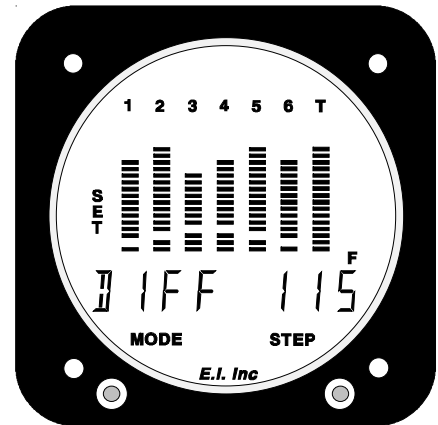
Programming the EGT Differential Limit:

It is recommended to set the EGT Differential Limit just outside the normal operating range for your engine so problems can be detected without causing false warnings. False warnings are annoying and can desensitize you to warnings in general. This could cause a serious delay in taking note of a warning which is an alert to a real problem.

Your engine's EGTs will vary at different power, altitude and mixture settings. To further enhance the UBG's ability to detect a problem, select the EGT Difference ("DIFF") on the UBG's digital display and note the EGT Difference during climb, cruise and descent. Set the EGT Differential Limit for 30°F higher than the observed maximum difference. This is only a recommended limit. As you get to know your engine's normal operating temperatures you may want to adjust this limit accordingly.

When operating in the Normal Mode only and displaying the EGT Difference ("DIFF"), the EGT Differential Limit may be set by performing the following steps:

1. Press and hold the mode switch to the left until the word "PROGRAM" appears in the digital display. Release the Mode Switch. "SET" will appear on the left side of the UBG display. Also, "DIFF" will appear in the left portion of the digital display and the right portion will show the current EGT Differential Limit. The digit to the far left will be blinking.
2. Use the Step Switch to increase or decrease the digit that is blinking. The EGT Differential Limit can be set from 0 to 499°F in 1°F increments (although this limit will be converted down to an even number).
3. Use the Mode Switch to blink a specific digit.
4. To exit this programming mode, push and hold the Mode Switch to the left until the word "END" appears in the digital display.



Note: Setting a limit to "000" will disable the limit and any alarms.

Power-up Programming:

Power-up Programming configures the UBG for the temperature probes and functional modules connected to its 16 input channels. To understand how to configure the UBG, it is necessary to understand how the input channels are arranged. On the back of the UBG are three circular connectors. The 16-pin circular connector on the left (as you face the UBG) is responsible for the left eight input channels on the UBG. This circular connector is used to monitor EGTs.

The 16-pin circular connector on the right is responsible for the right eight input channels on the UBG. This circular connector is used to monitor CHTs. Any remaining channels on either or both 16-pin circular connectors may be used to monitor other temperatures or functions.

The UBG Configuration Form found at the back of this manual and also located in the UBG Installation Instructions should be used as a guide for Power-up Programming. To configure the UBG, perform the following:

1. Enter the Power-up Programming Mode:

With the power to the UBG off, press and hold the Mode Switch to the left. Continue to hold the Mode Switch to the left and turn the power to the UBG on. After the UBG performs a self test, “PROGRAM” will appear in the digital display. Release the Mode Switch.

2. Configuring EGT and CHT Channels:

The digital display will indicate “EGT 1-X”. The number blinking (“X”) in the right portion of the digital display is the last EGT and CHT channel monitored. Left channels are used to monitor EGTs and right channels are use to monitor CHTs. EGTs and CHTs will be displayed in the columns of bars.

Use the Step Switch to set the number of EGT's and CHT's to be monitored.



3. Configuring the 7th Column of Bars:

Push the Mode Switch to the right. The digital display will indicate “BAR7 XXX”, providing the 7th column of bars has not been used to monitor a 7th EGT channel. (Note: a blinking “XXX” in the display = “OFF” or “TIT” or “OIL”.) Use the Step Switch to set the 7th column of bars to indicate either TIT, Oil Temp or to turn the 7th column OFF.

TIT or Oil Temperature can be displayed only on the 7th column of bars. However, the TIT or Oil Temperature probe represented by the 7th column of bars must be connected to the next available input channel after the last EGT channel on the left circular connector. Example: If configuring the UBG to monitor 4 EGTs and 4 CHTs and Oil Temperature, the 7th column of bars will display Oil Temperature, although that probe must be connected to the 5th input channel on the left circular connector.



4. Configuring the Remaining Left and Right Channels:

Push the Mode Switch to the right. The digital display will show “LX-YYY”.

- Note:** “L” = Left Channel,
“R” = Right Channel.
“X” = A number representing the channel to be configured.
“YYY” = The temperature or function for which the channel is configured, or the channel can be turned off at this point. (E.g., “YYY” can be OIL.T, OAT, CARB, COWL, TEMP, OIL.P, F.PRS, M.PRS, GYRO, RPM, FLOW, BUS or AMPS)



Use the Step Switch to set the configuration.

Note: Any channel not used should be set to “OFF”.

Note: If a channel’s configuration is changed, the programmable High and Low Limits may need to be reset.

5. Exiting the Programming Mode:

To exit this programming mode, push and hold the Mode Switch to the left until the word “END” appears in the digital display.



Operating the UBG in Your Aircraft:

1. Taxi:

During taxi most of your engine temperatures may be below the lower temperature limits. To cancel all active alarms for 10 minutes, push the Step Switch to the left until the word “CANCEL” appears in the digital display.

2. Run Up:

Check the Bar Graph Display for normal EGT levels at run up. Check that the CHTs are above 150°F, Oil Temperature is above 65°F and Oil Pressure is at a normal level.

During run up, your engine temperatures may or may not be below the lower temperature limits. To activate all canceled alarms, push the Step Switch to the right until the word “SCAN” appears in the digital display. An alarm during run up may or may not indicate a real problem. After a few flights you will get a feeling for what “normal” temperatures are for your engine.

3. Takeoff:

During takeoff, check the Bar Graph Display for proper EGTs. It is also vital to pay close attention to the Oil Pressure.

If you have activated all canceled alarms and the High and Low Limits have been set properly, the UBG will automatically diagnose your engine during takeoff. Activate all alarms by pushing the Step Switch to the right until the word "SCAN" appears in the digital display. For the first few seconds of the takeoff roll, the UBG may indicate a temporary alarm because the engine temperatures have not yet exceeded the programmed Low Limits. If a problem occurs, a red External Warning Light will alert you to that problem.

4. Climb:

During climb, check the Bar Graph Display for proper EGT and CHT levels. Also, it is important to pay close attention to Oil Temperature and Pressure.

If the High and Low Limits have been set properly, the UBG will automatically diagnose your engine during climb. If a problem occurs, a red External Warning Light will alert you to that problem.

An EGT Low Temperature Warning may occur during a climb in non-turbocharged aircraft. As an aircraft climbs, the air gets thinner and the engine will run richer. When this happens the EGTs will drop and may violate the Lower EGT Limits. If you choose to lean during climb, do not allow the EGTs to exceed 1300°F for throttle settings above 75% power. Refer to the engine and aircraft operator's manual for proper leaning during climb.

5. Cruise:

It's a good practice to lean your engine in cruise. A rich running engine wastes fuel. At cruise and during descent, a properly leaned engine means less spark plug fouling, longer life for the plugs, reduced maintenance costs, and cleaner combustion chambers with fewer lead salt deposits on the pistons and exhaust valves.

The UBG's unique features allow precise leaning of an engine to any desired temperature by eliminating false peaks, indicating the first cylinder to reach peak and the peak temperature reached, indicating as each cylinder passes peak, and displaying temperatures below peak.

To lean your engine, check the engine manufacturer's recommended procedures. It is not recommended to lean to peak EGT above 75% power settings. The richer mixture is needed to cool the combustion temperatures and keep the antiknock capability of the fuel high enough to prevent detonation from occurring at the higher power settings.

After leaning, put the UBG into the Normalized Operating Mode to check for any abnormal long-term trends in the EGTs.

If the High and Low Limits have been set properly, the UBG will automatically diagnose your engine during cruise. If a problem occurs, a red External Warning Light will alert you to the problem detected.

6. Descent:

During descent, the air gets heavier and the engine will run leaner. The manifold pressure will increase one inch for each thousand feet of descent. During descent, enrichen the mixture to maintain proper EGTs and gradually decrease the throttle to maintain proper Manifold Pressure. Attempt to maintain the same EGTs as during cruise.

If you significantly reduce throttle and enrichen the mixture, a shock cooling problem could occur. Some engines are prone to shock cooling, while it is rare in others. Be certain the shock cooling rate does not exceed 30°F per minute.

If the High and Low Limits have been set properly, the UBG will automatically diagnose your engine during descent. If a problem occurs, a red External Warning Light will alert you to that problem.

The versatility of the UBG's 34 programmable limits and its 1°F resolution makes the UBG the most sophisticated engine diagnostics tool you can buy for your aircraft. It is capable of detecting dozens of common engine problems. Setting the proper limits and personalizing the UBG for your engine is in your hands.

Work Sheet for Setting Limits

1. During High Power Climb to 5,000 ft. +:

A. Note highest CHT readings for each cylinder:	<u>Highest CHT Readings:</u>	<u>Set High CHT Limits for:</u>
	Cyl #1 _____ + 40 = _____	_____
	Cyl #2 _____ + 40 = _____	_____
	Cyl #3 _____ + 40 = _____	_____
B. Note EGT Differential reading: _____	Cyl #4 _____ + 40 = _____	_____
	Cyl #5 _____ + 40 = _____	_____
	Cyl #6 _____ + 40 = _____	_____

2. During Cruise, Normal Power, Around 2,000 ft. , Full Rich:

A. Note EGT readings for each cylinder:	<u>EGT Readings:</u>	<u>Set Low EGT Limits for:</u>
	Cyl #1 _____ - 40 = _____	_____
	Cyl #2 _____ - 40 = _____	_____
	Cyl #3 _____ - 40 = _____	_____
B. Note EGT Differential reading: _____	Cyl #4 _____ - 40 = _____	_____
	Cyl #5 _____ - 40 = _____	_____
	Cyl #6 _____ - 40 = _____	_____

C. Set Lower EGT Bar Trip Point: Lowest EGT Reading _____ - 100 = _____ (Limit)

3. During Cruise, Normal Power, Around 2,000 ft. , Leaned to Peak:

A. Note EGT readings for each cylinder:	<u>EGT Readings:</u>	<u>Set High EGT Limits for:</u>
	Cyl #1 _____ + 40 = _____	_____
	Cyl #2 _____ + 40 = _____	_____
	Cyl #3 _____ + 40 = _____	_____
B. Note EGT Differential reading: _____	Cyl #4 _____ + 40 = _____	_____
	Cyl #5 _____ + 40 = _____	_____
	Cyl #6 _____ + 40 = _____	_____

C. Set Upper EGT Bar Trip Point: Highest EGT Reading _____ + 50 = _____ (Limit)

3. Set Other Limits:

A. Set EGT Differential Limit: Highest EGT Differential Reading _____ + 30 = _____ (Limit)

B. Set All Lower CHT Limits: **150°F**

C. Set Shock Cooling Limit: **30°F/minute**

D. Set other limits just outside the normal operating range for the temperature or function measured.

"UBG-16" Configuration Form:

If you are installing the UBG-16, fill out the following configuration form. This form will document which Temperature probes or Functional Modules will be connected to specific input channels on the UBG-16.

<u>LEFT Channels:</u>	<u>Function:</u>	<u>Comments:</u>
1 to _____	<u>EGTs</u>	Up to 7 channels may be used to monitor EGTs. Each channel will be displayed on a column of bars. A total of 7 columns are available. Enter the number of EGTs you will be monitoring.
(BAR 7)	<u>TIT, Oil T, OFF</u>	The 7th column of bars is intended to display EGT (on a 7-cylinder engine) or TIT or Oil Temp or it may be turned off (circle one). However, the TIT or Oil Temp probe must be connected to the next channel after the last EGT channel (e.g., #5 on a 4-cylinder engine or #7 on a 6-cylinder engine).
L_____	_____	In order, list the unused channels on the LEFT connector and indicate the functions to be monitored on each channel. OAT or Carb Temp must only be connected to channel L7, L8, R7 or R8 (these are precision channels). If a channel is not used, write "OFF" in the Function Column for that channel. Channel 8 is the last available channel on the left.
L_____	_____	
L_____	_____	
L_ 8	_____	
<u>Right Channels:</u>	<u>Function:</u>	<u>Comments:</u>
1 to _____	<u>CHTs</u>	The number of CHTs monitored must be the same as the number of EGT's monitored. The CHTs are monitored on the RIGHT Channels. Enter the number of CHTs you will be monitoring.
R_____	_____	In order, list the unused channels on the RIGHT connector and indicate the functions to be monitored on each channel. OAT or Carb Temp must only be connected to channel L7, L8, R7 or R8 (these are precision channels). If a channel is not used, write "OFF" in the Function Column for that channel.
R_____	_____	
R_____	_____	
R_ 8	_____	

Note: The UBG-16 digital display steps through the channels starting with number one on the LEFT and ending with number 8 on the RIGHT.

Fuel/Air Profile

When viewing "Profile" the bar graph display shows the fuel/air distribution for your engine. This display is intended as a technical view of how your engine is operating. Once you know the fuel/air distribution for your engine, its easier to make logical decisions on how to run your engine (rich of peak, at peak, lean of peak, lean on climb, etc.). Also, it can be a troubleshooting tool for those hard-to-find problems (engine runs rough, not developing power, burns too much fuel, etc.).

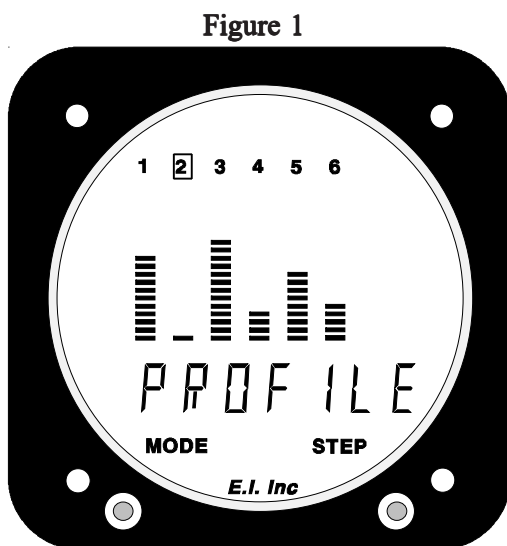
The Profile display is only accurate when viewed after you have leaned all of the cylinders past peak EGT in the Lean Operating Mode. The lit box around a specific cylinder number (located at the top of the columns) indicates the cylinder that first reached peak EGT. This is the leanest cylinder and there should only be one bar lit (if there is more than one bar lit, the Profile display is not accurate and you will need to perform the leaning process again). The remaining EGT and TIT columns will have one or more bars lit.

When the first (leanest) cylinder reaches peak EGT, a baseline temperature is established for each cylinder. For every 5°F an EGT must rise in order to reach peak (above the baseline temperature), one bar will be lit. The column with the most bars lit represents the cylinder that has the highest EGT rise before reaching peak. This is the richest cylinder. The more bars lit in a column the richer the cylinder.

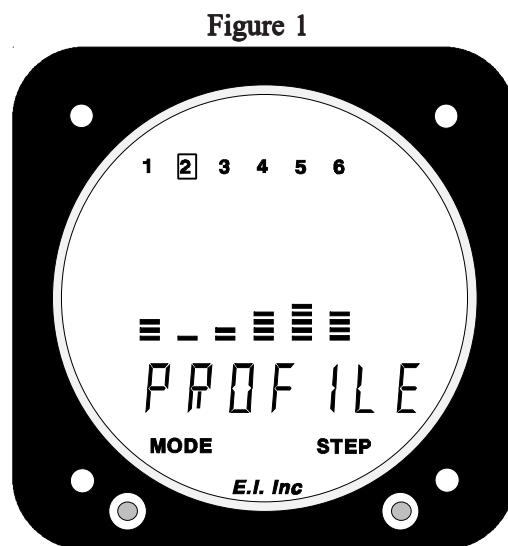
For Example: Figure 1 shows cylinder #2 reached peak EGT first. Cylinder #1's EGT rose 50°F before it reached peak (10 bars x 5°F = 50°F). Cylinder #1 is richer than cylinder #2.

Cylinder #4 only rose 15°F before it reached peak EGT (3 bars x 5°F = 15°F). Cylinders #2, and #4 reached peak EGT almost at the same time. Notice the right bank of cylinders (1, 3 and 5) on this engine is running much richer than the left bank (2, 4 and 6). This is a typical Profile display for a carbureted engine or an IO-470 or IO-520.

Figure 2 shows a typical fuel/air distribution profile for a well-balanced engine. All the cylinders reached peak EGT nearly at the same time. A well-balanced engine runs smoother, develops more power and burns less fuel when leaned out in cruise.



Carbureted Engine
or IO-470 or IO-520.



Well Balanced Engine

To produce a Fuel/Air Profile for your engine, perform the following:

1. Climb to cruise altitude and set your manifold pressure and RPM for cruise flight.
2. Enter the Lean Operating Mode and lean your engine slowly until all the cylinders' EGTs have passed peak (all the cylinder numbers located at the top of the EGT columns are blinking).

Note: It is not recommended to lean an engine for peak EGT above 75% power setting.

3. Before you enrichen the mixture, exit the Lean Operating Mode. Now you may enrichen the mixture if you wish. A Fuel/Air Profile for your engine has been stored into the UBG's memory.

Note: The Profile display will be lost if the power to the UBG is turned off or when you enter the Lean Operating Mode and lean your engine by 10°F or more.

4. Select "PEAK" in the digital display and push the Mode Switch to the Left. The digital display will show "PROFILE" and the columns of bars represent the fuel/air distribution for your engine. The more bars lit in a column, the richer the cylinder and the worse the fuel/air distribution is for your engine.

SPECIFICATIONS and OPERATING FEATURES

S1111981

11/11/98

Model: UBG-16 and UBG-16T

Weight: Unit only: 22 oz., One probe and 6 foot cable: 3.5 oz., One Probe and 20 foot cable: 7 oz.

Environmental: Meets TSO C43a

Power Requirements: 7.5 to 30 Volts, 1/2 Amp.

Display: Plasma (viewable in direct sunlight). Display dims for night operation.

Accuracy: 1/2% in accordance with TSO C43a.

Power-up Test: Flashes all bars, segments and nomenclature.

Probes: Type K, Ungrounded (for improved accuracy, stability and reliability).

Extension Cables: Type K, any length or size. Non-Temp cables are tin/copper.

Channels: Maximum of 16 Channels.

EGT and CHT Analyzer Channels: 1 to 7, programmable from front panel (left channels for EGTs and right channels for CHTs).

EGT Bar Resolution: 1 to 104°F per Bar, programmable from front panel.

CHT Bar Resolution: 33°F per Bar.

Lean Operating Mode:

- A. Activated after 10°F rise in hottest EGT.
- B. Peak detected when 5°F decrease in any EGT or TIT.

Scan Rate: Programmable from 1 to 9 second per channel.